SDHLibrary-CPP

0.0.2.10

Generated by Doxygen 1.7.3-20110123

Tue Sep 30 2014 15:59:05

Contents

Chapter 1

SDHLibrary_CPP

The C++ library for controlling the SDH (SCHUNK Dexterous Hand) from a PC

1.1 General project information

Author

Dirk Osswald

Project releases:

- Current release name and changelog: see PROJECT_RELEASE
- Current release date: see PROJECT_DATE

1.2 Purpose

This documentation describes the **sdh** library for the C++ language. It allows to control the SDH (SCHUNK Dexterous Hand) with a user program from a PC.

- For some demonstration programs see: demonstration programs.

1.3 Links

- The SCHUNK homepage: http://www.schunk.com/
- Additionally used libraries:
  - The C++ STL (Standard Template Library), especially the vector<T> type.
    See e.g.:
    * http://gcc.gnu.org/onlinedocs/libstdc++/documentation.html

    * http://msdn.microsoft.com/en-us/library/cscc687y(VS.80).aspx

- Used tools:
  - **gcc** (GNU Compiler Collection), namely g++, the C++ compiler. See http://gcc.gnu.org/onlinedocs/gcc/
  - **make** (GNU make), see http://www.gnu.org/software/make/manual/make.html
  - **Microsoft Visual Studio C++** can be used on windows as an alternative to the above
    * see e.g. Visual Studio 2008
    * see e.g. Visual Studio 2005
  - **Doxygen** for generating pdf and html documentation directly from the sources. See http://www.stack.nl/~dimitri/doxygen/

1.4 Copyright

Chapter 2

Bug List

File demo-GetFingerXYZ.cpp When compiled with MS Visual Studio then using the "-R" command line parameter will make the demonstration program demo-GetFingerXYZ abort.

Class SDH::cDSA cDSAException: Checksum Error on Windows console While communicating with the tactile sensor controller a "cDSAException: Checksum Error" might be thrown once in a while. This seems to happen only when the program is started from a native windows command console (cmd.exe), but not e.g. when the program is started from a cygwin console. Strange. **Workaround** is to catch the exception and ignore the frame.

=> Resolved in SDHLibrary-C++ v0.0.2.1

Problem was an overrun of the windows input buffer, e.g. on heavy processor load.

Member SDH::cDSA::GetMatrixSensitivity(int matrix_no) With DSACON32m firmware R218 and before this did not work, instead the factory default (0.5) was always reported

=> Resolved in DSACON32m firmware R268

Member SDH::cDSA::SetFramerate(UInt16 framerate, bool do_RLE=true, bool do_data_acquisition=true) SCHUNK-internal bugzilla ID: Bug 680

With DSACON32m firmware R276 and after and SDHLibrary-C++ v0.0.1.15 and before stopping of the sending did not work.

=> Resolved in SDHLibrary-C++ v0.0.1.16

SCHUNK-internal bugzilla ID: Bug 680

With DSACON32m firmware before R276 and SDHLibrary-C++ v0.0.1.16 and before acquiring of single frames did not work

=> Resolved in SDHLibrary-C++ v0.0.1.17

SCHUNK-internal bugzilla ID: Bug 703

With DSACON32m firmware R288 and before and SDHLibrary-C++ v0.0.2.1 and before tactile sensor frames could not be read reliably in single frame mode.

=> Resolved in DSACON32m firmware 2.9.0.0

=> Resolved in SDHLibrary-C++ v0.0.2.1 with workaround for older DSACON32m firmwares

Member SDH::cRS232::Open(void) The binary communication introduced in firmware 0.0.2.15 and SDHLibrary-C++ 0.0.2.0 did not work properly on Linux when RS232 was used for communication.

See also:

- Bug 1011: Bug: Binary communication does not work via RS232 on Linux
- SDH_USE_BINARY_COMMUNICATION
  => Resolved in SDHLibrary 0.0.2.2

Member SDH::cSDH::EmergencyStop(void) For now this will **NOT** work while a GripHand() command is executing, even if that was initiated non-sequentially!

Member SDH::cSDH::GripHand(eGraspId grip, double close, double velocity, bool sequ=true) With SDH firmware > 0.0.2.6 and SDHLibrary < 0.0.1.12 GripHand() does not work (Bug 575)

=> Resolved in SDHLibrary 0.0.1.12

With SDH firmware < 0.0.2.6 GripHand() does not work and might yield undefined behaviour there

=> Resolved in SDH firmware 0.0.2.6

Currently the performing of a skill or grip with GripHand() can **NOT** be interrupted!!! Even if the command is sent with *sequ=false* it **cannot** be stoped or emergency stopped.

With SDH firmware < 0.0.2.6 GripHand() does not work and might yield undefined behaviour there

=> Resolved in SDH firmware 0.0.2.6

Currently the performing of a skill or grip with GripHand() can **NOT** be interrupted!!! Even if the command is sent with *sequ=false* it **cannot** be stoped or emergency stopped.

Member SDH::cSDH::MoveAxis(std::vector< int >const &axes, bool sequ=true) With SDH firmware < 0.0.2.7 calling MoveAxis() while some axes are moving in eCT_POSE controller type will make the joints jerk. This is resolved in SDH firmware 0.0.2.7 for the eCT_POSE controller type with velocity profile eVP_RAMP. For the eCT_POSE controller type with velocity profile eVP_SIN_SQUARE changing target points/ velocities while moving will still make the axes jerk.

=> Partly resolved in SDH firmware 0.0.2.7

Member SDH::cSDH::MoveFinger(std::vector< int >const &fingers, bool sequ=true)
With SDH firmware < 0.0.2.7 calling MoveFinger() while some axes are moving in eCT_POSE controller type will make the joints jerk. This is resolved in SDH firmware 0.0.2.7 for the eCT_POSE controller type with velocity profile eVP_RAMP. For the eCT_POSE controller type with velocity profile eVP_SIN_SQUARE changing target points/ velocities while moving will still make the axes jerk.

=> Partly resolved in SDH firmware 0.0.2.7

Member SDH::cSDH::MoveHand(bool sequ=true) With SDH firmware < 0.0.2.7 calling MoveHand() while some axes are moving in eCT_POSE controller type will make the joints jerk. This is resolved in SDH firmware 0.0.2.7 for the eCT_POSE controller type with velocity profile eVP_RAMP. For the eCT_POSE controller type with velocity profile eVP_SIN_SQUARE changing target points/ velocities while moving will still make the axes jerk.

=> Parltly resolved in SDH firmware 0.0.2.7

Member SDH::cSDH::SetAxisValueVector(std::vector< int > const &axes, std::vector< double > const &values, pS
Setting a single axis velocity only sets the velocities of all other axes to 0! So in order to address only some axes you must provide the desired velocity for all axes that you want to move in every call:

With SDH firmware 0.0.2.16 and SDHLibrary-CPP 0.0.2.3 and binary communication (see also SDH_USE_BINARY_COMMUNICATION) setting of single (more precisely: less-than-all) axis parameters (position, velocity, acceleration) does not work as expected: If a single parameter is to be set for a single axis then that parameter is set to 0 for all other axes.

Workaround: If you want to access several different axes one after another then you have to keep a vector of the parameter for all your used axes in your application. You can then update single values of the vector on demand, but you have to send the complete vector to the SDHlibrary functions on every call.

With SDH firmware 0.0.2.16 and SDHLibrary-CPP 0.0.2.3 and binary communication (see also SDH_USE_BINARY_COMMUNICATION) setting of single (more precisely: less-than-all) axis parameters (position, velocity, acceleration) does not work as expected: If a single parameter is to be set for a single axis then that parameter is set to 0 for all other axes.

Workaround: If you want to access several different axes one after another then you have to keep a vector of the parameter for all your used axes in your application. You can then update single values of the vector on demand, but you have to send the complete vector to the SDHlibrary functions on every call.

Member SDH::cSDH::Stop(void) For now this will **NOT** work while a GripHand() command is executing, even if that was initiated non-sequentially!

With SDH firmware < 0.0.2.7 this made the axis jerk in eCT_POSE controller type. This is resolved in SDH firmware 0.0.2.7 for the eCT_POSE controller type

with velocity profile eVP_RAMP. For the eCT_POSE controller type with velocity profile eVP_SIN_SQUARE changing target points/ velocities while moving will still make the axes jerk.

=> Partly resolved in SDH firmware 0.0.2.7

With SDH firmware < 0.0.2.7 this made the axis jerk in eCT_POSE controller type. This is resolved in SDH firmware 0.0.2.7 for the eCT_POSE controller type with velocity profile eVP_RAMP. For the eCT_POSE controller type with velocity profile eVP_SIN_SQUARE changing target points/ velocities while moving will still make the axes jerk.

=> Partly resolved in SDH firmware 0.0.2.7

Member SDH::cSDH::WaitAxis(std::vector< int > const &axes, double timeout=-1.0) Due to a bug in SDH firmwares prior to 0.0.2.6 the WaitAxis() command was somewhat unreliable there. When called immediately after a movement command like MoveHand(), then the WaitAxis() command returned immediately without waiting for the end of the movement. With SDH firmwares 0.0.2.6 and newer this is no longer problematic and WaitAxis() works as expected.

=> Resolved in SDH firmware 0.0.2.6

With SDH firmware 0.0.2.6 WaitAxis() did not work if one of the new velocity based controllers (eCT_VELOCITY, eCT_VELOCITY_ACCELERATION) was used. With SDH firmwares 0.0.2.7 and newer this now works. Here the WaitAxis() waits until the selected axes come to velocity 0.0

=> Resolved in SDH firmware 0.0.2.7

With SDH firmware 0.0.2.6 WaitAxis() did not work if one of the new velocity based controllers (eCT_VELOCITY, eCT_VELOCITY_ACCELERATION) was used. With SDH firmwares 0.0.2.7 and newer this now works. Here the WaitAxis() waits until the selected axes come to velocity 0.0

=> Resolved in SDH firmware 0.0.2.7

Member SDH::cSDHSerial::kv(int axis=All, double *kv=NULL) With SDH firmware 0.0.2.9 kv() might not respond kv value correctly in case it was changed before. With SDH firmwares 0.0.2.10 and newer this now works.

=> Resolved in SDH firmware 0.0.2.10

Member SDH::cSDHSerial::Open(cSerialBase *_com) SCHUNK-internal bugzilla ID: Bug 1517

With SDH firmware 0.0.3.x the first connection to a newly powered up SDH can yield an error especially when connecting via TCP.

=> Resolved in SDHLibrary-C++ 0.0.2.10

Member SDH::cSDHSerial::pid(int axis, double *p=NULL, double *i=NULL, double *d=NULL) With SDH firmware 0.0.2.9 pid() might not respond pid values correctly in case

these were changed before. With SDH firmwares 0.0.2.10 and newer this now works.

=> **Resolved in SDH firmware 0.0.2.10**

Member SDH::cSDHSerial::tvav(int axis=All, double *velocity=NULL) With SDH firmware < 0.0.1.0 axis 0 can go no faster than 14 deg/s

=> **Resolved in SDH firmware 0.0.1.0**

Member SDH::cSDHSerial::v(int axis=All, double *velocity=NULL) With SDH firmware < 0.0.1.0 axis 0 can go no faster than 14 deg/s

=> **Resolved in SDH firmware 0.0.1.0**

Member SDHUSAGE_DEFAULT When compiled with VCC then the macros WITH_ESD_CAN / WITH_PEAK_CAN used above are not available since these are defined in the VCC project settings of the SDHLibrary VCC-Project. Therefore the value of SDHUSAGE_DEFAULT is incorrect and thus the cSDHOptions will display an incomplete usage string when called with -h/--help.

Workaround: use the online help contained in the doxygen documentation: `Online help of demonstration programs`

Chapter 3

Module Index

3.1 Modules

Here is a list of all modules:

Chapter 4

Namespace Index

4.1 Namespace List

Here is a list of all namespaces with brief descriptions:

Chapter 5

Class Index

5.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 6

Class Index

6.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 7

File Index

7.1 File List

Here is a list of all files with brief descriptions:

Chapter 8

Module Documentation

8.1 Compile time settings

Defines

- #define SDH_USE_NAMESPACE 1

  Flag, if 1 then all classes are put into a namespace called SDH. If 0 then the classes are left outside any namespace.

- #define SDH_USE_BINARY_COMMUNICATION 1

  Flag, if 1 then binary communication is used where possible for better performance (requires at least firmware 0.0.2.15)

8.1.1 Detailed Description

Primary settings to be adjusted by the user.

8.1.2 Define Documentation

8.1.2.1 #define SDH_USE_BINARY_COMMUNICATION 1

Flag, if 1 then binary communication is used where possible for better performance (requires at least firmware 0.0.2.15)

8.1.2.2 #define SDH_USE_NAMESPACE 1

Flag, if 1 then all classes are put into a namespace called SDH. If 0 then the classes are left outside any namespace.

8.2 Derived compile time settings

Defines

- #define NAMESPACE_SDH_START namespace SDH {
- #define NAMESPACE_SDH_END }
- #define USING_NAMESPACE_SDH using namespace SDH;
- #define NS_SDH SDH::

8.2.1 Detailed Description

Derived settings that users should not have to adjust. Adjustments should be done in Compile time settings

8.2.2 Define Documentation

8.2.2.1 #define NAMESPACE_SDH_END }

8.2.2.2 #define NAMESPACE_SDH_START namespace SDH {

8.2.2.3 #define NS_SDH SDH::

8.2.2.4 #define USING_NAMESPACE_SDH using namespace SDH;

8.3 Demonstration programs

Files

- file demo-benchmark.cpp

  Simple script to benchmark communication speed of the SDH. See __help__ and online help ("-h" or "--help") for available options.

- file demo-contact-grasping.cpp

  Simple script to do grasping using tactile sensor info feedback. See __help__ and online help ("-h" or "--help") for available options.

- file demo-dsa-simple.cpp

  Simple program to test class cDSA (tactile sensor reading). See __help__ and online help ("-h" or "--help") for available options.

- file demo-dsa.cpp

  Simple program to test class cDSA. See __help__ and online help ("-h" or "--help") for available options.

- file demo-GetAxisActualAngle.cpp

Print measured actual axis angles of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

- file demo-GetFingerXYZ.cpp

  Print measured actual axis angles of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

- file demo-griphand.cpp

  Very simple demonstration program using the SDHLibrary-CPP: Demonstrate the use of the GripHand command See __help__ and online help ("-h" or "--help") for available options.

- file demo-mimic.cpp

  Print measured actual axis angles of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

- file demo-radians.cpp

  Very simple demonstration program using the SDHLibrary-CPP: Make an attached SDH move one finger with "pose" controller type (coordinated position control), commanding in radians. See __help__ and online help ("-h" or "--help") for available options.

- file demo-simple.cpp

  Very simple demonstration program using the SDHLibrary-CPP: Make an attached SDH move one finger with "pose" controller type (coordinated position control). See __help__ and online help ("-h" or "--help") for available options.

- file demo-simple2.cpp

  Very simple C++ programm to make an attached SDH move. With non-sequential call of move and Stop. See __help__ and online help ("-h" or "--help") for available options.

- file demo-simple3.cpp

  Very simple C++ programm to make an attached SDH move. With non-sequential call of move and WaitAxis. See __help__ and online help ("-h" or "--help") for available options.

- file demo-temperature.cpp

  Print measured temperatures of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

- file demo-velocity-acceleration.cpp

  Very simple demonstration program using the SDHLibrary-CPP: Make an attached SDH move one finger in "velocity with acceleration ramp" control mode. See __help__ and online help ("-h" or "--help") for available options.

8.3.1 Detailed Description

Some demonstration programs are provided which show the usage of the classes in the SDHLibrary-C++ library:

8.4 Online help of demonstration programs

The provided demonstration programs have an online help which is shown below:

Online help for program `demo-benchmark.exe`

```
Simple script to benchmark communication speed of the SDH:
The hand will move to a start position in coordinated position control
mode first. Then periodic movements are performed using the velocity
with acceleration ramp controller while the communication and control
rate is printed.

- Example usage:
  - Make SDH connected via Ethernet move.
    The SDH has IP-Address 192.168.1.42 and is attached to TCP port 23.
    (Requires at least SDH-firmware v0.0.3.1)
    > demo-benchmark --tcp=192.168.1.42:23

  - Make SDH connected to port 2 = COM3 move:
    > demo-benchmark -p 2  --dsaport=3

  - Make SDH connected to USB to RS232 converter 0 move:
    > demo-benchmark --sdh_rs_device=/dev/ttyUSB0  --dsa_rs_device=/dev/ttyUSB1

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-benchmark --tcp=192.168.1.42 --dsa_tcp -v

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected to:
    - port 2 = COM3 (joint controllers) and
    - port 3 = COM4 (tactile sensor controller)
    > demo-benchmark --port=2 --dsaport=3 -v


usage: demo-benchmark [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
```

```
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

Online help for program `demo-contact-grasping.exe`

```
Simple script to do grasping with tactile sensor info feedback:
The hand will move to a pregrasp pose (open hand). You can then
reach an object to grasp into the hand. The actual grasping
```

```
is started as soon as a contact is detected. The finger
joints then try to move inwards until a certain
force is reached on the corresponding tactile sensors.

- Example usage:
  - Make SDH and tactile sensors connected via Ethernet grasp.
    The SDH and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    TCP port 23 and the tactile sensors to TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-contact-grasping --tcp=192.168.1.42:23 --dsa_tcp=:13000

  - Make SDH connected to port 2 = COM3 with tactile sensors
    connected to port 3 = COM4 grasp:
    > demo-contact-grasping -p 2  --dsaport=3

  - Make SDH connected to USB to RS232 converter 0 and with tactile sensors
    connected to USB to RS232 converter 1 grasp:
    > demo-contact-grasping --sdh_rs_device=/dev/ttyUSB0  --dsa_rs_device=/dev/tt
      yUSB1

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-contact-grasping --tcp=192.168.1.42 --dsa_tcp -v

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected to:
    - port 2 = COM3 (joint controllers) and
    - port 3 = COM4 (tactile sensor controller)
    > demo-contact-grasping --port=2 --dsaport=3 -v


usage: demo-contact-grasping [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.
```

```
Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)


DSA options (tactile sensor):
  -q PORT, --dsaport=PORT
      use RS232 communication PORT to connect to to  tactile sensor controller
      of SDH  instead of default 1='COM2'='/dev/ttyS1'.

  --dsa_tcp[=[IP_OR_HOSTNAME][:PORT]]
      use TCP for communication with the tactile sensor controller.
      The tactile sensor can be reached via TCP/IP on port PORT at
      IP_OR_HOSTNAME, which can be a numeric IPv4 address or a hostname.
      The default is "192.168.1.42:13000"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.2)

  --dsa_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".  If
      the DEVICE_FORMAT_STRING contains '%d' then the dsa PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  --no_rle
```

```
      Do not use the RunLengthEncoding
```

Online help for program `demo-dsa-simple.exe`

Online help for program `demo-dsa.exe`

```
Simple demo to test cDSA class of SDHLibrary-cpp.

Remarks:
- You must specify at least one of these options to see some output:
  -f | --fullframe
  -r | --resulting
  -c | --controllerinfo
  -s | --sensorinfoinfo
  -m | --matrixinfo=N

- Example usage:
  - Read a single full frame from tactile sensors connected to port 3 = COM4:
    > demo-dsa --dsaport=3 -f

  - Read a single full frame from tactile sensors connected via TCP/IP (ethernet)
      :
    The tactile sensors have IP-Address 192.168.1.42 and use TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-dsa --dsa_tcp=192.168.1.42:13000 -f

  - Read full frames continuously once per second from tactile sensors
    connected to port 3 = COM4:
    > demo-dsa --dsaport=3 -f -r 1

  - Read full frames continuously 10 times per second from tactile sensors
    connected to port 3 = COM4:
    > demo-dsa --dsaport=3 -f -r 10

  - Read full frames continuously as fast as possible (DSA push-mode)
    from tactile sensors connected to port 3 = COM4:
    > demo-dsa --dsaport=3 -f -r 30

  - Read a single full frame from tactile sensors connected to USB
    to RS232 converter 0:
    > demo-dsa --dsa_rs_device=/dev/ttyUSB0 -f

  - Read the sensor, controller, matrix 0 infos
    from tactile sensors connected to port 3 = COM4:
    > demo-dsa --dsaport=3 -s -c -m 0

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-dsa --tcp=192.168.1.42 --dsa_tcp -v
```

```
  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected to
    - port 2 = COM3 (joint controllers) and
    - port 3 = COM4 (tactile sensor controller)
    > demo-dsa -p 2 --dsaport=3 -v
  - Set the sensitivity of all tactile sensor matrixes to 0.75 temporarily.
    The value will be used only temporarily (until reset or power cycle).
    > demo-dsa --dsaport=3 --sensitivity=0.75

  - Set the sensitivity of all tactile sensor matrixes to 0.75 persistently.
    The value will be stored persistently (i.e. will remain after reset or
    power cycle).
    > demo-dsa --dsaport=3 --sensitivity=0.75 --persistent

  - Reset the sensitivity of all tactile sensor matrixes to factory default.
    > demo-dsa --dsaport=3 --sensitivity=0.75 --reset

  - Set the sensitivity of tactile sensor matrices 1 and 4 to individual
    values temporarily.
    The value will be used only temporarily (until reset or power cycle).
    Sensor 1 (distal sensor of finger 1) will be set to 0.1
    Sensor 4 (proximal sensor of finger 3) will be set to 0.4
    > demo-dsa --dsaport=3 --sensitivity1=0.1 --sensitivity4=0.4
  - Like for the sensitivity the thresholds can be adjusted via
    the --threshold=VALUE parameter.

- Known bugs:
  - see the bug description for "cDSAException: Checksum Error on Windows
    console" in the Related Pages->Bug List section of the doxygen
    documentation


usage: demo-dsa [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
```

```
      and 1000000 Bit/s (1MBit/s) for CAN

DSA options (tactile sensor):
  -q PORT, --dsaport=PORT
      use RS232 communication PORT to connect to to  tactile sensor controller
      of SDH  instead of default 1='COM2'='/dev/ttyS1'.

  --dsa_tcp[=[IP_OR_HOSTNAME][:PORT]]
      use TCP for communication with the tactile sensor controller.
      The tactile sensor can be reached via TCP/IP on port PORT at
      IP_OR_HOSTNAME, which can be a numeric IPv4 address or a hostname.
      The default is "192.168.1.42:13000"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.2)

  --dsa_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".  If
      the DEVICE_FORMAT_STRING contains '%d' then the dsa PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  --no_rle
      Do not use the RunLengthEncoding

  -r, --framerate=FRAMERATE
      Framerate for acquiring full tactile sensor frames.  Default value 0
      means 'acquire a single frame only'.  Any value > 0 will make the
      DSACON32m controller in the SDH send data at the highest possible rate
      (ca. 30 FPS (frames per second)).

  -f, --fullframe
      Print acquired full frames numerically.

  -S, --sensorinfo
      Print sensor info from DSA (texel dimensions, number of texels...).

  -C, --controllerinfo
      Print controller info from DSA (version...).

  -M, --matrixinfo=MATRIX_INDEX
      Print matrix info for matrix with index MATRIX_INDEX from DSA.
      This includes the current setting for sensitivity and threshold
      of the addressed matrix (if supported by the tactile sensor firmware).
       This option can be used multiple times.
  --sensitivity=SENSITIVITY
      Set the sensor sensitivity for all tactile sensor pads to the given
      value. The value SENSITIVITY must be in range [0.0 .. 1.0], where
      0.0 is minimum and 1.0 is maximum sensitivity.
      If --reset is given as well then SENSITIVITY is ignored and
      the sensitivity is reset to the factory default.
      To see the current setting for sensitivity use -M --matrixinfo
      For setting sensitivities individually for a specific sensor X [0..5]
      use --sensitivityX=SENSITIVITY

  --sensitivityX=SENSITIVITY
      X is a sensor index in range [0..5]. Set sensor sensitivity for a
      a specific sensor X. See also --sensitivity.
      This option can be used multiple times (with different X).

  --threshold=THRESHOLD
      Set the sensor threshold for all tactile sensor pads to the given
```

```
      value. The value THRESHOLD must be in range [0 .. 4095], where
      (0 is minimum, 4095 is maximum threshold).
      If --reset is given as well then THRESHOLD is ignored and
      the threshold is reset to the factory default.
  --thresholdX=THRESHOLD
      Set sensor threshold for a specific sensor X.
      X is a sensor index in range [0..5]. See also option --threshold.
      This option can be used multiple times (with different X).

  --reset
      If given, then the values given with --sensitivity(X)
      and/or --threshold(X) are reset to their factory default.

  --persistent
      If given, then all the currently set values for sensitivity
      and threshold are saved persistently in the configuration
      memory of the DSACON32m controller in the SDH.
      PLEASE NOTE: the maximum write endurance of the configuration memory
      is about 100.000 times!

  --showdsasettings
      If given, then current settings for sensitivity and
      threshold will be printed on stdout first.
```

Online help for program `demo-GetAxisActualAngle.exe`

```
Print measured actual axis angles of SDH.
(C++ demo application using the SDHLibrary-CPP library.)

- Example usage:
  - Print actual angles of an SDH connected via Ethernet.
    The SDH has IP-Address 192.168.1.42 and is attached to TCP port 23.
    (Requires at least SDH-firmware v0.0.3.1)
    > demo-GetAxisActualAngle --tcp=192.168.1.42:23

  - Print actual angles of an SDH connected to port 2 = COM3 once:
    > demo-GetAxisActualAngle -p 2

  - Print actual angles of an SDH connected to port 2 = COM3 every 500ms:
    > demo-GetAxisActualAngle -p 2 -t 0.5

  - Print actual angles of an SDH connected to USB to RS232 converter 0 once:
    > demo-GetAxisActualAngle --sdh_rs_device=/dev/ttyUSB0

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-GetAxisActualAngle --tcp=192.168.1.42 --dsa_tcp -v

  - Get the version info of an SDH connected to port 2 = COM3
    > demo-GetAxisActualAngle --port=2 -v


usage: demo-GetAxisActualAngle [options]

General options:
  -h, --help
```

```
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

```
Other options:
  -R, --radians
      Use radians and radians per second for angles and angular velocities
      instead of default degrees and degrees per second.
      (The demo programs provided might not evaluate this parameter
      correctly. Thus they might fail if this parameter is used.)

  -F, --fahrenheit
      Use degrees fahrenheit to report temperatures instead of default degrees
      celsius.

  -t PERIOD, --period=PERIOD
      For periodic commands only: Time period of measurements in seconds. The
      default of '0' means: report once only. If set then the time since start
      of measurement is printed at the beginning of every line.
```

Online help for program `demo-GetFingerXYZ.exe`

```
Print measured XYZ position of fingertips of SDH.
C++ demo application using the SDHLibrary-CPP library.)

For every finger the actual axis angles and the finger tip coordinates
are printed.

- Example usage:
  - Print finger angles and finger tip xyz coordinates of an SDH connected
    via Ethernet. The SDH has IP-Address 192.168.1.42 and is attached to TCP
    port 23.
    (Requires at least SDH-firmware v0.0.3.1)
    > demo-GetFingerXYZ --tcp=192.168.1.42:23

  - Print finger angles and finger tip xyz coordinates of an SDH connected
    to port 2 = COM3 once:
    > demo-GetFingerXYZ -p 2

  - Print finger angles and finger tip xyz coordinates of an SDH connected
    to port 2 = COM3 every 500ms:
    > demo-GetFingerXYZ -p 2 -t 0.5

  - Print finger angles and finger tip xyz coordinates of an SDH connected
    to USB to RS232 converter 0 once:
    > demo-GetFingerXYZ --sdh_rs_device=/dev/ttyUSB0

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-GetFingerXYZ --tcp=192.168.1.42 --dsa_tcp -v

  - Get the version info of an SDH connected to port 2 = COM3
    > demo-GetFingerXYZ --port=2 -v
- Known bugs:
  - Command line parameter "-R" does not work when compiled
    with MS Visual Studio


usage: demo-GetFingerXYZ [options]
```

```
General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
```

```
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)


Other options:
  -R, --radians
      Use radians and radians per second for angles and angular velocities
      instead of default degrees and degrees per second.
      (The demo programs provided might not evaluate this parameter
      correctly. Thus they might fail if this parameter is used.)

  -F, --fahrenheit
      Use degrees fahrenheit to report temperatures instead of default degrees
      celsius.

  -t PERIOD, --period=PERIOD
      For periodic commands only: Time period of measurements in seconds. The
      default of '0' means: report once only. If set then the time since start
      of measurement is printed at the beginning of every line.
```

Online help for program `demo-griphand.exe`

```
Demonstrate the use of the GripHand command.
(C++ demo application using the SDHLibrary-CPP library.)

- Example usage:
  - Make SDH connected via Ethernet move.
    The SDH has IP-Address 192.168.1.42 and is attached to TCP port 23.
    (Requires at least SDH-firmware v0.0.3.1)
    > demo-griphand --tcp=192.168.1.42:23

  - Make SDH connected to port 2 = COM3 move:
    > demo-griphand -p 2

  - Make SDH connected to USB to RS232 converter 0 move:
    > demo-griphand --sdh_rs_device=/dev/ttyUSB0

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-griphand --tcp=192.168.1.42 --dsa_tcp -v

  - Get the version info of an SDH connected to port 2 = COM3
    > demo-griphand --port=2 -v


usage: demo-griphand [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
```

```
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

Online help for program `demo-mimic.exe`

```
In case you have 2 SDHs you can operate one of them by moving the first
hand manualy. You must give parameters for 2 hands on the command line.
(C++ demo application using the SDHLibrary-CPP library.)
```

```
- Example usage:
  - Mimic the manual movements of SDH on port 2 = COM3
    with the SDH on port 5 = COM6:
    > demo-mimic -p 2  -p 5

  - Mimic the manual movements of SDH with CAN IDs 0x01 and 0x11 on
    ESD CAN bus with the SDH with CAN IDs 0x02 and 0x2 on the same
    ESD CAN bus
    > demo-mimic --can --id_read 0x1 --id_write 0x11  --can --id_read 0x2 --id_wr
      ite 0x22



usage: demo-mimic [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.
```

```
  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)


Other options:
  -R, --radians
      Use radians and radians per second for angles and angular velocities
      instead of default degrees and degrees per second.
      (The demo programs provided might not evaluate this parameter
      correctly. Thus they might fail if this parameter is used.)

  -F, --fahrenheit
      Use degrees fahrenheit to report temperatures instead of default degrees
      celsius.

  -t PERIOD, --period=PERIOD
      For periodic commands only: Time period of measurements in seconds. The
      default of '0' means: report once only. If set then the time since start
      of measurement is printed at the beginning of every line.
```

Online help for program `demo-radians.exe`

```
Move proximal and distal joints of finger 1 three times by 0.1745 rad (10 degrees
      ).
(C++ demo application using the SDHLibrary-CPP library.)

- Example usage:
  - Make SDH connected via Ethernet move.
    The SDH has IP-Address 192.168.1.42 and is attached to TCP port 23.
    (Requires at least SDH-firmware v0.0.3.1)
    > demo-radians --tcp=192.168.1.42:23

  - Make SDH connected to port 2 = COM3 move:
    > demo-radians -p 2

  - Make SDH connected to USB to RS232 converter 0 move:
    > demo-radians --sdh_rs_device=/dev/ttyUSB0

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-radians --tcp=192.168.1.42 --dsa_tcp -v
```

```
  - Get the version info of an SDH connected to port 2 = COM3
    > demo-radians --port=2 -v


usage: demo-radians [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).
```

```
  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

Online help for program `demo-ref`.exe

```
Do reference movement???


usage: demo-ref [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.
```

```
  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

Online help for program `demo-simple-withtiming.exe`

```
Move proximal and distal joints of finger 1 three times by 10 degrees and measure
       time for these actions.
(C++ demo application using the SDHLibrary-CPP library.)

usage: demo-simple-withtiming [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
```

```
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

Online help for program `demo-simple.exe`

```
Move proximal and distal joints of finger 1 three times by 10 degrees.
(C++ demo application using the SDHLibrary-CPP library.)

- Example usage:
  - Make SDH connected via Ethernet move.
    The SDH has IP-Address 192.168.1.42 and is attached to TCP port 23.
    (Requires at least SDH-firmware v0.0.3.1)
    > demo-simple --tcp=192.168.1.42:23

  - Make SDH connected to port 2 = COM3 move:
    > demo-simple -p 2

  - Make SDH connected to USB to RS232 converter 0 move:
    > demo-simple --sdh_rs_device=/dev/ttyUSB0

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-simple --tcp=192.168.1.42 --dsa_tcp -v

  - Get the version info of an SDH connected to port 2 = COM3
    > demo-simple --port=2 -v
```

```
usage: demo-simple [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
```

```
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

Online help for program `demo-simple2.exe`

```
Move proximal and distal joints of finger 1 three times by 10 degrees, stop movem
      ent when halfway done.
(C++ demo application using the SDHLibrary-CPP library.)

- Example usage:
  - Make SDH connected via Ethernet move.
    The SDH has IP-Address 192.168.1.42 and is attached to TCP port 23.
    (Requires at least SDH-firmware v0.0.3.1)
    > demo-simple2 --tcp=192.168.1.42:23

  - Make SDH connected to port 2 = COM3 move:
    > demo-simple2 -p 2

  - Make SDH connected to USB to RS232 converter 0 move:
    > demo-simple2 --sdh_rs_device=/dev/ttyUSB0

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-simple2 --tcp=192.168.1.42 --dsa_tcp -v

  - Get the version info of an SDH connected to port 2 = COM3
    > demo-simple2 --port=2 -v


usage: demo-simple2 [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.
```

```
Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

Online help for program `demo-simple3.exe`

```
Move axes 1,2 and 3 to a specific point.
(C++ demo application using the SDHLibrary-CPP library.)

- Example usage:
  - Make SDH connected via Ethernet move.
    The SDH has IP-Address 192.168.1.42 and is attached to TCP port 23.
    (Requires at least SDH-firmware v0.0.3.1)
    > demo-simple3 --tcp=192.168.1.42:23

  - Make SDH connected to port 2 = COM3 move:
    > demo-simple3 -p 2

  - Make SDH connected to USB to RS232 converter 0 move:
    > demo-simple3 --sdh_rs_device=/dev/ttyUSB0

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
```

```
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-simple3 --tcp=192.168.1.42 --dsa_tcp -v

  - Get the version info of an SDH connected to port 2 = COM3
    > demo-simple3 --port=2 -v


usage: demo-simple3 [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.
```

```
  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

Online help for program `demo-temperature`.exe

```
Print measured temperatures of SDH.
(C++ demo application using the SDHLibrary-CPP library.)

A vector of temperatures is reported. The first 7 temperatures
are from sensors close to the corresponding axes motors.
The 8th value is the temperature of the FPGA, the controller chip (CPU).
The 9th value is the temperature of the PCB (Printed circuit board)
in the body of the SDH.
- Example usage:
  - Print temperatures of an SDH connected via Ethernet.
    The SDH has IP-Address 192.168.1.42 and is attached to TCP port 23.
    (Requires at least SDH-firmware v0.0.3.1)
    > demo-GetAxisActualAngle --tcp=192.168.1.42:23

  - Print temperatures of an SDH connected to port 2 = COM3 once:
    > demo-temperature -p 2

  - Print temperatures of an SDH connected to port 2 = COM3 every 500ms:
    > demo-temperature -p 2 -t 0.5

  - Print temperatures of an SDH connected to USB to RS232 converter 0 move:
    > demo-temperature --sdh_rs_device=/dev/ttyUSB0

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-GetAxisActualAngle --tcp=192.168.1.42 --dsa_tcp -v

  - Get the version info of an SDH connected to port 2 = COM3
    > demo-temperature --port=2  -v


usage: demo-temperature [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.
```

```
  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)


Other options:
  -R, --radians
      Use radians and radians per second for angles and angular velocities
      instead of default degrees and degrees per second.
```

```
      (The demo programs provided might not evaluate this parameter
      correctly. Thus they might fail if this parameter is used.)

  -F, --fahrenheit
      Use degrees fahrenheit to report temperatures instead of default degrees
      celsius.

  -t PERIOD, --period=PERIOD
      For periodic commands only: Time period of measurements in seconds. The
      default of '0' means: report once only. If set then the time since start
      of measurement is printed at the beginning of every line.
```

Online help for program `demo-test.exe`

```
Tries to connect to SDH, read actual angles and exits.
(C++ demo application using the SDHLibrary-CPP library.)

usage: demo-test [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
```

```
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

Online help for program `demo-velocity-acceleration.exe`

```
Make the SDH move one finger in "velocity with acceleration ramp" control mode.
(C++ demo application using the SDHLibrary-CPP library.)

  - Make SDH connected via Ethernet move.
    The SDH has IP-Address 192.168.1.42 and is attached to TCP port 23.
    (Requires at least SDH-firmware v0.0.3.1)
    > demo-velocity-acceleration --tcp=192.168.1.42:23

- Example usage:
  - Make SDH connected to port 2 = COM3 move:
    > demo-velocity-acceleration -p 2

  - Make SDH connected to USB to RS232 converter 0 move:
    > demo-velocity-acceleration --sdh_rs_device=/dev/ttyUSB0

  - Get the version info of both the joint controllers and the tactile
    sensor firmware from an SDH connected via Ethernet.
    The joint controllers and the tactile sensors have a common IP-Address,
    here 192.168.1.42. The SDH controller is attached to the
    default TCP port 23 and the tactile sensors to the default TCP port 13000.
    (Requires at least SDH-firmware v0.0.3.2)
    > demo-velocity-acceleration --tcp=192.168.1.42 --dsa_tcp -v

  - Get the version info of an SDH connected to port 2 = COM3
    > demo-velocity-acceleration --port=2 -v


usage: demo-velocity-acceleration [options]

General options:
  -h, --help
      Show this help message and exit.

  -v, --version
      Print the version (revision/release names) and dates of application,
```

```
      library (and the attached SDH firmware, if found), then exit.

  -V, --version_check
      Check the firmware release of the connected SDH if it is the one
      recommended by this library. A message will be printed accordingly.

  -d LEVEL, --debug=LEVEL
      Print debug messages of level LEVEL or lower while executing the program.
      Level 0 (default): No messages,  1: application-level messages,
      2: cSDH-level messages, 3: cSDHSerial-level messages

  -l LOGFILE, --debuglog=LOGFILE
      Redirect the printed debug messages to LOGFILE instead of default
      standard error. If LOGFILE starts with '+' then the output will be
      appended to the file (without the leading '+'), else the file will be
      overwritten.


Communication options:
  -p PORT, --port=PORT, --sdhport=PORT
      Use RS232 communication PORT to connect to the SDH instead of the default
      0='COM1'='/dev/ttyS0'.

  --sdh_rs_device=DEVICE_FORMAT_STRING
      Use DEVICE_FORMAT_STRING instead of the default "/dev/ttyS%d". Useful
      e.g. to use USB to RS232 converters available via "/dev/ttyUSB%d".
      If the DEVICE_FORMAT_STRING contains '%d' then the PORT must also be
      provided. If not then the DEVICE_FORMAT_STRING is the full device name.

  -T TIMEOUT, --timeout=TIMEOUT Timeout in seconds when waiting for data from
      SDH. The default -1 means: wait forever.

  -b BAUDRATE, --baud=BAUDRATE
      Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232
      and 1000000 Bit/s (1MBit/s) for CAN
  -c, --can, --canesd
      Use CAN bus via an ESD adapter to connect to the SDH instead of RS232.

  -n NET, --net=NET
      Use ESD CAN NET for CAN communication, default=0.

  --canpeak
      Use CAN bus via a PEAK adapter to connect to the SDH instead of RS232.

  -e ID_READ, --id_read=ID_READ
      Use CAN ID ID_READ for receiving CAN messages (default: 43=0x2B).

  -w ID_WRITE, --id_write=ID_WRITE
      Use CAN ID ID_WRITE for writing CAN messages (default: 42=0x2A).

  --tcp[=[IP_OR_HOSTNAME][:PORT]]
      Use TCP for communication with the SDH. The SDH can be reached via
      TCP/IP on port PORT at IP_OR_HOSTNAME, which can be a numeric IPv4
      address or a hostname. The default is "192.168.1.42:23"
      When using --tcp and --dsa_tcp then only the last set IP_OR_HOSTNAME
      is used for both.
      (This feature requires at least SDH firmware 0.0.3.1)
```

Chapter 9

Namespace Documentation

9.1 SDH Namespace Reference

Classes

- class cCANSerial_ESD_Internal

  internal hardware specific implementation details of the lowlevel ESD CAN interface

- class cCANSerial_ESDException

  Derived exception class for low-level CAN ESD related exceptions.

- class cCANSerial_ESD

  *Low-level communication class to access a CAN port from company ESD (*http://www.esd.eu/*)*

- class cCANSerial_PEAK_Internal

  internal hardware specific implementation details of the lowlevel PEAK CAN interface

- class cCANSerial_PEAKException

  Derived exception class for low-level CAN PEAK related exceptions.

- class cCANSerial_PEAK

  *Low-level communication class to access a CAN port from company PEAK (*http://www.peak-system.com*)*

- class cCRC

  Cyclic Redundancy Code checker class, used for protecting communication against transmission errors.

- class cCRC_DSACON32m

  A derived CRC class that uses a CRC table and initial value suitable for the Weiss Robotics DSACON32m controller.

- class cCRC_SDH

  A derived CRC class that uses a CRC table and initial value suitable for protecing the binary communication with SDH via RS232.

- class cDBG

  A class to print colored debug messages.

- class cHexByteString

  dummy class for (debug) stream output of bytes as list of hex values

- class cDSAException

  Derived exception class for low-level DSA related exceptions.

- class cDSA

  SDH::cDSA is the end user interface class to access the DSACON32m, the tactile sensor controller of the SDH.

- class cRS232Exception

  Derived exception class for low-level RS232 related exceptions.

- class cRS232

  Low-level communication class to access a serial port on Cygwin and Linux.

- class cSDH

  SDH::cSDH is the end user interface class to control a SDH (SCHUNK Dexterous Hand).

- class cSDHErrorInvalidParameter

  Derived exception class for exceptions related to invalid parameters.

- class cSDHBase

  The base class to control the SCHUNK Dexterous Hand.

- class cMsg

  Class for short, fixed maximum length text messages.

- class cSDHLibraryException

  Base class for exceptions in the SDHLibrary-CPP.

- class cSDHErrorCommunication

  Derived exception class for exceptions related to communication between the SDHLibrary and the SDH.

- struct sSDHBinaryRequest

  data structure with binary data for request from PC to SDH

- struct sSDHBinaryResponse

data structure with binary data for response from SDH to PC

- class cSDHSerial

  The class to communicate with a SDH via RS232.

- class cSerialBaseException

  Derived exception class for low-level serial communication related exceptions.

- class cSerialBase

  Low-level communication class to access a serial port.

- class cSimpleStringList

  A simple string list. (Fixed maximum number of strings of fixed maximum length)

- class cSimpleTime

  Very simple class to measure elapsed time.

- class cSimpleVectorException

  Derived exception class for low-level simple vector related exceptions.

- class cSimpleVector

  A simple vector implementation.

- class cTCPSerialException

  Derived exception class for low-level CAN ESD related exceptions.

- class cTCPSerial

  Low-level communication class to access a CAN port.

- class cUnitConverter

  Unit conversion class to convert values between physical unit systems.

- class cSetValueTemporarily

  helper class to set value on construction and reset to previous value on destruction. (RAII-idiom)

Typedefs

- typedef int8_t Int8

  signed integer, size 1 Byte (8 Bit)

- typedef uint8_t UInt8

  unsigned integer, size 1 Byte (8 Bit)

- typedef int16_t Int16

signed integer, size 2 Byte (16 Bit)

- typedef uint16_t UInt16

  unsigned integer, size 2 Byte (16 Bit)

- typedef int32_t Int32

  signed integer, size 4 Byte (32 Bit)

- typedef uint32_t UInt32

  unsigned integer, size 4 Byte (32 Bit)

- typedef void * PCAN_HANDLE

  Linux libpcan uses HANDLE where Windows Pcan_usb.h uses no handle at all:

- typedef UInt16 tCRCValue

  the data type used to calculate and exchange CRC values with DSACON32m (16 bit integer)

- typedef cSimpleVector(cSDHSerial::* pSetFunction)(int, double *)

  Type of a pointer to a "set-axis-values" function like cSDHSerial::p, cSDHSerial::pos, ..., cSDHSerial::igrip, cSDHSerial::ihold or cSDHSerial::ilim.

- typedef cSimpleVector(cSDHSerial::* pGetFunction)(int, double *)

  Type of a pointer to a "get-axis-values" function like cSDHSerial::p, cSDHSerial::pos, ..., cSDHSerial::igrip, cSDHSerial::ihold or cSDHSerial::ilim.

- typedef void * tDeviceHandle

  generic device handle for CAN devices

- typedef time_t tTimevalSec
- typedef suseconds_t tTimevalUSec
- typedef double(cUnitConverter::* pDoubleUnitConverterFunction)(double) const

  Type of a pointer to a function like 'double SDH::cUnitConverter::ToExternal(double) const' or 'double SDH::cUnitConverter::ToInternal(double) const'.

Enumerations

- enum { eNUMBER_OF_ELEMENTS = cSimpleVector::eNUMBER_OF_ELEMENTS }

Functions

- VCC_EXPORT std::ostream & operator<< (std::ostream &stream, cHexByteString const &s)

output the bytes in s to stream as a list of space separated hex bytes (without 0x prefix)

- std::ostream & operator<< (std::ostream &stream, cDSA::sResponse const &response)
- VCC_EXPORT std::ostream & operator<< (std::ostream &stream, cDSA::sControllerInfo const &controller_info)
- VCC_EXPORT std::ostream & operator<< (std::ostream &stream, cDSA::sSensorInfo const &sensor_info)
- VCC_EXPORT std::ostream & operator<< (std::ostream &stream, cDSA::sMatrixInfo const &matrix_info)
- VCC_EXPORT std::ostream & operator<< (std::ostream &stream, cDSA const &dsa)
- char const * SDHCommandCodeToString (eCommandCode cc)
- char const * SDHReturnCodeToString (eReturnCode rc)
- std::ostream & operator<< (std::ostream &stream, cMsg const &msg)
- std::ostream & operator<< (std::ostream &stream, cSDHLibraryException const &e)
- struct SDH::sSDHBinaryRequest __attribute__ ((packed))
- std::ostream & operator<< (std::ostream &stream, sSDHBinaryRequest const &request)

  helper functions to insert a human readable form of the request into stream

- std::ostream & operator<< (std::ostream &stream, sSDHBinaryResponse const &response)

  helper functions to insert a human readable form of the restore into stream

- std::ostream & operator<< (std::ostream &stream, cSimpleStringList const &ssl)

  Output of cSimpleStringList objects in 'normal' output streams.

- std::vector< int > NumerifyRelease (char const *rev)

Auxiliary functions

- bool InIndex (int v, int max)
- bool InRange (double v, double min, double max)
- bool InRange (int n, double const *v, double const *min, double const *max)
- double ToRange (double v, double min, double max)
- void ToRange (int n, double *v, double const *min, double const *max)
- void ToRange (std::vector< double > &v, std::vector< double > const &min, std::vector< double > const &max)
- void ToRange (cSimpleVector &v, std::vector< double > const &min, std::vector< double > const &max)
- double Approx (double a, double b, double eps)
- bool Approx (int n, double *a, double *b, double *eps)
- double DegToRad (double d)
- double RadToDeg (double r)
- void SleepSec (double t)
- int CompareReleases (char const *rev1, char const *rev2)

compare release strings

- template<typename Function , typename Tp >
  void apply (Function f, Tp &sequence)
- template<typename Function , typename InputIterator >
  Function apply (Function f, InputIterator first, InputIterator last)
- template<typename Function , typename Tp >
  Tp map (Function f, Tp sequence)
- template<typename T >
  std::ostream & operator<< (std::ostream &stream, std::vector< T > const &v)

Variables

- SDH::cRS232Exception SDH__attribute__
- std::ostream * g_sdh_debug_log = &std::cerr
- cUnitConverter const uc_identity ("any","any","?", 1.0, 0.0, 4)

  Identity converter (internal = external)

9.1.1 Detailed Description

A namespace for all classes and functions in the SDHLibrary.

The use of the namespace can be disabled at compile time of the library by setting SDH_USE_NAMESPACE to 0.

9.1.2 Typedef Documentation

9.1.2.1 typedef int16_t SDH::Int16

signed integer, size 2 Byte (16 Bit)

9.1.2.2 typedef int32_t SDH::Int32

signed integer, size 4 Byte (32 Bit)

9.1.2.3 typedef int8_t SDH::Int8

signed integer, size 1 Byte (8 Bit)

9.1.2.4 typedef void* SDH::PCAN_HANDLE

Linux libpcan uses HANDLE where Windows Pcan_usb.h uses no handle at all:

9.1.2.5 typedef double(cUnitConverter::* SDH::pDoubleUnitConverterFunction)(double) const

Type of a pointer to a function like 'double SDH::cUnitConverter::ToExternal(double) const' or 'double SDH::cUnitConverter::ToInternal(double) const'.

9.1.2.6 typedef cSimpleVector(cSDHSerial::* SDH::pGetFunction)(int, double *)

Type of a pointer to a "get-axis-values" function like cSDHSerial::p, cSDHSerial::pos, ..., cSDHSerial::igrip, cSDHSerial::ihold or cSDHSerial::ilim.

9.1.2.7 typedef cSimpleVector(cSDHSerial::* SDH::pSetFunction)(int, double *)

Type of a pointer to a "set-axis-values" function like cSDHSerial::p, cSDHSerial::pos, ..., cSDHSerial::igrip, cSDHSerial::ihold or cSDHSerial::ilim.

9.1.2.8 typedef UInt16 SDH::tCRCValue

the data type used to calculate and exchange CRC values with DSACON32m (16 bit integer)

9.1.2.9 typedef void* SDH::tDeviceHandle

generic device handle for CAN devices

9.1.2.10 typedef time_t SDH::tTimevalSec

9.1.2.11 typedef suseconds_t SDH::tTimevalUSec

9.1.2.12 typedef uint16_t SDH::UInt16

unsigned integer, size 2 Byte (16 Bit)

9.1.2.13 typedef uint32_t SDH::UInt32

unsigned integer, size 4 Byte (32 Bit)

9.1.2.14 typedef uint8_t SDH::UInt8

unsigned integer, size 1 Byte (8 Bit)

9.1.3 Enumeration Type Documentation

9.1.3.1 anonymous enum

Enumerator:

eNUMBER_OF_ELEMENTS

9.1.4 Function Documentation

9.1.4.1 struct SDH::sSDHBinaryResponse SDH::__attribute__ ((packed))

9.1.4.2 template<typename Function , typename Tp > void SDH::apply (Function *f,* Tp & *sequence*)

Apply a function to every element of a sequence, the elements of the sequence are modified by *f*

Parameters

f	A unary function object.
sequence	The iterable sequence to modify.

Applies the function object `f` to each element of the *sequence*.

9.1.4.3 template<typename Function , typename InputIterator > Function SDH::apply (Function *f,* InputIterator *first,* InputIterator *last*)

Apply a function to every element of a sequence.

Parameters

first	An input iterator.
last	An input iterator.
f	A unary function object.

Returns

`f`.

Applies the function object `f` to each element in the range [first,last). `f` must not modify the order of the sequence. If `f` has a return value it is ignored.

9.1.4.4 VCC_EXPORT double SDH::Approx (double *a,* double *b,* double *eps*)

Return True if a is approximately the same as b. I.E. |a-b| < eps

9.1.4.5 VCC_EXPORT bool SDH::Approx (int *n,* double * *a,* double * *b,* double * *eps*)

Return True if list/tuple/array a=(a1,a2,...) is approximately the same as b=(b1,b2,...). I.E. |a_i-b_i| < eps[i]

9.1.4.6 VCC_EXPORT int SDH::CompareReleases (char const * *rev1,* char const * *rev2*)

compare release strings

compare release strings *rev1* and *rev2*.

Returns

-1,0, or 1 if *rev1* is older, equal or newer than *rev2*

Parameters

rev1	- a release string like "0.0.1.5" or "0.0.1.11-a"
rev2	- another release string

Example:

- CompareReleases("0.0.1.5", "0.0.1.5") ==> 0
- CompareReleases("0.0.1.5", "0.0.1.4") ==> 1
- CompareReleases("0.0.1.5", "0.0.2.1") ==> -1
- CompareReleases("0.0.1.5", "0.0.1.5-a") ==> -1

9.1.4.7 VCC_EXPORT double SDH::DegToRad (double *d*)

Return d in deg converted to rad

9.1.4.8 VCC_EXPORT bool SDH::InIndex (int *v,* int *max*)

Return True if v is in range [0 .. max[

9.1.4.9 VCC_EXPORT bool SDH::InRange (int *n,* double const * *v,* double const * *min,* double const * *max*)

Return True if in list/tuple/array v=(v1,v2,...) each v_i is in range [min_i..max_i] with min = (min1, min2,...) max = (max1, max2, ..)

9.1.4.10 VCC_EXPORT bool SDH::InRange (double *v,* double *min,* double *max*)

Return True if v is in range [min .. max]

9.1.4.11 template<typename Function , typename Tp > Tp SDH::map (Function *f,* Tp *sequence*)

map a function to every element of a sequence, returning a copy with the mapped elements

Parameters

f	- A unary function object.
sequence	- An iterable object.

Returns

copy of *sequence* with the mapped elements

9.1.4.12 std::vector<int> SDH::NumerifyRelease (char const * *rev*)

return a vector of integer numbers for a release string *rev*

Parameters

rev	release string like "0.0.1.11-a"

Returns

a vector of integer numbers like [0,0,1,11,1]

9.1.4.13 std::ostream & SDH::operator<< (std::ostream & *stream,* sSDHBinaryRequest const & *request*)

helper functions to insert a human readable form of the *request* into *stream*

9.1.4.14 VCC_EXPORT std::ostream& SDH::operator<< (std::ostream & *stream,* cHexByteString const & *s*) [inline]

output the bytes in *s* to *stream* as a list of space separated hex bytes (without 0x prefix)

9.1.4.15 template<typename T > std::ostream& SDH::operator<< (std::ostream & *stream,* std::vector< T > const & *v*)

Overloaded insertion operator for vectors: a comma and space separated list of the vector elements of *v* is inserted into *stream*

Parameters

stream	- the output stream to insert into
v	- the vector of objects to insert into *stream*

Returns

the stream with the inserted objects

Attention

If you use the SDH namespace then you should be aware that using this overloaded insertion operator can get tricky:

- If you use a `using namespace SDH` directive then things are easy and intuitive:

```
#include <sdh/util.h>
using namespace SDH;
std::vector<int> v;
std::cout << "this is a std::vector: " << v << "\n";
```

- But without the `using namespace SDH` accessing the operator is tricky, you have to use the 'functional' access `operator<<(s,v)` in order to be able to apply the scope resolution operator :: correctly:

```
#include <sdh/util.h>
std::vector<int> v;
SDH::operator<<( std::cout << "this is a std::vector: ", v ) << "\n";
```

- The more intuitive approaches do not work:

```
std::cout << faa ;                // obviously fails with "no match for >>op
 erator<<<< in >>std::cout << faa<<", as expected
std::cout SDH::<< faa ;           // is a syntax error
std::cout SDH::operator<< faa ;   // is a syntax error
std::cout operator SDH::<< faa ;  // is a syntax error
```

9.1.4.16 std::ostream & SDH::operator<< (std::ostream & *stream*, cDSA::sSensorInfo const & *sensor_info*)

9.1.4.17 VCC_EXPORT std::ostream & SDH::operator<< (std::ostream & *stream*, cMsg const & *msg*)

9.1.4.18 VCC_EXPORT std::ostream & SDH::operator<< (std::ostream & *stream*, cSDHLibraryException const & *e*)

9.1.4.19 VCC_EXPORT std::ostream & SDH::operator<< (std::ostream & *stream*, cSimpleStringList const & *ssl*)

Output of cSimpleStringList objects in 'normal' output streams.

9.1.4.20 std::ostream & SDH::operator<< (std::ostream & *stream*, cDSA::sMatrixInfo const & *matrix_info*)

9.1.4.21 std::ostream & SDH::operator<< (std::ostream & *stream*, sSDHBinaryResponse const & *response*)

helper functions to insert a human readable form of the *restore* into *stream*

9.1.4.22 VCC_EXPORT std::ostream & SDH::operator<< (std::ostream & *stream,* cDSA::sResponse const & *response*)

9.1.4.23 std::ostream & SDH::operator<< (std::ostream & *stream,* cDSA const & *dsa*)

9.1.4.24 std::ostream & SDH::operator<< (std::ostream & *stream,* cDSA::sControllerInfo const & *controller_info*)

9.1.4.25 VCC_EXPORT double SDH::RadToDeg (double *r*)

Return r in rad converted to deg

9.1.4.26 char const * SDH::SDHCommandCodeToString (eCommandCode *cc*)

9.1.4.27 char const * SDH::SDHReturnCodeToString (eReturnCode *rc*)

9.1.4.28 VCC_EXPORT void SDH::SleepSec (double *t*)

Sleep for t seconds. (t is a double!)

9.1.4.29 VCC_EXPORT void SDH::ToRange (int *n,* double * *v,* double const * *min,* double const * *max*)

Limit each v_i in v to range [min_i..max_i] with min = (min1, min2,...) max = (max1, max2, ..) This modifies **v!*

9.1.4.30 VCC_EXPORT double SDH::ToRange (double *v,* double *min,* double *max*)

Return v limited to range [min .. max]. I.e. if v is < min then min is returned, or if v > max then max is returned, else v is returned

9.1.4.31 VCC_EXPORT void SDH::ToRange (std::vector< double > & *v,* std::vector< double > const & *min,* std::vector< double > const & *max*)

Limit each v_i in v to range [min_i..max_i] with min = (min1, min2,...) max = (max1, max2, ..) This modifies *v!*

9.1.4.32 VCC_EXPORT void SDH::ToRange (cSimpleVector & *v,* std::vector< double > const & *min,* std::vector< double > const & *max*)

Limit each v_i in v to range [min_i..max_i] with min = (min1, min2,...) max = (max1, max2, ..) This modifies *v!*

9.1.5 Variable Documentation

9.1.5.1 VCC_EXPORT std::ostream * SDH::g_sdh_debug_log = &std::cerr

9.1.5.2 SDH::cSDHErrorInvalidParameter SDH::SDH__attribute__

9.1.5.3 cUnitConverter const SDH::uc_identity

Identity converter (internal = external)

Chapter 10

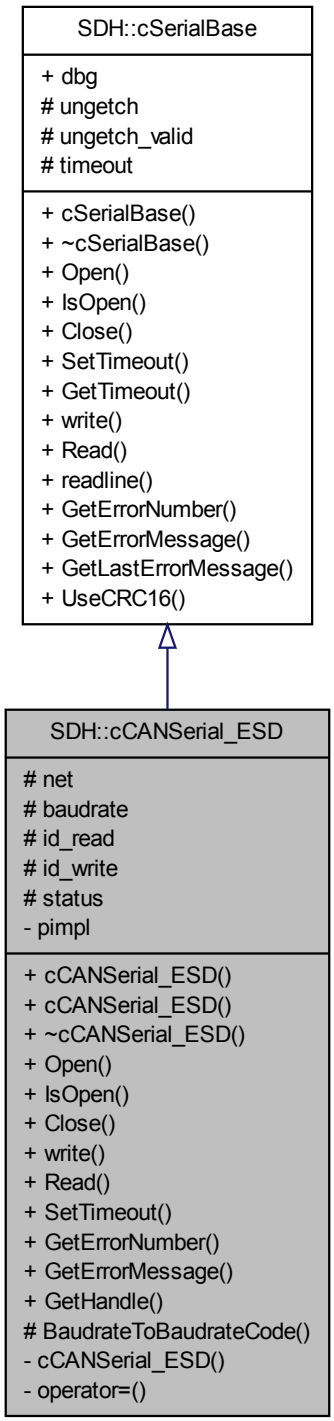
Class Documentation

10.1 SDH::cCANSerial_ESD Class Reference

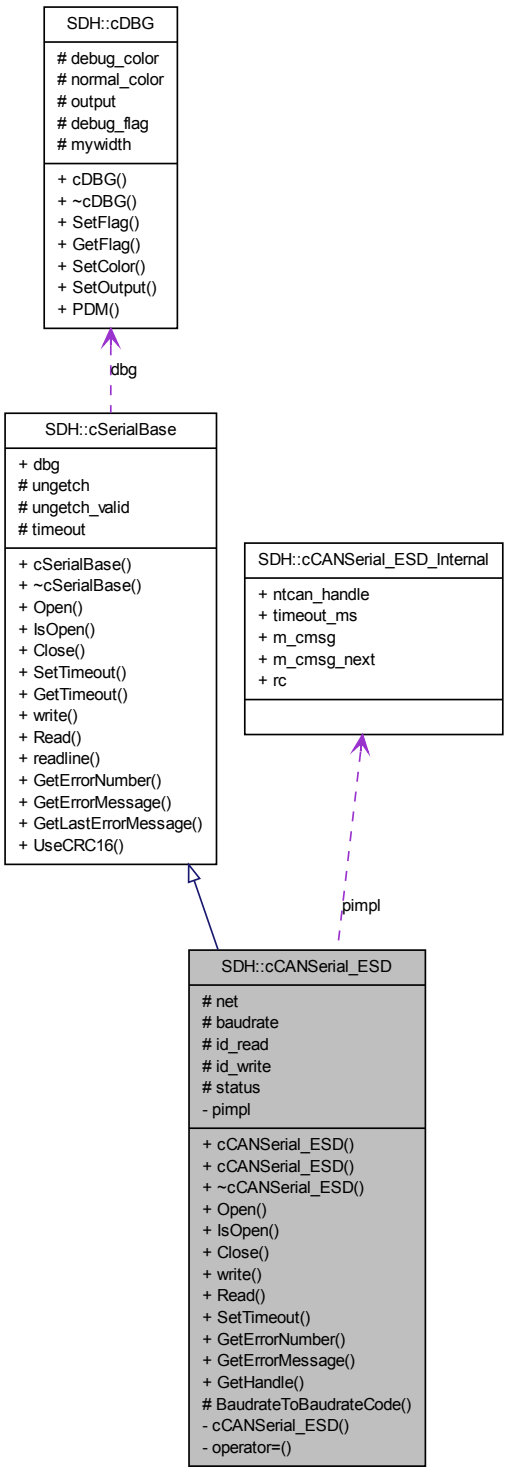
Low-level communication class to access a CAN port from company ESD (http://www.esd.eu/)

`#include <canserial-esd.h>`

Inheritance diagram for SDH::cCANSerial_ESD:



Collaboration diagram for SDH::cCANSerial_ESD:



Public Member Functions

- cCANSerial_ESD (int _net, unsigned long _baudrate, double _timeout, int _id_-read, int _id_write) throw (cCANSerial_ESDException∗)
- cCANSerial_ESD (tDeviceHandle _ntcan_handle, double _timeout, int _id_-read, int _id_write) throw (cCANSerial_ESDException∗)
- ∼cCANSerial_ESD ()

  destructor: clean up

- void Open (void) throw (cCANSerial_ESDException∗)
- bool IsOpen (void) throw ()

  Return true if interface to CAN ESD is open.

- void Close (void) throw (cCANSerial_ESDException∗)

  Close the previously opened CAN ESD interface port.

- int write (char const ∗ptr, int len=0) throw (cCANSerial_ESDException∗)

  Write data to a previously opened port.

- ssize_t Read (void ∗data, ssize_t size, long timeout_us, bool return_on_less_-data) throw (cCANSerial_ESDException∗)
- void SetTimeout (double _timeout) throw (cSerialBaseException∗)

  set the timeout for next readline() calls (negative value means: no timeout, wait for ever)

- virtual tErrorCode GetErrorNumber ()
- virtual char const ∗ GetErrorMessage (tErrorCode dw)
- tDeviceHandle GetHandle ()

  return the internally used NTCAN_HANDLE cast to a tDeviceHandle

Protected Member Functions

- unsigned int BaudrateToBaudrateCode (unsigned long baudrate) throw (cCANSerial_-ESDException∗)

  Translate a baudrate given as unsigned long into a baudrate code for struct termios.

Protected Attributes

- int net

  the ESD CAN net to use

- unsigned long baudrate

  the baudrate to use in bit/s

- int id_read

  the CAN ID used for reading

- int id_write

  the CAN ID used for writing

- int status

10.1.1 Detailed Description

Low-level communication class to access a CAN port from company ESD (http://www.esd.eu/) Since SDHLibrary-C++ release 0.0.2.0 implementation specific parts of the access to ESD CAN devices have been removed from the header file here in order to get rid of dependencies from the weird ntcan.h. Specifically the ntcan_handle of type NTCAN_-HANDLE member was removed. You can still provide an existing handle for reuse on construction, but you must cast your NTCAN_HANDLE to a tDeviceHandle. You can get the internally used NTCAN_HANDLE cast to a tDeviceHandle with GetHandle().

10.1.2 Constructor & Destructor Documentation

10.1.2.1 cCANSerial_ESD::cCANSerial_ESD (int *_net*, unsigned long *_baudrate*, double *_timeout*, int *_id_read*, int *_id_write*) throw (cCANSerial_ESDException*)

Constructor: constructs an object to communicate with an SDH via CAN bus using an ESD CAN card.

Parameters

_net	- the ESD CAN net to use
_baudrate	- the baudrate in bit/s. Only some bitrates are valid: (1000000,800000,500000,250000,125000,100000,50000,20000,10000)
_timeout	- the timeout in seconds (0 for no timeout = wait for ever)
_id_read	- the CAN ID to use for reading (The SDH sends data on this ID)
_id_write	- the CAN ID to use for writing (The SDH receives data on this ID)

10.1.2.2 cCANSerial_ESD::cCANSerial_ESD (tDeviceHandle *_ntcan_handle*, double *_timeout*, int *_id_read*, int *_id_write*) throw (cCANSerial_ESDException*)

Constructor: constructs an object to communicate with an SDH via CAN bus using an ESD CAN card by reusing an already existing handle.

Parameters

ntcan-handle	- the ESD CAN handle to reuse (please cast your NTCAN_HANDLE to tDeviceHandle! It is save to do that!)
_timeout	- the timeout in seconds (0 for no timeout = wait for ever)
_id_read	- the CAN ID to use for reading (The SDH sends data on this ID)
_id_write	- the CAN ID to use for writing (The SDH receives data on this ID)

10.1.2.3 cCANSerial_ESD::~cCANSerial_ESD ( )

destructor: clean up

10.1.3 Member Function Documentation

10.1.3.1 unsigned int cCANSerial_ESD::BaudrateToBaudrateCode (unsigned long *baudrate*) throw (cCANSerial_ESDException*) [protected]

Translate a baudrate given as unsigned long into a baudrate code for struct termios.

10.1.3.2 void cCANSerial_ESD::Close (void) throw (cCANSerial_ESDException*) [virtual]

Close the previously opened CAN ESD interface port.

Implements SDH::cSerialBase.

10.1.3.3 char const * cCANSerial_ESD::GetErrorMessage (tErrorCode *dw*) [virtual]

Overloaded helper function that returns an ESD error message for ESD error code dw.

Remarks

The string returned will be overwritten by the next call to the function

Reimplemented from SDH::cSerialBase.

10.1.3.4 cSerialBase::tErrorCode cCANSerial_ESD::GetErrorNumber ( ) [virtual]

Overloaded helper function that returns the last ESD error number.

Reimplemented from SDH::cSerialBase.

10.1.3.5 tDeviceHandle cCANSerial_ESD::GetHandle ( )

return the internally used NTCAN_HANDLE cast to a tDeviceHandle

10.1.3.6 bool cCANSerial_ESD::IsOpen (void) throw () [virtual]

Return true if interface to CAN ESD is open.

Implements SDH::cSerialBase.

10.1.3.7 void cCANSerial_ESD::Open (void) throw (cCANSerial_ESDException*) [virtual]

Open the device as configured by the parameters given to the constructor

Implements SDH::cSerialBase.

10.1.3.8 ssize_t cCANSerial_ESD::Read (void * *data*, ssize_t *size*, long *timeout_us*, bool *return_on_less_data*) throw (cCANSerial_ESDException*) [virtual]

Read data from device. This function waits until *max_time_us* us passed or the expected number of bytes are received via serial line. if (*return_on_less_data* is true (default value), the number of bytes that have been received are returned and the data is stored in *data* If the *return_on_less_data* is false, data is only read from serial line, if at least *size* bytes are available.

Implements SDH::cSerialBase.

10.1.3.9 void cCANSerial_ESD::SetTimeout (double *_timeout*) throw (cSerialBaseException*) [virtual]

set the timeout for next readline() calls (negative value means: no timeout, wait for ever)

Reimplemented from SDH::cSerialBase.

10.1.3.10 int cCANSerial_ESD::write (char const * *ptr*, int *len* = 0) throw (cCANSerial_ESDException*) [virtual]

Write data to a previously opened port.

Write *len* bytes from *ptr* to the CAN device

Parameters

ptr	- pointer the byte array to send in memory
len	- number of bytes to send

Returns

the number of bytes actually written

Implements SDH::cSerialBase.

10.1.4 Member Data Documentation

10.1.4.1 unsigned long SDH::cCANSerial_ESD::baudrate [protected]

the baudrate to use in bit/s

10.1.4.2 int SDH::cCANSerial_ESD::id_read [protected]

the CAN ID used for reading

10.1.4.3 int SDH::cCANSerial_ESD::id_write [protected]

the CAN ID used for writing

10.1.4.4 int SDH::cCANSerial_ESD::net [protected]

the ESD CAN net to use

10.1.4.5 int SDH::cCANSerial_ESD::status [protected]

The documentation for this class was generated from the following files:

- sdh/canserial-esd.h
- sdh/canserial-esd.cpp

10.2 SDH::cCANSerial_ESD_Internal Class Reference

internal hardware specific implementation details of the lowlevel ESD CAN interface

Public Attributes

- NTCAN_HANDLE ntcan_handle

  the internal handle to the driver

- int32_t timeout_ms
- CMSG m_cmsg
- int m_cmsg_next

  index of next received data byte to return to user in m_cmsg

- NTCAN_RESULT rc

10.2.1 Detailed Description

internal hardware specific implementation details of the lowlevel ESD CAN interface private data of cCANSerial_ESD.

Required to keep inclusion of ntcan.h out of public interface of cCANSerial_ESD.

10.2.2 Member Data Documentation

10.2.2.1 CMSG SDH::cCANSerial_ESD_Internal::m_cmsg

received messages might be split over several CAN messages it might therefore happen that more data is received than can be returned to the user. To not loose that data it is kept here to be be returned in a later call

10.2.2.2 int SDH::cCANSerial_ESD_Internal::m_cmsg_next

index of next received data byte to return to user in m_cmsg

10.2.2.3 NTCAN_HANDLE SDH::cCANSerial_ESD_Internal::ntcan_handle

the internal handle to the driver

10.2.2.4 NTCAN_RESULT SDH::cCANSerial_ESD_Internal::rc

10.2.2.5 int32_t SDH::cCANSerial_ESD_Internal::timeout_ms

The documentation for this class was generated from the following file:

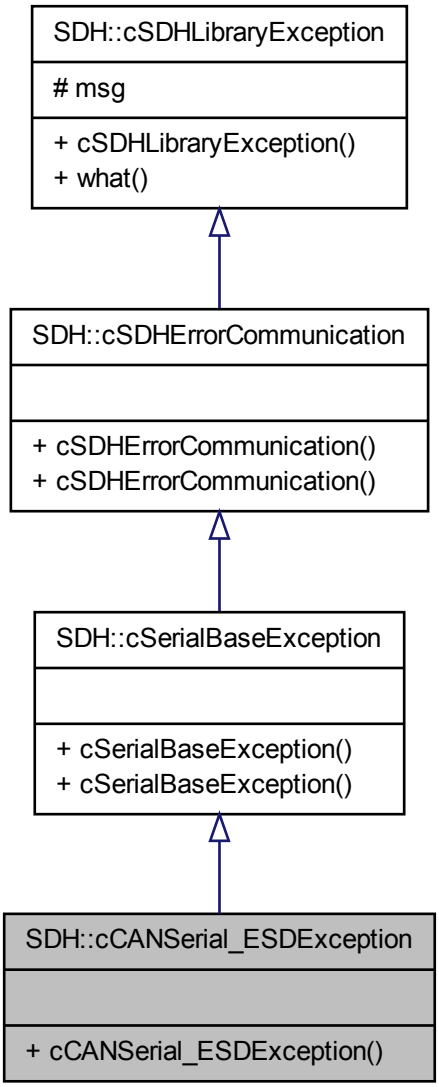
- sdh/canserial-esd.cpp

10.3 SDH::cCANSerial_ESDException Class Reference

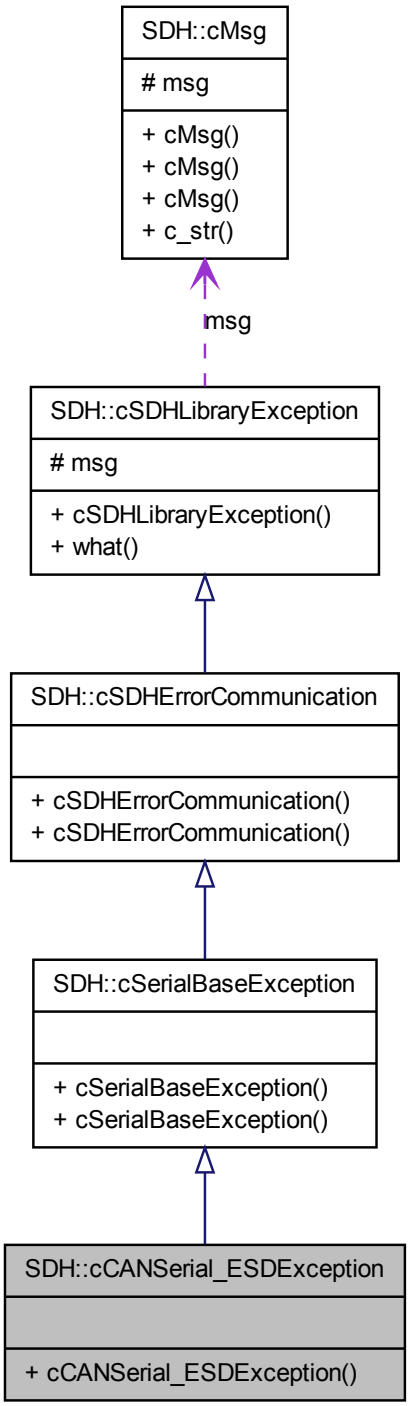
Derived exception class for low-level CAN ESD related exceptions.

`#include <canserial-esd.h>`

Inheritance diagram for SDH::cCANSerial_ESDException:



Collaboration diagram for SDH::cCANSerial_ESDException:



Public Member Functions

- cCANSerial_ESDException (cMsg const &_msg)

10.3.1 Detailed Description

Derived exception class for low-level CAN ESD related exceptions.

10.3.2 Constructor & Destructor Documentation

10.3.2.1 SDH::cCANSerial_ESDException::cCANSerial_ESDException (cMsg const & *_msg*) [inline]

The documentation for this class was generated from the following file:

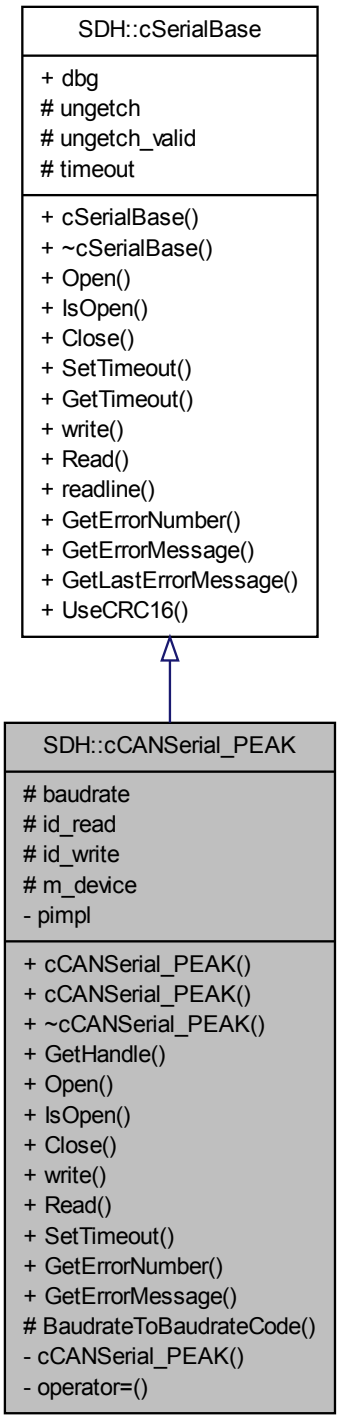
- sdh/canserial-esd.h

10.4 SDH::cCANSerial_PEAK Class Reference

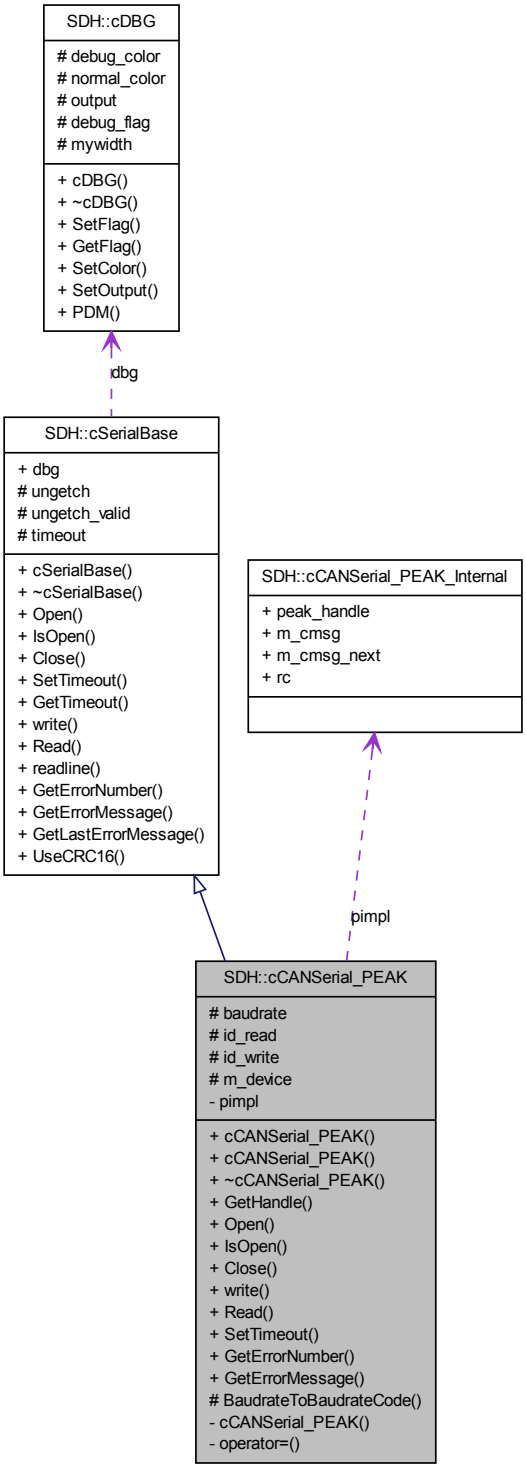
Low-level communication class to access a CAN port from company PEAK (http://www.peak-system.c

```
#include <canserial-peak.h>
```

Inheritance diagram for SDH::cCANSerial_PEAK:



Collaboration diagram for SDH::cCANSerial_PEAK:



Public Member Functions

- cCANSerial_PEAK (unsigned long _baudrate, double _timeout, int _id_read, int _id_write, const char *device="/dev/pcanusb0") throw (cCANSerial_PEAKException*)
- cCANSerial_PEAK (tDeviceHandle _peak_handle, double _timeout, int _id_read, int _id_write) throw (cCANSerial_PEAKException*)
- ~cCANSerial_PEAK ()

  destructor: clean up

- tDeviceHandle GetHandle ()
- void Open (void) throw (cCANSerial_PEAKException*)
- bool IsOpen (void) throw ()

  Return true if interface to CAN PEAK is open.

- void Close (void) throw (cCANSerial_PEAKException*)

  Close the previously opened CAN PEAK interface port.

- int write (char const *ptr, int len=0) throw (cCANSerial_PEAKException*)

  Write data to a previously opened port.

- ssize_t Read (void *data, ssize_t size, long timeout_us, bool return_on_less_data) throw (cCANSerial_PEAKException*)
- void SetTimeout (double _timeout) throw (cSerialBaseException*)

  set the timeout for next readline() calls (negative value means: no timeout, wait for ever)

- virtual tErrorCode GetErrorNumber ()
- virtual char const * GetErrorMessage (tErrorCode dw)

Protected Member Functions

- int BaudrateToBaudrateCode (unsigned long baudrate) throw (cCANSerial_PEAKException*)

  Translate a baudrate given as unsigned long into a baudrate code for struct termios.

Protected Attributes

- unsigned long baudrate

  the baudrate to use in bit/s

- int id_read

  the CAN ID used for reading

- int id_write

  the CAN ID used for writing

- char m_device [64]

10.4.1 Detailed Description

Low-level communication class to access a CAN port from company PEAK (http://www.peak-system.c
Since SDHLibrary-C++ release 0.0.2.0 implementation specific parts of the access to PEAK CAN devices have been removed from the header file here in order to get rid of dependencies from the Pcan_usb.h. Specifically the peak_handle of type PEAK_-HANDLE member was removed. You can still provide an existing handle for reuse on construction, but you must cast your HANDLE to a tDeviceHandle. You can get the internally used PEAK_HANDLE cast to a tDeviceHandle with GetHandle().

10.4.2 Constructor & Destructor Documentation

10.4.2.1 cCANSerial_PEAK::cCANSerial_PEAK (unsigned long *_baudrate*, double *_timeout*, int *_id_read*, int *_id_write*, const char * *device* = "/dev/pcanusb0") throw (cCANSerial_PEAKException*)

Constructor: constructs an object to communicate with an SDH via CAN bus using a PEAK CAN card.

Parameters

_baudrate	- the baudrate in bit/s. Only some bitrates are valid: (1000000,800000,500000,250000,125000,100000,50000,20000,10000)
_timeout	- the timeout in seconds (0 for no timeout = wait for ever)
_id_read	- the CAN ID to use for reading (The SDH sends data on this ID)
_id_write	- the CAN ID to use for writing (The SDH receives data on this ID)
device	- the name of the char device to communicate with the PEAD driver (Needed on Linux only!)

10.4.2.2 cCANSerial_PEAK::cCANSerial_PEAK (tDeviceHandle *_peak_handle*, double *_timeout*, int *_id_read*, int *_id_write*) throw (cCANSerial_PEAKException*)

Constructor: constructs an object to communicate with an SDH via CAN bus using a PEAK CAN card by reusing an already existing handle (will work in Linux only).

Parameters

peak-handle	- the PEAK CAN handle to reuse (Works on Linux only!)
_timeout	- the timeout in seconds (0 for no timeout = wait for ever)
_id_read	- the CAN ID to use for reading (The SDH sends data on this ID)
_id_write	- the CAN ID to use for writing (The SDH receives data on this ID)

10.4.2.3 cCANSerial_PEAK::~cCANSerial_PEAK ( )

destructor: clean up

10.4.3 Member Function Documentation

10.4.3.1 int cCANSerial_PEAK::BaudrateToBaudrateCode (unsigned long *baudrate*) throw (cCANSerial_PEAKException*) [protected]

Translate a baudrate given as unsigned long into a baudrate code for struct termios.

10.4.3.2 void cCANSerial_PEAK::Close (void) throw (cCANSerial_PEAKException*) [virtual]

Close the previously opened CAN PEAK interface port.

Implements SDH::cSerialBase.

10.4.3.3 char const * cCANSerial_PEAK::GetErrorMessage (tErrorCode *dw*) [virtual]

Overloaded helper function that returns a PEAK error message for error code dw.

Remarks

The string returned will be overwritten by the next call to the function

Reimplemented from SDH::cSerialBase.

10.4.3.4 cSerialBase::tErrorCode cCANSerial_PEAK::GetErrorNumber ( ) [virtual]

Overloaded helper function that returns the last Peak error number.

Reimplemented from SDH::cSerialBase.

10.4.3.5 tDeviceHandle cCANSerial_PEAK::GetHandle ( )

Return the value of the HANDLE to the actual CAN device. Works on Linux only! Only returns a valid handle after a call to Open()!

Remarks

The returned handle can be used to open a connection to a second SDH on the same CAN bus

Returns

the handle to the actual CAN device

10.4.3.6 bool cCANSerial_PEAK::IsOpen (void) throw () [virtual]

Return true if interface to CAN PEAK is open.

Implements SDH::cSerialBase.

10.4.3.7 void cCANSerial_PEAK::Open (void) throw (cCANSerial_PEAKException*) [virtual]

Open the device as configured by the parameters given to the constructor

Implements SDH::cSerialBase.

10.4.3.8 ssize_t cCANSerial_PEAK::Read (void * *data*, ssize_t *size*, long *timeout_us*, bool *return_on_less_data*) throw (cCANSerial_PEAKException*) [virtual]

Read data from device. This function waits until *max_time_us* us passed or the expected number of bytes are received via serial line. if (*return_on_less_data* is true (default value), the number of bytes that have been received are returned and the data is stored in *data* If the *return_on_less_data* is false, data is only read from serial line, if at least *size* bytes are available.

Implements SDH::cSerialBase.

10.4.3.9 void cCANSerial_PEAK::SetTimeout (double *_timeout*) throw (cSerialBaseException*) [virtual]

set the timeout for next readline() calls (negative value means: no timeout, wait for ever)

Reimplemented from SDH::cSerialBase.

10.4.3.10 int cCANSerial_PEAK::write (char const * *ptr*, int *len* = 0) throw (cCANSerial_PEAKException*) [virtual]

Write data to a previously opened port.

Write *len* bytes from **ptr* to the CAN device

Parameters

ptr	- pointer the byte array to send in memory
len	- number of bytes to send

Returns

the number of bytes actually written

Implements SDH::cSerialBase.

10.4.4 Member Data Documentation

10.4.4.1 unsigned long SDH::cCANSerial_PEAK::baudrate [protected]

the baudrate to use in bit/s

10.4.4.2 int SDH::cCANSerial_PEAK::id_read [protected]

the CAN ID used for reading

10.4.4.3 int SDH::cCANSerial_PEAK::id_write [protected]

the CAN ID used for writing

10.4.4.4 char SDH::cCANSerial_PEAK::m_device[64] [protected]

The documentation for this class was generated from the following files:

- sdh/canserial-peak.h
- sdh/canserial-peak.cpp

10.5 SDH::cCANSerial_PEAK_Internal Class Reference

internal hardware specific implementation details of the lowlevel PEAK CAN interface

Public Attributes

- PCAN_HANDLE peak_handle
  the internal handle to the driver
- TPCANMsg m_cmsg
- int m_cmsg_next
  index of next received data byte to return to user in m_cmsg
- DWORD rc
  last return code of calls to Peak functions

10.5.1 Detailed Description

internal hardware specific implementation details of the lowlevel PEAK CAN interface private data of cCANSerial_PEAK.

Required to keep inclusion of Pcan_usb.h out of public interface of cCANSerial_-PEAK.

10.5.2 Member Data Documentation

10.5.2.1 TPCANMsg SDH::cCANSerial_PEAK_Internal::m_cmsg

received messages might be split over several CAN messages it might therefore happen that more data is received than can be returned to the user. To not loose that data it is kept here to be be returned in a later call

10.5.2.2 int SDH::cCANSerial_PEAK_Internal::m_cmsg_next

index of next received data byte to return to user in m_cmsg

10.5.2.3 PCAN_HANDLE SDH::cCANSerial_PEAK_Internal::peak_handle

the internal handle to the driver

10.5.2.4 DWORD SDH::cCANSerial_PEAK_Internal::rc

last return code of calls to Peak functions

The documentation for this class was generated from the following file:

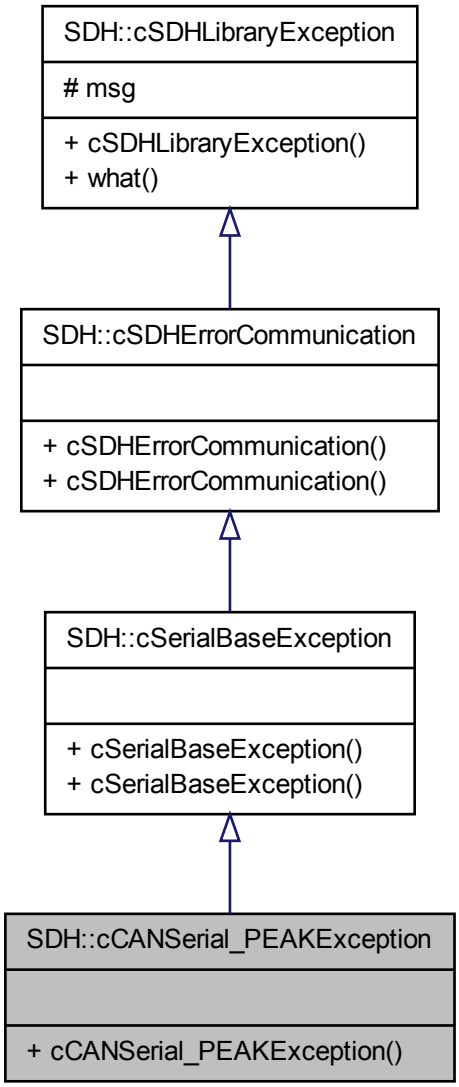
- sdh/canserial-peak.cpp

10.6 SDH::cCANSerial_PEAKException Class Reference

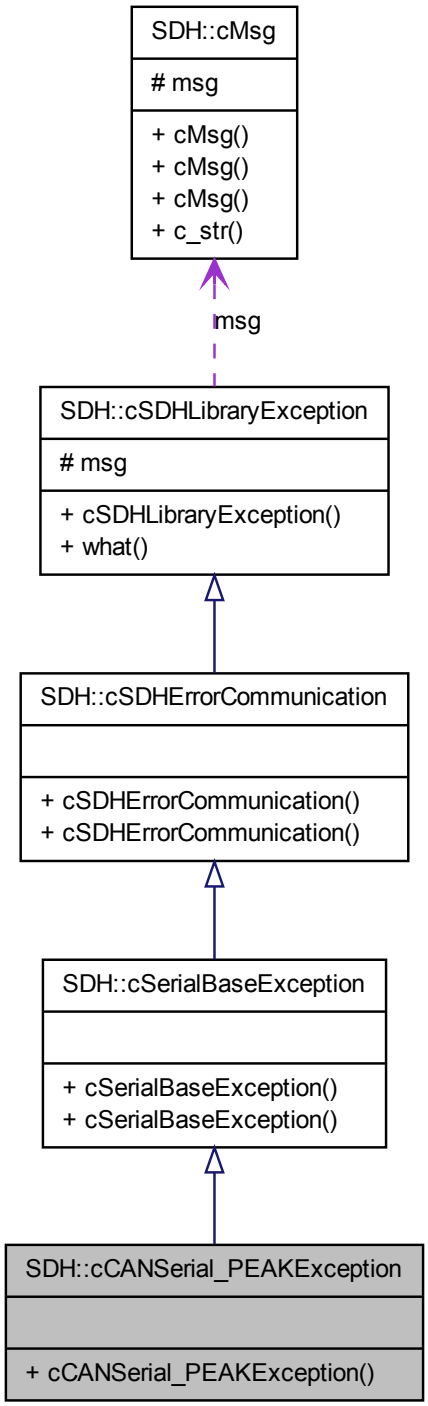
Derived exception class for low-level CAN PEAK related exceptions.

`#include <canserial-peak.h>`

Inheritance diagram for SDH::cCANSerial_PEAKException:



Collaboration diagram for SDH::cCANSerial_PEAKException:



Public Member Functions

- cCANSerial_PEAKException (cMsg const &_msg)

10.6.1 Detailed Description

Derived exception class for low-level CAN PEAK related exceptions.

10.6.2 Constructor & Destructor Documentation

10.6.2.1 SDH::cCANSerial_PEAKException::cCANSerial_PEAKException (cMsg const & *_msg*) [inline]

The documentation for this class was generated from the following file:

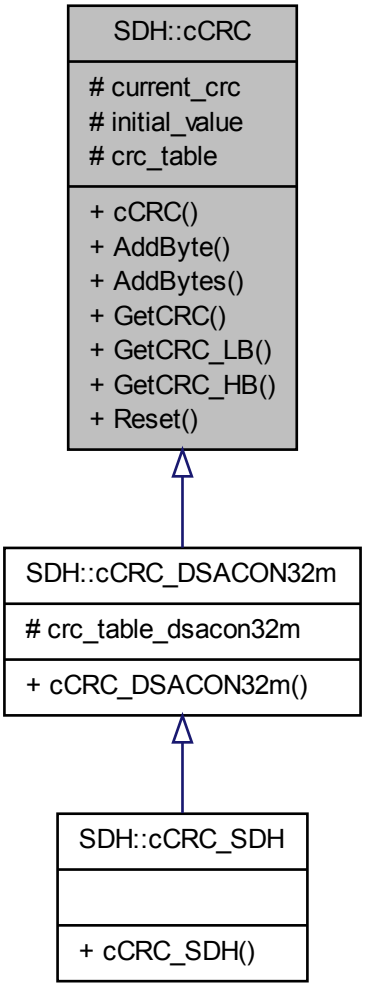
- sdh/canserial-peak.h

10.7 SDH::cCRC Class Reference

Cyclic Redundancy Code checker class, used for protecting communication against transmission errors.

```
#include <crc.h>
```

Inheritance diagram for SDH::cCRC:



Public Member Functions

- cCRC (tCRCValue const *_crc_table, tCRCValue _initial_value)

  constructor: create a new cCRC object and initialize the current value of the CRC checksum. crc_table is the CRC table to use.

- tCRCValue AddByte (unsigned char byte)

insert byte into CRC calculation and return the new current CRC checksum

- tCRCValue AddBytes (unsigned char *bytes, int nb_bytes)

  insert nb_bytes from bytes into CRC calculation and return the new current CRC checksum

- tCRCValue GetCRC ()

  return the current CRC value

- UInt8 GetCRC_LB ()

  return the low byte of the current CRC value

- UInt8 GetCRC_HB ()

  return the high byte of the current CRC value

- tCRCValue Reset ()

  reset the current CRC value to its initial value and return it;

Protected Attributes

- tCRCValue current_crc

  current value of the CRC checksum

- tCRCValue initial_value

  initial value of the CRC checksum

- tCRCValue const * crc_table

  table with precalculated CRC values

10.7.1 Detailed Description

Cyclic Redundancy Code checker class, used for protecting communication against transmission errors. Generic class to calculate a CRC using a given, precalculated table.

Use derived classes like cCRC_DSACON32m with a specifically set CRC table.

10.7.2 Constructor & Destructor Documentation

10.7.2.1 SDH::cCRC::cCRC (tCRCValue const * *_crc_table*, tCRCValue *_initial_value*) [inline]

constructor: create a new cCRC object and initialize the current value of the CRC checksum. *crc_table* is the CRC table to use.

10.7.3 Member Function Documentation

10.7.3.1 tCRCValue SDH::cCRC::AddByte (unsigned char *byte*) [inline]

insert byte into CRC calculation and return the new current CRC checksum

10.7.3.2 tCRCValue SDH::cCRC::AddBytes (unsigned char * *bytes*, int *nb_bytes*) [inline]

insert *nb_bytes* from *bytes* into CRC calculation and return the new current CRC checksum

10.7.3.3 tCRCValue SDH::cCRC::GetCRC ( ) [inline]

return the current CRC value

10.7.3.4 UInt8 SDH::cCRC::GetCRC_HB ( ) [inline]

return the high byte of the current CRC value

10.7.3.5 UInt8 SDH::cCRC::GetCRC_LB ( ) [inline]

return the low byte of the current CRC value

10.7.3.6 tCRCValue SDH::cCRC::Reset ( ) [inline]

reset the current CRC value to its initial value and return it;

10.7.4 Member Data Documentation

10.7.4.1 tCRCValue const* SDH::cCRC::crc_table [protected]

table with precalculated CRC values

10.7.4.2 tCRCValue SDH::cCRC::current_crc [protected]

current value of the CRC checksum

10.7.4.3 tCRCValue SDH::cCRC::initial_value [protected]

initial value of the CRC checksum

The documentation for this class was generated from the following file:

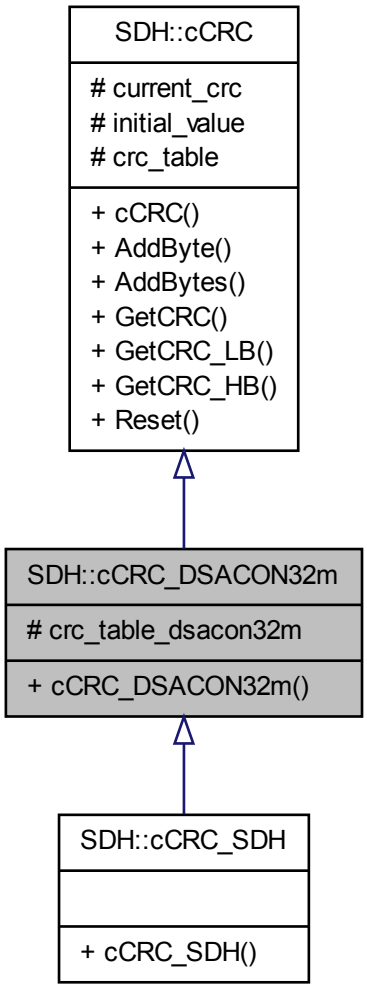
- sdh/crc.h

10.8 SDH::cCRC_DSACON32m Class Reference

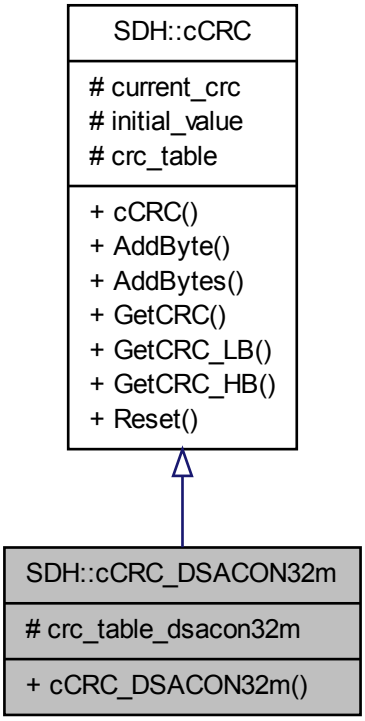
A derived CRC class that uses a CRC table and initial value suitable for the Weiss Robotics DSACON32m controller.

`#include <crc.h>`

Inheritance diagram for SDH::cCRC_DSACON32m:



Collaboration diagram for SDH::cCRC_DSACON32m:



Public Member Functions

- cCRC_DSACON32m (void)

  constructor to create a cCRC object suitable for checksumming the communication with a DSACON32m tactile sensor controller

Static Protected Attributes

- static tCRCValue const crc_table_dsacon32m [256]

  the CRC table used by the DSACON32m controller

10.8.1 Detailed Description

A derived CRC class that uses a CRC table and initial value suitable for the Weiss Robotics DSACON32m controller.

10.8.2 Constructor & Destructor Documentation

10.8.2.1 SDH::cCRC_DSACON32m::cCRC_DSACON32m (void) [inline]

constructor to create a cCRC object suitable for checksumming the communication with a DSACON32m tactile sensor controller

10.8.3 Member Data Documentation

10.8.3.1 tCRCValue const cCRC_DSACON32m::crc_table_dsacon32m [static, protected]

Initial value:

```
{
    0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50a5, 0x60c6, 0x70e7,
    0x8108, 0x9129, 0xa14a, 0xb16b, 0xc18c, 0xd1ad, 0xe1ce, 0xf1ef,
    0x1231, 0x0210, 0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
    0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c, 0xf3ff, 0xe3de,
    0x2462, 0x3443, 0x0420, 0x1401, 0x64e6, 0x74c7, 0x44a4, 0x5485,
    0xa56a, 0xb54b, 0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
    0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6, 0x5695, 0x46b4,
    0xb75b, 0xa77a, 0x9719, 0x8738, 0xf7df, 0xe7fe, 0xd79d, 0xc7bc,
    0x48c4, 0x58e5, 0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
    0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969, 0xa90a, 0xb92b,
    0x5af5, 0x4ad4, 0x7ab7, 0x6a96, 0x1a71, 0x0a50, 0x3a33, 0x2a12,
    0xdbfd, 0xcbdc, 0xfbbf, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
    0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03, 0x0c60, 0x1c41,
    0xedae, 0xfd8f, 0xcdec, 0xddcd, 0xad2a, 0xbd0b, 0x8d68, 0x9d49,
    0x7e97, 0x6eb6, 0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
    0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a, 0x9f59, 0x8f78,
    0x9188, 0x81a9, 0xb1ca, 0xa1eb, 0xd10c, 0xc12d, 0xf14e, 0xe16f,
    0x1080, 0x00a1, 0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
    0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c, 0xe37f, 0xf35e,
    0x02b1, 0x1290, 0x22f3, 0x32d2, 0x4235, 0x5214, 0x6277, 0x7256,
    0xb5ea, 0xa5cb, 0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
    0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
    0xa7db, 0xb7fa, 0x8799, 0x97b8, 0xe75f, 0xf77e, 0xc71d, 0xd73c,
    0x26d3, 0x36f2, 0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
    0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9, 0xb98a, 0xa9ab,
    0x5844, 0x4865, 0x7806, 0x6827, 0x18c0, 0x08e1, 0x3882, 0x28a3,
    0xcb7d, 0xdb5c, 0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
    0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0, 0x2ab3, 0x3a92,
    0xfd2e, 0xed0f, 0xdd6c, 0xcd4d, 0xbdaa, 0xad8b, 0x9de8, 0x8dc9,
    0x7c26, 0x6c07, 0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
    0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba, 0x8fd9, 0x9ff8,
    0x6e17, 0x7e36, 0x4e55, 0x5e74, 0x2e93, 0x3eb2, 0x0ed1, 0x1ef0
}
```

the CRC table used by the DSACON32m controller

The documentation for this class was generated from the following files:

- sdh/crc.h

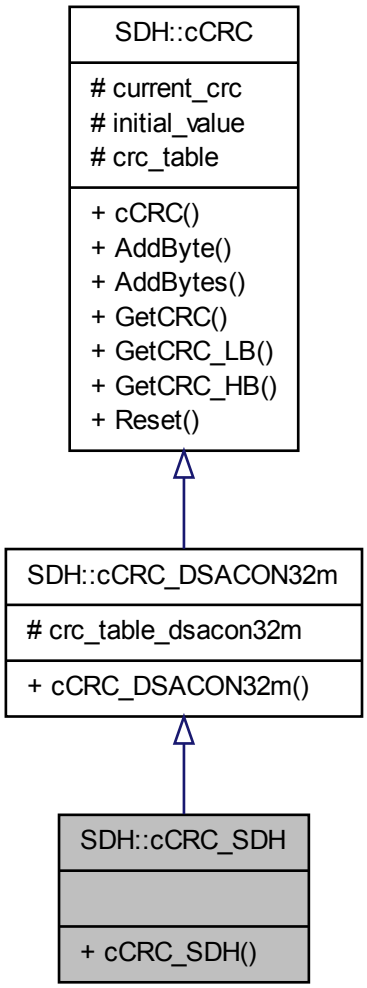
- sdh/crc.cpp

10.9 SDH::cCRC_SDH Class Reference

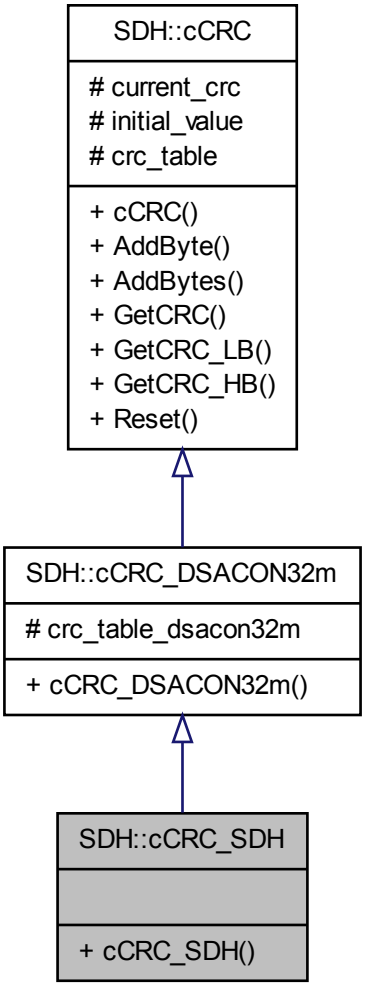
A derived CRC class that uses a CRC table and initial value suitable for protecing the binary communication with SDH via RS232.

```
#include <crc.h>
```

Inheritance diagram for SDH::cCRC_SDH:



Collaboration diagram for SDH::cCRC_SDH:



Public Member Functions

- cCRC_SDH (void)

  constructor to create a cCRC object suitable for checksumming the binary communication with SDH

10.9.1 Detailed Description

A derived CRC class that uses a CRC table and initial value suitable for protecing the binary communication with SDH via RS232. (for now we use the same CRC as for DSACON32m, but we use this separate class to simplify future changes).

10.9.2 Constructor & Destructor Documentation

10.9.2.1 SDH::cCRC_SDH::cCRC_SDH (void) [inline]

constructor to create a cCRC object suitable for checksumming the binary communication with SDH

The documentation for this class was generated from the following file:

- sdh/crc.h

10.10 SDH::cDBG Class Reference

A class to print colored debug messages.

`#include <dbg.h>`

Public Member Functions

- cDBG (bool flag=false, char const *color="red", std::ostream *fd=&std::cerr)
- ~cDBG ()
- void SetFlag (bool flag)
- bool GetFlag (void) const
- void SetColor (char const *color)
- void SetOutput (std::ostream *fd)
- void PDM (char const *fmt,...) SDH__attribute__((format(printf

Protected Attributes

- char const * debug_color
- char const * normal_color
- std::ostream * output
- bool debug_flag
- std::streamsize mywidth

10.10.1 Detailed Description

A class to print colored debug messages.

- The printing can be switched on or off so the debug code can remain in the code. (default is off)
- The messages can be colorized (default is red).
- The output can be redirected. (default is sys.stderr)
- Debug messages can be printed in a functional way or in C++ stream like way

If the environment variable "SDH_NO_COLOR" is defined then the messages are printed without coloring (usefull for logging or if your terminal does not support colors.

Example:

```
#include "sdh/dbg.h"
d = cDBG( true );
g = cDBG( true, "green" );

d.PDM( "This message is printed in default color red" );
g << "and this one in a nice green ";

g << "of course you can debug print any objects that have a string representat
   ion: " << 08 << 15 << true;

g << "Messages can be turned of and on, e.g. selected by command line options"
   ;
g.SetFlag(false);
g << "This messages is not printed";
```

10.10.2 Constructor & Destructor Documentation

10.10.2.1 SDH::cDBG::cDBG (bool *flag* = false, char const * *color* = "red", std::ostream * *fd* = &std::cerr) [inline]

constructor: construct a cDBG object

Parameters

flag	- the initial state of the flag, if true then messages sent to the object are printed. Default is false. Can be changed with SetFlag()
color	- the name of the color to use, default is "red". Can be changed with SetColor()
fd	- the ostream to use for output, default is stderr. Can be changed with SetOutput()

10.10.2.2 SDH::cDBG::~cDBG ( ) [inline]

10.10.3 Member Function Documentation

10.10.3.1 bool SDH::cDBG::GetFlag (void) const [inline]

Get debug_flag of this cDBG object.

10.10.3.2 void SDH::cDBG::PDM (char const * *fmt, ...*)

Print debug messages of printf like fmt, ... in the color set with SetColor, but only if debug_flag is true.

10.10.3.3 void SDH::cDBG::SetColor (char const * *color*) [inline]

Set debug_color of this cDBG object to color. color is a string like "red", see util.py for valid names.

Attention

The string is **NOT** copied, just a pointer is stored

10.10.3.4 void SDH::cDBG::SetFlag (bool *flag*) [inline]

Set debug_flag of this cDBG object to flag. After setting the flag to true debug messages are printed, else not.

10.10.3.5 void SDH::cDBG::SetOutput (std::ostream * *fd*) [inline]

Set output of this cDBG object to fd, which must be a file like object like sys.stderr

10.10.4 Member Data Documentation

10.10.4.1 char const* SDH::cDBG::debug_color [protected]

10.10.4.2 bool SDH::cDBG::debug_flag [protected]

10.10.4.3 std::streamsize SDH::cDBG::mywidth [protected]

10.10.4.4 char const* SDH::cDBG::normal_color [protected]

10.10.4.5 std::ostream* SDH::cDBG::output [protected]

The documentation for this class was generated from the following file:

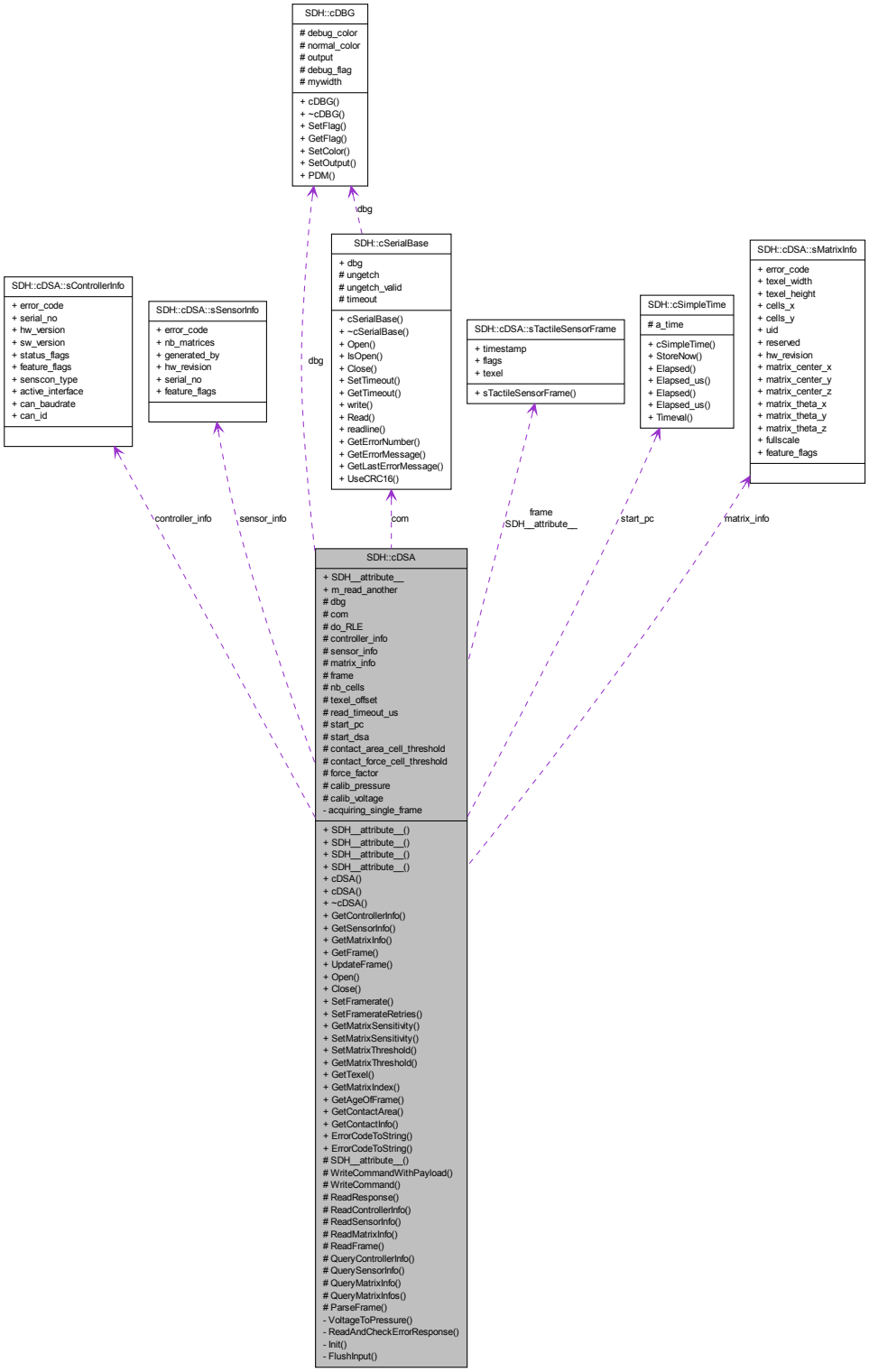
- sdh/dbg.h

10.11 SDH::cDSA Class Reference

SDH::cDSA is the end user interface class to access the DSACON32m, the tactile sensor controller of the SDH.

```
#include <dsa.h>
```

Collaboration diagram for SDH::cDSA:



Classes

- struct sContactInfo

  Structure to hold info about the contact of one sensor patch.

- struct sControllerInfo

  A data structure describing the controller info about the remote DSACON32m controller.

- struct sMatrixInfo

  A data structure describing a single sensor matrix connected to the remote DSACON32m controller.

- struct sResponse

  data structure for storing responses from the remote DSACON32m controller

- struct sSensitivityInfo

  Structure to hold info about the sensitivity settings of one sensor patch.

- struct sSensorInfo

  A data structure describing the sensor info about the remote DSACON32m controller.

- struct sTactileSensorFrame

  A data structure describing a full tactile sensor frame read from the remote DSACON32m controller.

Public Types

- enum eDSAErrorCode {

  E_SUCCESS, E_NOT_AVAILABLE, E_NO_SENSOR, E_NOT_INITIALIZED,

  E_ALREADY_RUNNING, E_FEATURE_NOT_SUPPORTED, E_INCONSISTENT_DATA, E_TIMEOUT,

  E_READ_ERROR, E_WRITE_ERROR, E_INSUFFICIENT_RESOURCES, E_CHECKSUM_ERROR,

  E_CMD_NOT_ENOUGH_PARAMS, E_CMD_UNKNOWN, E_CMD_FORMAT_ERROR, E_ACCESS_DENIED,

  E_ALREADY_OPEN, E_CMD_FAILED, E_CMD_ABORTED, E_INVALID_HANDLE,

  E_DEVICE_NOT_FOUND, E_DEVICE_NOT_OPENED, E_IO_ERROR, E_INVALID_PARAMETER,

  E_INDEX_OUT_OF_BOUNDS, E_CMD_PENDING, E_OVERRUN, E_RANGE_ERROR }

  error codes returned by the remote DSACON32m tactile sensor controller

- typedef UInt16 tTexel

  data type for a single 'texel' (tactile sensor element)

Public Member Functions

- struct SDH::cDSA::sControllerInfo SDH__attribute__ ((__packed__))
- struct SDH::cDSA::sSensorInfo SDH__attribute__ ((__packed__))
- struct SDH::cDSA::sMatrixInfo SDH__attribute__ ((__packed__))
- struct SDH::cDSA::sSensitivityInfo SDH__attribute__ ((__packed__))
- cDSA (int debug_level=0, int port=1, char const *device_format_string="/dev/ttyS%d")
- cDSA (int debug_level, char const *_tcp_adr, int _tcp_port=13000, double _timeout=1.0)
- ~cDSA ()

  Destructur: clean up and delete dynamically allocated memory.

- sControllerInfo const & GetControllerInfo (void) const

  Return a reference to the sControllerInfo read from the remote DSACON32m controller.

- sSensorInfo const & GetSensorInfo (void) const

  Return a reference to the sSensorInfo read from the remote DSACON32m controller.

- sMatrixInfo const & GetMatrixInfo (int m) const

  Return a reference to the sMatrixInfo of matrix m read from the remote DSACON32m controller.

- sTactileSensorFrame const & GetFrame () const

  return a reference to the latest tactile sensor frame without reading from remote DSACON32m

- sTactileSensorFrame const & UpdateFrame ()

  read the tactile sensor frame from remote DSACON32m and return a reference to it. A command to query the frame (periodically) must have been sent before.

- void Open (void) throw (cDSAException*, cSDHErrorCommunication*)

  (Re-)open connection to DSACON32m controller, this is called by the constructor automatically, but is still usefull to call after a call to Close()

- void Close (void) throw (cDSAException*, cSDHErrorCommunication*)

  Set the framerate of the remote DSACON32m controller to 0 and close connection to it.

- void SetFramerate (UInt16 framerate, bool do_RLE=true, bool do_data_acquisition=true) throw (cDSAException*, cSDHErrorCommunication*)
- void SetFramerateRetries (UInt16 framerate, bool do_RLE=true, bool do_data_acquisition=true, unsigned int retries=0, bool ignore_exceptions=false) throw (cDSAException*, cSDHErrorCommunication*)

- sSensitivityInfo GetMatrixSensitivity (int matrix_no) throw (cDSAException*, cSDHErrorCommunication*)
- void SetMatrixSensitivity (int matrix_no, double sensitivity, bool do_all_matrices=false, bool do_reset=false, bool do_persistent=false) throw (cDSAException*, cSDHErrorCommunication*)
- void SetMatrixThreshold (int matrix_no, UInt16 threshold, bool do_all_matrices=false, bool do_reset=false, bool do_persistent=false) throw (cDSAException*, cSDHErrorCommunication*)
- UInt16 GetMatrixThreshold (int matrix_no) throw (cDSAException*, cSDHErrorCommunication*)
- tTexel GetTexel (int m, int x, int y) const
- int GetMatrixIndex (int fi, int part)
- unsigned long GetAgeOfFrame (sTactileSensorFrame *frame_p)
- double GetContactArea (int m)
- sContactInfo GetContactInfo (int m)

Static Public Member Functions

- static char const * ErrorCodeToString (eDSAErrorCode error_code)
- static char const * ErrorCodeToString (UInt16 error_code)

Public Attributes

- struct VCC_EXPORT SDH::cDSA::sTactileSensorFrame SDH__attribute__
- bool m_read_another

Protected Member Functions

- struct SDH::cDSA::sResponse SDH__attribute__ ((__packed__))
- void WriteCommandWithPayload (UInt8 command, UInt8 *payload, UInt16 payload_len) throw (cDSAException*, cSDHErrorCommunication*)
- void WriteCommand (UInt8 command)
- void ReadResponse (sResponse *response, UInt8 command_id) throw (cDSAException*, cSDHErrorCommunication*)
- void ReadControllerInfo (sControllerInfo *_controller_info) throw (cDSAException*, cSDHErrorCommunication*)
- void ReadSensorInfo (sSensorInfo *_sensor_info) throw (cDSAException*, cSDHErrorCommunication*)
- void ReadMatrixInfo (sMatrixInfo *_matrix_info) throw (cDSAException*, cSDHErrorCommunication*)
- void ReadFrame (sTactileSensorFrame *frame_p) throw (cDSAException*, cSDHErrorCommunication*)
- void QueryControllerInfo (sControllerInfo *_controller_info) throw (cDSAException*, cSDHErrorCommunication*)
- void QuerySensorInfo (sSensorInfo *_sensor_info) throw (cDSAException*, cSDHErrorCommunication*)
- void QueryMatrixInfo (sMatrixInfo *_matrix_info, int matrix_no) throw (cDSAException*, cSDHErrorCommunication*)
- void QueryMatrixInfos (void) throw (cDSAException*, cSDHErrorCommunication*)
- void ParseFrame (sResponse *response, sTactileSensorFrame *frame_p) throw (cDSAException*)

Protected Attributes

- cDBG dbg

  A stream object to print coloured debug messages.

- cSerialBase * com

  the communication interface to use

- bool do_RLE

  flag, true if data should be sent Run Length Encoded by the remote DSACON32m controller

- sControllerInfo controller_info

  the controller info read from the remote DSACON32m controller

- sSensorInfo sensor_info

  the sensor info read from the remote DSACON32m controller

- sMatrixInfo * matrix_info

  the matrix infos read from the remote DSACON32m controller

- sTactileSensorFrame frame

  the latest frame received from the remote DSACON32m controller

- int nb_cells

  The total number of sensor cells.

- int * texel_offset

  an array with the offsets of the first texel of all matrices into the whole frame

- long read_timeout_us

  default timeout used for reading in us

- cSimpleTime start_pc
- UInt32 start_dsa
- tTexel contact_area_cell_threshold

  threshold of texel cell value for detecting contacts with GetContactArea

- tTexel contact_force_cell_threshold

  threshold of texel cell value for detecting forces with GetContactForce

- double force_factor

  additional calibration factor for forces in GetContactForce

- double calib_pressure
- double calib_voltage

  see calib_pressure

Friends

- VCC_EXPORT std::ostream & operator<< (std::ostream &stream, cDSA::sResponse const &response)

10.11.1 Detailed Description

SDH::cDSA is the end user interface class to access the DSACON32m, the tactile sensor controller of the SDH. Class to communicate with the tactile sensor controller DSACON32m of the SDH

Bug

cDSAException: Checksum Error on Windows console While communicating with the tactile sensor controller a "cDSAException: Checksum Error" might be thrown once in a while. This seems to happen only when the program is started from a native windows command console (cmd.exe), but not e.g. when the program is started from a cygwin console. Strange. **Workaround** is to catch the exception and ignore the frame.
=> Resolved in SDHLibrary-C++ v0.0.2.1
Problem was an overrun of the windows input buffer, e.g. on heavy processor load.

10.11.2 Member Typedef Documentation

10.11.2.1 typedef UInt16 SDH::cDSA::tTexel

data type for a single 'texel' (tactile sensor element)

10.11.3 Member Enumeration Documentation

10.11.3.1 enum SDH::cDSA::eDSAErrorCode

error codes returned by the remote DSACON32m tactile sensor controller

Enumerator:

E_SUCCESS

E_NOT_AVAILABLE

E_NO_SENSOR

E_NOT_INITIALIZED

E_ALREADY_RUNNING

E_FEATURE_NOT_SUPPORTED

E_INCONSISTENT_DATA

E_TIMEOUT

E_READ_ERROR

E_WRITE_ERROR
E_INSUFFICIENT_RESOURCES
E_CHECKSUM_ERROR
E_CMD_NOT_ENOUGH_PARAMS
E_CMD_UNKNOWN
E_CMD_FORMAT_ERROR
E_ACCESS_DENIED
E_ALREADY_OPEN
E_CMD_FAILED
E_CMD_ABORTED
E_INVALID_HANDLE
E_DEVICE_NOT_FOUND
E_DEVICE_NOT_OPENED
E_IO_ERROR
E_INVALID_PARAMETER
E_INDEX_OUT_OF_BOUNDS
E_CMD_PENDING
E_OVERRUN
E_RANGE_ERROR

10.11.4 Constructor & Destructor Documentation

10.11.4.1 cDSA::cDSA (int *debug_level* = 0, int *port* = 1, char const * *device_format_string* = "/dev/ttyS%d")

Constructor for cDSA. This constructs a cDSA object to communicate with the remote DSACON32m controller within the SDH via RS232.

The connection is opened and established, and the sensor, controller and matrix info is queried from the remote DSACON32m controller. This initialization may take up to 9 seconds, since the DSACON32m controller needs $>$ 8 seconds for "booting". If the SDH is already powered for some time then this will be much quicker.

Parameters

debug_level	- the level of debug messages to be printed: • if $>$ 0 (1,2,3...) then debug messages of cDSA itself are printed • if $>$ 1 (2,3,...) then debug messages of the low level communication interface object are printed too
port	- the RS232 port to use for communication. (port 0 = ttyS0 = COM1, port 1 = ttyS1 = COM2, ...)
device_format_string	- a format string (C string) for generating the device name, like "/dev/ttyS%d" (default) or "/dev/ttyUSB%d". Must contain a d where the port number should be inserted. This char array is duplicated on construction.
	When compiled with VCC (MS Visual C++) this is not used.

10.11.4.2 cDSA::cDSA (int *debug_level*, char const * *_tcp_adr*, int *_tcp_port* = 13000, double *_timeout* = 1.0)

Constructor for cDSA. This constructs a cDSA object to communicate with the remote DSACON32m controller within the SDH via TCP/IP (ethernet).

The connection is opened and established, and the sensor, controller and matrix info is queried from the remote DSACON32m controller. This initialization may take up to 9 seconds, since the DSACON32m controller needs > 8 seconds for "booting". If the SDH is already powered for some time then this will be much quicker.

Parameters

debug_level	- the level of debug messages to be printed: • if > 0 (1,2,3...) then debug messages of cDSA itself are printed • if > 1 (2,3,...) then debug messages of the low level communication interface object are printed too
_tcp_adr	: The tcp host address of the SDH. Either a numeric IP as string or a hostname
_tcp_port	: the tcp port number on the SDH to connect to
_timeout	: The timeout to use: • <= 0 : wait forever (default) • T : wait for T seconds

10.11.4.3 cDSA::~cDSA ( )

Destructur: clean up and delete dynamically allocated memory.

10.11.5 Member Function Documentation

10.11.5.1 void cDSA::Close (void) throw (cDSAException*, cSDHErrorCommunication*)

Set the framerate of the remote DSACON32m controller to 0 and close connection to it.

10.11.5.2 char const * cDSA::ErrorCodeToString (eDSAErrorCode *error_code*) [static]

Return a short string description for *error_code*

Parameters

error_code	- error code as returned from the remote DSACON32m tactile sensor controller

Returns

short string description for *error_code*

10.11.5.3 static char const* SDH::cDSA::ErrorCodeToString (UInt16 *error_code*) [inline, static]

10.11.5.4 unsigned long SDH::cDSA::GetAgeOfFrame (sTactileSensorFrame * *frame_p*) [inline]

return age of frame in ms (time in ms from frame sampling until now)

10.11.5.5 double cDSA::GetContactArea (int *m*)

Return contact area in mm*mm for matrix with index *m*

10.11.5.6 cDSA::sContactInfo cDSA::GetContactInfo (int *m*)

Return a sContactInfo struct (force,cog_x,cog_y,area) of contact force and center of gravity and contact area of that force for matrix with index *m*

10.11.5.7 sControllerInfo const& SDH::cDSA::GetControllerInfo (void) const [inline]

Return a reference to the sControllerInfo read from the remote DSACON32m controller.

10.11.5.8 sTactileSensorFrame const& SDH::cDSA::GetFrame ( ) const [inline]

return a reference to the latest tactile sensor frame without reading from remote DSACON32m

10.11.5.9 int SDH::cDSA::GetMatrixIndex (int *fi*, int *part*) [inline]

return the matrix index of the sensor matrix attached to finger with index *fi* [1..3] and *part* [0,1] = [proximal,distal]

10.11.5.10 sMatrixInfo const& SDH::cDSA::GetMatrixInfo (int *m*) const [inline]

Return a reference to the sMatrixInfo of matrix *m* read from the remote DSACON32m controller.

10.11.5.11 cDSA::sSensitivityInfo cDSA::GetMatrixSensitivity (int *matrix_no*) throw (cDSAException*, cSDHErrorCommunication*)

Send command to get matrix sensitivity. Returns sensitivities of matrix no *matrix_no*.

A struct is returned containing the members *error_code* - see DSACON32 Command Set Reference Manual *adj_flags* - see DSACON32 Command Set Reference Manual *cur_sens* - the currently set sensitivity as float [0.0 .. 1.0] (0.0 is minimum, 1.0 is maximum sensitivity) *fact_sens* - the factory sensitivity as float [0.0 .. 1.0] (0.0 is minimum, 1.0 is maximum sensitivity)

Raises a cDSAException in case of invalid responses from the remote DSACON32m controller.

Bug

With DSACON32m firmware R218 and before this did not work, instead the factory default (0.5) was always reported
=> Resolved in DSACON32m firmware R268

10.11.5.12 UInt16 cDSA::GetMatrixThreshold (int *matrix_no*) throw (cDSAException*, cSDHErrorCommunication*)

Send command to get matrix threshold. Returns threshold of matrix no *matrix_no*.

Returns

threshold - the currently set threshold as integer [0 .. 4095] (0 is minimum, 4095 is maximum threshold)

Raises a cDSAException in case of invalid responses from the remote DSACON32m controller.

Remarks

Getting the matrix threshold is only possible if the DSACON32m firmware is R268 or above.

10.11.5.13 sSensorInfo const& SDH::cDSA::GetSensorInfo (void) const [inline]

Return a reference to the sSensorInfo read from the remote DSACON32m controller.

10.11.5.14 cDSA::tTexel cDSA::GetTexel (int *m*, int *x*, int *y*) const

Return texel value at column *x* row *y* of matrix *m* of the last frame

10.11.5.15 void cDSA::Open (void) throw (cDSAException∗, cSDHErrorCommunication∗)

(Re-)open connection to DSACON32m controller, this is called by the constructor automatically, but is still usefull to call after a call to Close()

10.11.5.16 void cDSA::ParseFrame (sResponse ∗ *response*, sTactileSensorFrame ∗ *frame_p*) throw (cDSAException∗) [protected]

Parse a full frame response from remote DSA

10.11.5.17 void cDSA::QueryControllerInfo (sControllerInfo ∗ *_controller_info*) throw (cDSAException∗, cSDHErrorCommunication∗) [protected]

Send command to resquest controller info from remote DSACON32m. Read and parse the response from the remote DSACON32m.

10.11.5.18 void cDSA::QueryMatrixInfo (sMatrixInfo ∗ *_matrix_info*, int *matrix_no*) throw (cDSAException∗, cSDHErrorCommunication∗) [protected]

Send command to request matrix info from remote DSACON32m. Read and parse the response from the remote DSACON32m.

10.11.5.19 void cDSA::QueryMatrixInfos (void) throw (cDSAException∗, cSDHErrorCommunication∗) [protected]

Query all matrix infos

10.11.5.20 void cDSA::QuerySensorInfo (sSensorInfo ∗ *_sensor_info*) throw (cDSAException∗, cSDHErrorCommunication∗) [protected]

Send command to request sensor info from remote DSACON32m. Read and parse the response from the remote DSACON32m.

10.11.5.21 void cDSA::ReadControllerInfo (sControllerInfo ∗ *_controller_info*) throw (cDSAException∗, cSDHErrorCommunication∗) [protected]

Read and parse a controller info response from the remote DSA

10.11.5.22 void cDSA::ReadFrame (sTactileSensorFrame ∗ *frame_p*) throw (cDSAException∗, cSDHErrorCommunication∗) [protected]

read and parse a full frame response from remote DSA

10.11.5.23 void cDSA::ReadMatrixInfo (sMatrixInfo * *_matrix_info*) throw (cDSAException*, cSDHErrorCommunication*) [protected]

Read and parse a matrix info response from the remote DSA

10.11.5.24 void cDSA::ReadResponse (sResponse * *response,* UInt8 *command_id*) throw (cDSAException*, cSDHErrorCommunication*) [protected]

Read any response from the remote DSACON32m, expect the *command_id* as command id

- tries to find the preamble within the next at most DSA_MAX_PREAMBLE_-SEARCH bytes from the device
- reads the packet id and size
- reads all data indicated by the size read
- if there is enough space in the payload of the response then the received data is stored there if there is not enough space in the payload of the response then the data is received but forgotten (to keep the communication line clear)
- if sent, the CRC checksum is read and the data is checked. For invalid data an exception is thrown

10.11.5.25 void cDSA::ReadSensorInfo (sSensorInfo * *_sensor_info*) throw (cDSAException*, cSDHErrorCommunication*) [protected]

Read and parse a sensor info response from the remote DSA

10.11.5.26 struct SDH::cDSA::sResponse SDH::cDSA::SDH__attribute__ ((__packed__)) [protected]

10.11.5.27 struct SDH::cDSA::sControllerInfo SDH::cDSA::SDH__attribute__ ((__packed__))

10.11.5.28 struct SDH::cDSA::sSensorInfo SDH::cDSA::SDH__attribute__ ((__packed__))

10.11.5.29 struct SDH::cDSA::sSensitivityInfo SDH::cDSA::SDH__attribute__ ((__packed__))

10.11.5.30 struct SDH::cDSA::sMatrixInfo SDH::cDSA::SDH__attribute__ ((__packed__))

10.11.5.31 void cDSA::SetFramerate (UInt16 *framerate*, bool *do_RLE* = true, bool *do_data_acquisition* = true) throw (cDSAException*, cSDHErrorCommunication*)

Set the *framerate* for querying full frames.

Parameters

framerate	- rate of frames.
do_RLE	- flag, if true then use RLE (run length encoding) for sending frames
do_data_acquisition	- flag, enable or disable data acquisition. Must be true if you want to get new frames

- Use *framerate=0* and *do_data_acquisition=false* to make the remote DSACON32m in SDH stop sending frames
- Use *framerate=0* and *do_data_acquisition=true* to read a single frame
- Use *framerate>0* and *do_data_acquisition=true* to make the remote DSACON32m in SDH send frames at the highest possible rate (for now: 30 FPS (frames per second)).

Bug

SCHUNK-internal bugzilla ID: Bug 680
With DSACON32m firmware R276 and after and SDHLibrary-C++ v0.0.1.15 and before stopping of the sending did not work.
=> **Resolved in SDHLibrary-C++ v0.0.1.16**

Bug

SCHUNK-internal bugzilla ID: Bug 680
With DSACON32m firmware before R276 and SDHLibrary-C++ v0.0.1.16 and before acquiring of single frames did not work
=> **Resolved in SDHLibrary-C++ v0.0.1.17**

Bug

SCHUNK-internal bugzilla ID: Bug 703
With DSACON32m firmware R288 and before and SDHLibrary-C++ v0.0.2.1 and before tactile sensor frames could not be read reliably in single frame mode.
=> Resolved in DSACON32m firmware 2.9.0.0
=> Resolved in SDHLibrary-C++ v0.0.2.1 with workaround for older DSACON32m firmwares

10.11.5.32 void cDSA::SetFramerateRetries (UInt16 *framerate*, bool *do_RLE* = `true`, bool *do_data_acquisition* = `true`, unsigned int *retries* = `0`, bool *ignore_exceptions* = `false`) throw (cDSAException*, cSDHErrorCommunication*)

Set the *framerate* for querying full frames.

Parameters

framerate	- rate of frames. 0 will make the remote DSACON32m in SDH stop sending frames, any value > 0 will make the remote DSACON32m in SDH send frames at the highest possible rate (for now: 30 FPS (frames per second)).
do_RLE	- flag, if true then use RLE (run length encoding) for sending frames
do_data_acquisition	- flag, enable or disable data acquisition. Must be true if you want to get new frames
retries	- number of times the sending will be retried in case of an error (like timeout while waiting for response)
ignore_exceptions	- flag, if true then exceptions are ignored in case of error. After *retries* tries the function just returns even in case of an error

10.11.5.33 void cDSA::SetMatrixSensitivity (int *matrix_no*, double *sensitivity*, bool *do_all_matrices* = `false`, bool *do_reset* = `false`, bool *do_persistent* = `false`) throw (cDSAException*, cSDHErrorCommunication*)

Send command to set matrix sensitivity to *sensitivity* as float [0.0 .. 1.0] (0.0 is minimum, 1.0 is maximum sensitivity). If *do_all_matrices* is true then the *sensitivity* is set for all matrices. If *do_reset* is true then the sensitivity is reset to the factory default. If *do_persistent* is true then the sensitivity is saved persistently to configuration memory and will thus remain after the next power off/power on cycle and will become the new factory default value. If *do_persistent* is false (default) then the value will be reset to default on the next power off/power on cycle

Warning

PLEASE NOTE: the maximum write endurance of the configuration memory is about 100.000 times!

Raises a cDSAException in case of invalid responses from the remote DSACON32m controller.

Remarks

Setting the matrix sensitivity persistently is only possible if the DSACON32m firmware is R268 or above.

10.11.5.34 void cDSA::SetMatrixThreshold (int *matrix_no*, UInt16 *threshold*, bool *do_all_matrices* = `false`, bool *do_reset* = `false`, bool *do_persistent* = `false`) throw (cDSAException*, cSDHErrorCommunication*)

Send command to set matrix threshold to *threshold* as integer [0 .. 4095] (0 is minimum, 4095 is maximum threshold). If *do_all_matrices* is true then the *threshold* is set for all matrices. If *do_reset* is true then the threshold is reset to the factory default. If *do_persistent* is true then the threshold is saved persistently to configuration memory and will thus remain after the next power off/power on cycle and will become the new factory default value. If *do_persistent* is false (default) then the value will be reset to default on the next power off/power on cycle

Warning

PLEASE NOTE: the maximum write endurance of the configuration memory is about 100.000 times!

Raises a cDSAException in case of invalid responses from the remote DSACON32m controller.

Remarks

Getting the matrix threshold is only possible if the DSACON32m firmware is R268 or above.

10.11.5.35 sTactileSensorFrame const& SDH::cDSA::UpdateFrame ( ) `[inline]`

read the tactile sensor frame from remote DSACON32m and return a reference to it. A command to query the frame (periodically) must have been sent before.

10.11.5.36 void SDH::cDSA::WriteCommand (UInt8 *command*) [inline, protected]

10.11.5.37 void cDSA::WriteCommandWithPayload (UInt8 *command,* UInt8 * *payload,* UInt16 *payload_len*) throw (cDSAException*, cSDHErrorCommunication*) [protected]

10.11.6 Friends And Related Function Documentation

10.11.6.1 VCC_EXPORT std::ostream& operator<< (std::ostream & *stream,* cDSA::sResponse const & *response*) [friend]

10.11.7 Member Data Documentation

10.11.7.1 double SDH::cDSA::calib_pressure [protected]

For the voltage to pressure conversion in _VoltageToPressure() enter one pressure/voltage measurement here (from demo-dsa.py --calibration):

10.11.7.2 double SDH::cDSA::calib_voltage [protected]

see calib_pressure

10.11.7.3 cSerialBase* SDH::cDSA::com [protected]

the communication interface to use

10.11.7.4 tTexel SDH::cDSA::contact_area_cell_threshold [protected]

threshold of texel cell value for detecting contacts with GetContactArea

10.11.7.5 tTexel SDH::cDSA::contact_force_cell_threshold [protected]

threshold of texel cell value for detecting forces with GetContactForce

10.11.7.6 sControllerInfo SDH::cDSA::controller_info [protected]

the controller info read from the remote DSACON32m controller

10.11.7.7 cDBG SDH::cDSA::dbg [protected]

A stream object to print coloured debug messages.

10.11.7.8 bool SDH::cDSA::do_RLE [protected]

flag, true if data should be sent Run Length Encoded by the remote DSACON32m controller

10.11.7.9 double SDH::cDSA::force_factor [protected]

additional calibration factor for forces in GetContactForce

10.11.7.10 sTactileSensorFrame SDH::cDSA::frame [protected]

the latest frame received from the remote DSACON32m controller

10.11.7.11 bool SDH::cDSA::m_read_another

flag, if True then the ReadFrame() function will read tactile sensor frames until a timeout occurs. This will ignore intermediate frames as long as new ones are available. This was usefull some time in the past, or if you have a slow computer that cannot handle incoming frames fast enough. If False then any completely read valid frame will be reported. With new computers and fast communication like via TCP this should remain at "False".

10.11.7.12 sMatrixInfo* SDH::cDSA::matrix_info [protected]

the matrix infos read from the remote DSACON32m controller

10.11.7.13 int SDH::cDSA::nb_cells [protected]

The total number of sensor cells.

10.11.7.14 long SDH::cDSA::read_timeout_us [protected]

default timeout used for reading in us

10.11.7.15 struct VCC_EXPORT SDH::cDSA::sTactileSensorFrame SDH::cDSA::SDH__attribute__

10.11.7.16 sSensorInfo SDH::cDSA::sensor_info [protected]

the sensor info read from the remote DSACON32m controller

10.11.7.17 UInt32 SDH::cDSA::start_dsa [protected]

10.11.7.18 cSimpleTime SDH::cDSA::start_pc [protected]

10.11.7.19 int* SDH::cDSA::texel_offset [protected]

an array with the offsets of the first texel of all matrices into the whole frame

The documentation for this class was generated from the following files:

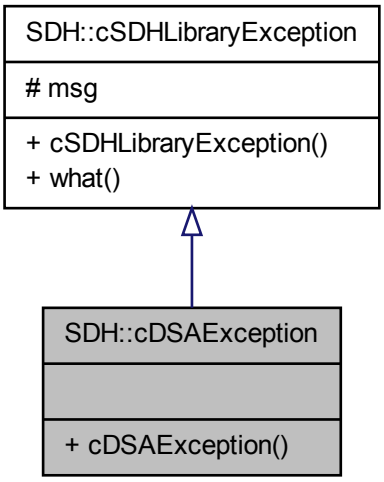
- sdh/dsa.h
- sdh/dsa.cpp

10.12 SDH::cDSAException Class Reference

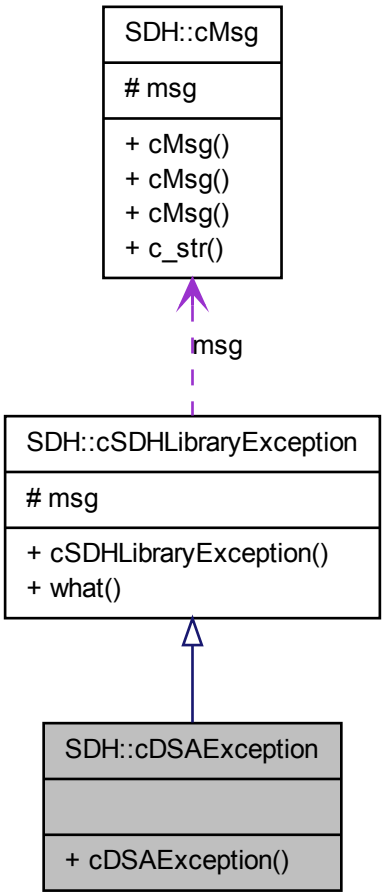
Derived exception class for low-level DSA related exceptions.

`#include <dsa.h>`

Inheritance diagram for SDH::cDSAException:



Collaboration diagram for SDH::cDSAException:



Public Member Functions

- cDSAException (cMsg const &_msg)

10.12.1 Detailed Description

Derived exception class for low-level DSA related exceptions.

10.12.2 Constructor & Destructor Documentation

10.12.2.1 SDH::cDSAException::cDSAException (cMsg const & *_msg*) [inline]

The documentation for this class was generated from the following file:

- sdh/dsa.h

10.13 cDSAUpdater Class Reference

Class to create an updater thread for continuously updating tactile sensor data.

`#include <dsaboost.h>`

Public Member Functions

- cDSAUpdater (cDSA *_ts, int _error_threshold=DEFAULT_ERROR_THRESHOLD)
- void interrupt ()

  interrupt the updater thread

Static Public Attributes

- static int const DEFAULT_ERROR_THRESHOLD = 16

  default error threshold, see parameter error_threshold in CTOR

10.13.1 Detailed Description

Class to create an updater thread for continuously updating tactile sensor data. Uses boost::thread from the boost library (http://www.boost.org)!

10.13.2 Constructor & Destructor Documentation

10.13.2.1 cDSAUpdater::cDSAUpdater (cDSA * *_ts*, int *_error_threshold* = DEFAULT_ERROR_THRESHOLD)

CTOR: start an updater thread for the connected tactile sensor *_ts*

Make remote DSA send frames. Create a thread that updates _ts->frame continuously

Parameters

_ts	- ptr to already initialized cDSA tactile sensor object

error-threshold	- the number of errors that causes a "reset" of the connection to the remote DSA: communication errors with the remote DSACON32m controllers are counted, • every error increments the error level, • every correct communication decrements the error level (down to 0) if the error level rises above ERROR_THRESHOLD then the connection is closed and the reopened. This is usefull to recover from emergency stop since the hands loose power temporarily in that case.

10.13.3 Member Function Documentation

10.13.3.1 void cDSAUpdater::interrupt ( ) [inline]

interrupt the updater thread

10.13.4 Member Data Documentation

10.13.4.1 int const cDSAUpdater::DEFAULT_ERROR_THRESHOLD = 16 [static]

default error threshold, see parameter *error_threshold* in CTOR

The documentation for this class was generated from the following files:

- demo/dsaboost.h
- demo/dsaboost.cpp

10.14 SDH::cHexByteString Class Reference

dummy class for (debug) stream output of bytes as list of hex values

`#include <dbg.h>`

Public Member Functions

- cHexByteString (char const *_bytes, int _len)

  ctor: create a cHexByteString with _len bytes at _bytes

Friends

- VCC_EXPORT std::ostream & operator<< (std::ostream &stream, cHexByteString const &s)

output the bytes in s to stream as a list of space separated hex bytes (without 0x prefix)

10.14.1 Detailed Description

dummy class for (debug) stream output of bytes as list of hex values

10.14.2 Constructor & Destructor Documentation

10.14.2.1 SDH::cHexByteString::cHexByteString (char const * *_bytes*, int *_len*) [inline]

ctor: create a cHexByteString with *_len* bytes at *_bytes*

10.14.3 Friends And Related Function Documentation

10.14.3.1 VCC_EXPORT std::ostream& operator<< (std::ostream & *stream*, cHexByteString const & *s*) [friend]

output the bytes in *s* to *stream* as a list of space separated hex bytes (without 0x prefix)

The documentation for this class was generated from the following file:

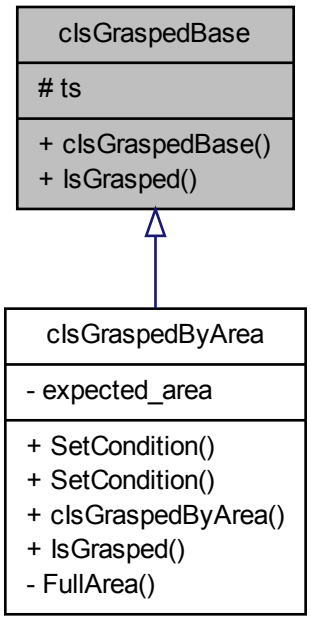
- sdh/dbg.h

10.15 cIsGraspedBase Class Reference

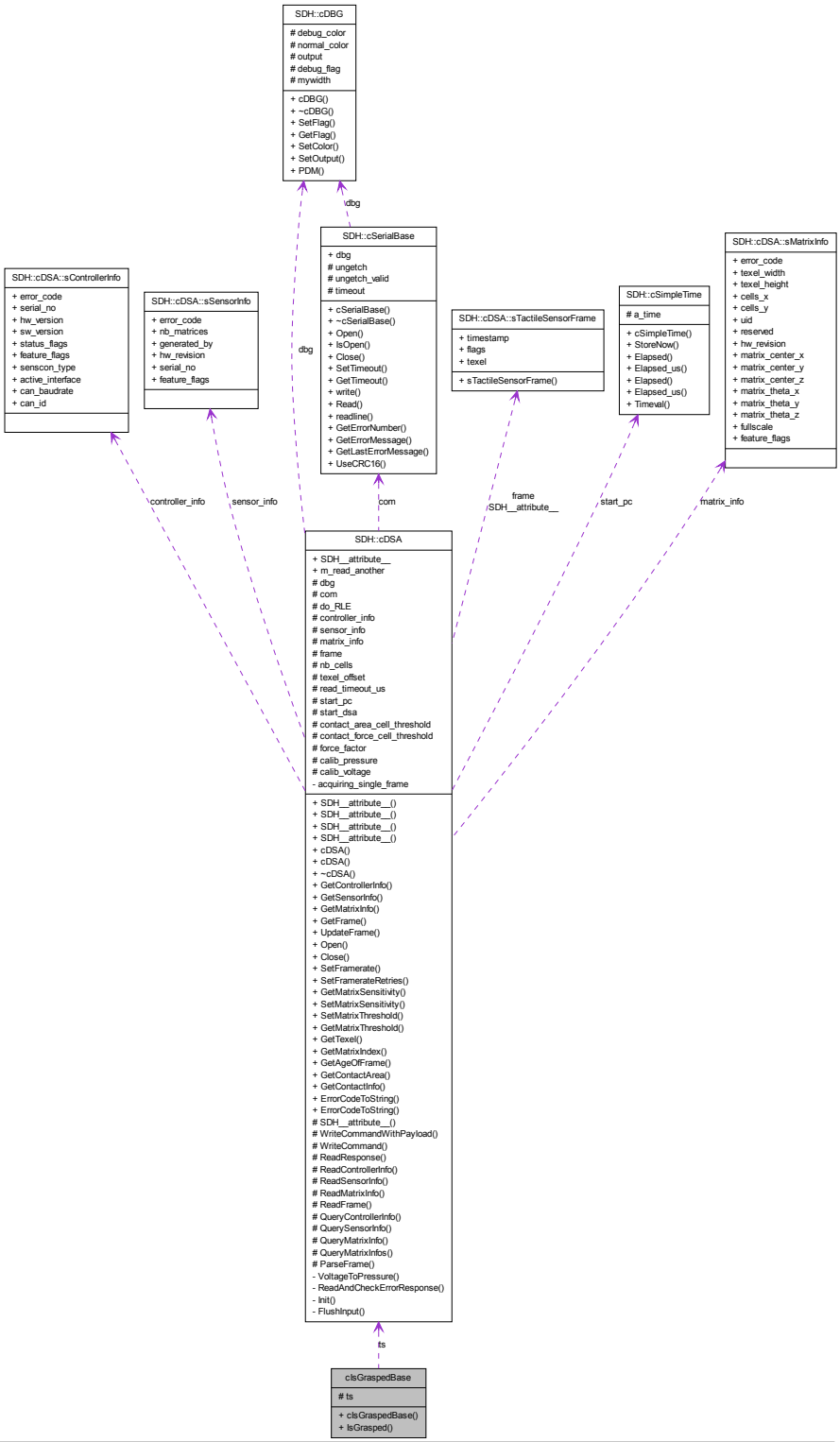
abstract base class for calculation of IsGrasped condition using tactile sensor information

`#include <dsaboost.h>`

Inheritance diagram for cIsGraspedBase:



Collaboration diagram for cIsGraspedBase:



Public Member Functions

- cIsGraspedBase (SDH::cDSA *_ts)
- virtual bool IsGrasped (void)=0

Protected Attributes

- SDH::cDSA * ts

  ptr to the cDSA tactile sensor object to use

10.15.1 Detailed Description

abstract base class for calculation of IsGrasped condition using tactile sensor information

10.15.2 Constructor & Destructor Documentation

10.15.2.1 cIsGraspedBase::cIsGraspedBase (SDH::cDSA * *_ts*) [inline]

10.15.3 Member Function Documentation

10.15.3.1 virtual bool cIsGraspedBase::IsGrasped (void) [pure virtual]

Implemented in cIsGraspedByArea.

10.15.4 Member Data Documentation

10.15.4.1 SDH::cDSA* cIsGraspedBase::ts [protected]

ptr to the cDSA tactile sensor object to use

The documentation for this class was generated from the following file:

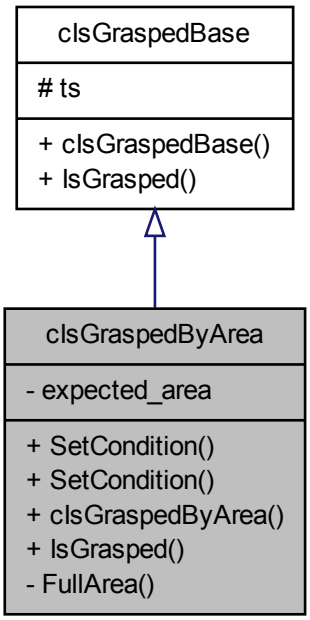
- demo/dsaboost.h

10.16 cIsGraspedByArea Class Reference

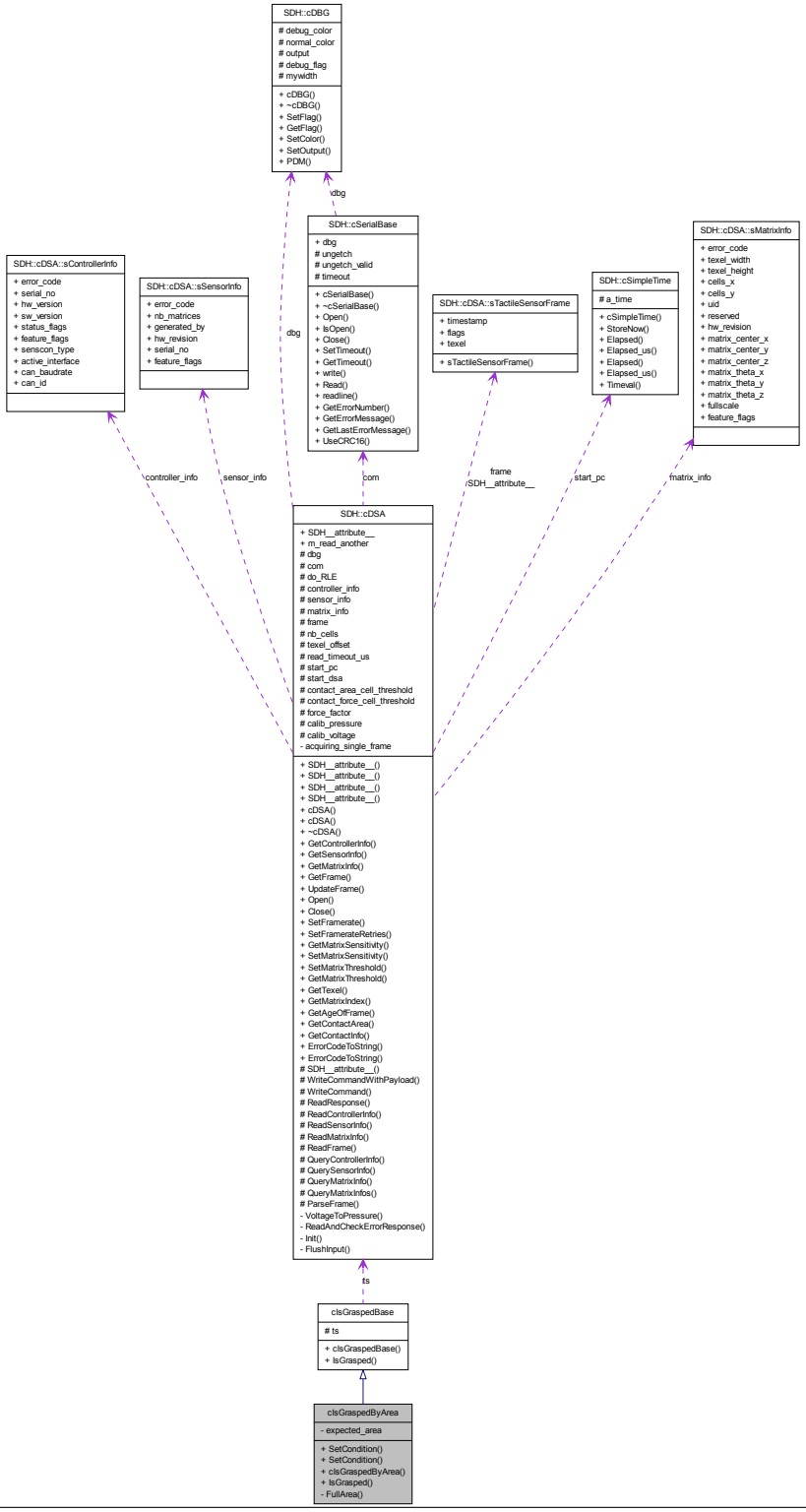
class for calculation of IsGrasped condition using an expected area of contact measured by the tactile sensors

```
#include <dsaboost.h>
```

Inheritance diagram for cIsGraspedByArea:



Collaboration diagram for clsGraspedByArea:



Public Member Functions

- void SetCondition (double eaf0p, double eaf0d, double eaf1p, double eaf1d, double eaf2p, double eaf2d)
- void SetCondition (double *eafx)

  overloaded variant which uses an array of doubles instead of 6 single double parameters

- cIsGraspedByArea (SDH::cDSA *_ts)

  default constructor which initializes the internal date

- virtual bool IsGrasped (void)

10.16.1 Detailed Description

class for calculation of IsGrasped condition using an expected area of contact measured by the tactile sensors

10.16.2 Constructor & Destructor Documentation

10.16.2.1 cIsGraspedByArea::cIsGraspedByArea (SDH::cDSA * *_ts*)

default constructor which initializes the internal date

10.16.3 Member Function Documentation

10.16.3.1 bool cIsGraspedByArea::IsGrasped (void) [virtual]

Implementation of is grasped condition.

Returns

true if the object is grasped according to the actual tactile sensor data in *ts* and the condition set with SetCondition()

Implements cIsGraspedBase.

10.16.3.2 void cIsGraspedByArea::SetCondition (double *eaf0p*, double *eaf0d*, double *eaf1p*, double *eaf1d*, double *eaf2p*, double *eaf2d*)

set the is grasped condition

Parameters

eaf0p	- expected area of finger 0 proximal for detecting grasp condition, value [0..1] with 0=no area, 1=full area

eaf0d	- expected area of finger 0 distal for detecting grasp condition, value [0..1] with 0=no area, 1=full area
eaf1p	- ...
eaf1d	- ...
eaf2p	- ...
eaf2d	- ...

10.16.3.3 void clsGraspedByArea::SetCondition (double * *eafx*)

overloaded variant which uses an array of doubles instead of 6 single double parameters

The documentation for this class was generated from the following files:

- demo/dsaboost.h
- demo/dsaboost.cpp

10.17 SDH::cMsg Class Reference

Class for short, fixed maximum length text messages.

`#include <sdhexception.h>`

Public Member Functions

- cMsg ()

  Default constructor, init message to empty string.

- cMsg (cMsg const &other)

  Copy constructor, copy message content of other object to this object.

- cMsg (char const *fmt,...) SDH__attribute__((format(printf

  Constructor with printf like format, argument parameters.

- char const * c_str () const

  Return the C-string representation of the messag in this object.

Protected Types

- enum { eMAX_MSG = 512 }

  anonymous enum instead of define macros

Protected Attributes

- char msg [eMAX_MSG]

10.17.1 Detailed Description

Class for short, fixed maximum length text messages. Simple message objects for short, fixed maximum length text messages, but with printf like initialization.

An object of type SDH::cMsg contains an ASCII-Z string of maximum length eMAX_MSG. It can be initialized with a 'printf-style' format string by the constructor. It is used in the SDHLibrary to further specify the cause of an exception in human readable form.

See SDH::cSDHLibraryException::cSDHLibraryException() for exemplary use.

10.17.2 Member Enumeration Documentation

10.17.2.1 anonymous enum [protected]

anonymous enum instead of define macros

Enumerator:

eMAX_MSG maximum length in bytes of a message to store

10.17.3 Constructor & Destructor Documentation

10.17.3.1 cMsg::cMsg ( )

Default constructor, init message to empty string.

10.17.3.2 cMsg::cMsg (cMsg const & *other*)

Copy constructor, copy message content of other object to this object.

10.17.3.3 cMsg::cMsg (char const * *fmt*, ...)

Constructor with printf like format, argument parameters.

10.17.4 Member Function Documentation

10.17.4.1 char const * cMsg::c_str ( ) const

Return the C-string representation of the messag in this object.

10.17.5 Member Data Documentation

10.17.5.1 char SDH::cMsg::msg[eMAX_MSG] [protected]

The documentation for this class was generated from the following files:

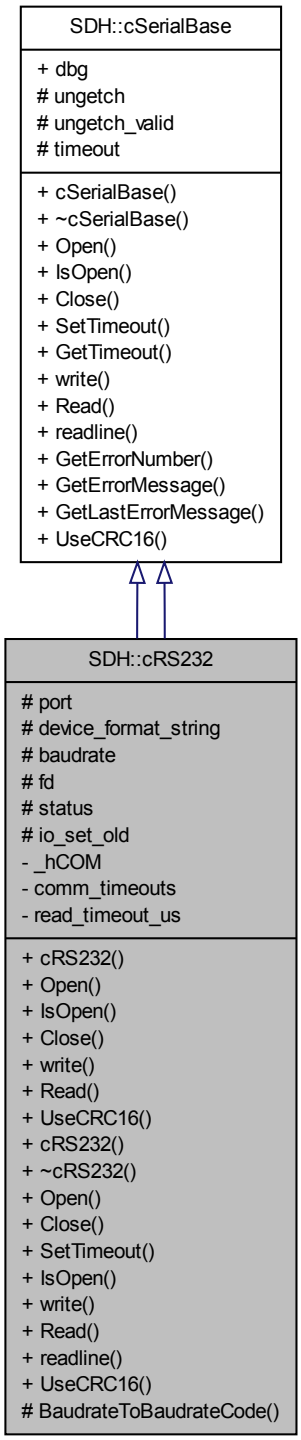
- sdh/sdhexception.h
- sdh/sdhexception.cpp

10.18 SDH::cRS232 Class Reference

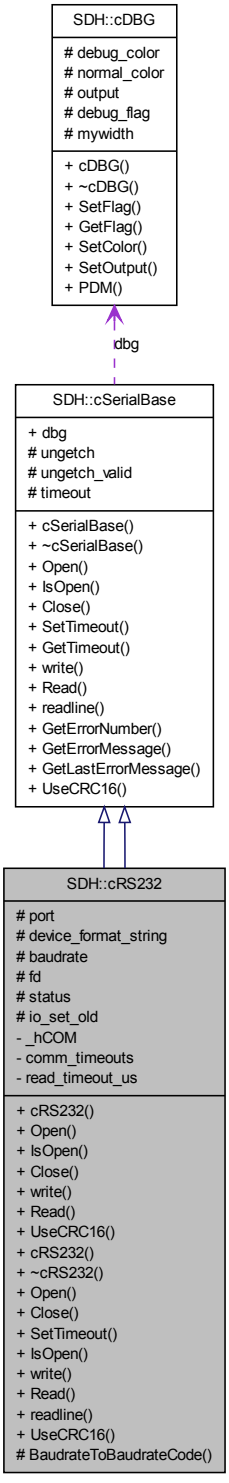
Low-level communication class to access a serial port on Cygwin and Linux.

`#include <rs232-vcc.h>`

Inheritance diagram for SDH::cRS232:



Collaboration diagram for SDH::cRS232:



Public Member Functions

- cRS232 (int _port, unsigned long _baudrate, double _timeout, char const *_device_format_string="/dev/ttyS%d")
- void Open (void) throw (cRS232Exception*)
- bool IsOpen (void) throw ()

  Return true if port to RS232 is open.

- void Close (void) throw (cRS232Exception*)

  Close the previously opened rs232 port.

- int write (char const *ptr, int len=0) throw (cRS232Exception*)

  Write data to a previously opened port.

- ssize_t Read (void *data, ssize_t size, long timeout_us, bool return_on_less_data) throw (cRS232Exception*)
- virtual bool UseCRC16 ()

  overloaded from cSerialBase::UseCRC16 since we want to use a CRC16 to protect binary RS232 communication

- cRS232 (int _port, unsigned long _baudrate, double _timeout, char const *_device_format_string="")
- ~cRS232 (void)
- void Open (void) throw (cRS232Exception*)

  Open rs232 port port.

- void Close (void) throw (cRS232Exception*)

  Close the previously opened communication channel.

- virtual void SetTimeout (double _timeout) throw (cSerialBaseException*)

  set the timeout for next readline() calls (negative value means: no timeout, wait for ever)

- bool IsOpen () throw ()

  Return true if communication channel is open.

- int write (char const *ptr, int len=0) throw (cRS232Exception*)

  Write data to a previously opened port.

- ssize_t Read (void *data, ssize_t size, long timeout_us, bool return_on_less_data) throw (cRS232Exception*)
- char * readline (char *line, int size, char *eol, bool return_on_less_data) throw (cRS232Exception*)
- virtual bool UseCRC16 ()

  overloaded from cSerialBase::UseCRC16 since we want to use a CRC16 to protect binary RS232 communication

Protected Member Functions

- tcflag_t BaudrateToBaudrateCode (unsigned long baudrate) throw (cRS232Exception*)

  Translate a baudrate given as unsigned long into a baudrate code for struct termios.

Protected Attributes

- int port

  the RS232 portnumber to use

- std::string device_format_string

  the sprintf format string to generate the device name from the port, see Constructor

- unsigned long baudrate

  the baudrate in bit/s

- int fd

  the file descriptor of the RS232 port

- int status
- termios io_set_old

10.18.1 Detailed Description

Low-level communication class to access a serial port on Cygwin and Linux. Low-level communication class to access a serial port on VCC Windows.

10.18.2 Constructor & Destructor Documentation

10.18.2.1 cRS232::cRS232 (int *_port*, unsigned long *_baudrate*, double *_timeout*, char const * *_device_format_string* = "/dev/ttyS%d")

Constructor: constructs an object to communicate with an SDH via RS232

Parameters

_port	- rs232 device number: 0='COM1'='/dev/ttyS0', 1='COM2'='/dev/ttyS1', ...
_baudrate	- the baudrate in bit/s
_timeout	- the timeout in seconds
_device_format_string	- a format string (C string) for generating the device name, like "/dev/ttyS%d" (default) or "/dev/ttyUSB%d". Must contain a d where the port number should be inserted. This char array is duplicated on construction

10.18.2.2 SDH::cRS232::cRS232 (int *_port*, unsigned long *_baudrate*, double *_timeout*, char const * *_device_format_string* = " ")

Constructor: constructs an object to communicate with an SDH via RS232

Parameters

_port	- rs232 device number: 0='COM1'='/dev/ttyS0', 1='COM2'='/dev/ttyS1', ...
_baudrate	- the baudrate in bit/s
_timeout	- the timeout in seconds
_device_format_string	- ignored for this VCC version

10.18.2.3 cRS232::~cRS232 (void)

10.18.3 Member Function Documentation

10.18.3.1 tcflag_t cRS232::BaudrateToBaudrateCode (unsigned long *baudrate*) throw (cRS232Exception*) [protected]

Translate a baudrate given as unsigned long into a baudrate code for struct termios.

10.18.3.2 void cRS232::Close (void) throw (cRS232Exception*) [virtual]

Close the previously opened rs232 port.

Implements SDH::cSerialBase.

10.18.3.3 void SDH::cRS232::Close (void) throw (cRS232Exception*) [virtual]

Close the previously opened communication channel.

Implements SDH::cSerialBase.

10.18.3.4 bool SDH::cRS232::IsOpen ( ) throw () [inline, virtual]

Return true if communication channel is open.

Implements SDH::cSerialBase.

10.18.3.5 bool cRS232::IsOpen (void) throw () [virtual]

Return true if port to RS232 is open.

Implements SDH::cSerialBase.

10.18.3.6 void SDH::cRS232::Open (void) throw (cRS232Exception*) [virtual]

Open rs232 port *port*.

Open the device with the parameters provided in the constructor

Implements SDH::cSerialBase.

10.18.3.7 void cRS232::Open (void) throw (cRS232Exception*) [virtual]

Open the device as configured by the parameters given to the constructor

Bug

The binary communication introduced in firmware 0.0.2.15 and SDHLibrary-C++ 0.0.2.0 did not work properly on Linux when RS232 was used for communication. See also:

- Bug 1011: Bug: Binary communication does not work via RS232 on Linux
- SDH_USE_BINARY_COMMUNICATION

  => **Resolved in SDHLibrary 0.0.2.2**

Implements SDH::cSerialBase.

10.18.3.8 ssize_t SDH::cRS232::Read (void * *data*, ssize_t *size*, long *timeout_us*, bool *return_on_less_data*) throw (cRS232Exception*) [virtual]

Read data from device. This function waits until *max_time_us* us passed or the expected number of bytes are received via serial line. if (*return_on_less_data* is true (default value), the number of bytes that have been received are returned and the data is stored in *data* If the *return_on_less_data* is false, data is only read from serial line, if at least *size* bytes are available.

Implements SDH::cSerialBase.

10.18.3.9 ssize_t cRS232::Read (void * *data*, ssize_t *size*, long *timeout_us*, bool *return_on_less_data*) throw (cRS232Exception*) [virtual]

Read data from device. This function waits until *max_time_us* us passed or the expected number of bytes are received via serial line. if (*return_on_less_data* is true (default value), the number of bytes that have been received are returned and the data is stored in *data* If the *return_on_less_data* is false, data is only read from serial line, if at least *size* bytes are available.

Implements SDH::cSerialBase.

10.18.3.10 char * cRS232::readline (char * *line*, int *size*, char * *eol*, bool *return_on_less_data*) throw (cRS232Exception*)

10.18.3.11 void cRS232::SetTimeout (double *_timeout*) throw (cSerialBaseException*) [virtual]

set the timeout for next readline() calls (negative value means: no timeout, wait for ever)

Reimplemented from SDH::cSerialBase.

10.18.3.12 virtual bool SDH::cRS232::UseCRC16 ( ) [inline, virtual]

overloaded from cSerialBase::UseCRC16 since we want to use a CRC16 to protect binary RS232 communication

Reimplemented from SDH::cSerialBase.

10.18.3.13 virtual bool SDH::cRS232::UseCRC16 ( ) [inline, virtual]

overloaded from cSerialBase::UseCRC16 since we want to use a CRC16 to protect binary RS232 communication

Reimplemented from SDH::cSerialBase.

10.18.3.14 int cRS232::write (char const * *ptr*, int *len* = 0) throw (cRS232Exception*) [virtual]

Write data to a previously opened port.

Write *len* bytes from *ptr* to the rs232 device

Parameters

ptr	- pointer the byte array to send in memory
len	- number of bytes to send

Returns

the number of bytes actually written

!! dwWritten is always 0! Damn bloody windows

Implements SDH::cSerialBase.

10.18.3.15 int SDH::cRS232::write (char const * *ptr*, int *len* = 0) throw (cRS232Exception*) [virtual]

Write data to a previously opened port.

Write *len* bytes from *ptr* to the rs232 device

Parameters

ptr	- pointer the byte array to send in memory
len	- number of bytes to send

Returns

the number of bytes actually written

Implements SDH::cSerialBase.

10.18.4 Member Data Documentation

10.18.4.1 unsigned long SDH::cRS232::baudrate [protected]

the baudrate in bit/s

10.18.4.2 std::string SDH::cRS232::device_format_string [protected]

the sprintf format string to generate the device name from the port, see Constructor

10.18.4.3 int SDH::cRS232::fd [protected]

the file descriptor of the RS232 port

10.18.4.4 termios SDH::cRS232::io_set_old [protected]

10.18.4.5 int SDH::cRS232::port [protected]

the RS232 portnumber to use

the RS232 port number to use (port 0 is COM1)

10.18.4.6 int SDH::cRS232::status [protected]

The documentation for this class was generated from the following files:

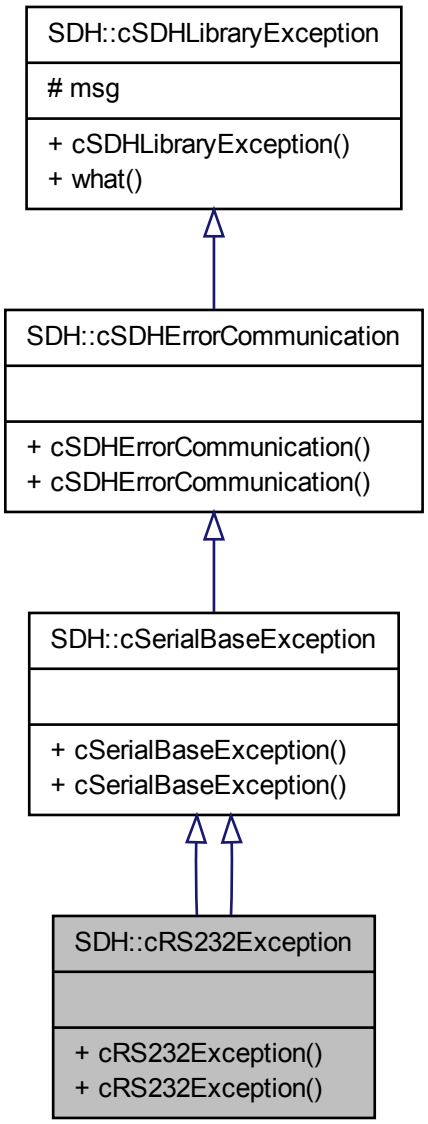
- sdh/rs232-cygwin.h
- sdh/rs232-vcc.h
- sdh/rs232-cygwin.cpp
- sdh/rs232-vcc.cpp

10.19 SDH::cRS232Exception Class Reference

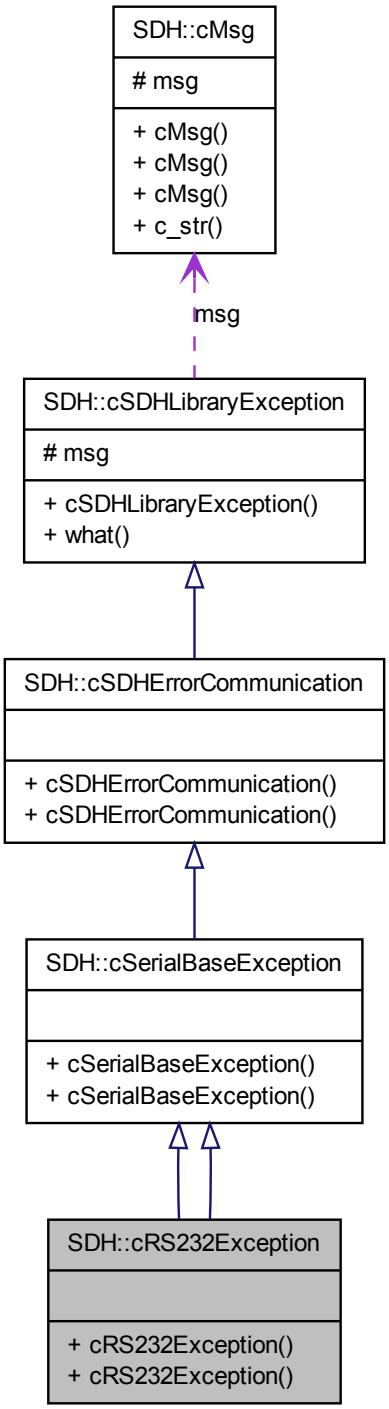
Derived exception class for low-level RS232 related exceptions.

`#include <rs232-vcc.h>`

Inheritance diagram for SDH::cRS232Exception:



Collaboration diagram for SDH::cRS232Exception:



Public Member Functions

- cRS232Exception (cMsg const &_msg)
- cRS232Exception (cMsg const &_msg)

10.19.1 Detailed Description

Derived exception class for low-level RS232 related exceptions.

10.19.2 Constructor & Destructor Documentation

10.19.2.1 SDH::cRS232Exception::cRS232Exception (cMsg const & *_msg*) [inline]

10.19.2.2 SDH::cRS232Exception::cRS232Exception (cMsg const & *_msg*) [inline]

The documentation for this class was generated from the following files:

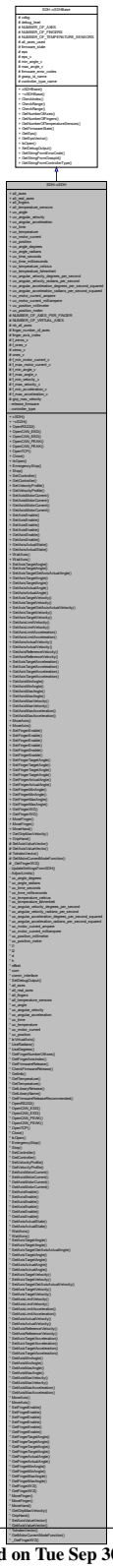
- sdh/rs232-cygwin.h
- sdh/rs232-vcc.h

10.20 SDH::cSDH Class Reference

SDH::cSDH is the end user interface class to control a SDH (SCHUNK Dexterous Hand).

```
#include <sdh.h>
```

Inheritance diagram for SDH::cSDH:



Collaboration diagram for SDH::cSDH:

Public Types

- enum eMotorCurrentMode { eMCM_MOVE = 0, eMCM_GRIP = 1, eMCM_-HOLD = 2, eMCM_DIMENSION }

  the motor current can be set specifically for these modes:

- enum eAxisState {

  eAS_IDLE = 0, eAS_POSITIONING, eAS_SPEED_MODE, eAS_NOT_INITIALIZED,

  eAS_CW_BLOCKED, eAS_CCW_BLOCKED, eAS_DISABLED, eAS_LIMITS_-REACHED,

  eAS_DIMENSION }

  The state of an axis (see TPOSCON_STATE in global.h of the SDH firmware)

Public Member Functions

- cSDH (bool _use_radians=false, bool _use_fahrenheit=false, int _debug_level=0)

  Constructor of cSDH class.

- virtual ~cSDH ()

Communication methods

- void OpenRS232 (int _port=0, unsigned long _baudrate=115200, double _-timeout=-1, char const *_device_format_string="/dev/ttyS%d") throw (cSDHLibraryException*)
- void OpenCAN_ESD (int _net=0, unsigned long _baudrate=1000000, double _timeout=0.0, Int32 _id_read=43, Int32 _id_write=42) throw (cSDHLibraryException*)
- void OpenCAN_ESD (tDeviceHandle _ntcan_handle, double _timeout=0.0, Int32 _id_read=43, Int32 _id_write=42) throw (cSDHLibraryException*)
- void OpenCAN_PEAK (unsigned long _baudrate=1000000, double _timeout=0.0, Int32 _id_read=43, Int32 _id_write=42, const char *_device="/dev/pcanusb0") throw (cSDHLibraryException*)
- void OpenCAN_PEAK (tDeviceHandle _handle, double _timeout=0.0, Int32 _id_read=43, Int32 _id_write=42) throw (cSDHLibraryException*)
- void OpenTCP (char const *_tcp_adr="192.168.1.1", int _tcp_port=23, double _timeout=0.0) throw (cSDHLibraryException*)
- void Close (bool leave_enabled=false) throw (cSDHLibraryException*)
- virtual bool IsOpen (void) throw ()

Auxiliary movement methods

- void EmergencyStop (void) throw (cSDHLibraryException*)
- void Stop (void) throw (cSDHLibraryException*)
- void SetController (cSDHBase::eControllerType controller) throw (cSDHLibraryException*)
- eControllerType GetController (void) throw (cSDHLibraryException*)
- void SetVelocityProfile (eVelocityProfile velocity_profile) throw (cSDHLibraryException*)

- eVelocityProfile GetVelocityProfile (void) throw (cSDHLibraryException*)

Methods to access SDH on axis-level

- void SetAxisMotorCurrent (std::vector< int > const &axes, std::vector< double > const &motor_currents, eMotorCurrentMode mode=eMCM_MOVE) throw (cSDHLibraryException*)
- void SetAxisMotorCurrent (int iAxis, double motor_current, eMotorCurrentMode mode=eMCM_MOVE) throw (cSDHLibraryException*)
- std::vector< double > GetAxisMotorCurrent (std::vector< int > const &axes, eMotorCurrentMode mode=eMCM_MOVE) throw (cSDHLibraryException*)
- double GetAxisMotorCurrent (int iAxis, eMotorCurrentMode mode=eMCM_MOVE) throw (cSDHLibraryException*)
- void SetAxisEnable (std::vector< int > const &axes, std::vector< double > const &states) throw (cSDHLibraryException*)
- void SetAxisEnable (int iAxis=All, double state=1.0) throw (cSDHLibraryException*)
- void SetAxisEnable (std::vector< int > const &axes, std::vector< bool > const &states) throw (cSDHLibraryException*)
- void SetAxisEnable (int iAxis=All, bool state=true) throw (cSDHLibraryException*)
- std::vector< double > GetAxisEnable (std::vector< int > const &axes) throw (cSDHLibraryException*)
- double GetAxisEnable (int iAxis) throw (cSDHLibraryException*)
- std::vector< eAxisState > GetAxisActualState (std::vector< int > const &axes) throw (cSDHLibraryException*)
- eAxisState GetAxisActualState (int iAxis) throw (cSDHLibraryException*)
- void WaitAxis (std::vector< int > const &axes, double timeout=-1.0) throw (cSDHLibraryException*)
- void WaitAxis (int iAxis, double timeout=-1.0) throw (cSDHLibraryException*)
- void SetAxisTargetAngle (std::vector< int > const &axes, std::vector< double > const &angles) throw (cSDHLibraryException*)
- void SetAxisTargetAngle (int iAxis, double angle) throw (cSDHLibraryException*)
- std::vector< double > SetAxisTargetGetAxisActualAngle (std::vector< int > const &axes, std::vector< double > const &angles) throw (cSDHLibraryException*)
- std::vector< double > GetAxisTargetAngle (std::vector< int > const &axes) throw (cSDHLibraryException*)
- double GetAxisTargetAngle (int iAxis) throw (cSDHLibraryException*)
- std::vector< double > GetAxisActualAngle (std::vector< int > const &axes) throw (cSDHLibraryException*)
- double GetAxisActualAngle (int iAxis) throw (cSDHLibraryException*)
- void SetAxisTargetVelocity (std::vector< int > const &axes, std::vector< double > const &velocities) throw (cSDHLibraryException*)
- void SetAxisTargetVelocity (int iAxis, double velocity) throw (cSDHLibraryException*)
- std::vector< double > SetAxisTargetGetAxisActualVelocity (std::vector< int > const &axes, std::vector< double > const &velocities) throw (cSDHLibraryException*)
- std::vector< double > GetAxisTargetVelocity (std::vector< int > const &axes) throw (cSDHLibraryException*)
- double GetAxisTargetVelocity (int iAxis) throw (cSDHLibraryException*)
- std::vector< double > GetAxisLimitVelocity (std::vector< int > const &axes) throw (cSDHLibraryException*)
- double GetAxisLimitVelocity (int iAxis) throw (cSDHLibraryException*)
- std::vector< double > GetAxisLimitAcceleration (std::vector< int > const &axes) throw (cSDHLibraryException*)

- double GetAxisLimitAcceleration (int iAxis) throw (cSDHLibraryException*)
- std::vector< double > GetAxisActualVelocity (std::vector< int >const &axes) throw (cSDHLibraryException*)
- double GetAxisActualVelocity (int iAxis) throw (cSDHLibraryException*)
- std::vector< double > GetAxisReferenceVelocity (std::vector< int >const &axes) throw (cSDHLibraryException*)
- double GetAxisReferenceVelocity (int iAxis) throw (cSDHLibraryException*)
- void SetAxisTargetAcceleration (std::vector< int >const &axes, std::vector< double >const &accelerations) throw (cSDHLibraryException*)
- void SetAxisTargetAcceleration (int iAxis, double acceleration) throw (cSDHLibraryException*)
- std::vector< double > GetAxisTargetAcceleration (std::vector< int >const &axes) throw (cSDHLibraryException*)
- double GetAxisTargetAcceleration (int iAxis) throw (cSDHLibraryException*)
- std::vector< double > GetAxisMinAngle (std::vector< int > const &axes) throw (cSDHLibraryException*)
- double GetAxisMinAngle (int iAxis) throw (cSDHLibraryException*)
- std::vector< double > GetAxisMaxAngle (std::vector< int > const &axes) throw (cSDHLibraryException*)
- double GetAxisMaxAngle (int iAxis) throw (cSDHLibraryException*)
- std::vector< double > GetAxisMaxVelocity (std::vector< int > const &axes) throw (cSDHLibraryException*)
- double GetAxisMaxVelocity (int iAxis) throw (cSDHLibraryException*)
- std::vector< double > GetAxisMaxAcceleration (std::vector< int > const &axes) throw (cSDHLibraryException*)
- double GetAxisMaxAcceleration (int iAxis) throw (cSDHLibraryException*)
- double MoveAxis (std::vector< int >const &axes, bool sequ=true) throw (cSDHLibraryException*)
- double MoveAxis (int iAxis, bool sequ=true) throw (cSDHLibraryException*)

Methods to access SDH on finger-level

- void SetFingerEnable (std::vector< int > const &fingers, std::vector< double > const &states) throw (cSDHLibraryException*)
- void SetFingerEnable (int iFinger, double state=1.0) throw (cSDHLibraryException*)
- void SetFingerEnable (std::vector< int > const &fingers, std::vector< bool > const &states) throw (cSDHLibraryException*)
- void SetFingerEnable (int iFinger, bool state) throw (cSDHLibraryException*)
- std::vector< double > GetFingerEnable (std::vector< int > const &fingers) throw (cSDHLibraryException*)
- double GetFingerEnable (int iFinger) throw (cSDHLibraryException*)
- void SetFingerTargetAngle (int iFinger, std::vector< double > const &angles) throw (cSDHLibraryException*)
- void SetFingerTargetAngle (int iFinger, double a0, double a1, double a2) throw (cSDHLibraryException*)
- std::vector< double > GetFingerTargetAngle (int iFinger) throw (cSDHLibraryException*)
- void GetFingerTargetAngle (int iFinger, double &a0, double &a1, double &a2) throw (cSDHLibraryException*)
- std::vector< double > GetFingerActualAngle (int iFinger) throw (cSDHLibraryException*)
- void GetFingerActualAngle (int iFinger, double &a0, double &a1, double &a2) throw (cSDHLibraryException*)
- std::vector< double > GetFingerMinAngle (int iFinger) throw (cSDHLibraryException*)
- void GetFingerMinAngle (int iFinger, double &a0, double &a1, double &a2) throw (cSDHLibraryException*)

- std::vector< double > GetFingerMaxAngle (int iFinger) throw (cSDHLibraryException*)
- void GetFingerMaxAngle (int iFinger, double &a0, double &a1, double &a2) throw (cSDHLibraryException*)
- std::vector< double > GetFingerXYZ (int iFinger, std::vector< double > const &angles) throw (cSDHLibraryException*)
- std::vector< double > GetFingerXYZ (int iFinger, double a0, double a1, double a2) throw (cSDHLibraryException*)
- double MoveFinger (std::vector< int >const &fingers, bool sequ=true) throw (cSDHLibraryException*)
- double MoveFinger (int iFinger, bool sequ=true) throw (cSDHLibraryException*)
- double MoveHand (bool sequ=true) throw (cSDHLibraryException*)

Methods to access %SDH grip skills

- double GetGripMaxVelocity (void)
- double GripHand (eGraspId grip, double close, double velocity, bool sequ=true) throw (cSDHLibraryException*)

Public Attributes

Predefined index vector objects

- std::vector< int > all_axes
  A vector with indices of all axes (in natural order), including the virtual axis.
- std::vector< int > all_real_axes
  A vector with indices of all real axes (in natural order), excluding the virtual axis.
- std::vector< int > all_fingers
  A vector with indices of all fingers (in natural order)
- std::vector< int > all_temperature_sensors
  A vector with indices of all temperature sensors.

Predefined unit conversion objects

Pointers to the unit converter objects used by this cSDH object.

The refered objects convert values between different unit systems. Example: convert angle values between degrees and radians, temperatures between degrees celsius and degrees fahrenheit or the like.

A cSDH object uses these converter objects to convert between external (user) and internal (SDH) units. The user can easily change the converter object that is used for a certain kind of unit. This way a cSDH object can easily report and accept parameters in the user or application specific unit system.

Additionally, users can easily add conversion objects for their own, even more user- or application-specific unit systems.

- const cUnitConverter * uc_angle
  unit convert for (axis) angles: default = SDH::cSDH::uc_angle_degrees

- const cUnitConverter * uc_angular_velocity
  unit convert for (axis) angular velocities: default = SDH::cSDH::uc_angular_velocity_degrees_per_second

- const cUnitConverter * uc_angular_acceleration
  unit convert for (axis) angular accelerations: default = SDH::cSDH::uc_angular_acceleration_degrees_per_second_squared

- const cUnitConverter * uc_time
  unit convert for times: default = uc_time_seconds

- const cUnitConverter * uc_temperature
  unit convert for temperatures: default = SDH::cSDH::uc_temperature_celsius

- const cUnitConverter * uc_motor_current
  unit converter for motor curent: default = SDH::cSDH::uc_motor_current_ampere

- const cUnitConverter * uc_position
  unit converter for position: default = SDH::cSDH::uc_position_millimeter

Static Public Attributes

Predefined unit conversion objecs

Some predefined cUnitConverter unit conversion objects to convert values between different unit systems. These are static members since the converter objects do not depend on the individiual cSDH object.

For every physical unit used in the cSDH class there is at least one (most of the time more than one) predefined unit converter. For example for angles there are radians and degrees.

- static cUnitConverter const uc_angle_degrees
  Default converter for angles (internal unit == external unit): degrees.

- static cUnitConverter const uc_angle_radians
  Converter for angles: external unit = radians.

- static cUnitConverter const uc_time_seconds
  Default converter for times (internal unit == external unit): seconds.

- static cUnitConverter const uc_time_milliseconds
  Converter for times: external unit = milliseconds.

- static cUnitConverter const uc_temperature_celsius
  Default converter for temparatures (internal unit == external unit): degrees celsius.

- static cUnitConverter const uc_temperature_fahrenheit
  Converter for temperatures: external unit = degrees fahrenheit.

- static cUnitConverter const uc_angular_velocity_degrees_per_second
  Default converter for angular velocities (internal unit == external unit): degrees / second.
- static cUnitConverter const uc_angular_velocity_radians_per_second
  Converter for angular velocieties: external unit = radians/second.
- static cUnitConverter const uc_angular_acceleration_degrees_per_second_squared
  Default converter for angular accelerations (internal unit == external unit): degrees / second.
- static cUnitConverter const uc_angular_acceleration_radians_per_second_squared
  Converter for angular velocieties: external unit = radians/second.
- static cUnitConverter const uc_motor_current_ampere
  Default converter for motor current (internal unit == external unit): Ampere.
- static cUnitConverter const uc_motor_current_milliampere
  Converter for motor current: external unit = milli Ampere.
- static cUnitConverter const uc_position_millimeter
  Default converter for position (internal unit == external unit): millimeter.
- static cUnitConverter const uc_position_meter
  Converter for position: external unit = meter.

Protected Member Functions

Internal helper methods

- std::vector< double > SetAxisValueVector (std::vector< int > const &axes, std::vector< double > const &values, pSetFunction ll_set, pGetFunction ll_get, cUnitConverter const *uc, std::vector< double > const &min_values, std::vector< double > const &max_values, char const *name) throw (cSDHLibraryException*)
- std::vector< double > GetAxisValueVector (std::vector< int > const &axes, pGetFunction ll_get, cUnitConverter const *uc, char const *name) throw (cSDHLibraryException*)
- std::vector< int > ToIndexVector (int index, std::vector< int > &all_replacement, int maxindex, char const *name) throw (cSDHLibraryException*)
- pSetFunction GetMotorCurrentModeFunction (eMotorCurrentMode mode) throw (cSDHLibraryException*)
- std::vector< double > _GetFingerXYZ (int fi, std::vector< double > r_angles) throw (cSDHLibraryException*)

Protected Attributes

- int NUMBER_OF_AXES_PER_FINGER

The number of axis per finger (for finger 1 this includes the "virtual" base axis)

- int NUMBER_OF_VIRTUAL_AXES

  The number of virtual axes.

- int nb_all_axes

  The number of all axes including virtual axes.

- std::vector< int > finger_number_of_axes

  Mapping of finger index to number of real axes of fingers:

- std::vector< std::vector< int > > finger_axis_index

  Mapping of finger index, finger axis index to axis index:

- std::vector< double > f_zeros_v

  Vector of 3 epsilon values.

- std::vector< double > f_ones_v

  Vector of 3 1.0 values.

- std::vector< double > zeros_v

  Vector of nb_all_axes 0.0 values.

- std::vector< double > ones_v

  Vector of nb_all_axes 1.0 values.

- std::vector< double > f_min_motor_current_v

  Minimum allowed motor currents (in internal units (Ampere)), including the virtual axis.

- std::vector< double > f_max_motor_current_v

  Maximum allowed motor currents (in internal units (Ampere)), including the virtual axis.

- std::vector< double > f_min_angle_v

  Minimum allowed axis angles (in internal units (degrees)), including the virtual axis.

- std::vector< double > f_max_angle_v

  Maximum allowed axis angles (in internal units (degrees)), including the virtual axis.

- std::vector< double > f_min_velocity_v

  Minimum allowed axis velocity (in internal units (degrees/second)), including the virtual axis.

- std::vector< double > f_max_velocity_v

  Maximum allowed axis velocity (in internal units (degrees/second)), including the virtual axis.

- std::vector< double > f_min_acceleration_v

  *Minimum allowed axis acceleration (in internal units (degrees/(second * second))), including the virtual axis.*

- std::vector< double > f_max_acceleration_v

  *Maximum allowed axis acceleration (in internal units (degrees/(second * second))), including the virtual axis.*

- double grip_max_velocity

  Maximum allowed grip velocity (in internal units (degrees/second))

Kinematic parameters of the Hand

- double l1

  length of limb 1 (proximal joint to distal joint) in mm

- double l2

  length of limb 2 (distal joint to fingertip) in mm

- double d
- double h
- std::vector< std::vector< double > > offset
- cSerialBase * com
- cSDHSerial comm_interface

  The object to interface with the SDH attached via serial RS232 or CAN or TCP.

- virtual void SetDebugOutput (std::ostream *debuglog)

  change the stream to use for debug messages

Miscellaneous methods

- bool IsVirtualAxis (int iAxis) throw (cSDHLibraryException*)

  Return `true` if index iAxis refers to a virtual axis.

- void UseRadians (void)
- void UseDegrees (void)
- int GetFingerNumberOfAxes (int iFinger) throw (cSDHLibraryException*)
- int GetFingerAxisIndex (int iFinger, int iFingerAxis) throw (cSDHLibraryException*)
- char const * GetFirmwareRelease (void) throw (cSDHLibraryException*)
- bool CheckFirmwareRelease (void) throw (cSDHLibraryException*)
- char const * GetInfo (char const *what) throw (cSDHLibraryException*)
- std::vector< double > GetTemperature (std::vector< int > const &sensors) throw (cSDHLibraryException*)

- double GetTemperature (int iSensor) throw (cSDHLibraryException∗)
- static char const ∗ GetLibraryRelease (void)
- static char const ∗ GetLibraryName (void)
- static char const ∗ GetFirmwareReleaseRecommended (void)

10.20.1 Detailed Description

SDH::cSDH is the end user interface class to control a SDH (SCHUNK Dexterous Hand). A general overview of the structure and architecture used is given here.

Remarks

- The cSDH class provides methods to access the 7 axes of the SDH individually as well as on a finger level.
  - When accessing the axes individually then the following axis indices must be used to address an axis / some axes:
    - 0 : common base axis of finger 0 and 2
    - 1 : proximal axis of finger 0
    - 2 : distal axis of finger 0
    - 3 : proximal axis of finger 1
    - 4 : distal axis of finger 1
    - 5 : proximal axis of finger 2
    - 6 : distal axis of finger 2
  - When accessing the axes on finger level then every finger has 3 axes for a uniform interface of the access methods. Her the following finger axis indices must be used:
    - 0 : base axis of finger (for finger 1 this is a "virtual" axis with min angle = max angle = 0.0)
    - 1 : proximal axis of finger
    - 2 : distal axis of finger
- Vector-like parmeters: The interface functions defined here make full use of the flexibility provided by the STL vector<T> type. I.E. for parameters of functions like axis indices or axis angles not only single numerical values can be given, but also vectors of `int` or `double` values. This way the same (overloaded) interface function can address a single axis individually or multiple axes in a call, as required by the application. Such parameters are herein refered to as "vectors".
- Parameters for methods are checked for validity. In case an invalid parameter is given the method throws a cSDHErrorInvalidParameter exception.
- The underlying physical unit system of parameters that do have a unit (like angles, velocities or temperatures) can be adapted to the users or the applications need. See also unit conversion objects". The default converter objects are set as the uc_∗ member variables (uc_angle, uc_angular_velocity, uc_angular_acceleration, uc_time, uc_temperature, uc_position). The units are changed in the communication between user application and cSDH object instance only (USERAPP and SDHLibrary-CPP in the overview figure"). For now the SDH firmware knows only about its internal unit system.

10.20.2 Member Enumeration Documentation

10.20.2.1 enum SDH::cSDH::eAxisState

The state of an axis (see TPOSCON_STATE in global.h of the SDH firmware)

Enumerator:

eAS_IDLE axis is idle

eAS_POSITIONING the goal position has not been reached yet

eAS_SPEED_MODE axis is in speed mode

eAS_NOT_INITIALIZED axis is not initialized or doesn't exist

eAS_CW_BLOCKED axis is blocked in counterwise direction

eAS_CCW_BLOCKED axis is blocked is blocked in against counterwise direction

eAS_DISABLED axis is disabled

eAS_LIMITS_REACHED position limits reached and axis stopped

eAS_DIMENSION Endmarker and Dimension.

10.20.2.2 enum SDH::cSDH::eMotorCurrentMode

the motor current can be set specifically for these modes:

Enumerator:

eMCM_MOVE The motor currents used while "moving" with a MoveHand() or MoveFinger() command.

eMCM_GRIP The motor currents used while "gripping" with a GripHand() command.

eMCM_HOLD The motor currents used after "gripping" with a GripHand() command (i.e. "holding")

eMCM_DIMENSION Endmarker and Dimension.

10.20.3 Constructor & Destructor Documentation

10.20.3.1 cSDH::cSDH (bool *_use_radians* = `false`, bool *_use_fahrenheit* = `false`, int *_debug_level* = `0`)

Constructor of cSDH class.

Creates an new object of type cSDH. One such object is needed for each SDH that you want to control. The constructor initializes internal data structures. A connection the SDH is **not** yet established, see OpenRS232() on how to do that.

After an object is created the user can adjust the unit systems used to set/report parameters to/from SDH. This is shown in the example code below. The default units used (if not overwritten by constructor parameters) are:

- `degrees` [deg] for (axis) angles
- `degrees per second` [deg/s] for (axis) angular velocities
- `seconds` [s] for times
- `degrees celsius` [deg C] for temperatures

Parameters

use-radians	: Flag, if true then use radians and radians/second to set/report (axis) angles and angular velocities instead of default degrees and degrees/s.
use-fahrenheit	: Flag, if true then use degrees fahrenheit to report temperatures instead of default degrees celsius.
debug-level	: The level of debug messages to print • 0: (default) no messages • 1: messages of this cSDH instance • 2: like 1 plus messages of the inner cSDHSerial instance

Examples:

Common use:

```
// Include the cSDH interface
#include <sdh.h>

// Create a cSDH object 'hand'.
cSDH hand();
```

The mentioned change of a unit system can be done like this:

```
// Assuming 'hand' is a cSDH object ...

// override default unit converter for (axis) angles:
hand.uc_angle = &cSDH::uc_angle_radians;

// override default unit converter for (axis) angular velocities:
hand.uc_angular_velocity = &
cSDH::uc_angular_velocity_radians_per_second;

// override default unit converter for (axis) angular accelerations:
hand.uc_angular_acceleration = &
cSDH::uc_angular_acceleration_radians_per_second_squared;

// instead of the last 3 calls the following shortcut could be used:
hand.UseRadians();

// override default unit converter for times:
hand.uc_time  = &cSDH::uc_time_milliseconds;

// override default unit converter for temperatures:
hand.uc_temperature = &cSDH::uc_temperature_fahrenheit;

// override default unit converter for positions:
hand.uc_position = &cSDH::uc_position_meter;
```

For convenience the most common settings can be specified as bool parameters for the constructor, like in:

```
// Include the cSDH interface
#include <sdh.h>

// Create a cSDH object 'hand' that uses
// - the non default radians and radians/s units,
// - the default temperature in degrees celsius,
// - A debug level of 2
cSDH hand( true, false, 2 );
```

unit convert for times: default = uc_time_seconds

unit convert for temperatures: default = uc_temperature_celsius

unit converter for motor curent: default = uc_motor_current_ampere

unit converter for position: default = uc_position_millimeter

The number of axis per finger (for finger 1 this includes the "virtual" base axis)

The number of virtual axes

Mapping of finger index to number of real axes of fingers:

Mapping of finger index, finger axis index to axis index:

Maximum allowed grip velocity (in internal units (degrees/second))

10.20.3.2 cSDH::~cSDH ( ) [virtual]

Virtual destructor to make compiler happy

If the connection to the SDH hardware/firmware is still open then the connection is closed, which will stop the axis controllers (and thus prevent overheating).

10.20.4 Member Function Documentation

10.20.4.1 std::vector< double > cSDH::_GetFingerXYZ (int *fi*, std::vector< double > *r_angles*) throw (cSDHLibraryException*) [protected]

return cartesian [x,y,z] position in mm of fingertip for finger fi at angles r_angles (rad)

10.20.4.2 bool cSDH::CheckFirmwareRelease (void) throw (cSDHLibraryException*)

Check the actual release of the firmware of the connected SDH against the recommended firmware release.

Returns

true - if the actual firmware is the recommended one false - the actual firmware is NOT the recommended one (communication with the SDH might not work as expected)

This will throw a (cSDHErrorCommunication*) exception if the connection to the SDH is not yet opened.

Examples:

```
// Assuming 'hand' is a cSDH object ...

if ( hand.CheckFirmwareRelease() )
{
    cout << "The firmware release of the connected SDH is the one recomm
ended by this SDHLibrary\n";
}
else
{
    cout << "The firmware release of the connected SDH is NOT the one re
commended by this SDHLibrary\n";
    cout << "  Actual SDH firmware release      " << hand.GetFirmwareRel
ease() << "\n";
    cout << "  Recommended SDH firmware release " << hand.GetFirmwareRel
easeRecommended() << "\n";
}
```

See also

See GetFirmwareReleaseRecommended() to get the recommended SDH firmware release.

10.20.4.3 void cSDH::Close (bool *leave_enabled* = `false`) throw (cSDHLibraryException*)

Close connection to SDH.

The default behaviour is to **not** leave the controllers of the SDH enabled (to prevent overheating). To keep the controllers enabled (e.g. to keep the finger axes actively in position) set *leave_enabled* to `true`. Only already enabled axes will be left enabled.

Parameters

leave_enabled	- Flag: true to leave the controllers on, false (default) to disable the controllers (switch powerless)

This throws a (cSDHErrorCommunication*) exception if the connection was not opened before.

Examples:

```
// Assuming 'hand' is a cSDH object ...

// Close connection to SDH, power off controllers:
hand.Close();

// To leave the already enabled controllers enabled:
hand.Close( true );
```

10.20.4.4 void cSDH::EmergencyStop (void) throw (cSDHLibraryException*)

Stop movement of all axes of the SDH and switch off the controllers

This command will always be executed sequentially: it will return only after the SDH has confirmed the emergency stop.

Bug

For now this will **NOT** work while a GripHand() command is executing, even if that was initiated non-sequentially!

Examples:

```
// Assuming 'hand' is a cSDH object ...

// Perform an emergency stop:
hand.EmergencyStop();
```

10.20.4.5 std::vector< double > cSDH::GetAxisActualAngle (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get the current actual angle(s) of axis(axes).

The actual angles are read from the SDH.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the actual angles of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angle unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisActualAngle(int) for an overloaded variant to access a single axis.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get actual axis angle of all axes
std::vector<double> v = hand.GetAxisActualAngle( hand.all_axes );
```

```
// now v is something like {0.0, 0.0, 42.0, 0.0, 47.11, 0,0, 0.0}

// Get actual axis angle of axis 2
double v2 = hand.GetAxisActualAngle( 2 );
// 2 is now something like 42.0


// Get actual axis angle of axis 2 and 4
std::vector<int> axes24;
axes24.push_back( 2 );
axes24.push_back( 4 );

v = hand.GetAxisActualAngle( axes24 );
// now v is something like {42.0, 47.11}
```

10.20.4.6 double cSDH::GetAxisActualAngle (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisActualAngle(std::vector<int>const&), just for a single axis *iAxis* and returning a single angle, see there for details and examples.

10.20.4.7 std::vector< cSDH::eAxisState > cSDH::GetAxisActualState (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get the current actual state(s) of axis(axes).

The actual axis states are read from the SDH.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the actual states of the selected axes.
- The values are given as eAxisState enum values
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisActualState(int) for an overloaded variant to access a single axis.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get actual axis state of all axes
std::vector<eAxisState> v = hand.GetAxisActualState( hand.all_axes )
// now v is something like {eAS_IDLE, eAS_POSITIONING, eAS_IDLE, eAS_ID
```

```
LE, eAS_IDLE, eAS_DISABLED, eAS_IDLE}

    // Get actual axis state of axis 3
    eAxisState v3 = hand.GetAxisActualState( 3 );
    // v3 is now something like eAS_IDLE


    // Get actual state of axis 2 and 5
    std::vector<int> axes25;
    axes25.push_back( 2 );
    axes25.push_back( 5 );

    v = hand.GetAxisActualState( axes25 );
    // now v is something like {eAS_IDLE, eAS_DISABLED}
```

10.20.4.8 cSDH::eAxisState cSDH::GetAxisActualState (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisActualState(std::vector<int>const&), just for a single axis *iAxis*, see there for details and examples.

10.20.4.9 std::vector< double > cSDH::GetAxisActualVelocity (std::vector< int >const & *axes*) throw (cSDHLibraryException*)

Get the actual velocity(s) of axis(axes).

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the actual velocities of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angular_velocity unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisActualVelocity(int) for an overloaded variant to access a single axis.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Get actual axis velocity of all axes
    std::vector<double> v = hand.GetAxisActualVelocity( hand.all_axes );
```

```
// now v is something like {0.1, 0.2, 0.3, 13.2, 0.5, 0.0, 0.7}

// Get actual axis velocity of axis 2 and 4
std::vector<int> axes24;
axes24.push_back( 2 );
axes24.push_back( 4 );
v = hand.GetAxisActualVelocity( axes24 );
// now v is something like {13.2, 0.0}

// Get actual axis velocity of axis 2
double v3 = hand.GetAxisActualVelocity( 2 );
// v3 is now something like 13.2
```

10.20.4.10 double cSDH::GetAxisActualVelocity (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisActualVelocity(std::vector<int>const&), just for a single axis *iAxis* and returning a single velocity, see there for details and examples.

10.20.4.11 double cSDH::GetAxisEnable (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisEnable(std::vector<int>const&), just for a single axis *iAxis*, see there for details and examples.

10.20.4.12 std::vector< double > cSDH::GetAxisEnable (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get enabled/disabled state of axis controller(s).

The enabled/disabled state of the controllers of the selected axes is read from the SDH.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of enabled/disabled states as doubles (0=disabled, 1.0=enabled) of the selected axes.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisEnable(int) for an overloaded variant to access a single axis.

Examples:

```
// Assuming 'hand' is a cSDH object ...
```

```
// Get enabled state of all axes:
std::vector<double> v = hand.GetAxisEnable( hand.all_axes );
// now v is something like {0.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0}

// Get enabled state of axis 3 and 5
std::vector<int> axes35;
axes35.push_back( 3 );
axes35.push_back( 5 );

v = hand.GetAxisEnable( axes35 );
// now v is something like {1.0, 0.0}


// Get enabled state of axis 3
double v3 = hand.GetAxisEnable( 3 );
// now v3 is something like 1.0
```

10.20.4.13 std::vector< double > cSDH::GetAxisLimitAcceleration (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get the acceleration limit(s) of axis(axes).

The acceleration limit(s) are read from the SDH.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the acceleration limits of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angular_acceleration unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisLimitAcceleration(int) for an overloaded variant to access a single axis.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get axis acceleration limits of all axes
std::vector<double> v = hand.GetAxisLimitAcceleration( hand.all_axes );

// now v is something like {81.0, 140.0, 120.0, 140.0, 120.0, 140.0, 12
0.0}
```

```
// Get axis acceleration limit of axis 2
double v2 = hand.GetAxisLimitAcceleration( 2 );
// v2 is now something like 120.0


// Get axis acceleration limits of axis 2 and 4
std::vector<int> axes24;
axes24.push_back( 2 );
axes24.push_back( 4 );

v = hand.GetAxisLimitAcceleration( axes24 );
// now v is something like {120.0,120.0}
```

10.20.4.14 double cSDH::GetAxisLimitAcceleration (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisLimitAcceleration(std::vector<int>const&), just for a single axis *iAxis* and returning a single acceleration limit, see there for details and examples.

10.20.4.15 double cSDH::GetAxisLimitVelocity (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisLimitVelocity(std::vector<int>const&), just for a single axis *iAxis* and returning a single velocity limit, see there for details and examples.

10.20.4.16 std::vector< double > cSDH::GetAxisLimitVelocity (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get the velocity limit(s) of axis(axes).

The velocity limit(s) are read from the SDH.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the velocity limits of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angular_velocity unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisLimitVelocity(int) for an overloaded variant to access a single axis.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Get axis velocity limits of all axes
    std::vector<double> v = hand.GetAxisLimitVelocity( hand.all_axes );
    // now v is something like {81.0, 140.0, 120.0, 140.0, 120.0, 140.0, 12
0.0}

    // Get axis velocity limit of axis 2
    double v2 = hand.GetAxisLimitVelocity( 2 );
    // v2 is now something like 120.0


    // Get axis velocity limits of axis 2 and 4
    std::vector<int> axes24;
    axes24.push_back( 2 );
    axes24.push_back( 4 );

    v = hand.GetAxisLimitVelocity( axes24 );
    // now v is something like {120.0,120.0}
```

10.20.4.17 std::vector< double > cSDH::GetAxisMaxAcceleration (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get the maximum acceleration(s) of axis(axes).

The maximum accelerations are currently not read from the SDH, but are stored in the library.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the max angular accelerations of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angular_acceleration unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisMaxAcceleration(int) for an overloaded variant to access a single axis.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Get maximum axis angular accelerations of all axes
```

```
    std::vector<double> v = hand.GetAxisMaxAcceleration( hand.all_axes );
    // now v is something like {1000.0, 1000.0, 1000.0, 1000.0, 1000.0, 100
0.0, 1000.0}

    // Get maximum axis angular acceleration of axis 3
    double v3 = hand.GetAxisMaxAcceleration( 3 );
    // v3 is now something like 1000.0

    // Get maximum axis angular acceleration of axis 2 and 4
    std::vector<int> axes24;
    axes24.push_back( 2 );
    axes24.push_back( 4 );

    v = hand.GetAxisMaxAcceleration( axes24 );
    // now v is something like {1000.0, 1000.0}


    // Or if you change the angular acceleration unit system:
    hand.UseRadians();

    v = hand.GetAxisMaxAcceleration( hand.all_axes );
    // now v is something like {17.453292519943293, 17.453292519943293, 17.
453292519943293, 17.453292519943293, 17.453292519943293, 17.453292519943293, 17.4
53292519943293}
```

10.20.4.18 double cSDH::GetAxisMaxAcceleration (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisMaxAcceleration(std::vector<int>const&), just for a single axis *iAxis* and returning a single minimum angle, see there for details and examples.

10.20.4.19 double cSDH::GetAxisMaxAngle (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisMaxAngle(std::vector<int>const&), just for a single axis *iAxis* and returning a single maximum angle, see there for details and examples.

10.20.4.20 std::vector< double > cSDH::GetAxisMaxAngle (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get the maximum angle(s) of axis(axes).

The maximum angles are currently not read from the SDH, but are stored in the library.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the max angles of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angle unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisMaxAngle(int) for an overloaded variant to access a single axis.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get maximum axis angles of all axes
std::vector<double> v = hand.GetAxisMaxAngle( hand.all_axes );
// now v is something like {90.0, 90.0, 90.0, 90.0, 90.0, 90.0, 90.0}

// Get maximum axis angle of axis 3
double v3 = hand.GetAxisMaxAngle( 3 );
// v3 is now something like 90.0

// Get maximum axis angle of axis 2 and 4
std::vector<int> axes24;
axes24.push_back( 2 );
axes24.push_back( 4 );

v = hand.GetAxisMaxAngle( axes24 );
// now v is something like {90.0, 90.0}


// Or if you change the angle unit system:
hand.UseRadians();

v = hand.GetAxisMaxAngle( hand.all_axes );
// now v is something like { 1.5707963267948966, 1.5707963267948966, 1.
5707963267948966, 1.5707963267948966, 1.5707963267948966, 1.5707963267948966, 1.5
707963267948966}
```

10.20.4.21 double cSDH::GetAxisMaxVelocity (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisMaxVelocity(std::vector<int>const&), just for a single axis *iAxis* and returning a single minimum angle, see there for details and examples.

10.20.4.22 std::vector< double > cSDH::GetAxisMaxVelocity (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get the maximum velocity(s) of axis(axes). These are the (theoretical) maximum velocities as determined by the maximum motor velocity and gear box ratio. The values do not take things like friction or inertia into account. So it is likely that these maximum velocities cannot be reached by the real hardware in reality.

The maximum velocities are currently read once from the SDH when the communication to the SDH is opened. Later queries of this maximum velocities will use the values stored in the library.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the max angular velocities of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angular_velocity unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisMaxVelocity(int) for an overloaded variant to access a single axis.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Get maximum axis angular velocities of all axes
    std::vector<double> v = hand.GetAxisMaxVelocity( hand.all_axes );
    // now v is something like {83.857,200.000,157.895,200.000,157.895,200.
000,157.895}

    // Get maximum axis angular velocity of axis 3
    double v3 = hand.GetAxisMaxVelocity( 3 );
    // v3 is now something like 200.0

    // Get maximum axis angular velocity of axis 2 and 4
    std::vector<int> axes24;
    axes24.push_back( 2 );
    axes24.push_back( 4 );

    v = hand.GetAxisMaxVelocity( axes24 );
    // now v is something like {157.895, 157.895}


    // Or if you change the angular velocity unit system:
    hand.UseRadians();

    v = hand.GetAxisMaxVelocity( hand.all_axes );
    // now v is something like {1.46358075084, 3.49065850399, 2.75578762244
, 3.49065850399, 2.75578762244, 3.49065850399, 2.75578762244}
```

10.20.4.23 std::vector< double > cSDH::GetAxisMinAngle (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get the minimum angle(s) of axis(axes).

The minimum angles are currently not read from the SDH, but are stored in the library.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the min angles of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angle unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisMinAngle(int) for an overloaded variant to access a single axis.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Get minimum axis angles of all axes
    std::vector<double> v = hand.GetAxisMinAngle( hand.all_axes );
    // now v is something like {0.0, -90.0, -90.0, -90.0, -90.0, -90.0, -90
.0}

    // Get minimum axis angle of axis 3
    double v3 = hand.GetAxisMinAngle( 3 );
    // v3 is now something like -90.0

    // Get minimum axis angle of axis 2 and 4
    std::vector<int> axes24;
    axes24.push_back( 2 );
    axes24.push_back( 4 );

    v = hand.GetAxisMinAngle( axes24 );
    // now v is something like {-90.0, -90.0}


    // Or if you change the angle unit system:
    hand.UseRadians();

    v = hand.GetAxisMinAngle( hand.all_axes );
    // now v is something like {0.0, -1.5707963267948966, -1.57079632679489
66, -1.5707963267948966, -1.5707963267948966, -1.5707963267948966, -1.57079632679
48966}
```

10.20.4.24 double cSDH::GetAxisMinAngle (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisMinAngle(std::vector<int>const&), just for a single axis *iAxis* and returning a single minimum angle, see there for details and examples.

10.20.4.25 std::vector< double > cSDH::GetAxisMotorCurrent (std::vector< int > const & *axes*, eMotorCurrentMode *mode* = eMCM_MOVE) throw (cSDHLibraryException*)

Get the maximum allowed motor current(s) of axis(axes).

The maximum allowed motor currents are read from the SDH. The motor currents are stored:

- axis specific
- mode specific (see eMotorCurrentMode)

Parameters

axes	- A vector of axis indices to access.
mode	- the mode to set the maximum motor current for. One of the eMotorCurrentMode modes.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the motor currents of the selected axes.
- The values are converted to the selected external unit system using the configured uc_motor_current unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisMotorCurrent(int,eMotorCurrentMode) for an overloaded variant to access a single axis.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get maximum allowed motor currents of all axes
std::vector<double> v = hand.GetAxisMotorCurrent( hand.all_axes );
// now v is something like {0.1, 0.2, 0.3, 0.4, 0.5, 0,6, 0.7}

// Get maximum allowed motor current of axis 3 in mode "eMCM_MOVE"
double mc3 = hand.GetAxisMotorCurrent( 3, eMCM_MOVE );
// mc3 is now something like 0.75

// Get maximum allowed motor current of axis 3 and 5 in mode "eMCM_GRIP
"
std::vector<int> axes35;
axes35.push_back( 3 );
axes35.push_back( 5 );

v = hand.GetAxisMotorCurrent( axes35, eMCM_GRIP );
// now v is something like {0.5,0.5};
```

10.20.4.26 double cSDH::GetAxisMotorCurrent (int *iAxis*, eMotorCurrentMode *mode* = eMCM_MOVE) throw (cSDHLibraryException*)

Like GetAxisMotorCurrent(std::vector<int>const&,eMotorCurrentMode), just for a single axis, see there for details and examples.

10.20.4.27 std::vector< double > cSDH::GetAxisReferenceVelocity (std::vector< int >const & *axes*) throw (cSDHLibraryException*)

Get the current reference velocity(s) of axis(axes). (This velocity is used internally by the SDH in eCT_VELOCITY_ACCELERATION mode).

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the reference velocities of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angular_velocity unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisReferenceVelocity(int) for an overloaded variant to access a single axis.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Switch to "velocity control with acceleration ramp" controller mode
first.
    // (When in another controller mode like the default eCT_POSE,
    //  then the reference velocities will not be valid):
    hand.SetController( eCT_VELOCITY_ACCELERATION );

    // Get reference axis velocity of all axes
    std::vector<double> v = hand.GetAxisReferenceVelocity( hand.all_axes );

    // now v is something like {0.1, 0.2, 0.3, 13.2, 0.5, 0.0, 0.7}

    // Get reference axis velocity of axis 2 and 4
    std::vector<int> axes24;
    axes24.push_back( 2 );
    axes24.push_back( 4 );
    v = hand.GetAxisReferenceVelocity( axes24 );
    // now v is something like {13.2, 0.0}
```

```
// Get reference axis velocity of axis 2
double v3 = hand.GetAxisReferenceVelocity( 2 );
// v3 is now something like 13.2
```

Remarks

- the underlying rvel command of the SDH firmware is not available in firmwares prior to 0.0.2.6. For such hands calling rvel will fail miserably.
- The availability of an appropriate SDH firmware is **not** checked here due to performance losses when this function is used often.

10.20.4.28 double cSDH::GetAxisReferenceVelocity (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisReferenceVelocity(std::vector<int>const&), just for a single axis *iAxis* and returning a single velocity, see there for details and examples.

10.20.4.29 std::vector< double > cSDH::GetAxisTargetAcceleration (std::vector< int >const & *axes*) throw (cSDHLibraryException*)

Get the target acceleration(s) of axis(axes).

The currently set target accelerations are read from the SDH.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the target accelerations of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angular_acceleration unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisTargetAcceleration(int) for an overloaded variant to access a single axis.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get target axis acceleration of all axes
std::vector<double> v = hand.GetAxisTargetAcceleration( hand.all_axes )
```

```
;
    // now v is something like {100.0, 100.0, 100.0, 100.0, 100.0, 100.0, 1
00.0}

    // Get target axis acceleration of axis 2
    double v2 = hand.GetAxisTargetAcceleration( 2 );
    // v2 is now something like 100.0


    // Get target axis acceleration of axis 2 and 4
    std::vector<int> axes24;
    axes24.push_back( 2 );
    axes24.push_back( 4 );

    v = hand.GetAxisTargetAcceleration( axes24 );
    // now v is something like {100.0, 100.0}
```

10.20.4.30 double cSDH::GetAxisTargetAcceleration (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisTargetAcceleration(std::vector<int>const&), just for a single axis *iAxis* and returning a single acceleration, see there for details and examples.

10.20.4.31 double cSDH::GetAxisTargetAngle (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisTargetAngle(std::vector<int>const&), just for a single axis *iAxis* and returning a single angle, see there for details and examples.

10.20.4.32 std::vector< double > cSDH::GetAxisTargetAngle (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get the target angle(s) of axis(axes).

The currently set target angles are read from the SDH.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the target angles of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angle unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisTargetAngle(int) for an overloaded variant to access a single axis.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get target axis angle of all axes
std::vector<double> v = hand.GetAxisTargetAngle( hand.all_axes );
// now v is something like {0.0, 0.0, 42.0, 0.0, 47.11, 0,0, 0.0}

// Get target axis angle of axis 2
double v2 = hand.GetAxisTargetAngle( 2 );
// v2 is now something like 42.0


// Get target axis angle of axis 2 and 4
std::vector<int> axes24;
axes24.push_back( 2 );
axes24.push_back( 4 );

v = hand.GetAxisTargetAngle( axes24 );
// now v is something like {42.0, 47.11}
```

10.20.4.33 std::vector< double > cSDH::GetAxisTargetVelocity (std::vector< int > const & *axes*) throw (cSDHLibraryException*)

Get the target velocity(s) of axis(axes).

The currently set target velocities are read from the SDH.

Parameters

axes	- A vector of axis indices to access.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the target velocities of the selected axes.
- The values are converted to the selected external unit system using the configured uc_angular_velocity unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisTargetVelocity(int) for an overloaded variant to access a single axis.

Examples:

```
// Assuming "hand" is a cSDH object ...
```

```
// Get target axis velocity of all axes
std::vector<double> v = hand.GetAxisTargetVelocity( hand.all_axes );
// now v is something like {0.0, 0.0, 42.0, 0.0, 47.11, 0,0, 0.0}

// Get target axis velocity of axis 2
double v2 = hand.GetAxisTargetVelocity( 2 );
// v2 is now something like 42.0


// Get target axis velocity of axis 2 and 4
std::vector<int> axes24;
axes24.push_back( 2 );
axes24.push_back( 4 );

v = hand.GetAxisTargetVelocity( axes24 );
// now v is something like {42.0, 47.11}
```

10.20.4.34 double cSDH::GetAxisTargetVelocity (int *iAxis*) throw (cSDHLibraryException*)

Like GetAxisTargetVelocity(std::vector<int>const&), just for a single axis *iAxis* and returning a single velocity, see there for details and examples.

10.20.4.35 std::vector< double > cSDH::GetAxisValueVector (std::vector< int > const & *axes*, pGetFunction *ll_get*, cUnitConverter const * *uc*, char const * *name*) throw (cSDHLibraryException*) [protected]

Generic get function: get some given axes values

Parameters

axes	- a vector of axis indices
ll_get	- a pointer to the low level get function to use
uc	- a pointer to the unit converter object to apply before returning values
name	- a string with the name of the values (for constructing error message)

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the addressed values for the selected axes.
- The values are converted to external unit system using the *uc* unit converter object.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

10.20.4.36 cSDHBase::eControllerType cSDH::GetController (void) throw (cSDHLibraryException*)

Get the type of axis controller used in the SDH

The currently set controller type will be queried and returned (One of eControllerType)

Examples:

```
// Assuming 'hand' is a sdh.cSDH object ...

// Get the controller type of the attached SDH:
ct = hand.GetController();

// Print result, numerically and symbolically
std::cout << "Currently the axis controller type is set to " << ct;
std::cout << "(" << GetStringFromControllerType(ct) << ")\n";
```

10.20.4.37 std::vector< double > cSDH::GetFingerActualAngle (int *iFinger*) throw (cSDHLibraryException*)

Get the current actual axis angles of a single finger.

The current actual axis angles of finger *iFinger* are read from the SDH.

Parameters

iFinger	- index of finger to access. This must be a single index.

Remarks

- The *iFinger* index is checked if it is a valid finger index.
- If *iFinger* is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A list of the current actual axis angles of the selected finger
- The values are returned in the configured angle unit system uc_angle.

See also GetFingerActualAngle(int,double&,double&,double&) for an overloaded variant to get finger axis actual angles into single `double` values.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get actual axis angles of finger 0
std::vector<double> v = hand.GetFingerActualAngle( 0 );
// v is now something like {42.0, -10.0, 47.11}

// Get actual axis angles of finger 1
double a0, a1, a2;
hand.GetFingerTargetAngle( 1, a0, a1, a2 );
// now a0, a1, a2 are something like 0.0, 24.7 and -5.5 respectively.
```

10.20.4.38 void cSDH::GetFingerActualAngle (int *iFinger*, double & *a0*, double & *a1*, double & *a2*) throw (cSDHLibraryException*)

Like GetFingerActualAngle(int), just returning the actual axis angles in the *a0*, *a1* and *a2* parameters which are given by reference.

10.20.4.39 int cSDH::GetFingerAxisIndex (int *iFinger*, int *iFingerAxis*) throw (cSDHLibraryException*)

Return axis index of *iFingerAxis* axis of finger with index iFinger

For *iFinger=2*, iFingerAxis=0 this will return the index of the virtual base axis of the finger

Parameters

iFinger	- index of finger in range [0..NUMBER_OF_FINGERS-1]
iFingerAxis	- index of finger axis in range [0..NUMBER_OF_AXES_PER_FINGER-1]

Returns

- Axis index of *iFingerAxis-th* axis of finger with index *iFinger*
- If *iFinger* or *iFingerAxis* is invalid a (cSDHErrorInvalidParameter*) exception is thrown.

Examples:

```
// Assuming 'hand' is a cSDH object ...

cout << "The 1st axis of finger 2 has real axis index " << hand.GetFinge
rNumberOfAxes( 2, 0 ) << "\n";
```

10.20.4.40 std::vector< double > cSDH::GetFingerEnable (std::vector< int > const & *fingers*) throw (cSDHLibraryException*)

Get enabled/disabled state of axis controllers of finger(s).

The enabled/disabled state of the controllers of the selected fingers is read from the SDH. A finger is reported disabled if any of its axes is disabled and reported enabled if all its axes are enabled.

Parameters

fingers	- A vector of finger indices to access.

- The indices in *fingers* are checked if they are valid finger indices.
- If **any** finger index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of enabled/disabled states as doubles (0=disabled, 1.0=enabled) of the selected axes.
- The order of the elements of the *axes* vector and the returned values vector *rv* matches. I.e. `rv`[i] will be the value of axis `axes`[i] (not axis `i`).

See also GetAxisEnable(int) for an overloaded variant to access a single axis.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get enabled state of all fingers:
std::vector<double> v = hand.GetFingerEnable( hand.all_fingers );
// now v is something like {0.0, 1.0, 0.0}

// Get enabled state of finger 0 and 2
std::vector<int> fingers02;
fingers02.push_back( 0 );
fingers02.push_back( 2 );

v = hand.GetFingerEnable( fingers02 );
// now v is something like {0.0, 0.0}

// Get enabled state of finger 1
double v1 = hand.GetFingerEnable( 1 );
// now v1 is something like 1.0
```

10.20.4.41 double cSDH::GetFingerEnable (int *iFinger*) throw (cSDHLibraryException*)

Like GetFingerEnable(std::vector<int>const&), just for a single finger *iFinger* and returning a single double value

10.20.4.42 std::vector< double > cSDH::GetFingerMaxAngle (int *iFinger*) throw (cSDHLibraryException*)

Get the maximum axis angles of a single finger.

The maximum axis angles of finger *iFingers* axes, stored in the library, are returned.

Parameters

iFinger	- index of finger to access. This must be a single index

Remarks

- The *iFinger* index is checked if it is a valid finger index.
- If *iFinger* is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A list of the selected fingers maximum axis angles
- The values are returned in the configured angle unit system uc_angle.

See also GetFingerMaxAngle(int,double&,double&,double&) for an overloaded variant to get finger axis max angles into single `double` values.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get maximum axis angles of finger 0
std::vector<double> v = hand.GetFingerMaxAngle( 0 );
// now v is something like {90.0, 90.0, 90.0}


// Get target axis angles of finger 1
double a0, a1, a2;
hand.GetFingerMaxAngle( 1, a0, a1, a2 );
// now a0, a1, a2 are something like 90.0, 90.0, 90.0 respectively.


// Or if you change the angle unit system:
hand.UseRadians();
v = hand.GetFingerMaxAngle( 0 );
// now v is something like {1.5707963267948966, 1.5707963267948966, 1.5
707963267948966}
```

10.20.4.43 void cSDH::GetFingerMaxAngle (int *iFinger*, double & *a0*, double & *a1*, double & *a2*) throw (cSDHLibraryException*)

Like GetFingerMaxAngle(int), just returning the finger axis max angles in the *a0*, *a1* and *a2* parameters which are given by reference.

10.20.4.44 void cSDH::GetFingerMinAngle (int *iFinger*, double & *a0*, double & *a1*, double & *a2*) throw (cSDHLibraryException*)

Like GetFingerMinAngle(int), just returning the finger axis min angles in the *a0*, *a1* and *a2* parameters which are given by reference.

10.20.4.45 std::vector< double > cSDH::GetFingerMinAngle (int *iFinger*) throw (cSDHLibraryException*)

Get the minimum axis angles of a single finger.

The minimum axis angles of finger *iFingers* axes, stored in the library, are returned.

Parameters

iFinger	- index of finger to access. This must be a single index

Remarks

- The *iFinger* index is checked if it is a valid finger index.
- If *iFinger* is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A list of the selected fingers minimum axis angles
- The values are returned in the configured angle unit system uc_angle.

See also GetFingerMinAngle(int,double&,double&,double&) for an overloaded variant to get finger axis min angles into single `double` values.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get minimum axis angles of finger 0
std::vector<double> v = hand.GetFingerMinAngle( 0 );
// now v is something like {0.0, -90.0, -90.0}


// Get target axis angles of finger 1
double a0, a1, a2;
hand.GetFingerMinAngle( 1, a0, a1, a2 );
// now a0, a1, a2 are something like 0.0, -90.0, -90.0 respectively.


// Or if you change the angle unit system:
hand.UseRadians();
v = hand.GetFingerMinAngle( 0 );
// now v is something like {0.0, -1.5707963267948966, -1.57079632679489
66}
```

10.20.4.46 int cSDH::GetFingerNumberOfAxes (int *iFinger*) throw (cSDHLibraryException*)

Return the number of real axes of finger with index *iFinger*.

Parameters

iFinger	- index of finger in range [0..NUMBER_OF_FINGERS-1]

Returns

- Number of real axes of finger with index *iFinger*
- If *iFinger* is invalid a (cSDHErrorInvalidParameter*) exception is thrown.

Examples:

```
// Assuming 'hand' is a cSDH object ...

cout << "The finger 0 has " << hand.GetFingerNumberOfAxes( 0 ) << " real
```

```
axes\n";
```

10.20.4.47 std::vector< double > cSDH::GetFingerTargetAngle (int *iFinger*) throw (cSDHLibraryException*)

Get the target axis angles of a single finger.

The target axis angles of finger *iFinger* are read from the SDH.

Parameters

iFinger	- index of finger to access. This must be a single index

Remarks

- The *iFinger* index is checked if it is a valid finger index.
- If *iFinger* is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A list of the selected fingers target axis angles
- The values are returned in the configured angle unit system uc_angle.

See also GetFingerTargetAngle(int,double&,double&,double&) for an overloaded variant to get finger axis target angles into single `double` values.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get target axis angles of finger 0
std::vector<double> v = hand.GetFingerTargetAngle( 0 );
// now v is something like {42.0, -10.0, 47.11}

// Get target axis angles of finger 1
double a0, a1, a2;
hand.GetFingerTargetAngle( 1, a0, a1, a2 );
// now a0, a1, a2 are something like 0.0, 24.7 and -5.5 respectively.
```

10.20.4.48 void cSDH::GetFingerTargetAngle (int *iFinger*, double & *a0*, double & *a1*, double & *a2*) throw (cSDHLibraryException*)

Like GetFingerTargetAngle(int), just returning the target axis angles in the *a0*, *a1* and *a2* parameters which are given by reference.

10.20.4.49 std::vector< double > cSDH::GetFingerXYZ (int *iFinger*, double *a0*, double *a1*, double *a2*) throw (cSDHLibraryException*)

Like SetFingerTargetAngle(int,std::vector<double>const&), just with individual finger axis angles *a0*, *a1* and *a2*.

10.20.4.50 std::vector< double > cSDH::GetFingerXYZ (int *iFinger*, std::vector< double > const & *angles*) throw (cSDHLibraryException*)

Get the cartesian xyz finger tip position of a single finger from the given axis angles (forward kinematics).

Parameters

iFinger	- index of finger to access. This must be a single index
angles	- a vector of NUMBER_OF_AXES_PER_FINGER angles. The values are expected in the configured angle unit system uc_angle.

Remarks

- The *iFinger* index is checked if it is a valid finger index.
- The angles are checked if they are in the allowed range [0 .. f_max_angle_v], i.e. it is checked that `angles`[i], converted to internal units, is in [0 .. `f_max_angle_v`[finger_axis_index[iFinger][i]]].
- If any index or value is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

- A vector of the x,y,z values of the finger tip position
- The values are returned in the configured position unit system uc_position.

See also GetFingerXYZ(int,double,double,double) for an overloaded variant to get finger tip position from single `double` values.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Get actual finger angles of finger 0:
    std::vector<double> angles = hand.GetFingerActualAngle( 0 );

    // Get actual finger tip position of finger 0:
    std::vector<double> position = hand.GetFingerXYZ( 0, angles );
    // now position is something like {18.821618775581801, 32.6000000000000
01, 174.0}
    // (assuming that finger 0 is at axis angles {0,0,0})

    // Get finger tip position of finger 2 at axis angles {90,-90,-90}:
    position = hand.GetFingerXYZ( 2, 90, -90, -90 );
    // now position is something like {18.821618775581804, 119.600000000000
02, -53.0}

    // Or if you change the angle unit system:
    hand.UseRadians();
    position = hand.GetFingerXYZ( 0, 1.5707963267948966, -1.570796326794896
6, -1.5707963267948966 );
    // now position is still something like {18.821618775581804, 119.600000
00000002, -53.0}

    // Or if you change the position unit system too:
```

```
    hand.uc_position = &cSDH::uc_position_meter
    position = hand.GetFingerXYZ( 0, 1.5707963267948966, -1.570796326794896
6, -1.5707963267948966 );
    // now position is still something like {0.018821618775581, 0.119.60000
000000002, -0.052999999999}
```

10.20.4.51 char const * cSDH::GetFirmwareRelease (void) throw (cSDHLibraryException*)

Return the actual release name of the firmware of the SDH (not the library) as string.

This will throw a (cSDHErrorCommunication*) exception if the connection to the SDH is not yet opened.

Examples:

```
  // Assuming 'hand' is a cSDH object ...

  cout << "The SDH firmware reports release " << hand.GetFirmwareRelease()
 << "\n";
```

See also

See GetFirmwareReleaseRecommended() to get the recommended SDH firmware release.

10.20.4.52 char const * cSDH::GetFirmwareReleaseRecommended (void) [static]

Return the recommended release of the firmware of the SDH by this library as string.

Examples:

```
  // static member function, so no cSDH object is needed for access:

  cout << "This SDHLibrary recommends an SDH firmware release " <<
cSDH::GetFirmwareReleaseRecommended() << "\n";
```

See also

See GetFirmwareRelease() to get the actual release of the SDH firmware

10.20.4.53 double cSDH::GetGripMaxVelocity (void)

Get the maximum velocity of grip skills

The maximum velocity is currently not read from the SDH, but is stored in the library.

Returns

- a single double value is returned representing the velocity in the uc_angular_velocity unit system

Examples:

```
// Assuming "hand" is a cSDH object ...

// Get maximum grip skill velocity
double v = hand.GetGripMaxVelocity();
// v is now something like 100.0

// Or if you change the velocity unit system:
hand.UseRadians();
v = hand.GetGripMaxVelocity();
// now v is something like 1.7453292519943295
```

10.20.4.54 char const * cSDH::GetInfo (char const * *what*) throw (cSDHLibraryException*)

Return info according to *what* # # The following values are valid for *what:* # - "date-library" : date of the SDHLibrary-python release # - "release-library" : release name of the sdh.py python module # - "release-firmware" : release name of the SDH firmware (requires # an opened communication to the SDH) # - "release-firmware-recommended" : recommended release name of the SDH # firmware # - "date-firmware" : date of the SDH firmware (requires # an opened communication to the SDH) # - "release-soc" : release name of the SDH SoC (requires # an opened communication to the SDH) # - "date-soc" : date of the SDH SoC (requires # an opened communication to the SDH) # - "id-sdh" : ID of SDH # - "sn-sdh" : Serial number of SDH # #

Examples:

```
#

    #    # Assuming 'hand' is a sdh.cSDH object ...
    #
    #    print "The SDH firmware reports release %s" % ( hand.GetInfo( "release-f
      irmware" ) )
    #
    #

# #
```

10.20.4.55 char const * cSDH::GetLibraryName (void) [static]

Return the name of the library as string.

Examples:

```
// static member function, so no cSDH object is needed for access:

cout << "The SDHLibrary reports name " << cSDH::GetLibraryName() << "\n"
;
```

10.20.4.56 char const * cSDH::GetLibraryRelease (void) [static]

Return the release name of the library (not the firmware of the SDH) as string.

Examples:

```
    // static member function, so no cSDH object is needed for access:

    cout << "The SDHLibrary reports release name " << cSDH::GetReleaseLibrar
y() << "\n";
```

10.20.4.57 pSetFunction cSDH::GetMotorCurrentModeFunction (eMotorCurrentMode *mode*) throw (cSDHLibraryException*) [protected]

Internal helper function: return the get/set function of the comm_interface object that is responsible for setting/getting motor currents in *mode*.

10.20.4.58 std::vector< double > cSDH::GetTemperature (std::vector< int > const & *sensors*) throw (cSDHLibraryException*)

Return temperature(s) measured within the SDH.

Parameters

sensors	- A vector of indices of temperature sensors to access. • index 0 is sensor near motor of axis 0 (root) • index 1 is sensor near motor of axis 1 (proximal finger 1) • index 2 is sensor near motor of axis 2 (distal finger 1) • index 3 is sensor near motor of axis 3 (proximal finger 2) • index 4 is sensor near motor of axis 4 (distal finger 2) • index 5 is sensor near motor of axis 5 (proximal finger 3) • index 6 is sensor near motor of axis 6 (distal finger 3) • index 7 is FPGA temperature (controller chip) • index 8 is PCB temperature (Printed Circuit Board)

Remarks

- The indices in *sensors* are checked if they are valid sensor indices.
- If **any** sensor index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.

To access a single temperature sensor use GetTemperature(int), see there.

Returns

The temperatures of the selected sensors are returned as std::vector<double> in the configured temperature unit system uc_temperature.

Examples:

```
    // Assuming 'hand' is a cSDH object ...

    // Get measured values of all sensors
    std::vector<double> temps = hand.GetTemperature( hand.all_temperature_s
ensors );
    // Now temps is something like { 38.500,37.250,35.750,37.250,33.500,36.
500,32.250,59.625,52.500 }

    // Get controller temperature only:
    double temp_controller = hand.GetTemperature( 0 );
    // Now temp_controller is something like 40.5

    // If we - for some obscure islandish reason - would want
    // temperatures reported in degrees fahrenheit, the unit
    // converter can be changed:
    hand.uc_temperature = &cSDH::uc_temperature_fahrenheit;

    // Get all temperaturs again:
    temps = hand.GetTemperature( hand.all_temperature_sensors );
    // Now temps is something like {100.0, 96.8, 92.3, 97.7, 91.8, 96.8, 90
.1,  137.5,  125.2}
```

10.20.4.59 double cSDH::GetTemperature (int *iSensor*) throw (cSDHLibraryException*)

Like GetTemperature(std::vector<int>const&), just for one sensor *iSensor* and returning a single temperature as double.

10.20.4.60 cSDHBase::eVelocityProfile cSDH::GetVelocityProfile (void) throw (cSDHLibraryException*)

Get the type of velocity profile used in the SDH

Returns

the currently set velocity profile as integer, see eVelocityProfileType

Examples:

```
// Assuming 'hand' is a cSDH object ...

// Get the velocity profile from the SDH:
velocity_profile = hand.GetVelocityProfile();
// now velocity_profile is something like eVP_SIN_SQUARE or eVP_RAMP
```

10.20.4.61 double cSDH::GripHand (eGraspId *grip*, double *close*, double *velocity*, bool *sequ* = `true`) throw (cSDHLibraryException*)

Perform one of the internal eGraspId "grips" or "grasps"

Warning

THIS DOES NOT WORK WITH SDH FIRMWARE PRIOR TO 0.0.2.6 AND SDHLIBRARY-CPP PRIOR to 0.0.1.12 This was a feature in the ancient times of the SDH1 and now does work again for SDH firmware 0.0.2.6 and newer and SDHLIBRARY-CPP 0.0.1.12 and newer. We intend to further improve this feature (e.g. store user defined grips within the SDH) in the future, but a particular deadline a has not been determined yet.

Bug

With SDH firmware > 0.0.2.6 and SDHLibrary < 0.0.1.12 GripHand() does not work (Bug 575)
=> Resolved in SDHLibrary 0.0.1.12

Bug

With SDH firmware < 0.0.2.6 GripHand() does not work and might yield undefined behaviour there
=> Resolved in SDH firmware 0.0.2.6

Bug

Currently the performing of a skill or grip with GripHand() can **NOT** be interrupted!!! Even if the command is sent with *sequ=false* it **cannot** be stoped or emergency stopped.

Parameters

grip	- The index of the grip to perform [0..eGID_DIMENSION-1] (s.a. eGraspId)
close	- close-ratio: [0.0 .. 1.0] where 0.0 is 'fully opened' and 1.0 is 'fully closed'
velocity	- maximum allowed angular axis velocity in the chosen external unit system uc_angular_velocity
sequ	- flag: if true (default) then the function executes sequentially and returns not until after the SDH has finished the movement. If false then the function returns immediately after the movement command has been sent to the SDH.

- The *close* and *velocity* values are checked if they are in their allowed range.
- If **any** value is invalid then **no** grip is perfomed, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

The expected/elapsed execution time for the movement in the configured time unit system uc_time.

Remarks

- Currently the actual movement velocity of an axis is determined by the SDH firmware to make the movements of all involved axes start and end syn-

chronously at the same time. Therefore the axis that needs the longest time for its movement at its given maximum velocity determines the velocities of all the other axes.

- The currently set target axis angles are not changed by this command
- The movement uses the eMotorCurrentMode motor current modes "eMCM_-GRIP" while gripping and then changes the motor current mode to "eMCM_-HOLD". After the movement previously set motor currents set for mode "eMCM_MOVE" are **overwritten!**

Examples:

```
// Assuming 'hand' is a cSDH object ...

// Perform a fully opened centrical grip at 50 degrees per second:
hand.GripHand( hand.eGID_CENTRICAL, 0.0, 50.0, true );

// Now close it 50% with 30 degrees per second:
hand.GripHand( hand.eGID_CENTRICAL, 0.5, 30.0, true );

// Then close it completely with 20 degrees per second:
hand.GripHand( hand.eGID_CENTRICAL, 1.0, 20.0, true );
```

10.20.4.62 bool cSDH::IsOpen (void) throw () [virtual]

Return true if connection to SDH firmware/hardware is open.

Implements SDH::cSDHBase.

10.20.4.63 bool cSDH::IsVirtualAxis (int *iAxis*) throw (cSDHLibraryException*)

Return `true` if index *iAxis* refers to a virtual axis.

10.20.4.64 double cSDH::MoveAxis (std::vector< int >const & *axes*, bool *sequ* = `true`) throw (cSDHLibraryException*)

Move selected axis/axes to the previously set target pose with the previously set velocity profile, (maximum) target velocities and target accelerations

Parameters

axes	- A vector of axis indices to access.
sequ	- flag: if true (default) then the function executes sequentially and returns not until after the SDH has finished the movement. If false then the function returns immediately after the movement command has been sent to the SDH (the currently set target axis angles for other axes will then be **overwritten** with their current actual axis angles).

- The indices in *axes* are checked if they are valid axis indices.

- If any index is invalid then no movement is performed, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

The expected/elapsed execution time for the movement in the configured time unit system uc_time

Remarks

- The axes will be enabled automatically.
- Currently the actual movement velocity of an axis is determined by the SDH firmware to make the movements of all involved axes start and end synchronously at the same time. Therefore the axis that needs the longest time for its movement at its given maximum velocity determines the velocities of all the other axes.
- Other axes than those selected by *axes* will **NOT** move, even if target axis angles for the axes have been set. (Remember: as axis 0 is used by finger 0 and 2 these two fingers cannot be moved completely idependent of each other.)
- If *sequ* is true then the currently set target axis angles for other fingers will be restored upon return of the function.
- If *sequ* is false then the currently set target axis angles for other fingers will be **overwritten** with their current actual axis angles

See also MoveAxis(int,bool) for an overloaded variant to move a single axis.

Examples:

```
// Assuming 'hand' is a cSDH object ...

// create an index vector for adressing axes 0, 4 and 2 (in that order)

std::vector<int> axes042;
axes042.push_back( 0 );
axes042.push_back( 4 );
axes042.push_back( 2 );

// Set a new target pose for axes 0, 4 and 2:
std::vector<double> angles042;
angles042.push_back( 0.0 );
angles042.push_back( -44.4 );
angles042.push_back( -22.2 );

hand.SetFingerTargetAngle( axes042, angles042 );


// First move Axis 0 only to its new target position:
hand.MoveAxis( 0 );

// The axis 0 has now reached its target position 0.0 degrees.  The
// target poses for axes 4 and 2 are still set since the
// last MoveAxes() call was sequentially (und thus it could
// restore the previously set target axis angles of not
```

```
// selected axes after the movement finished)


// So move axes 4 and 2 now, this time non-sequentially:
std::vector<int> axes42;
axes42.push_back( 4 );
axes42.push_back( 2 );

double t = hand.MoveAxes( axis42, false );

// The two axes 4 and 2 are now moving to their target position.
// We have to wait until the non-sequential call has finished:
SleepSec( t );

// The axes 4 and 2 have now moved to -44.4 and -22.2.

// The target angles for other axes have by now been
// overwritten since the last MoveAxis() call was
// non-sequentially (und thus it could \b NOT restore the
// previously set target axis angles of not selected axes
// after the movement finished)


// Set new target angles for all axes ("home pose");
hand.SetAxisTargetAngle( hand.All, 0.0 );

// Now move all axes back to home pose:
hand.MoveAxes( hand.All );
```

Bug

With SDH firmware < 0.0.2.7 calling MoveAxis() while some axes are moving in eCT_POSE controller type will make the joints jerk. This is resolved in SDH firmware 0.0.2.7 for the eCT_POSE controller type with velocity profile eVP_RAMP. For the eCT_POSE controller type with velocity profile eVP_SIN_SQUARE changing target points/ velocities while moving will still make the axes jerk.
=> **Partly resolved in SDH firmware 0.0.2.7**

10.20.4.65 double cSDH::MoveAxis (int *iAxis*, bool *sequ* = `true`) throw (cSDHLibraryException*)

Like MoveAxis(std::vector<int>const&,bool), just for a single axis *iAxis* (or all axes if All is given).

10.20.4.66 double cSDH::MoveFinger (int *iFinger*, bool *sequ* = `true`) throw (cSDHLibraryException*)

Like MoveFinger(std::vector<int>const&,bool), just for a single finger *iFinger* (or all fingers if All is given).

10.20.4.67 double cSDH::MoveFinger (std::vector< int >const & *fingers*, bool *sequ* = `true`) throw (cSDHLibraryException*)

Move selected finger(s) to the previously set target pose with the previously set velocity profile, (maximum) target velocities and target accelerations.

Parameters

fingers	- A vector of finger indices to access.
sequ	- flag: if true (default) then the function executes sequentially and returns not until after the SDH has finished the movement. If false then the function returns immediately after the movement command has been sent to the SDH (the currently set target axis angles for other fingers will then be **overwritten** with their current actual axis angles).

- The indices in *fingers* are checked if they are valid finger indices.
- If any index is invalid then no movement is performed, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

Returns

The expected/elapsed execution time for the movement in the configured time unit system uc_time

Remarks

- The axes will be enabled automatically.
- Currently the actual movement velocity of an axis is determined by the SDH firmware to make the movements of all involved axes start and end synchronously at the same time. Therefore the axis that needs the longest time for its movement at its given maximum velocity determines the velocities of all the other axes.
- Other fingers than *iFinger* will **NOT** move, even if target axis angles for their axes have been set. (Exception: as axis 0 is used by finger 0 and 2 these two fingers cannot be moved completely idependent of each other.)
- If *sequ* is true then the currently set target axis angles for other fingers will be restored upon return of the function.
- If *sequ* is false then the currently set target axis angles for other fingers will be **overwritten** with their current actual axis angles

See also MoveFinger(int,bool) for an overloaded variant to move a single finger.

Examples:

```
// Assuming 'hand' is a cSDH object ...

// Set a new target pose for finger 0:
hand.SetFingerTargetAngle( 0, 0.0, 0.0, 0.0 );

// Set a new target pose for finger 1
```

```
    hand.SetFingerTargetAngle( 1, 0.0, -10.0, -10.0 );

    // Set a new target pose for finger 2
    hand.SetFingerTargetAngle( 2, 20.0, -20.0, -20.0 );

    // Move finger 0 only (and finger 2 partly as axis 0 also belongs to fi
nger 2);
    hand.MoveFinger( 0, true );
    // The finger 0 has been moved to {20,0,0}
    // (axis 0 is 'wrong' since the target angle for axis 0 has been overwr
itten
    //  while setting the target angles for finger 2);

    // The target poses for finger 1 and 2 are still set since the
    // last MoveFinger() call was sequentially.
    // So move finger 1 now:
    double t = hand.MoveFinger( 1, false );

    // wait until the non-sequential call has finished:
    SleepSec( t );

    // The finger 1 has been moved to {0,-10,-10}.

    // The target angles for finger 2 have been overwritten since the
    // last MoveFinger() call was non-sequentially.

    // Therefore this next call will just keep the fingers in their
    // current positions:
    hand.MoveFinger( hand.All, true );


    // Set new target angles for all axes ("home pose");
    hand.SetAxisTargetAngle( hand.All, 0.0 );

    // Now move all axes back to home pose:
    hand.MoveHand();
```

Bug

With SDH firmware $<$ 0.0.2.7 calling MoveFinger() while some axes are moving in eCT_POSE controller type will make the joints jerk. This is resolved in SDH firmware 0.0.2.7 for the eCT_POSE controller type with velocity profile eVP_RAMP. For the eCT_POSE controller type with velocity profile eVP_SIN_SQUARE changing target points/ velocities while moving will still make the axes jerk.
=> Partly resolved in SDH firmware 0.0.2.7

10.20.4.68 double cSDH::MoveHand (bool *sequ* = `true`) throw (cSDHLibraryException*)

Move all fingers to the previously set target pose with the previously set (maximum) velocities.

This is just a shortcut to MoveFinger(int,bool) with *iFinger* set to `hand.All` and *sequ* as indicated, so see there for details and examples.

Bug

With SDH firmware < 0.0.2.7 calling MoveHand() while some axes are moving in eCT_POSE controller type will make the joints jerk. This is resolved in SDH firmware 0.0.2.7 for the eCT_POSE controller type with velocity profile eVP_RAMP. For the eCT_POSE controller type with velocity profile eVP_SIN_-SQUARE changing target points/ velocities while moving will still make the axes jerk.
=> Parltly resolved in SDH firmware 0.0.2.7

10.20.4.69 void cSDH::OpenCAN_ESD (int *_net* = 0, unsigned long *_baudrate* = 1000000, double *_timeout* = 0.0, Int32 *_id_read* = 43, Int32 *_id_write* = 42) throw (cSDHLibraryException*)

Open connection to SDH via CAN using an ESD CAN card. If the library was compiled without ESD CAN support then this will just throw an exception. See setting for WITH_ESD_CAN in the top level makefile.

Parameters

_net	: The ESD CAN net number of the CAN port to use. (default: 0)
_baudrate	: the CAN baudrate in bit/s. Only some bitrates are valid: (1000000 (default),800000,500000,250000,125000,100000,50000,20000,10000)
_timeout	: The timeout to use: • <= 0 : wait forever (default) • T : wait for T seconds
_id_read	- the CAN ID to use for reading (The SDH sends data on this ID, default=43=0x02b)
_id_write	- the CAN ID to use for writing (The SDH receives data on this ID, default=42=0x02a)

Examples:

```
// Assuming 'hand' is a cSDH object ...

// use default parameters for net, baudrate, timeout and IDs
hand.OpenCAN_ESD( );

// use non default settings:
// net=1, baudrate=500000, timeout=1.0, id_read=0x143, id_write=0x142
hand.OpenCAN_ESD( 1, 500000, 1.0, 0x143, 0x142 );
```

10.20.4.70 void cSDH::OpenCAN_ESD (tDeviceHandle *_ntcan_handle*, double *_timeout* = 0.0, Int32 *_id_read* = 43, Int32 *_id_write* = 42) throw (cSDHLibraryException*)

Open connection to SDH via CAN using an ESD CAN card using an existing handle. If the library was compiled without ESD CAN support then this will just throw an exception. See setting for WITH_ESD_CAN in the top level makefile.

Parameters

_ntcan_handle	: the ESD CAN handle to reuse (please cast your NTCAN_HANDLE to tDeviceHandle! It is save to do that!)
_timeout	: The timeout to use: • <= 0 : wait forever (default) • T : wait for T seconds
_id_read	- the CAN ID to use for reading (The SDH sends data on this ID, default=43=0x2a)
_id_write	- the CAN ID to use for writing (The SDH receives data on this ID, default=42=0x2a)

Examples:

```
// Assuming 'hand' is a cSDH object ...
// and 'handle' is a valid NTCAN_HANDLE for the ESD device

// use default parameters for timeout and IDs
hand.OpenCAN_ESD( tDeviceHandle(handle) );

// or use non default settings:
// timeout=1.0, id_read=0x143, id_write=0x142
hand.OpenCAN_ESD( handle, 1.0, 0x143, 0x142 );
```

10.20.4.71 void cSDH::OpenCAN_PEAK (unsigned long *_baudrate* = 1000000, double *_timeout* = 0.0, Int32 *_id_read* = 43, Int32 *_id_write* = 42, const char * *_device* = "/dev/pcanusb0") throw (cSDHLibraryException*)

Open connection to SDH via CAN using an PEAK CAN card. If the library was compiled without PEAK CAN support then this will just throw an exception. See setting for WITH_PEAK_CAN in the top level makefile.

Parameters

_baudrate	: the CAN baudrate in bit/s. Only some bitrates are valid: (1000000 (default),800000,500000,250000,125000,100000,50000,20000,10000)
_timeout	: The timeout to use: • <= 0 : wait forever (default) • T : wait for T seconds
_id_read	- the CAN ID to use for reading (The SDH sends data on this ID, default=43=0x02b)
_id_write	- the CAN ID to use for writing (The SDH receives data on this ID, default=42=0x02a)
_device	- the PEAK device name. Used for the Linux char dev driver only. default="/dev/pcanusb0"

Examples:

```
// Assuming 'hand' is a cSDH object ...
```

```
    // use default parameters for baudrate, timeout, IDs and device
    hand.OpenCAN_PEAK( );

    // use non default settings:
    // baudrate=500000, timeout=1.0, id_read=0x143, id_write=0x142, , const
char *device="/dev/pcanusb1"
    hand.OpenCAN_PEAK( 500000, 1.0, 0x143, 0x142, "/dev/pcanusb1" );
```

10.20.4.72 void cSDH::OpenCAN_PEAK (tDeviceHandle *_handle,* double *_timeout* = 0.0, Int32 *_id_read* = 43, Int32 *_id_write* = 42) throw (cSDHLibraryException*)

Open connection to SDH via CAN using an PEAK CAN card using an existing handle. If the library was compiled without PEAK CAN support then this will just throw an exception. See setting for WITH_PEAK_CAN in the top level makefile.

Parameters

_handle	: The PEAK CAN handle to reuse to connect to the PEAK CAN driver (please cast your PEAK_HANDLE to tDeviceHandle! It is save to do that!)
_timeout	: The timeout to use: • <= 0 : wait forever (default) • T : wait for T seconds
_id_read	- the CAN ID to use for reading (The SDH sends data on this ID, default=43=0x2a)
_id_write	- the CAN ID to use for writing (The SDH receives data on this ID, default=42=0x2a)

Examples:

```
// Assuming 'hand' is a cSDH object ...
// and 'handle' is a valid HANDLE for the PEAK device

// use default parameters for timeout and IDs
hand.OpenCAN_PEAK( tDeviceHandle(handle) );

// or use non default settings:
// timeout=1.0, id_read=0x143, id_write=0x142
hand.OpenCAN_PEAK( handle, 1.0, 0x143, 0x142 );
```

10.20.4.73 void cSDH::OpenRS232 (int *_port* = 0, unsigned long *_baudrate* = 115200, double *_timeout* = -1, char const * *_device_format_string* = "/dev/ttyS%d") throw (cSDHLibraryException*)

Open connection to SDH via RS232.

Parameters

_port	: The number of the serial port to use. The default value port=0 refers to 'COM1' in Windows and to the corresponding '/dev/ttyS0' in Linux.

_baudrate,:	the baudrate in bit/s, the default is 115200 which happens to be the default for the SDH too
_timeout	: The timeout to use: • -1 : wait forever • T : wait for T seconds
device-format_-string	: a format string (C string) for generating the device name, like "/dev/ttyS%d" (default) or "/dev/ttyUSB%d". Must contain a d where the port number should be inserted. This char array is duplicated on construction When compiled with VCC (MS-Visual C++) then this is not used.

Examples:

```
// Assuming 'hand' is a cSDH object ...

// Open connection to SDH via default port:
hand.OpenRS232();

// Use a different port 2 == COM3 == /dev/ttyS2 for a second hand "hand2
":
cSDH hand2();
hand2.OpenRS232( 2 );

// Linux only: Use a different USB to RS232 device on port 3 /dev/ttyUSB
3 for a third hand "hand3":
cSDH hand3();
hand2.OpenRS232( 3, 115200, -1, "/dev/ttyUSB%d" );
```

10.20.4.74 void cSDH::OpenTCP (char const * *_tcp_adr* = "192.168.1.1", int *_tcp_port* = 23, double *_timeout* = 0.0) throw (cSDHLibraryException*)

Open connection to SDH via TCP using TCP/IP address *_tcp_adr* and *_tcp_port*.

Parameters

_tcp_adr	: The tcp host address of the SDH. Either a numeric IP as string or a hostname
_tcp_port	: the tcp port number on the SDH to connect to
_timeout	: The timeout to use: • <= 0 : wait forever (default) • T : wait for T seconds

Examples:

```
// Assuming 'hand' is a cSDH object ...

// IP-address 192.168.1.1, port 23, timeout=0.0
hand.OpenTCP( "192.168.1.1.", 23, 0.0 );
```

10.20.4.75 void cSDH::SetAxisEnable (std::vector< int > const & *axes*, std::vector< bool > const & *states*) throw (cSDHLibraryException*)

Like SetAxisEnable(std::vector<int>const&,std::vector<double>const&), just accepting a vector of `bool` values as states, see there.

10.20.4.76 void cSDH::SetAxisEnable (std::vector< int > const & *axes*, std::vector< double > const & *states*) throw (cSDHLibraryException*)

Set enabled/disabled state of axis controller(s).

The controllers of the selected axes are enabled/disabled in the SDH. Disabled axes are not powered and thus might not remain in their current pose due to gravity, inertia or other external influences. But to prevent overheating the axis controllers should be switched of when not needed.

Parameters

axes	- A vector of axis indices to access.
states	- A vector of enabled states (0 = disabled, !=0 = enabled) to set. If any of the numbers in the vector is `NaN` (Not a Number) then the currently set enabled state will be kept for the corresponding axis.

Remarks

- The lengths of the *axes* and *states* vector must match.
- The indices can be given in any order, but the order of their elements must match, i.e. `state`[i] will be applied to axis `axes`[i] (not axis `i`).
- The indices are checked if they are valid axis indices.
- If **any** index is invalid then **none** of the specified values is sent to the SDH, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

See also SetAxisEnable(int,double), SetAxisEnable(int,bool) for overloaded variants to set a single axis enabled/disabled or to set the same state for all axes. See further SetAxisEnable(std::vector<int>const&,std::vector<bool>const&) for a variant that accepts a `bool` vector for the states to set.

Examples:

```
// Assuming 'hand' is a cSDH object ...

// Enable all axes:
hand.SetAxisEnable( hand.all_axes, hand.ones_v );

// Disable all axes:
hand.SetAxisEnable( All, 0 );

// Enable axis 0 and 2 while disabling axis 4:
std::vector<int> axes042;
axes042.push_back( 0 );
axes042.push_back( 4 );
axes042.push_back( 2 );
```

```
std::vector<double> states042;
states042.push_back( 1.0 );
states042.push_back( 0.0 );
states042.push_back( 1.0 );

hand.SetAxisEnable( axes042, states042 );


// Disable axis 2
hand.SetAxisEnable( 2, false );
```

10.20.4.77 void cSDH::SetAxisEnable (int *iAxis* = `All`, double *state* = `1.0`) throw (cSDHLibraryException*)

Like SetAxisEnable(std::vector<int>const&,std::vector<double>const&), just for a single axis *iAxis* and a single axis state *state*, see there.

If *iAxis* is All then *state* is applied to all axes.

10.20.4.78 void cSDH::SetAxisEnable (int *iAxis* = `All`, bool *state* = `true`) throw (cSDHLibraryException*)

Like SetAxisEnable(std::vector<int>const&,std::vector<double>const&), just for a single axis *iAxis* and a single axis state *state*, see there.

If *iAxis* is All then *state* is applied to all axes.

10.20.4.79 void cSDH::SetAxisMotorCurrent (int *iAxis*, double *motor_current*, eMotorCurrentMode *mode* = `eMCM_MOVE`) throw (cSDHLibraryException*)

Like SetAxisMotorCurrent(std::vector<int>const&,std::vector<double>const&,eMotorCurrentMode), just for a single axis *iAxis* and a single motor current *motor_current*, see there.

If *iAxis* is All then *motor_current* is set for all axes.

10.20.4.80 void cSDH::SetAxisMotorCurrent (std::vector< int > const & *axes*, std::vector< double > const & *motor_currents*, eMotorCurrentMode *mode* = `eMCM_MOVE`) throw (cSDHLibraryException*)

Set the maximum allowed motor current(s) for axes.

The maximum allowed motor currents are sent to the SDH. The motor currents can be stored:

- axis specific
- mode specific (see eMotorCurrentMode)

Parameters

axes	- A vector of axis indices to access.
motor_currents	- A vector of motor currents to set. If any of the numbers in the vector is `NaN` (Not a Number) then the currently set axis motor current will be kept for the corresponding axis. The value(s) are expected in the configured motor current unit system uc_motor_current.
mode	- the mode to set the maximum motor current for. One of the eMotorCurrentMode modes.

Remarks

- The lengths of the *axes* and *motor_currents* vector must match.
- The indices can be given in any order, but the order of their elements must match, i.e. `motor_currents`[i] will be applied to axis `axes`[i] (not axis `i`).
- The indices are checked if they are valid axis indices.
- The motor currents are checked if they are in the allowed range [0 .. f_max_motor_current_v], i.e. it is checked that `motor_currents`[i], converted to internal units, is in [0 .. `f_max_motor_currents_v`[axes[i]]].
- If **any** index or value is invalid then **none** of the specified values is sent to the SDH, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

See also SetAxisMotorCurrent(int,double,eMotorCurrentMode) for an overloaded variant to set a single axis motor current or to set the same motor current for all axes.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Set maximum allowed motor current of all axes to the given values in
 mode "eMCM_MOVE"::
    std::vector<double> all_motor_currents;
    all_motor_currents.push_back( 0.0 );
    all_motor_currents.push_back( 0.1 );
    all_motor_currents.push_back( 0.2 );
    all_motor_currents.push_back( 0.3 );
    all_motor_currents.push_back( 0.4 );
    all_motor_currents.push_back( 0.5 );
    all_motor_currents.push_back( 0.6 );

    hand.SetAxisMotorCurrent( hand.all_axes, all_motor_currents );


    // Set maximum allowed motor current of all axes to 0.1 A in mode "eMCM
_HOLD":
    hand.SetAxisMotorCurrent( hand.All, 1.0, eMCM_HOLD );

    // Set maximum allowed motor current of axis 3 to 0.75 A in mode "eMCM_
MOVE":
    hand.SetAxisMotorCurrent( 3, 0.75, eMCM_MOVE );

    // Set maximum allowed motor current of for axis 0, 4 and 2 to 0.0 A,
    // 0.4 A and 0.2 A respectively in mode "eMCM_GRIP"
    std::vector<int> axes042;
```

```
axes042.push_back( 0 );
axes042.push_back( 4 );
axes042.push_back( 2 );
std::vector<double> motor_currents042;
motor_currents042.push_back( 0.0 );
motor_currents042.push_back( 0.4 );
motor_currents042.push_back( 0.2 );

hand.SetAxisMotorCurrent( axes042, states042, eMCM_GRIP );
```

10.20.4.81 void cSDH::SetAxisTargetAcceleration (int *iAxis*, double *acceleration*) throw (cSDHLibraryException*)

Like SetAxisTargetAcceleration(std::vector<int>const&,std::vector<double>const&), just for a single axis *iAxis* and a single acceleration *acceleration*, see there for details and examples.

10.20.4.82 void cSDH::SetAxisTargetAcceleration (std::vector< int >const & *axes*, std::vector< double >const & *accelerations*) throw (cSDHLibraryException*)

Set the target acceleration(s) for axis(axes).

The target accelerations are stored in the SDH and are used only for:

- the eCT_POSE controller type with eVP_RAMP velocity profile
- the eCT_VELOCITY_ACCELERATION controller type

Setting the target acceleration will not affect an ongoing movement, nor will it start a new movement. To take effect an additional command must be sent:

- in eCT_POSE controller type a move command: MoveAxis() MoveFinger() MoveHand()
- in eCT_VELOCITY_ACCELERATION controller type the velocity must be set: SetAxisTargetVelocity()

Parameters

axes	- A vector of axis indices to access.
accelerations	- A vector of axis target accelerations to set. If any of the numbers in the vector is `NaN` (Not a Number) then the currently set axis target angle will be kept for the corresponding axis. The value(s) are expected in the configured angular acceleration unit system uc_angular_acceleration.

Remarks

- The lengths of the *axes* and *accelerations* vector must match.
- The indices can be given in any order, but the order of their elements must match, i.e. `accelerations`[i] will be applied to axis `axes`[i] (not axis `i`).

- The indices are checked if they are valid axis indices.
- The accelerations are checked if they are in the allowed range [0 .. f_max_velocity_v], i.e. it is checked that `accelerations`[i], converted to internal units, is in [0 .. `f_max_velocity_v`[axes[i]]].
- If **any** index or value is invalid then **none** of the specified values is sent to the SDH, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

See also SetAxisTargetAcceleration(int,double) for an overloaded variant to set a single axis target acceleration or to set the same target acceleration for all axes.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Set target axis acceleration of all axes to the given values:
    std::vector<double> all_accelerations;
    all_accelerations.push_back( 100.0 );
    all_accelerations.push_back( 101.0 );
    all_accelerations.push_back( 102.0 );
    all_accelerations.push_back( 103.0 );
    all_accelerations.push_back( 104.0 );
    all_accelerations.push_back( 105.0 );
    all_accelerations.push_back( 106.0 );

    hand.SetAxisTargetAcceleration( hand.all_axes, all_accelerations );


    // Set target axis acceleration of axis 3 to 420 degrees per square-sec
ond:
    hand.SetAxisTargetAcceleration( 3, 420.0 );

    // Set target acceleration of for axis 0,4 and 2 to 0.0, 444.0 and 222
degrees per square-second respectively:
    std::vector<int> axes042;
    axes042.push_back( 0 );
    axes042.push_back( 4 );
    axes042.push_back( 2 );
    std::vector<double> accelerations042;
    accelerations042.push_back( 100.0 );
    accelerations042.push_back( 104.0 );
    accelerations042.push_back( 102.0 );

    hand.SetAxisTargetAcceleration( axes042, accelerations042 );


    // Set target axis acceleration of all axes to 142.1 degrees per square
-second
    hand.SetAxisTargetAcceleration( hand.All, 142.1 );
```

10.20.4.83 void cSDH::SetAxisTargetAngle (int *iAxis*, double *angle*) throw (cSDHLibraryException*)

Like SetAxisTargetAngle(std::vector<int>const&,std::vector<double>const&), just for a single axis *iAxis* and a single angle *angle*, see there for details and examples.

If *iAxis* is All then *motor_current* is set for all axes.

10.20.4.84 void cSDH::SetAxisTargetAngle (std::vector< int > const & *axes*, std::vector< double > const & *angles*) throw (cSDHLibraryException*)

Set the target angle(s) for axis(axes).

The target angles are stored in the SDH, the movement is not executed until an additional move command is sent.

Parameters

axes	- A vector of axis indices to access.
angles	- A vector of axis target angles to set. If any of the numbers in the vector is `NaN` (Not a Number) then the currently set axis target angle will be kept for the corresponding axis. The value(s) are expected in the configured angle unit system uc_angle.

Remarks

- Setting the target angle will **not** make the axis/axes move.
- The lengths of the *axes* and *angles* vector must match.
- The indices can be given in any order, but the order of their elements must match, i.e. `angles`[i] will be applied to axis `axes`[i] (not axis `i`).
- The indices are checked if they are valid axis indices.
- The angles are checked if they are in the allowed range [f_min_angle_v .. f_max_angle_v], i.e. it is checked that `angles`[i], converted to internal units, is in [f_min_angle_v[axes[i]] .. `f_max_angle_v`[axes[i]]].
- If **any** index or value is invalid then **none** of the specified values is sent to the SDH, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

See also SetAxisTargetAngle(int,double) for an overloaded variant to set a single axis target angle or to set the same target angle for all axes.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Set target axis angle of all axes to the given values:
std::vector<double> all_angles;
all_angles.push_back( 0.0 );
all_angles.push_back( -11.0 );
all_angles.push_back( -22.0 );
all_angles.push_back( -33.0 );
all_angles.push_back( -44.0 );
all_angles.push_back( -55.0 );
all_angles.push_back( -66.0 );

hand.SetAxisTargetAngle( hand.all_axes, all_angles );


// Set target axis angle of axis 3 to -42 degrees:
hand.SetAxisTargetAngle( 3, -42.0 );

// Set target angle of for axis 0, 4 and 2 to 0.0, -44.4 and -2.22 degr
ees respectively:
```

```
std::vector<int> axes042;
axes042.push_back( 0 );
axes042.push_back( 4 );
axes042.push_back( 2 );
std::vector<double> angles042;
angles042.push_back( 0.0 );
angles042.push_back( -44.4 );
angles042.push_back( -2.22 );

hand.SetAxisTargetAngle( axes042, angles042 );


// Set target axis angle of all axes to 0 degrees (home-position)
hand.SetAxisTargetAngle( hand.All, 0.0 );
```

10.20.4.85 std::vector< double > cSDH::SetAxisTargetGetAxisActualAngle (std::vector< int > const & *axes*, std::vector< double > const & *angles*) throw (cSDHLibraryException*)

Set the **target** angle(s) and get the **actual** angle(s) for axis(axes).

Opposed to SetAxisTargetAngle() this will make the fingers move to the set target angles immediately, if the axis controllers are already enabled!

Parameters

axes	- A vector of axis indices to access.
angles	- A vector of axis target angles to set. If any of the numbers in the vector is `NaN` (Not a Number) then the currently set axis target angle will be kept for the corresponding axis. The value(s) are expected in the configured angle unit system uc_angle.

Returns

the actual angle(s) of the selected axes

Remarks

- The lengths of the *axes* and *angles* vector must match.
- The indices can be given in any order, but the order of their elements must match, i.e. `angles`[i] will be applied to axis `axes`[i] (not axis `i`).
- The indices are checked if they are valid axis indices.
- The angles are checked if they are in the allowed range [f_min_angle_v .. f_max_angle_v], i.e. it is checked that `angles`[i], converted to internal units, is in [f_min_angle_v[axis[i]] .. `f_max_angle_v`[axes[i]]].
- If **any** index or value is invalid then **none** of the specified values is sent to the SDH, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

Examples:

```
// Assuming "hand" is a cSDH object ...
```

```
    // Set target axis angles of all axes to the given values and read back
 the actual angle:
    std::vector<double> all_target_angles;
    all_target_angles.push_back( 0.0 );
    all_target_angles.push_back( 11.0 );
    all_target_angles.push_back( 22.0 );
    all_target_angles.push_back( 33.0 );
    all_target_angles.push_back( 44.0 );
    all_target_angles.push_back( 55.0 );
    all_target_angles.push_back( 66.0 );

    std::vector<double> all_acutal_angles;
    all_acutal_angles = hand.SetAxisTargetGetAxisActualAngle( hand.all_axes
, all_target_angles );


    // Set target angle of for axis 0,4 and 2 to 0.0, 44.4 and 2.22 degrees
 per second respectively:
    std::vector<int> axes042;
    axes042.push_back( 0 );
    axes042.push_back( 4 );
    axes042.push_back( 2 );
    std::vector<double> target_angles042;
    target_angles042.push_back( 0.0 );
    target_angles042.push_back( 44.4 );
    target_angles042.push_back( 2.22 );

    std::vector<double> actual_angles042;
    actual_angles042 = hand.SetAxisTargetGetAxisActualAngle( axes042, targe
t_angles042 );
```

10.20.4.86 std::vector< double > cSDH::SetAxisTargetGetAxisActualVelocity (std::vector< int > const & *axes*, std::vector< double > const & *velocities*) throw (cSDHLibraryException*)

Set the **target** velocity(s) and get the **actual** velocitiy(s) for axis(axes).

The target velocities are stored in the SDH. The time at which a new target velocities will take effect depends on the current axis controller type:

- in eCT_POSE controller type the new target velocities will not take effect until an additional move command is sent: MoveAxis(), MoveFinger(), MoveHand()
- in eCT_VELOCITY and eCT_VELOCITY_ACCELERATION controller type the new target velocity will take effect immediately, if the axis controllers are already enabled. This means that in eCT_VELOCITY_ACCELERATION controller type the accelerations must be set with SetAxisTargetAcceleration() **before** calling SetAxisTargetVelocity().

Parameters

axes	- A vector of axis indices to access.
velocities	- A vector of axis target velocities to set. If any of the numbers in the vector is `NaN` (Not a Number) then the currently set axis target velocity will be kept for the corresponding axis. The value(s) are expected in the configured angular velocity unit system uc_angular_velocity.

Returns

the actual velocity(s) of the selected axes

Remarks

- The lengths of the *axes* and *velocities* vector must match.
- The indices can be given in any order, but the order of their elements must match, i.e. `velocities`[i] will be applied to axis `axes`[i] (not axis `i`).
- The indices are checked if they are valid axis indices.
- The velocities are checked if they are in the allowed range:
  - in eCT_POSE controller type: [0 .. f_max_velocity_v], i.e. it is checked that `velocities`[i], converted to internal units, is in [0 .. `f_max_velocity_v`[axes[i]]].
  - in eCT_VELOCITY and eCT_VELOCITY_ACCELERATION controller type: [-f_max_velocity_v .. f_max_velocity_v], i.e. it is checked that `velocities`[i], converted to internal units, is in [-f_max_velocity_v[axes[i]] .. `f_max_velocity_v`[axes[i]]].
- If **any** index or value is invalid then **none** of the specified values is sent to the SDH, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Set target axis velocity of all axes to the given values and read ba
ck the actual velocity:
    std::vector<double> all_target_velocities;
    all_target_velocities.push_back( 0.0 );
    all_target_velocities.push_back( 11.0 );
    all_target_velocities.push_back( 22.0 );
    all_target_velocities.push_back( 33.0 );
    all_target_velocities.push_back( 44.0 );
    all_target_velocities.push_back( 55.0 );
    all_target_velocities.push_back( 66.0 );

    std::vector<double> all_acutal_velocities;
    all_acutal_velocities = hand.SetAxisTargetGetAxisActualVelocity( hand.a
ll_axes, all_target_velocities );


    // Set target velocity of for axis 0,4 and 2 to 0.0, 44.4 and 2.22 degr
ees per second respectively:
    std::vector<int> axes042;
    axes042.push_back( 0 );
    axes042.push_back( 4 );
    axes042.push_back( 2 );
    std::vector<double> target_velocities042;
    target_velocities042.push_back( 0.0 );
    target_velocities042.push_back( 44.4 );
    target_velocities042.push_back( 2.22 );

    std::vector<double> actual_velocities042;
    actual_velocities042 = hand.SetAxisTargetGetAxisActualVelocity( axes042
, target_velocities042 );
```

10.20.4.87 void cSDH::SetAxisTargetVelocity (int *iAxis*, double *velocity*) throw (cSDHLibraryException*)

Like SetAxisTargetVelocity(std::vector<int>const&,std::vector<double>const&), just for a single axis *iAxis* and a single velocity *velocity*, see there for details and examples.

10.20.4.88 void cSDH::SetAxisTargetVelocity (std::vector< int > const & *axes*, std::vector< double > const & *velocities*) throw (cSDHLibraryException*)

Set the target velocity(s) for axis(axes).

The target velocities are stored in the SDH. The time at which a new target velocities will take effect depends on the current axis controller type:

- in eCT_POSE controller type the new target velocities will not take effect until an additional move command is sent: MoveAxis(), MoveFinger(), MoveHand()
- in eCT_VELOCITY and eCT_VELOCITY_ACCELERATION controller type the new target velocity will take effect immediately, if the axis controllers are already enabled. This means that in eCT_VELOCITY_ACCELERATION controller type the accelerations must be set with SetAxisTargetAcceleration() **before** calling SetAxisTargetVelocity().

Parameters

axes	- A vector of axis indices to access.
velocities	- A vector of axis target angles to set. If any of the numbers in the vector is `NaN` (Not a Number) then the currently set axis target velocity will be kept for the corresponding axis. The value(s) are expected in the configured angular velocity unit system uc_angular_velocity.

Remarks

- The lengths of the *axes* and *velocities* vector must match.
- The indices can be given in any order, but the order of their elements must match, i.e. `velocities`[i] will be applied to axis `axes`[i] (not axis `i`).
- The indices are checked if they are valid axis indices.
- The velocities are checked if they are in the allowed range:
  - in eCT_POSE controller type: [0 .. f_max_velocity_v], i.e. it is checked that `velocities`[i], converted to internal units, is in [0 .. `f_max_velocity_v`[axes[i]]].
  - in eCT_VELOCITY and eCT_VELOCITY_ACCELERATION controller type: [-f_max_velocity_v .. f_max_velocity_v], i.e. it is checked that `velocities`[i], converted to internal units, is in [-f_max_velocity_v[axes[i]] .. `f_max_velocity_v`[axes[i]]].
- If **any** index or value is invalid then **none** of the specified values is sent to the SDH, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

See also SetAxisTargetVelocity(int,double) for an overloaded variant to set a single axis target velocity or to set the same target velocity for all axes.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Set target axis velocity of all axes to the given values:
std::vector<double> all_velocities;
all_velocities.push_back( 0.0 );
all_velocities.push_back( 11.0 );
all_velocities.push_back( 22.0 );
all_velocities.push_back( 33.0 );
all_velocities.push_back( 44.0 );
all_velocities.push_back( 55.0 );
all_velocities.push_back( 66.0 );

hand.SetAxisTargetVelocity( hand.all_axes, all_velocities );


// Set target axis velocity of axis 3 to 42 degrees per second:
hand.SetAxisTargetVelocity( 3, 42.0 );

// Set target velocity of for axis 0,4 and 2 to 0.0, 44.4 and 2.22 degr
ees per second respectively:
std::vector<int> axes042;
axes042.push_back( 0 );
axes042.push_back( 4 );
axes042.push_back( 2 );
std::vector<double> velocities042;
velocities042.push_back( 0.0 );
velocities042.push_back( 44.4 );
velocities042.push_back( 2.22 );

hand.SetAxisTargetVelocity( axes042, velocities042 );


// Set target axis velocity of all axes to 47.11 degrees per second
hand.SetAxisTargetVelocity( hand.All, 47.11 );
```

10.20.4.89 std::vector< double > cSDH::SetAxisValueVector (std::vector< int > const & *axes*, std::vector< double > const & *values*, pSetFunction *ll_set*, pGetFunction *ll_get*, cUnitConverter const * *uc*, std::vector< double > const & *min_values*, std::vector< double > const & *max_values*, char const * *name*) throw (cSDHLibraryException*) [protected]

Generic set function: set some given axes to given values

Parameters

axes	- a vector of axis indices
values	- a vector of values
ll_set	- a pointer to the low level set function to use
ll_get	- a pointer to the low level get function to use (for those axes where the given value is NaN)
uc	- a pointer to the unit converter object to use before sending values to *ll_set*

min_values	- a vector with the minimum allowed values in internal units
max_values	- a vector with the maximum allowed values in internal units
name	- a string with the name of the values (for constructing error message)

Returns

the values returned from the SDH will be returned (for most commands ll_set/ll_-get functions this will be the *values*, except for the cSDHSerial::tvav and cSDHSe-rial::tpap functions)

Remarks

- The length of the *axis* and *values* vector must match.
- The indices can be given in any order, but the order of the elements of *axes* and *values* must match too. I.e. `values`[i] will be applied to axis `axes`[i] (not axis `i`)
- The indices are checked if they are valid axis indices.
- The values are checked if they are in the allowed range [*min_values* .. *f_-max_values*], i.e. it is checked that `value`[i], converted to the internal unit system by *uc->ToInternal()*, is in [*min_values*[axes[i]] .. *max_values*[axes[i]]].
- If **any** index or value is invalid then **none** of the specified values is sent to the SDH, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

Bug

Setting a single axis velocity only sets the velocities of all other axes to 0! So in order to address only some axes you must provide the desired velocity for all axes that you want to move in every call:

Bug

With SDH firmware 0.0.2.16 and SDHLibrary-CPP 0.0.2.3 and binary communication (see also SDH_USE_BINARY_COMMUNICATION) setting of single (more precisely: less-than-all) axis parameters (position, velocity, acceleration) does not work as expected: If a single parameter is to be set for a single axis then that parameter is set to 0 for all other axes.
Workaround: If you want to access several different axes one after another then you have to keep a vector of the parameter for all your used axes in your application. You can then update single values of the vector on demand, but you have to send the complete vector to the SDHlibrary functions on every call.

10.20.4.90 void cSDH::SetController (cSDHBase::eControllerType *controller*) throw (cSDHLibraryException*)

Set the type of axis controller to be used in the SDH

With SDH firmware >= 0.0.2.7 this will automatically set valid default values for all target velocities, accelerations and positions in the SDH firmware, according to the *controller* type:

- eCT_POSE:
  - target velocities will be set to default (40 deg/s)
  - target accelerations will be set to default (100 deg/(s∗s))
  - target positions will be set to default (0.0 deg)
- eCT_VELOCITY:
  - target velocities will be set to default (0 deg/s)
- eCT_VELOCITY_ACCELERATION:
  - target velocities will be set to default (0 deg/s)
  - target accelerations will be set to default (100 deg/(s∗s))

This will also adjust the lower limits of the allowed velocities here in the SDHLibrary, since the eCT_POSE controller allows only positive velocities while the eCT_VELOCITY and eCT_VELOCITY_ACCELERATION controllers require also negative velocities.

Attention

The availability of a controller type depends on the SDH firmware of the attached SDH and is checked here.

- firmware <= 0.0.2.5: only eCT_POSE
- firmware >= 0.0.2.6: eCT_POSE, eCT_VELOCITY, eCT_VELOCITY_ACCELERATION

Parameters

controller	- identifier of controller to set. Valid values are defined in eControllerType

Examples:

```
   // Assuming 'hand' is a cSDH object ...

   // Set the pose controller in the SDH
   // (see e.g. demo-simple.cpp, demo-simple2.cpp, demo-simple3.cpp for fur
ther examples)
   hand.SetController( hand.eCT_POSE );

   // Set the simple velocity controller in the SDH:
   hand.SetController( hand.eCT_VELOCITY );

   // Set the velocity with acceleration ramp controller in the SDH:
   // (see e.g. demo-velocity-acceleration.cpp for further examples)
   hand.SetController( hand.eCT_VELOCITY_ACCELERATION );
```

10.20.4.91 virtual void SDH::cSDH::SetDebugOutput (std::ostream ∗ *debuglog*) [inline, virtual]

change the stream to use for debug messages

Reimplemented from SDH::cSDHBase.

10.20.4.92 void cSDH::SetFingerEnable (std::vector< int > const & *fingers*, std::vector< double > const & *states*) throw (cSDHLibraryException*)

Set enabled/disabled state of axis controllers of finger(s).

The controllers of the axes of the selected fingers are enabled/disabled in the SDH. Disabled axes are not powered and thus might not remain in their current pose due to gravity, inertia or other external influences. But to prevent overheating the axis controllers should be switched of when not needed.

Parameters

fingers	- A vector of finger indices to access.
states	- A vector of enabled states (0 = disabled, !=0 = enabled) to set. If any of the numbers in the vector is `NaN` (Not a Number) then the currently set enabled state will be kept for the corresponding axis.

Remarks

- The lengths of the *fingers* and *states* vector must match.
- The indices can be given in any order, but the order of their elements must match, i.e. `state`[i] will be applied to finger `fingers`[i] (not finger `i`).
- The indices are checked if they are valid finger indices.
- If **any** index is invalid then **none** of the specified values is sent to the SDH, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.
- As axis 0 is used for finger 0 and 2, axis 0 is disabled only if both finger 0 and 1 are disabled.

See also SetFingerEnable(int,double), SetFingerEnable(int,bool) for overloaded variants to set a single finger enabled/disabled or to set the same state for all fingers. See further SetFingerEnable(std::vector<int>const&,std::vector<bool>const&) for a variant that accepts a `bool` vector for the states to set.

Examples:

```
// Assuming "hand" is a cSDH object ...

// Enable finger 1 and 2 while disabling finger 0 :
std::vector<double> states012;
states012.push_back( 0.0 );
states012.push_back( 1.0 );
states012.push_back( 1.0 );

hand.SetFingerEnable( hand.all_axes, states012 );
// (this will keep axis 0 (used by the disabled finger 0) enabled,
// since axis 0 is needed by the enabled finger 2 too);

// Enable all fingers:
hand.SetFingerEnable( hand.All,true );
```

```
// Disable all fingers:
hand.SetFingerEnable( hand.All, 0.0 );

// Disable finger 2:
hand.SetFingerEnable( 2, false );
```

10.20.4.93 void cSDH::SetFingerEnable (std::vector< int > const & *fingers*, std::vector< bool > const & *states*) throw (cSDHLibraryException*)

Like SetFingerEnable(std::vector<int>const&,std::vector<double>const&), just with states as vector of `bool` values, see there for details and examples.

10.20.4.94 void cSDH::SetFingerEnable (int *iFinger*, bool *state*) throw (cSDHLibraryException*)

Like SetFingerEnable(std::vector<int>const&,std::vector<double>const&), just for a single finger *iAxis* and a single angle *angle*, see there for details and examples.

10.20.4.95 void cSDH::SetFingerEnable (int *iFinger*, double *state* = `1.0`) throw (cSDHLibraryException*)

Like SetFingerEnable(std::vector<int>const&,std::vector<double>const&), just for a single finger *iAxis* and a single angle *angle*, see there for details and examples.

10.20.4.96 void cSDH::SetFingerTargetAngle (int *iFinger*, std::vector< double > const & *angles*) throw (cSDHLibraryException*)

Set the target angle(s) for a single finger.

The target axis angles *angle* of finger *iFinger* are stored in the SDH. The movement is not executed until an additional move command is sent.

Parameters

iFinger	- index of finger to access. This must be a single index.
angles	- the angle(s) to set or `None` to set the current actual axis angles of the finger as target angle. This can be a single number or a vector of numbers. The value(s) are expected in the configured angle unit system uc_angle.

Remarks

- Setting the target angles will **not** make the finger move.
- The *iFinger* index is checked if it is a valid finger index.
- The angles are checked if they are in the allowed range [0 .. f_max_angle_v], i.e. it is checked that `angles`[i], converted to internal units, is in [0 .. `f_max_angle_v`[finger_axis_index[iFinger][i]]].
- If **any** index or value is invalid then **none** of the specified values is sent to the SDH, instead a SDH::cSDHErrorInvalidParameter* exception is thrown.

See also SetFingerTargetAngle(int,double,double,double) for an overloaded variant to set finger axis target angles from single `double` values.

Examples:

```
    // Assuming "hand" is a cSDH object ...

    // Set target axis angles of finger 0 to { 10.0, -08.15, 47.11 } degree
s
    std::vector<double> angles;
    angles.push_back( 10.0 );
    angles.push_back( -08.15 );
    angles.push_back(  47.11 );

    hand.SetFingerTargetAngle( 0, angles );


    // Set target axis angles of finger 1 to { 0.0, 24.7, 17.4 } degrees
    angles[0] = 0.0;   // "virtual" base axis of finger 1
    angles[1] = 24.7;
    angles[2] = 17.4;
    hand.SetFingerTargetAngle( 1, { 0.0, 24.7, 17.4 } );


    // Set target axis angles of all axes of finger 0 to 12.34 degrees
    hand.SetFingerTargetAngle( 0, 12.34, 12.34, 12.34 );


    // REMARK: the last command changed the previously set target axis
    // angle for axis 0, since axis 0 is used as base axis for both
    // finger 0 and 2!
```

10.20.4.97 void cSDH::SetFingerTargetAngle (int *iFinger*, double *a0*, double *a1*, double *a2*) throw (cSDHLibraryException*)

Like SetFingerTargetAngle(int,std::vector<double>const&), just with individual finger axis angles *a0*, *a1* and *a2*.

10.20.4.98 void cSDH::SetVelocityProfile (eVelocityProfile *velocity_profile*) throw (cSDHLibraryException*)

Set the type of velocity profile to be used in the SDH

Parameters

velocity_profile	- Name or number of velocity profile to set. Valid values are defined in eVelocityProfileType

Examples:

```
    // Assuming 'hand' is a cSDH object ...

    // Set the sin square velocity profile in the SDH:
    hand.SetVelocityProfile( hand.eVP_SIN_SQUARE );
```

```
// Or else set the ramp velocity profile in the SDH:
hand.SetVelocityProfile( hand.eVP_RAMP )
```

10.20.4.99 void cSDH::Stop (void) throw (cSDHLibraryException*)

Stop movement of all axes but keep controllers on

This command will always be executed sequentially: it will return only after the SDH has confirmed the stop

Bug

For now this will **NOT** work while a GripHand() command is executing, even if that was initiated non-sequentially!

Bug

With SDH firmware < 0.0.2.7 this made the axis jerk in eCT_POSE controller type. This is resolved in SDH firmware 0.0.2.7 for the eCT_POSE controller type with velocity profile eVP_RAMP. For the eCT_POSE controller type with velocity profile eVP_SIN_SQUARE changing target points/ velocities while moving will still make the axes jerk.
=> Partly resolved in SDH firmware 0.0.2.7

Examples:

```
// Assuming 'hand' is a cSDH object ...

// Perform a stop:
hand.Stop();
```

10.20.4.100 std::vector< int > cSDH::ToIndexVector (int *index*, std::vector< int > & *all_replacement*, int *maxindex*, char const * *name*) throw (cSDHLibraryException*) [protected]

Internal helper function: return a vector of checked indices according to index.

Parameters

index	- The index to vectorize or All
all_replacement	- a vector to return if *index* is All
maxindex	- the *index* is checked if in [0..\ maxindex[(i.e. not including *maxindex*)
name	- A name for the things index, used to report out of bounds errors

Returns

- If *index* is All then *all_replacement* is returned.
- If *index* is a single number >= 0 then it is checked if in [0..\ maxindex[and

a vector of length 1 is returned containing only *index*.

- In case *index* exceeds *maxindex* a (cSDHErrorInvalidParameter∗) exception is thrown.

10.20.4.101 void cSDH::UseDegrees (void)

Shortcut to set the unit system to degrees.

After calling this (axis) angles are set/reported in degrees and angular velocities are set/reported in degrees/second

Examples:

```
   // Assuming 'hand' is a cSDH object ...

   // make hand object use degrees and degrees/second for angles and angula
r velocities
   hand.UseDegrees();
   // as degrees, degrees/second are the default this is needed only if the

   // unit system was changed before
```

10.20.4.102 void cSDH::UseRadians (void)

Shortcut to set the unit system to radians.

After calling this axis angles are set/reported in radians and angular velocities are set/reported in radians/second

Examples:

```
   // Assuming 'hand' is a cSDH object ...

   // make hand object use radians and radians/second for angles and angula
r velocities
   hand.UseRadians();
```

10.20.4.103 void cSDH::WaitAxis (int *iAxis*, double *timeout* = -1.0) throw (cSDHLibraryException∗)

Like WaitAxis(std::vector<int>const&,double), just for a single axis *iAxis*, see there for details and examples.

If *iAxis* is All then wait for all axes axes.

10.20.4.104 void cSDH::WaitAxis (std::vector< int > const & *axes*, double *timeout* = -1.0) throw (cSDHLibraryException∗)

Wait until the movement(s) of of axis(axes) has finished

The state of the given axis(axes) is(are) queried until all axes are no longer moving.

Parameters

axes	- A vector of axis indices to access.
timeout	- a timeout in seconds or -1.0 (default) to wait indefinetly.

- The indices in *axes* are checked if they are valid axis indices.
- If **any** axis index is invalid then a SDH::cSDHErrorInvalidParameter* exception is thrown.
  - If *timeout* < 0 then this function will wait arbitrarily long
  - If a *timeout* is given then this function will throw a cSDHErrorCommunication exception if the given axes are still moving after *timeout* many seconds

See also WaitAxis(int,double) for an overloaded variant to wait for a single axis or all axes.

Bug

Due to a bug in SDH firmwares prior to 0.0.2.6 the WaitAxis() command was somewhat unreliable there. When called immediately after a movement command like MoveHand(), then the WaitAxis() command returned immediately without waiting for the end of the movement. With SDH firmwares 0.0.2.6 and newer this is no longer problematic and WaitAxis() works as expected.
=> Resolved in SDH firmware 0.0.2.6

Bug

With SDH firmware 0.0.2.6 WaitAxis() did not work if one of the new velocity based controllers (eCT_VELOCITY, eCT_VELOCITY_ACCELERATION) was used. With SDH firmwares 0.0.2.7 and newer this now works. Here the WaitAxis() waits until the selected axes come to velocity 0.0
=> Resolved in SDH firmware 0.0.2.7

Examples:

Example 1, WaitAxis and eCT_POSE controller, see also the demo program demo-simple3:

```
// Assuming "hand" is a cSDH object ...

hand.SetController( eCT_POSE );

// Set a new target pose for axis 1,2 and 3
std::vector<int> axes123;
axes123.push_back( 1 );
axes123.push_back( 2 );
axes123.push_back( 3 );

std::vector<double> angles123;
angles123.push_back( -20.0 );
angles123.push_back( -30.0 );
angles123.push_back( -40.0 );
```

```
        hand.SetAxisTargetAngle( axes123, angles123 );

        // Move axes there non sequentially:
        hand.MoveAxis( axes123, false );

        // The last call returned immediately so we now have time to
        // do something else while the hand is moving:

        // ... insert any calculation here ...

        // Before doing something else with the hand make sure the
        // selected axes have finished the last movement:
        hand.WaitAxis( axes123 );


        // go back home (all angles to 0.0):
        hand.SetAxisTargetAngle( hand.All, 0.0 );

        // Move all axes there non sequentially:
        hand.MoveAxis( hand.All, False );

        // ... insert any other calculation here ...

        // Wait until all axes are there, with a timeout of 10s:
        hand.WaitAxis( hand.All, 10.0 );

        // now we are at the desired position.
```

Example 2, WaitAxis and eCT_VELOCITY_ACCELERATION controller, see also the demo program demo-velocity-acceleration

```
    // Assuming "hand" is a cSDH object ...

    hand.SetController( eCT_VELOCITY_ACCELERATION);

    // Set a new target velocity for axis 1,2 and 3
    std::vector<int> axes123;
    axes123.push_back( 1 );
    axes123.push_back( 2 );
    axes123.push_back( 3 );

    std::vector<double> velocities123;
    velocities123.push_back( -20.0 );
    velocities123.push_back( -30.0 );
    velocities123.push_back( -40.0 );


    hand.SetAxisTargetVelocity( axes123, velocities123 ); // this will make
the axes move!

    // The last call returned immediately so we now have time to
    // do something else while the hand is moving:

    // ... insert any calculation here ...

    // to break and stop the movement just set the target velocities to 0.0

    velocities123[0] = 0.0;
    velocities123[1] = 0.0;
    velocities123[2] = 0.0;
```

```
   hand.SetAxisTargetVelocity( axes123, velocities123 ); // this will make
the axes break with the default (de)acceleration

   // The previous command returned immediately, so
   // before doing something else with the hand make sure the
   // selected axes have stopped:
   hand.WaitAxis( axes123 );

   // now the axes have stopped
```

10.20.5 Member Data Documentation

10.20.5.1 std::vector<int> SDH::cSDH::all_axes

A vector with indices of all axes (in natural order), including the virtual axis.

10.20.5.2 std::vector<int> SDH::cSDH::all_fingers

A vector with indices of all fingers (in natural order)

10.20.5.3 std::vector<int> SDH::cSDH::all_real_axes

A vector with indices of all real axes (in natural order), excluding the virtual axis.

10.20.5.4 std::vector<int> SDH::cSDH::all_temperature_sensors

A vector with indices of all temperature sensors.

10.20.5.5 cSerialBase* SDH::cSDH::com [protected]

10.20.5.6 cSDHSerial SDH::cSDH::comm_interface

The object to interface with the SDH attached via serial RS232 or CAN or TCP.

10.20.5.7 double SDH::cSDH::d [protected]

10.20.5.8 std::vector<double> SDH::cSDH::f_max_acceleration_v [protected]

Maximum allowed axis acceleration (in internal units (degrees/(second * second))), including the virtual axis.

10.20.5.9 std::vector<double> SDH::cSDH::f_max_angle_v [protected]

Maximum allowed axis angles (in internal units (degrees)), including the virtual axis.

10.20.5.10 std::vector<double> SDH::cSDH::f_max_motor_current_v [protected]

Maximum allowed motor currents (in internal units (Ampere)), including the virtual axis.

10.20.5.11 std::vector<double> SDH::cSDH::f_max_velocity_v [protected]

Maximum allowed axis velocity (in internal units (degrees/second)), including the virtual axis.

10.20.5.12 std::vector<double> SDH::cSDH::f_min_acceleration_v [protected]

Minimum allowed axis acceleration (in internal units (degrees/(second $*$ second))), including the virtual axis.

10.20.5.13 std::vector<double> SDH::cSDH::f_min_angle_v [protected]

Minimum allowed axis angles (in internal units (degrees)), including the virtual axis.

10.20.5.14 std::vector<double> SDH::cSDH::f_min_motor_current_v [protected]

Minimum allowed motor currents (in internal units (Ampere)), including the virtual axis.

10.20.5.15 std::vector<double> SDH::cSDH::f_min_velocity_v [protected]

Minimum allowed axis velocity (in internal units (degrees/second)), including the virtual axis.

10.20.5.16 std::vector<double> SDH::cSDH::f_ones_v [protected]

Vector of 3 1.0 values.

10.20.5.17 std::vector<double> SDH::cSDH::f_zeros_v [protected]

Vector of 3 epsilon values.

Vector of 3 0.0 values

10.20.5.18 std::vector<std::vector<int> > SDH::cSDH::finger_axis_index [protected]

Mapping of finger index, finger axis index to axis index:

10.20.5.19 std::vector<int> SDH::cSDH::finger_number_of_axes [protected]

Mapping of finger index to number of real axes of fingers:

10.20.5.20 double SDH::cSDH::grip_max_velocity [protected]

Maximum allowed grip velocity (in internal units (degrees/second))

10.20.5.21 double SDH::cSDH::h [protected]

10.20.5.22 double SDH::cSDH::l1 [protected]

length of limb 1 (proximal joint to distal joint) in mm

10.20.5.23 double SDH::cSDH::l2 [protected]

length of limb 2 (distal joint to fingertip) in mm

10.20.5.24 int SDH::cSDH::nb_all_axes [protected]

The number of all axes including virtual axes.

10.20.5.25 int SDH::cSDH::NUMBER_OF_AXES_PER_FINGER [protected]

The number of axis per finger (for finger 1 this includes the "virtual" base axis)

10.20.5.26 int SDH::cSDH::NUMBER_OF_VIRTUAL_AXES [protected]

The number of virtual axes.

10.20.5.27 std::vector<std::vector<double> > SDH::cSDH::offset [protected]

list of xyz-vectors for all fingers with offset from (0,0,0) of proximal joint in mm

10.20.5.28 std::vector<double> SDH::cSDH::ones_v [protected]

Vector of nb_all_axes 1.0 values.

10.20.5.29 const cUnitConverter* SDH::cSDH::uc_angle

unit convert for (axis) angles: default = SDH::cSDH::uc_angle_degrees

10.20.5.30 cUnitConverter const cSDH::uc_angle_degrees [static]

Default converter for angles (internal unit == external unit): degrees.

10.20.5.31 cUnitConverter const cSDH::uc_angle_radians [static]

Converter for angles: external unit = radians.

10.20.5.32 const cUnitConverter* SDH::cSDH::uc_angular_acceleration

unit convert for (axis) angular accelerations: default = SDH::cSDH::uc_angular_acceleration_-degrees_per_second_squared

10.20.5.33 cUnitConverter const cSDH::uc_angular_acceleration_degrees_per_-second_squared [static]

Default converter for angular accelerations (internal unit == external unit): degrees / second.

10.20.5.34 cUnitConverter const cSDH::uc_angular_acceleration_radians_per_-second_squared [static]

Converter for angular velocieties: external unit = radians/second.

10.20.5.35 const cUnitConverter* SDH::cSDH::uc_angular_velocity

unit convert for (axis) angular velocities: default = SDH::cSDH::uc_angular_velocity_-degrees_per_second

10.20.5.36 cUnitConverter const cSDH::uc_angular_velocity_degrees_per_second [static]

Default converter for angular velocities (internal unit == external unit): degrees / second.

10.20.5.37 cUnitConverter const cSDH::uc_angular_velocity_radians_per_second [static]

Converter for angular velocieties: external unit = radians/second.

10.20.5.38 const cUnitConverter* SDH::cSDH::uc_motor_current

unit converter for motor curent: default = SDH::cSDH::uc_motor_current_ampere

10.20.5.39 cUnitConverter const cSDH::uc_motor_current_ampere [static]

Default converter for motor current (internal unit == external unit): Ampere.

10.20.5.40 cUnitConverter const cSDH::uc_motor_current_milliampere [static]

Converter for motor current: external unit = milli Ampere.

10.20.5.41 const cUnitConverter* SDH::cSDH::uc_position

unit converter for position: default = SDH::cSDH::uc_position_millimeter

10.20.5.42 cUnitConverter const cSDH::uc_position_meter [static]

Converter for position: external unit = meter.

10.20.5.43 cUnitConverter const cSDH::uc_position_millimeter [static]

Default converter for position (internal unit == external unit): millimeter.

10.20.5.44 const cUnitConverter* SDH::cSDH::uc_temperature

unit convert for temperatures: default = SDH::cSDH::uc_temperature_celsius

10.20.5.45 cUnitConverter const cSDH::uc_temperature_celsius [static]

Default converter for temparatures (internal unit == external unit): degrees celsius.

10.20.5.46 cUnitConverter const cSDH::uc_temperature_fahrenheit [static]

Converter for temperatures: external unit = degrees fahrenheit.

10.20.5.47 const cUnitConverter* SDH::cSDH::uc_time

unit convert for times: default = uc_time_seconds

10.20.5.48 cUnitConverter const cSDH::uc_time_milliseconds [static]

Converter for times: external unit = milliseconds.

10.20.5.49 cUnitConverter const cSDH::uc_time_seconds [static]

Default converter for times (internal unit == external unit): seconds.

10.20.5.50 std::vector<double> SDH::cSDH::zeros_v [protected]

Vector of nb_all_axes 0.0 values.

The documentation for this class was generated from the following files:

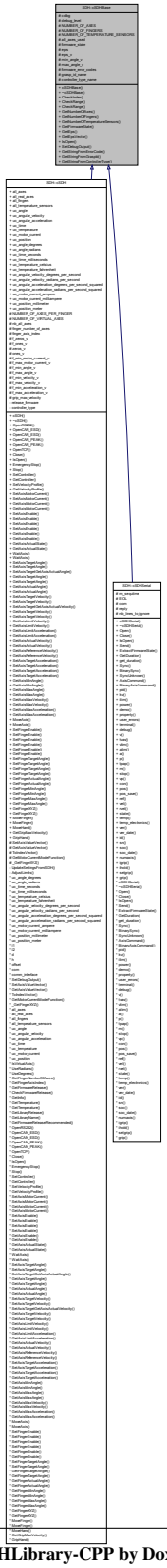
- sdh/sdh.h
- sdh/sdh.cpp

10.21 SDH::cSDHBase Class Reference

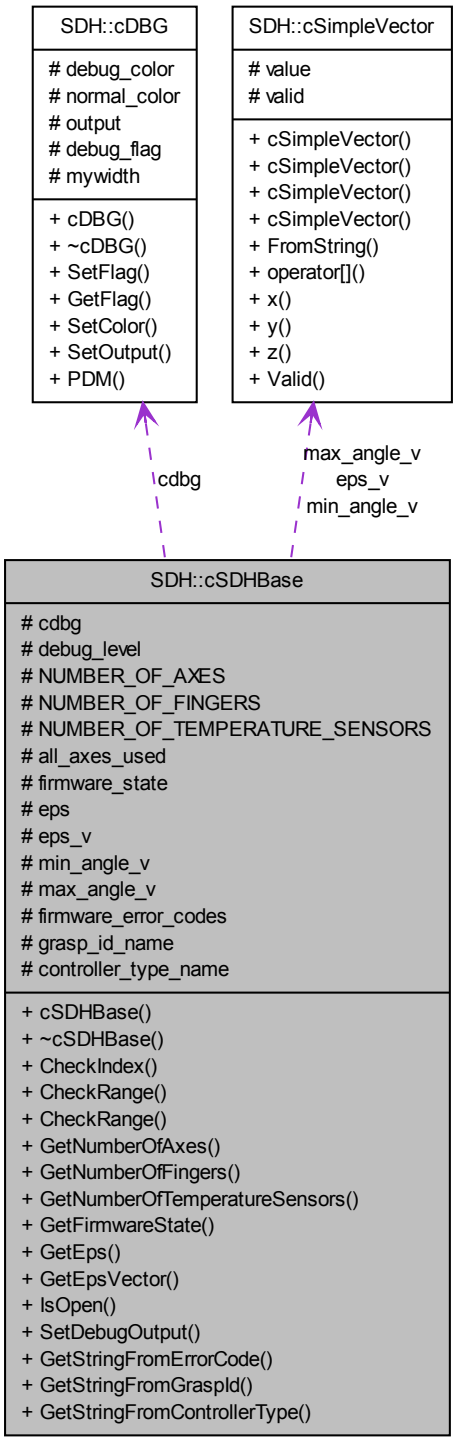
The base class to control the SCHUNK Dexterous Hand.

`#include <sdhbase.h>`

Inheritance diagram for SDH::cSDHBase:



Collaboration diagram for SDH::cSDHBase:



Public Types

- enum { All = -1 }

  Anonymous enum (instead of define like macros)

- enum eErrorCode {

  eEC_SUCCESS = 0, eEC_NOT_AVAILABLE, eEC_NOT_INITIALIZED, eEC_-ALREADY_RUNNING,

  eEC_FEATURE_NOT_SUPPORTED, eEC_INCONSISTENT_DATA, eEC_TIMEOUT, eEC_READ_ERROR,

  eEC_WRITE_ERROR, eEC_INSUFFICIENT_RESOURCES, eEC_CHECKSUM_-ERROR, eEC_NOT_ENOUGH_PARAMS,

  eEC_NO_PARAMS_EXPECTED, eEC_CMD_UNKNOWN, eEC_CMD_FORMAT_-ERROR, eEC_ACCESS_DENIED,

  eEC_ALREADY_OPEN, eEC_CMD_FAILED, eEC_CMD_ABORTED, eEC_-INVALID_HANDLE,

  eEC_DEVICE_NOT_FOUND, eEC_DEVICE_NOT_OPENED, eEC_IO_ERROR, eEC_INVALID_PARAMETER,

  eEC_RANGE_ERROR, eEC_NO_DATAPIPE, eEC_INDEX_OUT_OF_BOUNDS, eEC_HOMING_ERROR,

  eEC_AXIS_DISABLED, eEC_OVER_TEMPERATURE, eEC_MAX_COMMANDS_-EXCEEDED, eEC_INVALID_PASSWORD,

  eEC_MAX_COMMANDLINE_EXCEEDED, eEC_CRC_ERROR, eEC_NO_-COMMAND, eEC_INTERNAL,

  eEC_UNKNOWN_ERROR, eEC_DIMENSION }

- enum eGraspId {

  eGID_INVALID = -1, eGID_CENTRICAL = 0, eGID_PARALLEL = 1, eGID_-CYLINDRICAL = 2,

  eGID_SPHERICAL = 3, eGID_DIMENSION }

  The enum values of the known grasps.

- enum eControllerType {

  eCT_INVALID = -1, eCT_POSE = 0, eCT_VELOCITY, eCT_VELOCITY_-ACCELERATION,

  eCT_DIMENSION }

  An enum for all possible SDH internal controller types (order must match that in the SDH firmware in inc/sdh2.h)

- enum eVelocityProfile { eVP_INVALID = -1, eVP_SIN_SQUARE, eVP_RAMP, eVP_DIMENSION }

  An enum for all possible SDH internal velocity profile types.

Public Member Functions

- cSDHBase (int debug_level)
- virtual ~cSDHBase ()
- void CheckIndex (int index, int maxindex, char const *name="") throw (cSDHErrorInvalidParameter*)

  Check if index is in [0 .. maxindex-1] or All. Throw a cSDHErrorInvalidParameter exception if not.

- void CheckRange (double value, double minvalue, double maxvalue, char const *name="") throw (cSDHErrorInvalidParameter*)

  Check if value is in [minvalue .. maxvalue]. Throw a cSDHErrorInvalidParameter exception if not.

- void CheckRange (double *values, double *minvalues, double *maxvalues, char const *name="") throw (cSDHErrorInvalidParameter*)

  Check if any value[i] in array values is in [minvalue[i] .. maxvalue[i]]. Throw a cSDHErrorInvalidParameter exception if not.

- int GetNumberOfAxes (void)

  Return the number of axes of the SDH.

- int GetNumberOfFingers (void)

  Return the number of fingers of the SDH.

- int GetNumberOfTemperatureSensors (void)

  Return the number of temperature sensors of the SDH.

- eErrorCode GetFirmwareState (void)

  Return the last known state of the SDH firmware.

- double GetEps (void)

  Return the eps value.

- cSimpleVector const & GetEpsVector (void)

  Return simple vector of number of axes epsilon values.

- virtual bool IsOpen (void)=0

  Return true if connection to SDH firmware/hardware is open.

- virtual void SetDebugOutput (std::ostream *debuglog)

  change the stream to use for debug messages

Static Public Member Functions

- static char const * GetStringFromErrorCode (eErrorCode error_code)

  Return a ptr to a (static) string describing error code error_code.

- static char const * GetStringFromGraspId (eGraspId grasp_id)

  Return a ptr to a (static) string describing grasp id grasp_id.

- static char const * GetStringFromControllerType (eControllerType controller_type)

  Return a ptr to a (static) string describing controller type controller_Type.

Protected Attributes

- cDBG cdbg

  debug stream to print colored debug messages

- int debug_level

  debug level of this object

- int NUMBER_OF_AXES

  The number of axes.

- int NUMBER_OF_FINGERS

  The number of fingers.

- int NUMBER_OF_TEMPERATURE_SENSORS

  The number of temperature sensors.

- int all_axes_used

  Bit field with the bits for all axes set.

- eErrorCode firmware_state

  the last known state of the SDH firmware

- double eps

  epsilon value (max absolute deviation of reported values from actual hardware values) (needed since SDH firmware limits number of digits reported)

- cSimpleVector eps_v

  simple vector of 7 epsilon values

- cSimpleVector min_angle_v

  simple vector of 7 0 values ???

- cSimpleVector max_angle_v

  Maximum allowed axis angles (in internal units (degrees))

Static Protected Attributes

- static char const * firmware_error_codes [ ]

  A mapping from eErrorCode error code enums to strings with human readable error messages.

- static char const * grasp_id_name [ ]

  A mapping from eGraspId grasp id enums to strings with human readable grasp id names.

- static char const * controller_type_name [ ]

  A mapping from eControllerType controller type enums to strings with human readable controller type names.

10.21.1 Detailed Description

The base class to control the SCHUNK Dexterous Hand. End-Users should **NOT** use this class directly, as it only provides some common settings and no function interface. End users should use the class cSDH instead, as it provides the end-user functions to control the SDH.

10.21.2 Member Enumeration Documentation

10.21.2.1 anonymous enum

Anonymous enum (instead of define like macros)

Enumerator:

All A meta-value that means "access all possible values".

10.21.2.2 enum SDH::cSDHBase::eControllerType

An enum for all possible SDH internal controller types (order must match that in the SDH firmware in inc/sdh2.h)

Enumerator:

eCT_INVALID invalid controller_type (needed for cSDHSerial::con() to indicate "read current controller type")

eCT_POSE coordinated position controller (position per axis => "pose controller"), all axes start and stop moving at the same time

eCT_VELOCITY velocity controller, velocities of axes are controlled independently (not implemented in SDH firmwares up to and including 0.0.2.5)

eCT_VELOCITY_ACCELERATION velocity controller with acceleration ramp, velocities and accelerations of axes are controlled independently (not implemented in SDH firmwares up to and including 0.0.2.5)

eCT_DIMENSION Endmarker and dimension.

10.21.2.3 enum SDH::cSDHBase::eErrorCode

The error codes of the SDH firmware

Enumerator:

eEC_SUCCESS

eEC_NOT_AVAILABLE

eEC_NOT_INITIALIZED

eEC_ALREADY_RUNNING

eEC_FEATURE_NOT_SUPPORTED

eEC_INCONSISTENT_DATA

eEC_TIMEOUT

eEC_READ_ERROR

eEC_WRITE_ERROR

eEC_INSUFFICIENT_RESOURCES

eEC_CHECKSUM_ERROR

eEC_NOT_ENOUGH_PARAMS

eEC_NO_PARAMS_EXPECTED

eEC_CMD_UNKNOWN

eEC_CMD_FORMAT_ERROR

eEC_ACCESS_DENIED

eEC_ALREADY_OPEN

eEC_CMD_FAILED

eEC_CMD_ABORTED

eEC_INVALID_HANDLE

eEC_DEVICE_NOT_FOUND

eEC_DEVICE_NOT_OPENED

eEC_IO_ERROR

eEC_INVALID_PARAMETER

eEC_RANGE_ERROR

eEC_NO_DATAPIPE

eEC_INDEX_OUT_OF_BOUNDS

eEC_HOMING_ERROR

eEC_AXIS_DISABLED

eEC_OVER_TEMPERATURE

eEC_MAX_COMMANDS_EXCEEDED

eEC_INVALID_PASSWORD

eEC_MAX_COMMANDLINE_EXCEEDED

eEC_CRC_ERROR

eEC_NO_COMMAND

eEC_INTERNAL

eEC_UNKNOWN_ERROR

eEC_DIMENSION Endmarker and dimension.

10.21.2.4 enum SDH::cSDHBase::eGraspId

The enum values of the known grasps.

Enumerator:

eGID_INVALID invalid grasp id

eGID_CENTRICAL centrical grasp: ???

eGID_PARALLEL parallel grasp: ???

eGID_CYLINDRICAL cylindrical grasp: ???

eGID_SPHERICAL spherecial grasp: ???

eGID_DIMENSION Endmarker and dimension.

10.21.2.5 enum SDH::cSDHBase::eVelocityProfile

An enum for all possible SDH internal velocity profile types.

Enumerator:

eVP_INVALID not a valid velocity profile, used to make SDH::cSDHSerial::vp() read the velocity profile from the SDH firmware

eVP_SIN_SQUARE sin square velocity profile

eVP_RAMP ramp velocity profile

eVP_DIMENSION endmarker and dimension

10.21.3 Constructor & Destructor Documentation

10.21.3.1 cSDHBase::cSDHBase (int *debug_level*)

Constructor of cSDHBase class, initilize internal variables and settings

Parameters

debug_level	: debug level of the created object. If the *debug_level* of an object is > 0 then it will output debug messages. • (Subclasses of cSDHBase like cSDH or cSDHSerial use additional settings, see there.)

10.21.3.2 virtual SDH::cSDHBase::~cSDHBase ( ) [inline, virtual]

virtual destructor to make compiler happy

10.21.4 Member Function Documentation

10.21.4.1 void cSDHBase::CheckIndex (int *index*, int *maxindex*, char const * *name* = " ") throw (cSDHErrorInvalidParameter*)

Check if *index* is in [0 .. *maxindex-1*] or All. Throw a cSDHErrorInvalidParameter exception if not.

10.21.4.2 void cSDHBase::CheckRange (double *value*, double *minvalue*, double *maxvalue*, char const * *name* = " ") throw (cSDHErrorInvalidParameter*)

Check if *value* is in [*minvalue* .. *maxvalue*]. Throw a cSDHErrorInvalidParameter exception if not.

10.21.4.3 void cSDHBase::CheckRange (double * *values*, double * *minvalues*, double * *maxvalues*, char const * *name* = " ") throw (cSDHErrorInvalidParameter*)

Check if any value[i] in array *values* is in [*minvalue*[i] .. *maxvalue*[i]]. Throw a cSDHErrorInvalidParameter exception if not.

10.21.4.4 double cSDHBase::GetEps (void)

Return the eps value.

10.21.4.5 cSimpleVector const & cSDHBase::GetEpsVector (void)

Return simple vector of number of axes epsilon values.

10.21.4.6 cSDHBase::eErrorCode cSDHBase::GetFirmwareState (void)

Return the last known state of the SDH firmware.

10.21.4.7 int cSDHBase::GetNumberOfAxes (void)

Return the number of axes of the SDH.

10.21.4.8 int cSDHBase::GetNumberOfFingers (void)

Return the number of fingers of the SDH.

10.21.4.9 int cSDHBase::GetNumberOfTemperatureSensors (void)

Return the number of temperature sensors of the SDH.

10.21.4.10 char const * cSDHBase::GetStringFromControllerType (eControllerType *controller_type*) [static]

Return a ptr to a (static) string describing controller type *controller_Type*.

10.21.4.11 char const * cSDHBase::GetStringFromErrorCode (eErrorCode *error_code*) [static]

Return a ptr to a (static) string describing error code *error_code*.

10.21.4.12 char const * cSDHBase::GetStringFromGraspId (eGraspId *grasp_id*) [static]

Return a ptr to a (static) string describing grasp id *grasp_id*.

10.21.4.13 virtual bool SDH::cSDHBase::IsOpen (void) [pure virtual]

Return true if connection to SDH firmware/hardware is open.

Implemented in SDH::cSDH, and SDH::cSDHSerial.

10.21.4.14 virtual void SDH::cSDHBase::SetDebugOutput (std::ostream * *debuglog*) [inline, virtual]

change the stream to use for debug messages

Reimplemented in SDH::cSDH.

10.21.5 Member Data Documentation

10.21.5.1 int SDH::cSDHBase::all_axes_used [protected]

Bit field with the bits for all axes set.

10.21.5.2 cDBG SDH::cSDHBase::cdbg [protected]

debug stream to print colored debug messages

10.21.5.3 char const * cSDHBase::controller_type_name [static, protected]

Initial value:

```
{

    "eCT_POSE: position/pose controller coordinated",
    "eCT_VELOCITY: velocity controller",
    "eCT_VELOCITY_ACCELERATION: velocity with acceleration ramp controller",



    "eCT_DIMENSION: number of controller types"
}
```

A mapping from eControllerType controller type enums to strings with human readable controller type names.

10.21.5.4 int SDH::cSDHBase::debug_level [protected]

debug level of this object

10.21.5.5 double SDH::cSDHBase::eps [protected]

epsilon value (max absolute deviation of reported values from actual hardware values) (needed since SDH firmware limits number of digits reported)

10.21.5.6 cSimpleVector SDH::cSDHBase::eps_v [protected]

simple vector of 7 epsilon values

10.21.5.7 char const * cSDHBase::firmware_error_codes [static, protected]

Initial value:

```
{

    "eEC_SUCCESS: No error",
    "eEC_NOT_AVAILABLE: Service or data is not available",
    "eEC_NOT_INITIALIZED: The device is not initialized",
    "eEC_ALREADY_RUNNING: Data acquisition: the acquisition loop is already r
  unning",
    "eEC_FEATUReEC_NOT_SUPPORTED: The asked feature is not supported",
    "eEC_INCONSISTENT_DATA: One or more dependent parameters mismatch",
    "eEC_TIMEOUT: Timeout error",
    "eEC_READ_ERROR: Error while reading from a device",
    "eEC_WRITE_ERROR: Error while writing to a device",
    "eEC_INSUFFICIENT_RESOURCES: No memory available",
    "eEC_CHECKSUM_ERROR: Checksum error",
    "eEC_NOT_ENOUGH_PARAMS: Not enough parameters",
    "eEC_NO_PARAMS_EXPECTED: No parameters expected",
    "eEC_CMD_UNKNOWN: Unknown command",
    "eEC_CMD_FORMAT_ERROR: Command format error",
    "eEC_ACCESS_DENIED: Access denied",
    "eEC_ALREADY_OPEN: Interface already open",
    "eEC_CMD_FAILED: Command failed",
    "eEC_CMD_ABORTED: Command aborted",
    "eEC_INVALID_HANDLE: Invalid handle",
    "eEC_DEVICE_NOT_FOUND: Device not found",
    "eEC_DEVICE_NOT_OPENED: Device not open",
    "eEC_IO_ERROR: General I/O-Error",
    "eEC_INVALID_PARAMETER: Invalid parameter",
    "eEC_RANGE_ERROR: Range error",
    "eEC_NO_DATAPIPE: No datapipe was found to open the specified device path
  ",
    "eEC_INDEX_OUT_OF_BOUNDS: The passed index is out of bounds",
    "eEC_HOMING_ERROR: Error while homing",
    "eEC_AXIS_DISABLED: The selected axis is disabled",
    "eEC_OVER_TEMPERATURE: Over-temperature",
    "eEC_MAX_COMMANDS_EXCEEDED: E_MAX_COMMANDS_EXCEEDED: cannot add more than
   CI_MAX_COMMANDS to interpreter / POSCON_MAX_OSCILLOSCOPE parameters to oscillosc
  ope",
    "eEC_INVALID_PASSWORD: E_INVALID_PASSWORD: invalid password given for cha
  nge user command",
    "eEC_MAX_COMMANDLINE_EXCEEDEDE_COMMANDLINE_EXCEEDED: the command line giv
  en is too long",
    "eEC_CRC_ERROR: Cyclic Redundancy Code error",
    "eEC_NO_COMMAND: No command available",

    "eEC_INTERNAL: internal error",
    "eEC_UNKNOWN_ERROR: unknown error",

    "eEC_DIMENSION: Number of error codes"
}
```

A mapping from eErrorCode error code enums to strings with human readable error messages.

10.21.5.8 eErrorCode SDH::cSDHBase::firmware_state [protected]

the last known state of the SDH firmware

10.21.5.9 char const * cSDHBase::grasp_id_name [static, protected]

Initial value:

```
{

    "eGID_CENTRICAL: centrical grasp",
    "eGID_PARALLEL: parallel grasp",
    "eGID_CYLINDRICAL: cylindrical grasp",
    "eGID_SPHERICAL: spherecial grasp",

    "eGID_DIMENSION: number of predefined grasp ids"
}
```

A mapping from eGraspId grasp id enums to strings with human readable grasp id names.

10.21.5.10 cSimpleVector SDH::cSDHBase::max_angle_v [protected]

Maximum allowed axis angles (in internal units (degrees))

10.21.5.11 cSimpleVector SDH::cSDHBase::min_angle_v [protected]

simple vector of 7 0 values ???

simple vector of 7 1 values ??? Minimum allowed axis angles (in internal units (degrees))

10.21.5.12 int SDH::cSDHBase::NUMBER_OF_AXES [protected]

The number of axes.

10.21.5.13 int SDH::cSDHBase::NUMBER_OF_FINGERS [protected]

The number of fingers.

10.21.5.14 int SDH::cSDHBase::NUMBER_OF_TEMPERATURE_SENSORS [protected]

The number of temperature sensors.

The documentation for this class was generated from the following files:

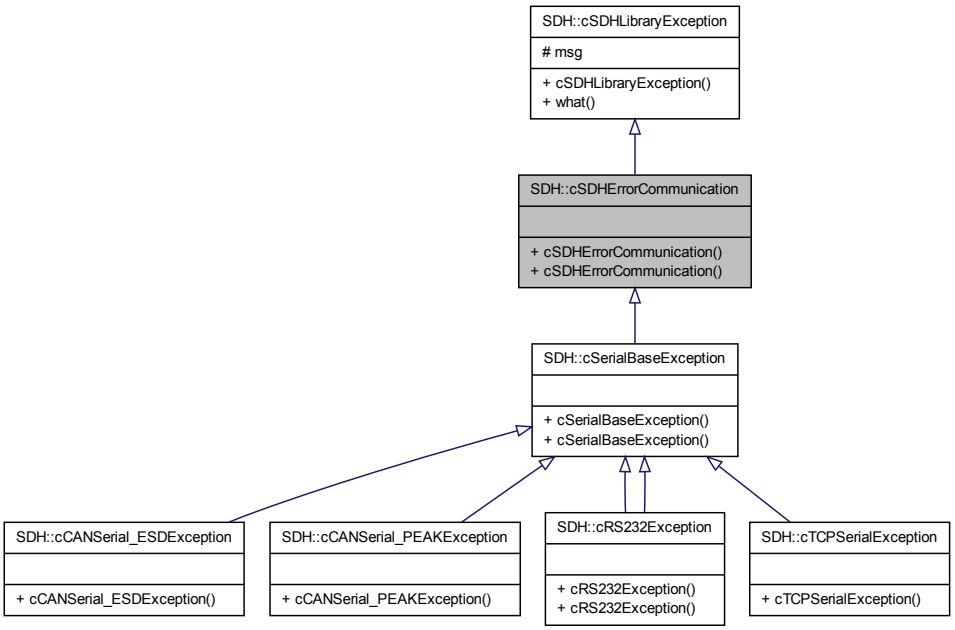
- sdh/sdhbase.h
- sdh/sdhbase.cpp

10.22 SDH::cSDHErrorCommunication Class Reference

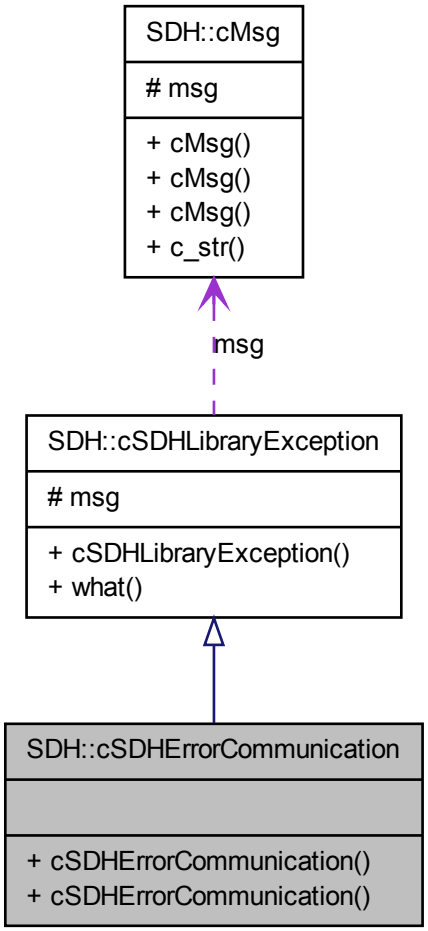
Derived exception class for exceptions related to communication between the SDHLibrary and the SDH.

`#include <sdhexception.h>`

Inheritance diagram for SDH::cSDHErrorCommunication:



Collaboration diagram for SDH::cSDHErrorCommunication:



Public Member Functions

- cSDHErrorCommunication (cMsg const &_msg)
- cSDHErrorCommunication (char const *_type, cMsg const &_msg)

10.22.1 Detailed Description

Derived exception class for exceptions related to communication between the SDHLibrary and the SDH.

10.22.2 Constructor & Destructor Documentation

10.22.2.1 SDH::cSDHErrorCommunication::cSDHErrorCommunication (cMsg const & *_msg*) [inline]

10.22.2.2 SDH::cSDHErrorCommunication::cSDHErrorCommunication (char const * *_type*, cMsg const & *_msg*) [inline]

The documentation for this class was generated from the following file:

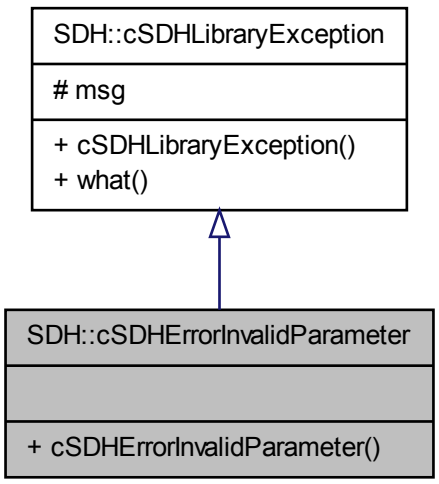
- sdh/sdhexception.h

10.23 SDH::cSDHErrorInvalidParameter Class Reference

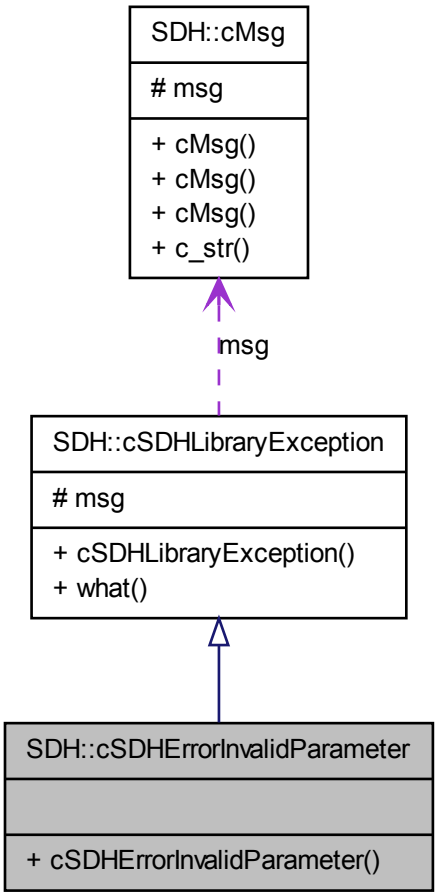
Derived exception class for exceptions related to invalid parameters.

`#include <sdhbase.h>`

Inheritance diagram for SDH::cSDHErrorInvalidParameter:



Collaboration diagram for SDH::cSDHErrorInvalidParameter:



Public Member Functions

- cSDHErrorInvalidParameter (cMsg const &_msg)

10.23.1 Detailed Description

Derived exception class for exceptions related to invalid parameters.

10.23.2 Constructor & Destructor Documentation

10.23.2.1 SDH::cSDHErrorInvalidParameter::cSDHErrorInvalidParameter (cMsg const & *_msg*) [inline]

The documentation for this class was generated from the following file:

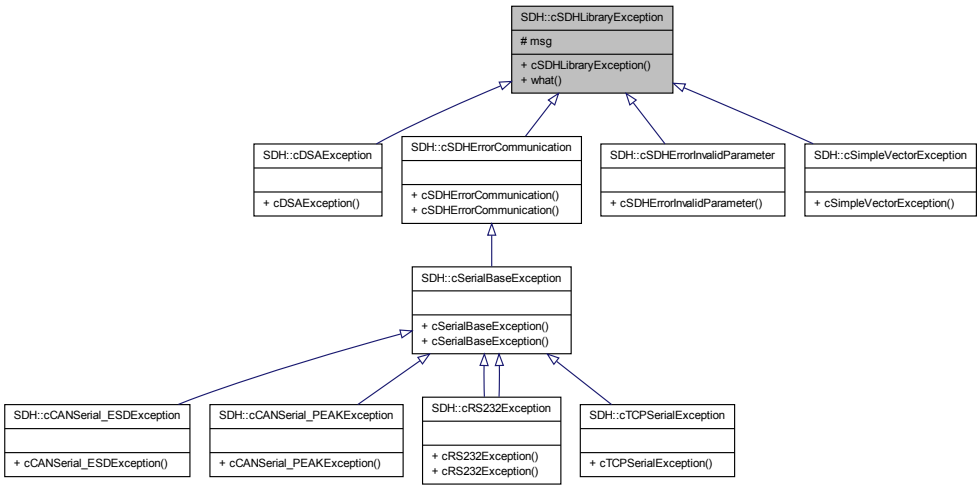
- sdh/sdhbase.h

10.24 SDH::cSDHLibraryException Class Reference

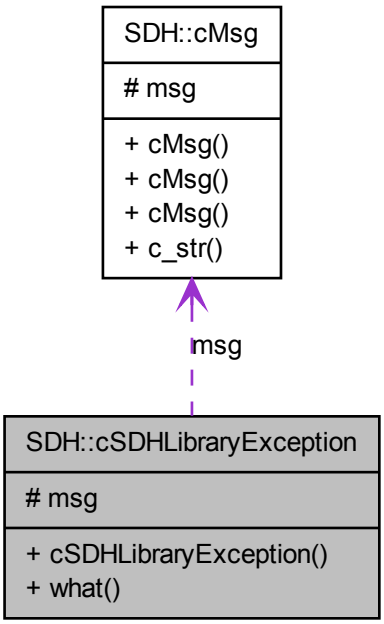
Base class for exceptions in the SDHLibrary-CPP.

`#include <sdhexception.h>`

Inheritance diagram for SDH::cSDHLibraryException:



Collaboration diagram for SDH::cSDHLibraryException:



Public Member Functions

- cSDHLibraryException (char const *_type, cMsg const &_msg)
- virtual const char * what () const throw ()

Protected Attributes

- cMsg msg

  The message object.

10.24.1 Detailed Description

Base class for exceptions in the SDHLibrary-CPP. At construction time a cMsg object is stored in the msg member of the cSDHLibraryException object. The cMsg object should contain a string wich further describes the actual cause of the exception thrown.

The string in the cMsg object can be queried with the overloaded what() member function, just like in the std::exception class.

See the verbose description of the constructor SDH::cSDHLibraryException::cSDHLibraryException() for examplary use.

10.24.2 Constructor & Destructor Documentation

10.24.2.1 cSDHLibraryException::cSDHLibraryException (char const * *_type*, cMsg const & *_msg*)

Constructor of sdh exception base class.

Parameters

_type	- the type name of the exception. By convention this is the class name of the exception
_msg	- a reference to a cMsg object that further describes the exception.

Remarks

- The *_type* parameter is mainly usefull in derived classes
- The *_msg* given as parameter is copied to the msg member. Thus the given *_msg* object can be an anonymous object, like in:

```
...
if ( v > v_max )
  throw new cSDHLibraryException( "cSDHLibraryException", cMsg( "Failed sin
ce v is invalid (v=%d > %d=v_max)", v, v_max ) );
```

- But exceptions of the base will hardly ever be thrown. Instead objects of derived, more specific classes will be thrown. This looks like:

```
// Derived exception class for more specific exceptions:
class VCC_EXPORT cDerivedException : public cSDHLibraryException
{
public:
  cDerivedException( cMsg const & _msg )
    : cSDHLibraryException( "cDerivedException", _msg )
  {}
}
// (Yes that is really all that must be done here!)

...

try
{
  ...
  if ( v > v_max )
    throw new cDerivedException( cMsg( "Failed since v is invalid (v=%d > %
d=v_max)", v, v_max ) );
  ...
}
catch ( cDerivedException *e )
{
  cerr << "Caught exception " << e->what() << "\n";
```

```
  // handle exception
  ...

  // finally delete the caught exception
  delete e;
}
```

10.24.3 Member Function Documentation

10.24.3.1 const char * cSDHLibraryException::what ( ) const throw () [virtual]

Return the msg member

10.24.4 Member Data Documentation

10.24.4.1 cMsg SDH::cSDHLibraryException::msg [protected]

The message object.

The documentation for this class was generated from the following files:

- sdh/sdhexception.h
- sdh/sdhexception.cpp

10.25 cSDHOptions Class Reference

class for command line option parsing holding option parsing results

`#include <sdhoptions.h>`

Public Member Functions

- cSDHOptions (char const *option_selection="general sdhcom_serial sdhcom_-common sdhcom_esdcan sdhcom_peakcan sdhcom_cancommon sdhcom_tcp")
- ~cSDHOptions ()

  destructor, clean up

- int Parse (int argc, char **argv, char const *helptext, char const *progname, char const *version, char const *libname, char const *librelease)
- void OpenCommunication (NS_SDH cSDH &hand)

Public Attributes

- std::string usage
- int debug_level
- std::ostream * debuglog

- int sdhport
- char sdh_rs_device [MAX_DEV_LENGTH]
- double timeout
- unsigned long rs232_baudrate
- bool use_can_esd
- int net
- bool use_can_peak
- char sdh_canpeak_device [MAX_DEV_LENGTH]
- unsigned long can_baudrate
- unsigned int id_read
- unsigned int id_write
- bool use_radians
- bool use_fahrenheit
- double period
- int dsaport
- char dsa_rs_device [MAX_DEV_LENGTH]
- bool do_RLE
- int framerate
- bool fullframe
- bool sensorinfo
- bool controllerinfo
- int matrixinfo [6]
- double sensitivity [6]
- unsigned int threshold [6]
- bool reset_to_default
- bool persistent
- bool showdsasettings
- bool use_tcp
- std::string tcp_adr
- int tcp_port
- bool dsa_use_tcp
- int dsa_tcp_port

Static Public Attributes

- static int const MAX_DEV_LENGTH = 32

10.25.1 Detailed Description

class for command line option parsing holding option parsing results

10.25.2 Constructor & Destructor Documentation

10.25.2.1 cSDHOptions::cSDHOptions (char const * *option_selection* = "general sdhcom_serial sdhcom_common sdhcom_esdcan sdhcom_peakcan sdhcom_cancommon sdhcom_tcp")

constructor: init members to their default values

Parameters

option_selection	- string that names the options to include in helptext for online help. With a text including one of the following keywords the corresponding helptext is added to the usage helptext • "general" see sdhusage_general • "sdhcom_serial" see sdhusage_sdhcom_serial • "sdhcom_common" see sdhusage_sdhcom_common • "sdhcom_esdcan" see sdhusage_sdhcom_esdcan • "sdhcom_peakcan" see sdhusage_sdhcom_peakcan • "sdhcom_cancommon" see sdhusage_sdhcom_cancommon • "sdhcom_tcp" see sdhusage_sdhcom_tcp • "sdhother" see sdhusage_sdhother • "dsacom" see sdhusage_dsacom • "dsaother" see sdhusage_dsaother

10.25.2.2 cSDHOptions::~cSDHOptions ( )

destructor, clean up

10.25.3 Member Function Documentation

10.25.3.1 void cSDHOptions::OpenCommunication (NS_SDH cSDH & *hand*)

convenience function to open the communication of the given *hand* object according to the parsed parameters.

Parameters

hand	- reference to a cSDH object to open

10.25.3.2 int cSDHOptions::Parse (int *argc,* char ∗∗ *argv,* char const ∗ *helptext,* char const ∗ *progname,* char const ∗ *version,* char const ∗ *libname,* char const ∗ *librelease*)

parse the command line parameters *argc*, *argv* into members. *helptext*, *progname*, *version*, *libname* and *librelease* are used when printing online help. start parsing at option with index ∗p_option_index parse all options if parse_all is true, else only one option is parsed

Returns

the optind index of the first non option argument in argv

10.25.4 Member Data Documentation

10.25.4.1 unsigned long cSDHOptions::can_baudrate

10.25.4.2 bool cSDHOptions::controllerinfo

10.25.4.3 int cSDHOptions::debug_level

10.25.4.4 std::ostream* cSDHOptions::debuglog

10.25.4.5 bool cSDHOptions::do_RLE

10.25.4.6 char cSDHOptions::dsa_rs_device[MAX_DEV_LENGTH]

10.25.4.7 int cSDHOptions::dsa_tcp_port

10.25.4.8 bool cSDHOptions::dsa_use_tcp

10.25.4.9 int cSDHOptions::dsaport

10.25.4.10 int cSDHOptions::framerate

10.25.4.11 bool cSDHOptions::fullframe

10.25.4.12 unsigned int cSDHOptions::id_read

10.25.4.13 unsigned int cSDHOptions::id_write

10.25.4.14 int cSDHOptions::matrixinfo[6]

10.25.4.15 int const cSDHOptions::MAX_DEV_LENGTH = 32 [static]

10.25.4.16 int cSDHOptions::net

10.25.4.17 double cSDHOptions::period

10.25.4.18 bool cSDHOptions::persistent

10.25.4.19 bool cSDHOptions::reset_to_default

10.25.4.20 unsigned long cSDHOptions::rs232_baudrate

10.25.4.21 char cSDHOptions::sdh_canpeak_device[MAX_DEV_LENGTH]

10.25.4.22 char cSDHOptions::sdh_rs_device[MAX_DEV_LENGTH]

10.25.4.23 int cSDHOptions::sdhport

10.25.4.24 double cSDHOptions::sensitivity[6]

10.25.4.25 bool cSDHOptions::sensorinfo

10.25.4.26 bool cSDHOptions::showdsasettings

10.25.4.27 std::string cSDHOptions::tcp_adr

10.25.4.28 int cSDHOptions::tcp_port

10.25.4.29 unsigned int cSDHOptions::threshold[6]

- demo/sdhoptions.h

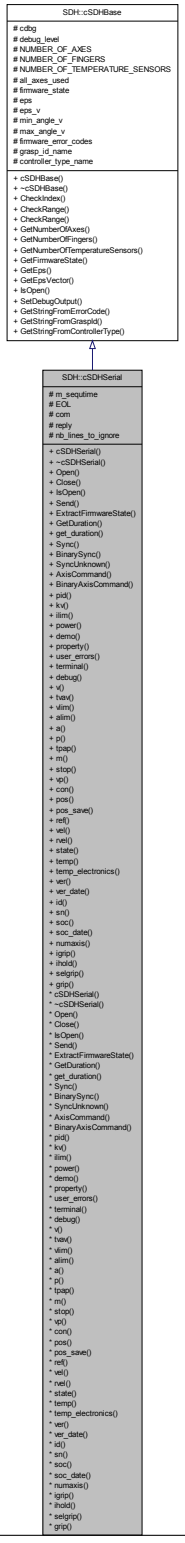
- demo/sdhoptions.cpp

10.26 SDH::cSDHSerial Class Reference

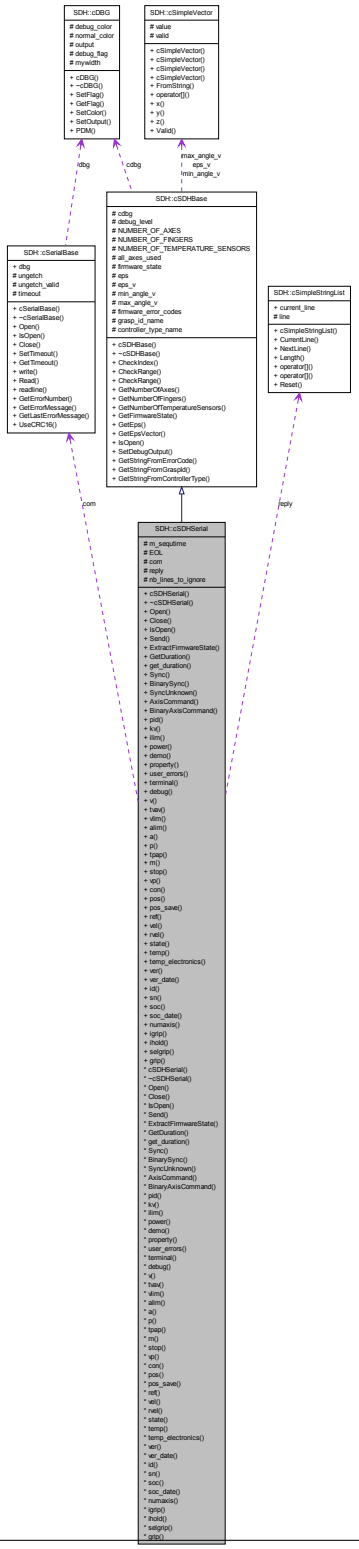
The class to communicate with a SDH via RS232.

`#include <sdhserial.h>`

Inheritance diagram for SDH::cSDHSerial:



Collaboration diagram for SDH::cSDHSerial:



Public Member Functions

Internal methods

- cSDHSerial (int _debug_level=0)
  Constructor of cSDHSerial.

- virtual ~cSDHSerial ()
- void Open (cSerialBase *_com) throw (cSDHLibraryException*)
- void Close () throw (cSDHLibraryException*)
- virtual bool IsOpen (void)
- void Send (char const *s, int nb_lines=All, int nb_lines_total=All, int max_-retries=3) throw (cSDHLibraryException*)
- void ExtractFirmwareState () throw (cSDHErrorCommunication*)
- double GetDuration (char *line) throw (cSDHErrorCommunication*)
- double get_duration (void)
- void Sync () throw (cSDHErrorCommunication*)
- void BinarySync (double timeout_s=0.5) throw (cSDHErrorCommunication*)
- void SyncUnknown () throw (cSDHErrorCommunication*)
- cSimpleVector AxisCommand (char const *command, int axis=All, double *value=NULL) throw (cSDHLibraryException*)
- cSimpleVector BinaryAxisCommand (eCommandCode command, int axis=All, double *value=NULL) throw (cSDHLibraryException*)

Setup and configuration methods

- cSimpleVector pid (int axis, double *p=NULL, double *i=NULL, double *d=NULL) throw (cSDHLibraryException*)
- cSimpleVector kv (int axis=All, double *kv=NULL) throw (cSDHLibraryException*)
- cSimpleVector ilim (int axis=All, double *limit=NULL) throw (cSDHLibraryException*)
- cSimpleVector power (int axis=All, double *flag=NULL) throw (cSDHLibraryException*)

Misc. methods

- void demo (bool onoff)
- int property (char const *propname, int value)
- int user_errors (int value)
- int terminal (int value)
- int debug (int value)

Movement methods

- cSimpleVector v (int axis=All, double *velocity=NULL) throw (cSDHLibraryException*)
- cSimpleVector tvav (int axis=All, double *velocity=NULL) throw (cSDHLibraryException*)
- cSimpleVector vlim (int axis=All, double *dummy=NULL) throw (cSDHLibraryException*)
- cSimpleVector alim (int axis=All, double *dummy=NULL) throw (cSDHLibraryException*)
- cSimpleVector a (int axis=All, double *acceleration=NULL) throw (cSDHLibraryException*)
- cSimpleVector p (int axis=All, double *angle=NULL) throw (cSDHLibraryException*)
- cSimpleVector tpap (int axis=All, double *angle=NULL) throw (cSDHLibraryException*)
- double m (bool sequ) throw (cSDHLibraryException*)
- void stop (void) throw (cSDHLibraryException*)

- eVelocityProfile vp (eVelocityProfile velocity_profile=eVP_INVALID) throw (cSDHLibraryException∗)
- eControllerType con (eControllerType controller) throw (cSDHLibraryException∗)

Diagnostic and identification methods

- cSimpleVector pos (int axis=All, double ∗dummy=NULL) throw (cSDHLibraryException∗)
- cSimpleVector pos_save (int axis=All, double ∗value=NULL) throw (cSDHLibraryException∗)
- cSimpleVector ref (int axis=All, double ∗value=NULL) throw (cSDHLibraryException∗)
- cSimpleVector vel (int axis=All, double ∗dummy=NULL) throw (cSDHLibraryException∗)
- cSimpleVector rvel (int axis, double ∗dummy=NULL) throw (cSDHLibraryException∗)
- cSimpleVector state (int axis=All, double ∗dummy=NULL) throw (cSDHLibraryException∗)
- cSimpleVector temp (void) throw (cSDHLibraryException∗)
- cSimpleVector temp_electronics (void) throw (cSDHLibraryException∗)
- char ∗ ver (void) throw (cSDHLibraryException∗)
- char ∗ ver_date (void) throw (cSDHLibraryException∗)
- char ∗ id (void) throw (cSDHLibraryException∗)
- char ∗ sn (void) throw (cSDHLibraryException∗)
- char ∗ soc (void) throw (cSDHLibraryException∗)
- char ∗ soc_date (void) throw (cSDHLibraryException∗)
- int numaxis (void) throw (cSDHLibraryException∗)

Grip methods

- cSimpleVector igrip (int axis=All, double ∗limit=NULL) throw (cSDHLibraryException∗)
- cSimpleVector ihold (int axis=All, double ∗limit=NULL) throw (cSDHLibraryException∗)
- double selgrip (eGraspId grip, bool sequ) throw (cSDHLibraryException∗)
- double grip (double close, double velocity, bool sequ) throw (cSDHLibraryException∗)

Protected Attributes

- double m_sequtime

  additional time in seconds to wait for sequential execution of m command (as these are always executed non-sequentially by the SDH firmware

- char const ∗ EOL

  String to use as "End Of Line" marker when sending to SDH.

- cSerialBase ∗ com

  The communication object to the serial device (RS232 port or ESD CAN net)

- cSimpleStringList reply

  Space for the replies from the SDH.

- int nb_lines_to_ignore

  number of remaining reply lines of a previous (non-sequential) command

Friends

- struct sSDHBinaryRequest
- struct sSDHBinaryResponse

10.26.1 Detailed Description

The class to communicate with a SDH via RS232. End-Users should **NOT** use this class directly! The interface of cSDHSerial is subject to change in future releases. End users should use the class cSDH instead, as that interface is considered more stable.

10.26.2 Constructor & Destructor Documentation

10.26.2.1 cSDHSerial::cSDHSerial (int *_debug_level* = 0)

Constructor of cSDHSerial.

Parameters

_debug_level	: debug level of the created object. If the *debug_level* of an object is > 0 then it will output debug messages. (forwared to constructor of base class)

String to use as "End Of Line" marker when sending to SDH

10.26.2.2 virtual SDH::cSDHSerial::~cSDHSerial ( ) [inline, virtual]

virtual destructor to make compiler happy

10.26.3 Member Function Documentation

10.26.3.1 cSimpleVector cSDHSerial::a (int *axis* = All, double * *acceleration* = NULL) throw (cSDHLibraryException*)

Get/Set target acceleration for axis. (NOT the actual acceleration!)

- If axis is All and acceleration is None then a NUMBER_OF_AXES-list of the actually set target accelerations is returned
- If axis is a single number and acceleration is None then the target acceleration for that axis is returned.
- If axis and acceleration are single numbers then the target acceleration for that axis is set (and returned).
- If axis is All and acceleration is a NUMBER_OF_AXES-vector then all axes target accelerations are set accordingly, the NUMBER_OF_AXES-list is returned.

Accelerations are set/reported in degrees per second squared.

10.26.3.2 cSimpleVector cSDHSerial::alim (int *axis* = `All`, double * *dummy* = `NULL`) throw (cSDHLibraryException*)

Get acceleration limits.

- If axis is All then a NUMBER_OF_AXES-list of the acceleration limits is returned
- If axis is a single number then the acceleration limit for that axis is returned.

dummy parameter is just needed to make this function have the same signature as e.g. v(), so it can be used as a function pointer.

Acceleration limits are reported in degrees per (second*second).

10.26.3.3 cSimpleVector cSDHSerial::AxisCommand (char const * *command*, int *axis* = `All`, double * *value* = `NULL`) throw (cSDHLibraryException*)

Get/Set values.

- If axis is All and value is None then a NUMBER_OF_AXES-list of the actual values read from the SDH is returned
- If axis is a single number and value is None then the actual value for that axis is read from the SDH and is returned
- If axis and value are single numbers then that value is set for that axis and returned.
- If axis is All and value is a NUMBER_OF_AXES-vector then all axes values are set accordingly, a NUMBER_OF_AXES-list is returned.

10.26.3.4 cSimpleVector cSDHSerial::BinaryAxisCommand (eCommandCode *command*, int *axis* = `All`, double * *value* = `NULL`) throw (cSDHLibraryException*)

Get/Set values using binary mode.

- If axis is All and value is None then a NUMBER_OF_AXES-list of the actual values read from the SDH is returned
- If axis is a single number and value is None then the actual value for that axis is read from the SDH and is returned
- If axis and value are single numbers then that value is set for that axis and returned.
- If axis is All and value is a NUMBER_OF_AXES-vector then all axes values are set accordingly, a NUMBER_OF_AXES-list is returned.

10.26.3.5 void cSDHSerial::BinarySync (double *timeout_s* = 0.5) throw (cSDHErrorCommunication*)

Read all available bytes within *timeout_s* seconds to resync execution of PC and SDH.

10.26.3.6 void cSDHSerial::Close (void) throw (cSDHLibraryException*)

Close connection to serial port.

10.26.3.7 cSDHBase::eControllerType cSDHSerial::con (eControllerType *controller*) throw (cSDHLibraryException*)

Get/set controller type.

If *controller* is < 0 then the actually set controller is read from the SDH firmware and returned. Else the given controller type is set in the SDH firmware if valid.

10.26.3.8 int cSDHSerial::debug (int *value*)

10.26.3.9 void cSDHSerial::demo (bool *onoff*)

Enable/disable SCHUNK demo

10.26.3.10 void cSDHSerial::ExtractFirmwareState ( ) throw (cSDHErrorCommunication*)

Try to extract the state of the SDH firmware from the last reply

10.26.3.11 double cSDHSerial::get_duration (void)

Send get_duration command. Returns the calculated duration of the currently configured movement (target positions, velocities, accelerations and velocity profile.

return the expected duration of the execution of the command in seconds

10.26.3.12 double cSDHSerial::GetDuration (char * *line*) throw (cSDHErrorCommunication*)

Return duration of the execution of a SDH command as reported by line

10.26.3.13 double cSDHSerial::grip (double *close,* double *velocity,* bool *sequ*) throw (cSDHLibraryException*)

send "grip=close,velocity" command to SDH close : [0.0 .. 1.0] where 0.0 is 'fully opened' and 1.0 is 'fully closed' velocity :]0.0 .. 100.0] where 0.0 (not allowed) is

very slow and 100.0 is very fast

If sequ is True then wait until SDH hardware fully executed the command. Else return immediately and do not wait until SDH hardware fully executed the command.

This seems to work with sin square velocity profile only, so the velocity profile is switched to that if necessary.

return the expected duration of the execution of the command in seconds

10.26.3.14 char * cSDHSerial::id (void) throw (cSDHLibraryException*)

Return id of SDH

Attention

The string returned is stored internally in this object and might be overwritten by the next command to this object

10.26.3.15 cSimpleVector cSDHSerial::igrip (int *axis* = All, double * *limit* = NULL) throw (cSDHLibraryException*)

Get/Set motor current limits for grip commands

- If axis is All and limit is None then a NUMBER_OF_AXES-list of the actually set motor current limits is returned
- If axis is a single number and limit is None then the motor current limit for that axis is returned.
- If axis and limit are single numbers then the motor current limit for that axis is set (and returned).
- If axis is All and limit is a NUMBER_OF_AXES-vector then all axes motor current limits are set accordingly, the NUMBER_OF_AXES-list is returned.

10.26.3.16 cSimpleVector cSDHSerial::ihold (int *axis* = All, double * *limit* = NULL) throw (cSDHLibraryException*)

Get/Set motor current limits for hold commands

- If axis is All and limit is None then a NUMBER_OF_AXES-list of the actually set motor current limits is returned
- If axis is a single number and limit is None then the motor current limit for that axis is returned.
- If axis and limit are single numbers then the motor current limit for that axis is set (and returned).
- If axis is All and limit is a NUMBER_OF_AXES-vector then all axes motor current limits are set accordingly, the NUMBER_OF_AXES-list is returned.

10.26.3.17 cSimpleVector cSDHSerial::ilim (int *axis* = All, double * *limit* = NULL) throw (cSDHLibraryException*)

Get/Set actual motor current limit for m command

- If axis is All and limit is None then a NUMBER_OF_AXES-list of the actually set motor current limits is returned
- If axis is a single number and limit is None then the motor current limit for that axis is returned.
- If axis and limit are single numbers then the motor current limit for that axis is set (and returned).
- If axis is All and limit is a NUMBER_OF_AXES-vector then all axes motor current limits are set accordingly, the NUMBER_OF_AXES-list is returned.

10.26.3.18 bool cSDHSerial::IsOpen (void) [virtual]

Return true if connection to SDH firmware/hardware is open

Implements SDH::cSDHBase.

10.26.3.19 cSimpleVector cSDHSerial::kv (int *axis* = All, double * *kv* = NULL) throw (cSDHLibraryException*)

Get/Set kv parameter

- If axis is All and kv is None then a NUMBER_OF_AXES-list of the actually set kv parameters is returned
- If axis is a single number and kv is None then the kv parameter for that axis is returned.
- If axis and kv are single numbers then the kv parameter for that axis is set (and returned).
- If axis is All and kv is a NUMBER_OF_AXES-vector then all axes kv parameters are set accordingly, NUMBER_OF_AXES-list is returned.

Bug

With SDH firmware 0.0.2.9 kv() might not respond kv value correctly in case it was changed before. With SDH firmwares 0.0.2.10 and newer this now works.
=> **Resolved in SDH firmware 0.0.2.10**

10.26.3.20 double cSDHSerial::m (bool *sequ*) throw (cSDHLibraryException*)

Send move command. Moves all enabled axes to their previously set target angle. The movement duration is determined by that axis that takes longest with its actually set velocity. The actual velocity of all other axes is set so that all axes begin and end their movements synchronously.

If sequ is True then wait until SDH hardware fully executed the command. Else return immediately and do not wait until SDH hardware fully executed the command.

return the expected duration of the execution of the command in seconds

10.26.3.21 int cSDHSerial::numaxis (void) throw (cSDHLibraryException*)

Return number of axis of SDH

10.26.3.22 void cSDHSerial::Open (cSerialBase * *_com*) throw (cSDHLibraryException*)

Open the serial device and check connection to SDH by querying the SDH firmware version

Parameters

_com	- ptr to the serial device to use

This may throw an exception on failure.

The serial port on the PC-side can be opened successfully even if no SDH is attached. Therefore this routine tries to read the SDH firmware version with a 1s timeout after the port is opened. If the SDH does not reply in time then

- an error message is printed on stderr,
- the port is closed
- and a cSerialBaseException* exception is thrown.

Bug

SCHUNK-internal bugzilla ID: Bug 1517
With SDH firmware 0.0.3.x the first connection to a newly powered up SDH can yield an error especially when connecting via TCP.
=> Resolved in SDHLibrary-C++ 0.0.2.10

10.26.3.23 cSimpleVector cSDHSerial::p (int *axis* = `All`, double * *angle* = `NULL`) throw (cSDHLibraryException*)

Get/Set target angle for axis. (NOT the actual angle!)

- If axis is All and angle is None then a NUMBER_OF_AXES-list of the actually set target angles is returned
- If axis is a single number and angle is None then the target angle for that axis is returned.
- If axis and angle are single numbers then the target angle for that axis is set (and returned).
- If axis is All and angle is a NUMBER_OF_AXES-vector then all axes target angles are set accordingly, the NUMBER_OF_AXES-list is returned.

Angles are set/reported in degrees.

10.26.3.24 cSimpleVector cSDHSerial::pid (int *axis*, double * *p* = NULL, double * *i* = NULL, double * *d* = NULL) throw (cSDHLibraryException*)

Get/Set PID controller parameters

- axis must be a single number: the index of the axis to get/set
- If p,i,d are None then a list of the actually set PID controller parameters of the axis is returned
- If p,i,d are numbers then the PID controller parameters for that axis are set (and returned).

Bug

With SDH firmware 0.0.2.9 pid() might not respond pid values correctly in case these were changed before. With SDH firmwares 0.0.2.10 and newer this now works.
=> **Resolved in SDH firmware 0.0.2.10**

10.26.3.25 cSimpleVector cSDHSerial::pos (int *axis* = All, double * *dummy* = NULL) throw (cSDHLibraryException*)

Get actual angle/s of axis/axes.

- If axis is All then a NUMBER_OF_AXES-vector of the actual axis angles is returned
- If axis is a single number then the actual angle of that axis is returned.

Angles are reported in degrees.

Remarks

dummy ptr is never used, but needed nonetheless to make the signature of the function the same as for the other axis-access functions. This way a pointer to it can be used as a pointer to the other functions, which is needed by the generic cSDH::SetAxisValue and cSDH::GetAxisValue functions.

10.26.3.26 cSimpleVector cSDHSerial::pos_save (int *axis* = All, double * *value* = NULL) throw (cSDHLibraryException*)

Save actual angle/s to non volatile memory. (Usefull for axes that dont have an absolute encoder)

- If value is None then an exception is thrown since this is NOT usefull if any axis has an absolute encoder that the LLC knows about since these positions will be invalidated at the next start
- If axis and value are single numbers then that axis is saved.
- If axis is All and value is a NUMBER_OF_AXES-vector then all axes are saved if the corresponding value is 1.
- This will yield a E_RANGE_ERROR if any of the given values is not 0 or 1

10.26.3.27 cSimpleVector cSDHSerial::power (int *axis* = All, double * *flag* = NULL) throw (cSDHLibraryException*)

Get/Set actual power state

- If axis is All and flag is None then a NUMBER_OF_AXES-list of the actually set power states is returned
- If axis is a single number and flag is None then the power state for that axis is returned.
- If axis is a single number and flag is a single number or a boolean value then the power state for that axis is set (and returned).
- If axis is All and flag is a NUMBER_OF_AXES-vector then all axes power states are set accordingly, the NUMBER_OF_AXES-list is returned.
- If axis is All and flag is a a single number or a boolean value then all axes power states are set to that value, the NUMBER_OF_AXES-list is returned.

10.26.3.28 int cSDHSerial::property (char const * *propname*, int *value*)

Set named property

Valid propnames are:

- "user_errors"
- "terminal"
- "debug"

10.26.3.29 cSimpleVector cSDHSerial::ref (int *axis* = `All`, double * *value* = `NULL`) throw (cSDHLibraryException*)

Do reference movements with selected axes. (Usefull for axes that dont have an absolute encoder)

each *value* must be either

- 0 : do not reference
- 1 : reference till mechanical block in positive direction
- 2 : reference till mechanical block in negative direction

- If *axis* and *value* are single numbers then that axis is referenced as requested
- If *axis* is All and *value* is a NUMBER_OF_AXES-vector then all axes are referenced as requested.
- This will yield a E_RANGE_ERROR if any of the given values is not 0 or 1 or 2

10.26.3.30 cSimpleVector cSDHSerial::rvel (int *axis*, double * *dummy* = `NULL`) throw (cSDHLibraryException*)

Get current reference angular velocity/s of axis/axes. The reference angular velocity is used by the eCT_VELOCITY_ACCELERATION controller type only.

- If axis is All then a NUMBER_OF_AXES-vector of the current reference velocities is returned
- If axis is a single number then the current reference angular velocity of that axis is returned.

Angular velocities are reported in degrees/second.

Remarks

- *dummy* ptr is never used, but needed nonetheless to make the signature of the function the same as for the other axis-access functions. This way a pointer to it can be used as a pointer to the other functions, which is needed by the generic cSDH::SetAxisValue and cSDH::GetAxisValue functions.
- the underlying rvel command of the SDH firmware is not available in SDH firmwares prior to 0.0.2.6. For such hands calling rvel will fail miserably.

10.26.3.31 double cSDHSerial::selgrip (eGraspId *grip*, bool *sequ*) throw (cSDHLibraryException*)

Send "selgrip grip" command to SDH. Where grip is in [0..eGID_DIMENSION-1] or one of the eGraspId enums.

If sequ is True then wait until SDH hardware fully executed the command. Else return immediately and do not wait until SDH hardware fully executed the command.

This seems to work with sin square velocity profile only, so the velocity profile is switched to that if necessary.

return the expected duration of the execution of the command in seconds

10.26.3.32 void cSDHSerial::Send (char const * *s*, int *nb_lines* = `All`, int *nb_lines_total* = `All`, int *max_retries* = `3`) throw (cSDHLibraryException*)

Send command string s+EOL to com and read reply according to nb_lines.

If nb_lines == All then reply lines are read until a line without "@" prefix is found. If nb_lines != All it is the number of lines to read.

firmware_state is set according to reply (if read) nb_lines_total contains the total number of lines replied for the s command. If fewer lines are read then nb_lines_total-nb_lines will be remembered to be ignored before the next command can be sent.

Return a list of all read lines of the reply from the SDH hardware.

10.26.3.33 char * cSDHSerial::sn (void) throw (cSDHLibraryException*)

Return sn of SDH

Attention

The string returned is stored internally in this object and might be overwritten by the next command to this object

10.26.3.34 char * cSDHSerial::soc (void) throw (cSDHLibraryException*)

Return soc (System On Chip) ID of SDH

Attention

The string returned is stored internally in this object and might be overwritten by the next command to this object

10.26.3.35 char * cSDHSerial::soc_date (void) throw (cSDHLibraryException*)

Return date of soc (System On Chip) ID of SDH

Attention

The string returned is stored internally in this object and might be overwritten by the next command to this object

10.26.3.36 cSimpleVector cSDHSerial::state (int *axis* = `All`, double * *dummy* = `NULL`) throw (cSDHLibraryException*)

Get actual state/s of axis/axes.

A state of 0 means "not moving" while 1 means "moving".

- If axis is All then a NUMBER_OF_AXES-vector of the actual axis states is returned
- If axis is a single number then the actual state of that axis is returned.

10.26.3.37 void cSDHSerial::stop (void) throw (cSDHLibraryException*)

Stop sdh.

Will NOT interrupt a previous "selgrip" or "grip" command, only an "m" command!

10.26.3.38 void cSDHSerial::Sync ( ) throw (cSDHErrorCommunication*)

Read all pending lines from SDH to resync execution of PC and SDH.

10.26.3.39 void cSDHSerial::SyncUnknown ( ) throw (cSDHErrorCommunication*)

Read an unknown number of lines from SDH to resync execution of PC and SDH.

10.26.3.40 cSimpleVector cSDHSerial::temp (void) throw (cSDHLibraryException*)

Get actual temperatures of the axis motors

Returns a list of the actual controller and driver temperature in degrees celsius.

10.26.3.41 cSimpleVector cSDHSerial::temp_electronics (void) throw (cSDHLibraryException*)

Get actual temperatures of the electronics, i.e. teh FPGA and the PCB. (FPGA = Field Programmable Gate Array = the reprogrammable chip with the soft processors) (PCB = Printed Circuit Board)

Returns a list of the actual controller and driver temperature in degrees celsius.

10.26.3.42 int cSDHSerial::terminal (int *value*)

10.26.3.43 cSimpleVector cSDHSerial::tpap (int *axis* = All, double * *angle* = NULL) throw (cSDHLibraryException*)

Set target angle and get actual angle for axis.

- If axis is All and angle is None then a NUMBER_OF_AXES-list of the actual angles is returned
- If axis is a single number and angle is None then the actual angle for that axis is returned.
- If axis and angle are single numbers then the target angle for that axis is set and the actual angles are returned.
- If axis is All and angle is a NUMBER_OF_AXES-vector then all axes target angles are set accordingly, the NUMBER_OF_AXES-list of actual angles is returned.

Angles are set/reported in degrees.

10.26.3.44 cSimpleVector cSDHSerial::tvav (int *axis* = All, double * *velocity* = NULL) throw (cSDHLibraryException*)

Set target velocity and get actual velocity!)

The default velocity is 40 deg/s for axes 0-6 in eCT_POSE controller type. The default velocity is 0.0 deg/s for axes 0-6 in eCT_VELOCITY and eCT_VELOCITY_ACCELERATION controller types.

- If axis is All and velocity is None then a NUMBER_OF_AXES-list of the actual velocities is returned
- If axis is a single number and velocity is None then the actual velocity for that axis is returned.
- If axis and velocity are single numbers then the target velocity for that axis is set and the actual velocity is returned.
- If axis is All and velocity is a NUMBER_OF_AXES-vector then all axes target velocities are set accordingly, the NUMBER_OF_AXES-list of actual velocities is returned.

Velocities are set/reported in degrees per second.

Bug

With SDH firmware < 0.0.1.0 axis 0 can go no faster than 14 deg/s
=> **Resolved in SDH firmware 0.0.1.0**

10.26.3.45 int cSDHSerial::user_errors (int *value*)

10.26.3.46 cSimpleVector cSDHSerial::v (int *axis* = All, double * *velocity* = NULL) throw (cSDHLibraryException*)

Get/Set target velocity. (NOT the actual velocity!)

The default velocity is 40 deg/s for axes 0-6 in eCT_POSE controller type. The default velocity is 0.0 deg/s for axes 0-6 in eCT_VELOCITY and eCT_VELOCITY_-ACCELERATION controller types.

- If axis is All and velocity is None then a NUMBER_OF_AXES-list of the actually set target velocities is returned
- If axis is a single number and velocity is None then the target velocity for that axis is returned.
- If axis and velocity are single numbers then the target velocity for that axis is set (and returned).
- If axis is All and velocity is a NUMBER_OF_AXES-vector then all axes target velocities are set accordingly, the NUMBER_OF_AXES-list is returned.

Velocities are set/reported in degrees per second.

Bug

With SDH firmware $<$ 0.0.1.0 axis 0 can go no faster than 14 deg/s
=> **Resolved in SDH firmware 0.0.1.0**

10.26.3.47 cSimpleVector cSDHSerial::vel (int *axis* = All, double * *dummy* = NULL) throw (cSDHLibraryException*)

Get actual angular velocity/s of axis/axes.

- If axis is All then a NUMBER_OF_AXES-vector of the actual axis angular velocities is returned
- If axis is a single number then the actual angular velocity of that axis is returned.

Angular velocities are reported in degrees/second.

Remarks

dummy ptr is never used, but needed nonetheless to make the signature of the function the same as for the other axis-access functions. This way a pointer to it can be used as a pointer to the other functions, which is needed by the generic cSDH::SetAxisValue and cSDH::GetAxisValue functions.

10.26.3.48 char * cSDHSerial::ver (void) throw (cSDHLibraryException*)

Return version of SDH firmware

Attention

The string returned is stored internally in this object and might be overwritten by the next command to this object

10.26.3.49 char * cSDHSerial::ver_date (void) throw (cSDHLibraryException*)

Return date of SDH firmware

Attention

The string returned is stored internally in this object and might be overwritten by the next command to this object

10.26.3.50 cSimpleVector cSDHSerial::vlim (int *axis* = `All`, double * *dummy* = `NULL`) throw (cSDHLibraryException*)

Get velocity limits.

- If axis is All then a NUMBER_OF_AXES-list of the velocity limits is returned
- If axis is a single number then the velocity limit for that axis is returned.

dummy parameter is just needed to make this function have the same signature as e.g. v(), so it can be used as a function pointer.

Velocity limits are reported in degrees per second.

10.26.3.51 cSDHBase::eVelocityProfile cSDHSerial::vp (eVelocityProfile *velocity_profile* = `eVP_INVALID`) throw (cSDHLibraryException*)

Get/set velocity profile.

If *velocity_profile* is < 0 then the actually set velocity profile is read from the SDH firmware and returned. Else the given velocity_profile type is set in the SDH firmware if valid.

10.26.4 Friends And Related Function Documentation

10.26.4.1 friend struct sSDHBinaryRequest [friend]

10.26.4.2 friend struct sSDHBinaryResponse [friend]

10.26.5 Member Data Documentation

10.26.5.1 cSerialBase* SDH::cSDHSerial::com [protected]

The communication object to the serial device (RS232 port or ESD CAN net)

10.26.5.2 char const* SDH::cSDHSerial::EOL [protected]

String to use as "End Of Line" marker when sending to SDH.

10.26.5.3 double SDH::cSDHSerial::m_sequtime [protected]

additional time in seconds to wait for sequential execution of m command (as these are always executed non-sequentially by the SDH firmware

10.26.5.4 int SDH::cSDHSerial::nb_lines_to_ignore [protected]

number of remaining reply lines of a previous (non-sequential) command

10.26.5.5 cSimpleStringList SDH::cSDHSerial::reply [protected]

Space for the replies from the SDH.

The documentation for this class was generated from the following files:

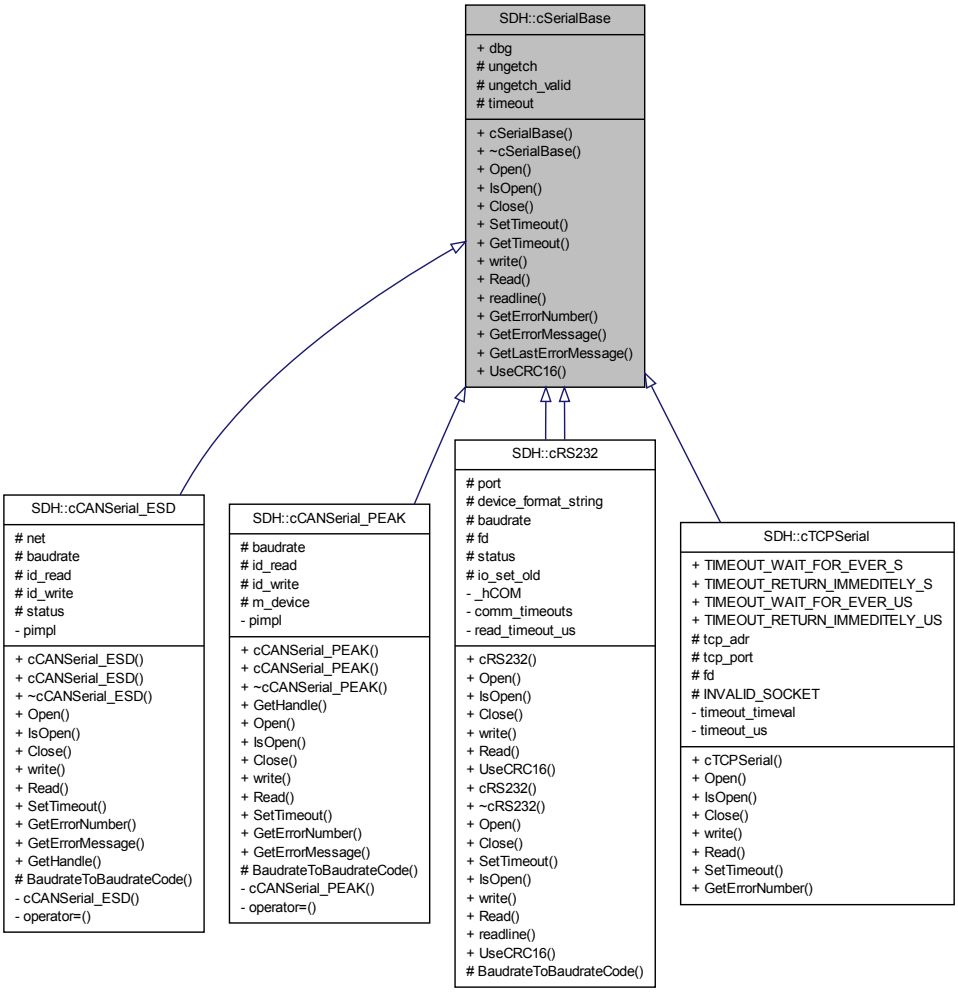
- sdh/sdhserial.h
- sdh/sdhserial.cpp

10.27 SDH::cSerialBase Class Reference

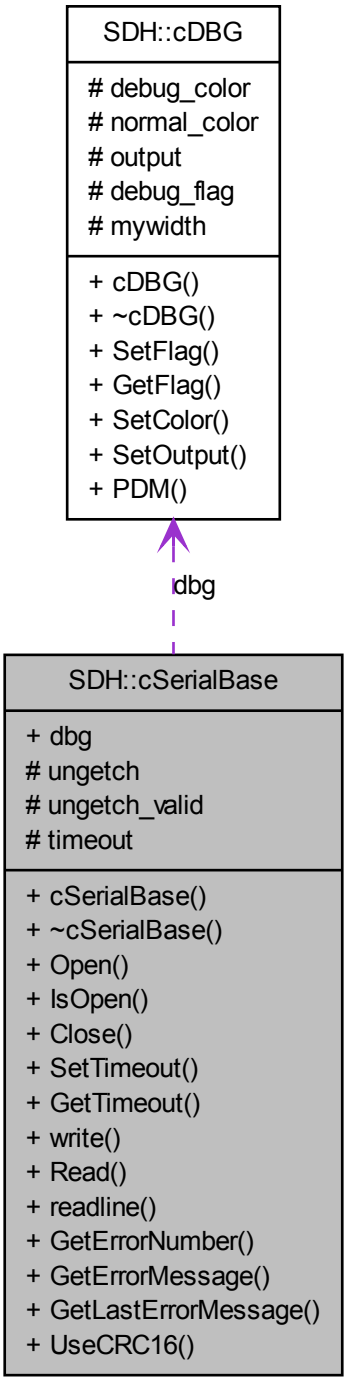
Low-level communication class to access a serial port.

`#include <serialbase.h>`

Inheritance diagram for SDH::cSerialBase:



Collaboration diagram for SDH::cSerialBase:



Classes

- class cSetTimeoutTemporarily

  helper class to set timeout of _serial_base on construction and reset to previous value on destruction. (RAII-idiom)

Public Types

- typedef int tErrorCode

  type of the error code, DWORD on windows and int on Linux/cygwin

Public Member Functions

- cSerialBase ()

  ctor

- virtual ~cSerialBase (void)

  dtor

- virtual void Open (void)=0 throw (cSerialBaseException*)

  Open rs232 port port.

- virtual bool IsOpen (void)=0 throw ()

  Return true if communication channel is open.

- virtual void Close (void)=0 throw (cSerialBaseException*)

  Close the previously opened communication channel.

- virtual void SetTimeout (double _timeout) throw (cSerialBaseException*)

  set the timeout for next readline() calls (negative value means: no timeout, wait for ever)

- virtual double GetTimeout ()

  get the timeout for next readline() calls (negative value means: no timeout, wait for ever)

- virtual int write (char const *ptr, int len=0)=0 throw (cSerialBaseException*)

  Write data to a previously opened port.

- virtual ssize_t Read (void *data, ssize_t size, long timeout_us, bool return_on_less_data)=0 throw (cSerialBaseException*)
- virtual char * readline (char *line, int size, char const *eol="\n", bool return_on_less_data=false) throw (cSerialBaseException*)

  Read a line from the device.

- virtual tErrorCode GetErrorNumber ()
- virtual char const * GetErrorMessage (tErrorCode dw)
- char const * GetLastErrorMessage (void)

  return the last error message as string. The string returned will be overwritten by the next call to the function

- virtual bool UseCRC16 ()

Public Attributes

- cDBG dbg

  A stream object to print colored debug messages.

Protected Attributes

- char ungetch

  an already read data byte of the next line

- bool ungetch_valid

  Flag, true if ungetch is valid.

- double timeout

  timeout in seconds

10.27.1 Detailed Description

Low-level communication class to access a serial port. (This is an abstract base class with pure virtual functions)

10.27.2 Member Typedef Documentation

10.27.2.1 typedef int SDH::cSerialBase::tErrorCode

type of the error code, DWORD on windows and int on Linux/cygwin

10.27.3 Constructor & Destructor Documentation

10.27.3.1 SDH::cSerialBase::cSerialBase ( ) [inline]

ctor

10.27.3.2 virtual SDH::cSerialBase::~cSerialBase (void) [inline, virtual]

dtor

10.27.4 Member Function Documentation

10.27.4.1 virtual void SDH::cSerialBase::Close (void) throw (cSerialBaseException*) [pure virtual]

Close the previously opened communication channel.

Implemented in SDH::cCANSerial_ESD, SDH::cCANSerial_PEAK, SDH::cRS232, SDH::cRS232, and SDH::cTCPSerial.

10.27.4.2 char const * cSerialBase::GetErrorMessage (tErrorCode *dw*) [virtual]

Helper function that returns an error message for error code dw.

- On windows FormatMessageA() is used
- On cygwin/linux this uses errno

Remarks

The string returned will be overwritten by the next call to the function

Reimplemented in SDH::cCANSerial_ESD, and SDH::cCANSerial_PEAK.

10.27.4.3 virtual tErrorCode SDH::cSerialBase::GetErrorNumber ( ) [inline, virtual]

Helper function that returns the last error number.

- On windows GetLastError() is used
- On cygwin/linux this uses errno

Reimplemented in SDH::cCANSerial_ESD, SDH::cCANSerial_PEAK, and SDH::cTCPSerial.

10.27.4.4 char const* SDH::cSerialBase::GetLastErrorMessage (void) [inline]

return the last error message as string. The string returned will be overwritten by the next call to the function

10.27.4.5 virtual double SDH::cSerialBase::GetTimeout ( ) [inline, virtual]

get the timeout for next readline() calls (negative value means: no timeout, wait for ever)

10.27.4.6 virtual bool SDH::cSerialBase::IsOpen (void) throw () [pure virtual]

Return true if communication channel is open.

Implemented in SDH::cCANSerial_ESD, SDH::cCANSerial_PEAK, SDH::cRS232, SDH::cRS232, and SDH::cTCPSerial.

10.27.4.7 virtual void SDH::cSerialBase::Open (void) throw (cSerialBaseException*) [pure virtual]

Open rs232 port *port*.

Open the device with the parameters provided in the constructor

Implemented in SDH::cCANSerial_ESD, SDH::cCANSerial_PEAK, SDH::cRS232, SDH::cRS232, and SDH::cTCPSerial.

10.27.4.8 virtual ssize_t SDH::cSerialBase::Read (void * *data*, ssize_t *size*, long *timeout_us*, bool *return_on_less_data*) throw (cSerialBaseException*) [pure virtual]

Read data from device. This function waits until *max_time_us* us passed or the expected number of bytes are received via serial line. if (*return_on_less_data* is true (default value), the number of bytes that have been received are returned and the data is stored in *data* If the *return_on_less_data* is false, data is only read from serial line, if at least *size* bytes are available.

Implemented in SDH::cCANSerial_ESD, SDH::cCANSerial_PEAK, SDH::cRS232, SDH::cRS232, and SDH::cTCPSerial.

10.27.4.9 char * cSerialBase::readline (char * *line*, int *size*, char const * *eol* = "\n", bool *return_on_less_data* = false) throw (cSerialBaseException*) [virtual]

Read a line from the device.

A line is terminated with one of the end-of-line (*eol*) characters ('

' by default) or until timeout. Up to *size-1* bytes are read and a '\0' char is appended.

Parameters

line	- ptr to where to store the read line
size	- space available in line (bytes)
eol	- a string containing all the chars that mark an end of line
return_on_less_data	- if (*return_on_less_data* is true (default value), the number of bytes that have been received are returned and the data is stored in *data* If the *return_on_less_data* is false, data is only read from serial line, if at least *size* bytes are available.

A pointer to the line read is returned.

10.27.4.10 virtual void SDH::cSerialBase::SetTimeout (double *_timeout*) throw (cSerialBaseException*) [inline, virtual]

set the timeout for next readline() calls (negative value means: no timeout, wait for ever)

Reimplemented in SDH::cCANSerial_ESD, SDH::cCANSerial_PEAK, SDH::cRS232, and SDH::cTCPSerial.

10.27.4.11 virtual bool SDH::cSerialBase::UseCRC16 ( ) [inline, virtual]

function that returns true if a CRC16 is used to protect binary communication.

The default is false since only RS232 communication needs this.

Reimplemented in SDH::cRS232, and SDH::cRS232.

10.27.4.12 virtual int SDH::cSerialBase::write (char const * *ptr*, int *len* = 0) throw (cSerialBaseException*) [pure virtual]

Write data to a previously opened port.

Write *len* bytes from *ptr* to the rs232 device

Parameters

ptr	- pointer the byte array to send in memory
len	- number of bytes to send

Returns

the number of bytes actually written

Implemented in SDH::cCANSerial_ESD, SDH::cCANSerial_PEAK, SDH::cRS232, SDH::cRS232, and SDH::cTCPSerial.

10.27.5 Member Data Documentation

10.27.5.1 cDBG SDH::cSerialBase::dbg

A stream object to print colored debug messages.

10.27.5.2 double SDH::cSerialBase::timeout [protected]

timeout in seconds

10.27.5.3 char SDH::cSerialBase::ungetch [protected]

an already read data byte of the next line

10.27.5.4 bool SDH::cSerialBase::ungetch_valid [protected]

Flag, true if ungetch is valid.

The documentation for this class was generated from the following files:

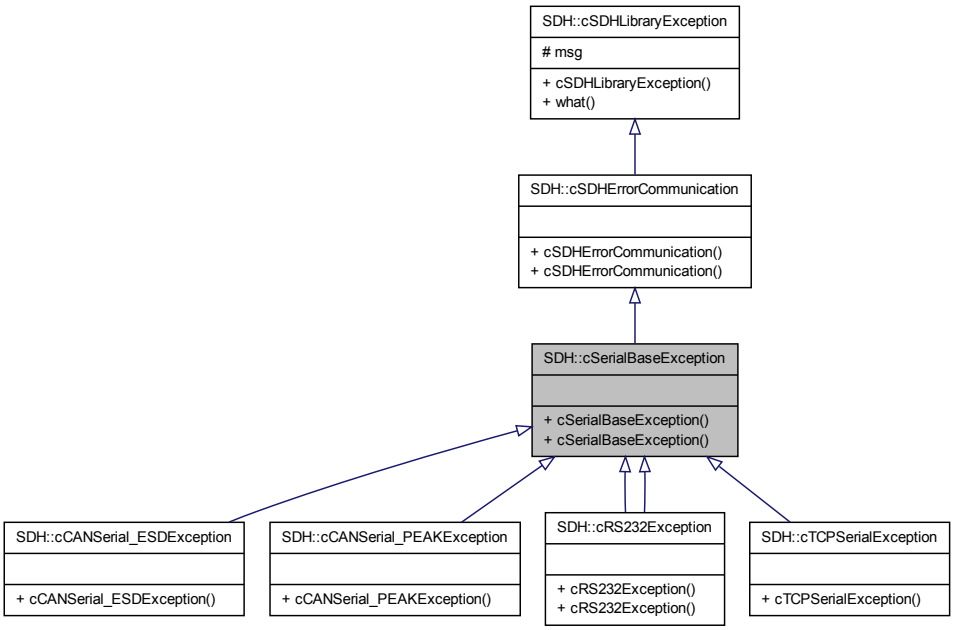
- sdh/serialbase.h
- sdh/serialbase.cpp

10.28 SDH::cSerialBaseException Class Reference

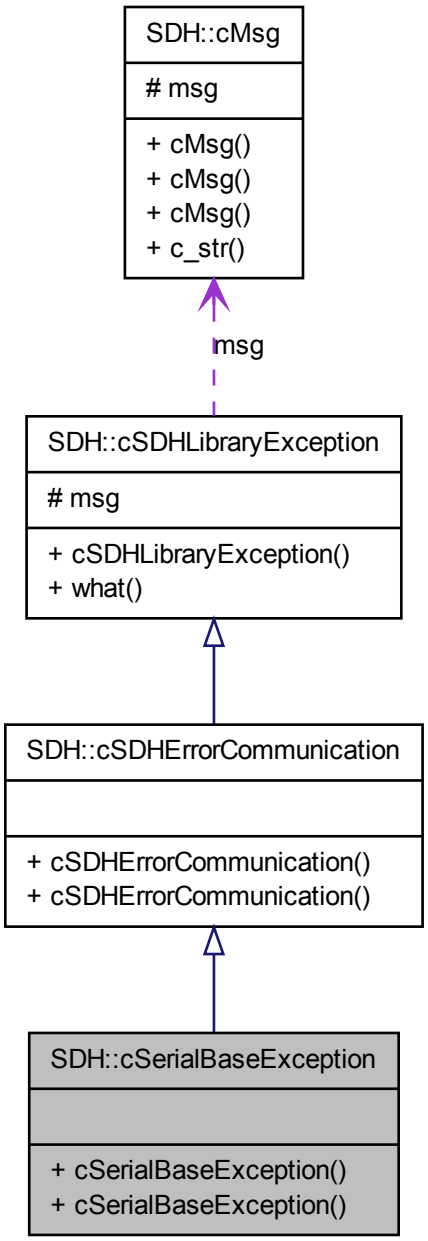
Derived exception class for low-level serial communication related exceptions.

`#include <serialbase.h>`

Inheritance diagram for SDH::cSerialBaseException:



Collaboration diagram for SDH::cSerialBaseException:



Public Member Functions

- cSerialBaseException (cMsg const &_msg)
- cSerialBaseException (char const *_type, cMsg const &_msg)

10.28.1 Detailed Description

Derived exception class for low-level serial communication related exceptions.

10.28.2 Constructor & Destructor Documentation

10.28.2.1 SDH::cSerialBaseException::cSerialBaseException (cMsg const & *_msg*) [inline]

10.28.2.2 SDH::cSerialBaseException::cSerialBaseException (char const * *_type*, cMsg const & *_msg*) [inline]

The documentation for this class was generated from the following file:

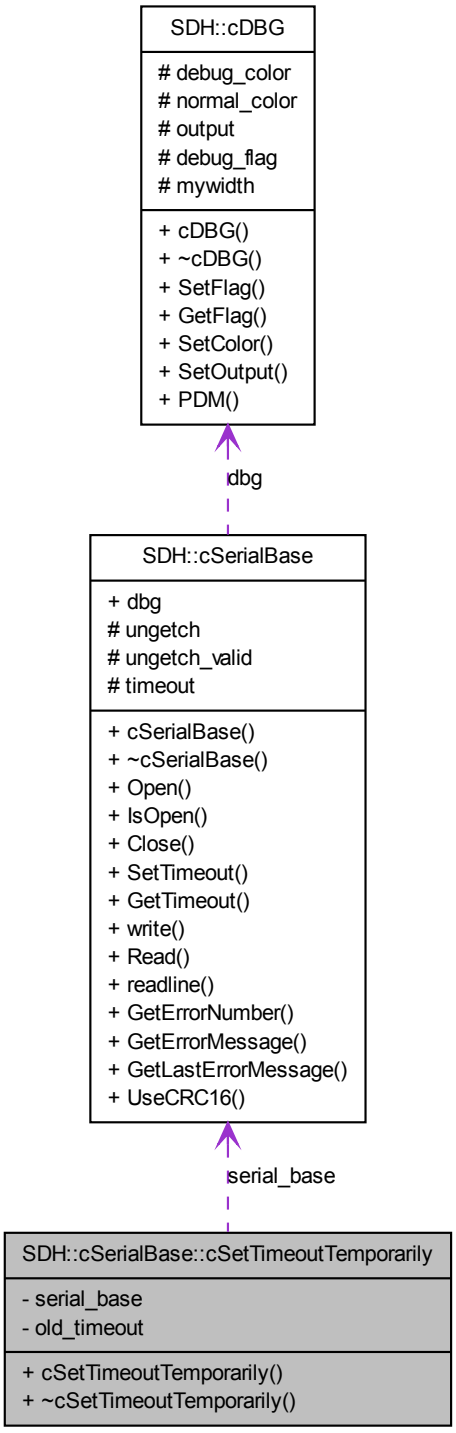
- sdh/serialbase.h

10.29 SDH::cSerialBase::cSetTimeoutTemporarily Class Reference

helper class to set timeout of _serial_base on construction and reset to previous value on destruction. (RAII-idiom)

`#include <serialbase.h>`

Collaboration diagram for SDH::cSerialBase::cSetTimeoutTemporarily:



Public Member Functions

- cSetTimeoutTemporarily (cSerialBase *_serial_base, double new_timeout)

  CTOR: remember current timeout of _serial_base and set its timeout to new_timeout, but only if current timeout and new_timeout differ.

- ~cSetTimeoutTemporarily ()

  DTOR: restore the remembered timeout.

10.29.1 Detailed Description

helper class to set timeout of _serial_base on construction and reset to previous value on destruction. (RAII-idiom)

10.29.2 Constructor & Destructor Documentation

10.29.2.1 SDH::cSerialBase::cSetTimeoutTemporarily::cSetTimeoutTemporarily (cSerialBase * *_serial_base*, double *new_timeout*) [inline]

CTOR: remember current timeout of *_serial_base* and set its timeout to *new_timeout*, but only if current timeout and new_timeout differ.

10.29.2.2 SDH::cSerialBase::cSetTimeoutTemporarily::~cSetTimeoutTemporarily ( ) [inline]

DTOR: restore the remembered timeout.

The documentation for this class was generated from the following file:

- sdh/serialbase.h

10.30 SDH::cSetValueTemporarily< T > Class Template Reference

helper class to set value on construction and reset to previous value on destruction. (RAII-idiom)

`#include <util.h>`

Public Member Functions

- cSetValueTemporarily (T *_value_ptr, T new_value)

  CTOR: remember current value of _value_ptr and set it to new_value.

- ~cSetValueTemporarily ()

DTOR: restore the remembered value.

10.30.1 Detailed Description

template<typename T> class SDH::cSetValueTemporarily< T >

helper class to set value on construction and reset to previous value on destruction. (RAII-idiom)

10.30.2 Constructor & Destructor Documentation

10.30.2.1 template<typename T > SDH::cSetValueTemporarily< T >::cSetValueTemporarily (T * *_value_ptr*, T *new_value*) [inline]

CTOR: remember current value of *_value_ptr* and set it to *new_value*.

10.30.2.2 template<typename T > SDH::cSetValueTemporarily< T >::~cSetValueTemporarily ( ) [inline]

DTOR: restore the remembered value.

The documentation for this class was generated from the following file:

- sdh/util.h

10.31 SDH::cSimpleStringList Class Reference

A simple string list. (Fixed maximum number of strings of fixed maximum length)

`#include <simplestringlist.h>`

Public Types

- enum { eMAX_LINES = 256, eMAX_CHARS = 256 }

  anonymous enum instead of define macros

Public Member Functions

- cSimpleStringList ()

  Default constructor: init members.

- char * CurrentLine ()

Return the current line.

- char * NextLine ()

  Return the next line, this increases current_line.

- int Length () const

  Return number of lines stored.

- char * operator[ ] (int index)

  return ptr to line with index.

- char const * operator[ ] (int index) const

  return ptr to line with index.

- void Reset ()

  reset list

Public Attributes

- int current_line

  the index of the current line. For empty cSimpleStringLists this is -1.

Protected Attributes

- char line [eMAX_LINES][eMAX_CHARS]

  a fixed length array of lines with fixed length

10.31.1 Detailed Description

A simple string list. (Fixed maximum number of strings of fixed maximum length)

10.31.2 Member Enumeration Documentation

10.31.2.1 anonymous enum

anonymous enum instead of define macros

Enumerator:

eMAX_LINES

eMAX_CHARS

10.31.3 Constructor & Destructor Documentation

10.31.3.1 cSimpleStringList::cSimpleStringList ( )

Default constructor: init members.

10.31.4 Member Function Documentation

10.31.4.1 char * cSimpleStringList::CurrentLine ( )

Return the current line.

10.31.4.2 int cSimpleStringList::Length ( ) const

Return number of lines stored.

10.31.4.3 char * cSimpleStringList::NextLine ( )

Return the next line, this increases current_line.

10.31.4.4 char * cSimpleStringList::operator[] (int *index*)

return ptr to line with index.

if index < 0 then the numbering starts from the end, thus [-1] gives the last line, [-2] the next to last, ...

10.31.4.5 char const * cSimpleStringList::operator[] (int *index*) const

return ptr to line with index.

if index < 0 then the numbering starts from the end, thus [-1] gives the last line, [-2] the next to last, ...

10.31.4.6 void cSimpleStringList::Reset ( )

reset list

10.31.5 Member Data Documentation

10.31.5.1 int SDH::cSimpleStringList::current_line

the index of the current line. For empty cSimpleStringLists this is -1.

10.31.5.2 char SDH::cSimpleStringList::line[eMAX_LINES][eMAX_CHARS] [protected]

a fixed length array of lines with fixed length

The documentation for this class was generated from the following files:

- sdh/simplestringlist.h
- sdh/simplestringlist.cpp

10.32 SDH::cSimpleTime Class Reference

Very simple class to measure elapsed time.

`#include <simpletime.h>`

Public Member Functions

- cSimpleTime ()

  Constructor: store current time ("now") internally.

- void StoreNow (void)

  Store current time internally.

- double Elapsed (void) const

  Return time in seconds elapsed between the time stored in the object and now.

- long Elapsed_us (void) const

  Return time in micro seconds elapsed between the time stored in the object and now.

- double Elapsed (cSimpleTime const &other) const

  Return time in seconds elapsed between the time stored in the object and other.

- long Elapsed_us (cSimpleTime const &other) const

  Return time in micro seconds elapsed between the time stored in the object and other.

- timeval Timeval (void)

  Return the time stored as C struct timeval.

Protected Attributes

- struct timeval a_time

10.32.1 Detailed Description

Very simple class to measure elapsed time.

10.32.2 Constructor & Destructor Documentation

10.32.2.1 SDH::cSimpleTime::cSimpleTime ( ) [inline]

Constructor: store current time ("now") internally.

10.32.3 Member Function Documentation

10.32.3.1 double SDH::cSimpleTime::Elapsed (void) const [inline]

Return time in seconds elapsed between the time stored in the object and now.

10.32.3.2 double SDH::cSimpleTime::Elapsed (cSimpleTime const & *other*) const [inline]

Return time in seconds elapsed between the time stored in the object and *other*.

10.32.3.3 long SDH::cSimpleTime::Elapsed_us (cSimpleTime const & *other*) const [inline]

Return time in micro seconds elapsed between the time stored in the object and *other*.

10.32.3.4 long SDH::cSimpleTime::Elapsed_us (void) const [inline]

Return time in micro seconds elapsed between the time stored in the object and now.

10.32.3.5 void SDH::cSimpleTime::StoreNow (void) [inline]

Store current time internally.

10.32.3.6 timeval SDH::cSimpleTime::Timeval (void) [inline]

Return the time stored as C struct timeval.

10.32.4 Member Data Documentation

10.32.4.1 struct timeval SDH::cSimpleTime::a_time [protected]

The documentation for this class was generated from the following file:

- sdh/simpletime.h

10.33 SDH::cSimpleVector Class Reference

A simple vector implementation.

`#include <simplevector.h>`

Public Types

- enum { eNUMBER_OF_ELEMENTS = 7 }

  anonymous enum (instead of define like macros)

Public Member Functions

- cSimpleVector () throw (cSimpleVectorException∗)

  Default constructor: init members to zero.

- cSimpleVector (int nb_values, char const ∗str) throw (cSimpleVectorException∗)

  Constructor: init members from nb_values comma separated values in the give string str.

- cSimpleVector (int nb_values, int start_index, char const ∗str) throw (cSimpleVectorException∗)

  Constructor: init members from nb_values comma separated values in the give string str.

- cSimpleVector (int nb_values, int start_index, float ∗values) throw (cSimpleVectorException∗)

  Constructor: init members beginning with start_index from nb_values in arrray values.

- void FromString (int nb_values, int start_index, char const ∗str) throw (cSimpleVectorException∗)

  init nb_values starting from index start_index from comma separated values in str

- double & operator[ ] (unsigned int index)

  index operator, return a reference to the index-th element of this

- double & x (void)

  Interpret object as x/y/z vector: return x = the first element, if that is valid.

- double & y (void)

Interpret object as x/y/z vector: return x = the first element, if that is valid.

- double & z (void)

  Interpret object as x/y/z vector: return x = the first element, if that is valid.

- bool Valid (unsigned int index) const

  Return true if vector element index is valid (has been accessed at least once)

Protected Attributes

- double value [eNUMBER_OF_ELEMENTS]
- int valid

  bit mask which values in value are valid

10.33.1 Detailed Description

A simple vector implementation. Objects of this class are used to return vector like answers from the SDH firmware to the cSDHBase class. End users need not use this class, as cSDH, the real end user interface class provides a more convenient way using STL vectors.

10.33.2 Member Enumeration Documentation

10.33.2.1 anonymous enum

anonymous enum (instead of define like macros)

Enumerator:

eNUMBER_OF_ELEMENTS number of elements in vector

10.33.3 Constructor & Destructor Documentation

10.33.3.1 cSimpleVector::cSimpleVector ( ) throw (cSimpleVectorException*)

Default constructor: init members to zero.

10.33.3.2 cSimpleVector::cSimpleVector (int *nb_values*, char const * *str*) throw (cSimpleVectorException*)

Constructor: init members from *nb_values* comma separated values in the give string *str*.

10.33.3.3 cSimpleVector::cSimpleVector (int *nb_values*, int *start_index*, char const * *str*) throw (cSimpleVectorException*)

Constructor: init members from *nb_values* comma separated values in the give string *str*.

10.33.3.4 cSimpleVector::cSimpleVector (int *nb_values*, int *start_index*, float * *values*) throw (cSimpleVectorException*)

Constructor: init members beginning with *start_index* from *nb_values* in arrray *values*.

10.33.4 Member Function Documentation

10.33.4.1 void cSimpleVector::FromString (int *nb_values*, int *start_index*, char const * *str*) throw (cSimpleVectorException*)

init *nb_values* starting from index *start_index* from comma separated values in *str*

10.33.4.2 double & cSimpleVector::operator[] (unsigned int *index*)

index operator, return a reference to the *index-th* element of this

10.33.4.3 bool cSimpleVector::Valid (unsigned int *index*) const

Return true if vector element *index* is valid (has been accessed at least once)

10.33.4.4 double & cSimpleVector::x (void)

Interpret object as x/y/z vector: return x = the first element, if that is valid.

10.33.4.5 double & cSimpleVector::y (void)

Interpret object as x/y/z vector: return x = the first element, if that is valid.

10.33.4.6 double & cSimpleVector::z (void)

Interpret object as x/y/z vector: return x = the first element, if that is valid.

10.33.5 Member Data Documentation

10.33.5.1 int SDH::cSimpleVector::valid [protected]

bit mask which values in value are valid

10.33.5.2 double SDH::cSimpleVector::value[eNUMBER_OF_ELEMENTS] [protected]

The documentation for this class was generated from the following files:

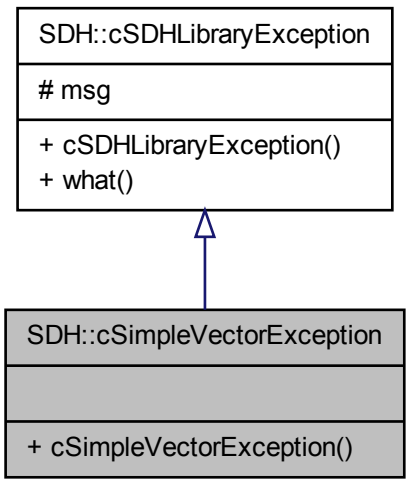
- sdh/simplevector.h
- sdh/simplevector.cpp

10.34 SDH::cSimpleVectorException Class Reference

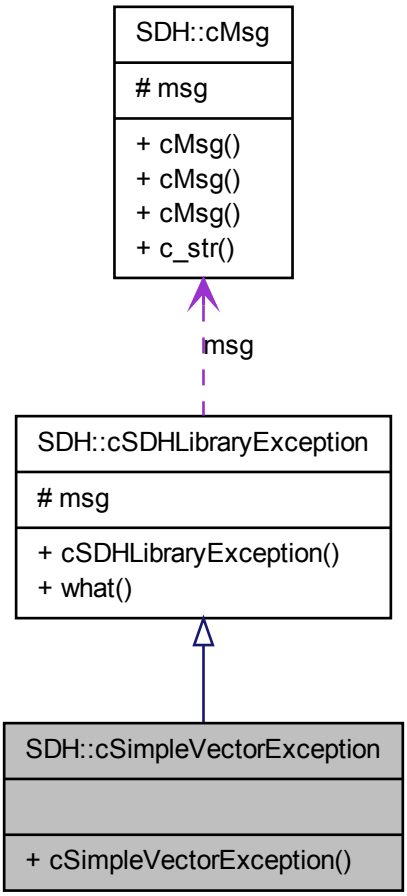
Derived exception class for low-level simple vector related exceptions.

`#include <simplevector.h>`

Inheritance diagram for SDH::cSimpleVectorException:



Collaboration diagram for SDH::cSimpleVectorException:



Public Member Functions

- cSimpleVectorException (cMsg const &_msg)

10.34.1 Detailed Description

Derived exception class for low-level simple vector related exceptions.

10.34.2 Constructor & Destructor Documentation

10.34.2.1 SDH::cSimpleVectorException::cSimpleVectorException (cMsg const & *_msg*) [inline]

The documentation for this class was generated from the following file:

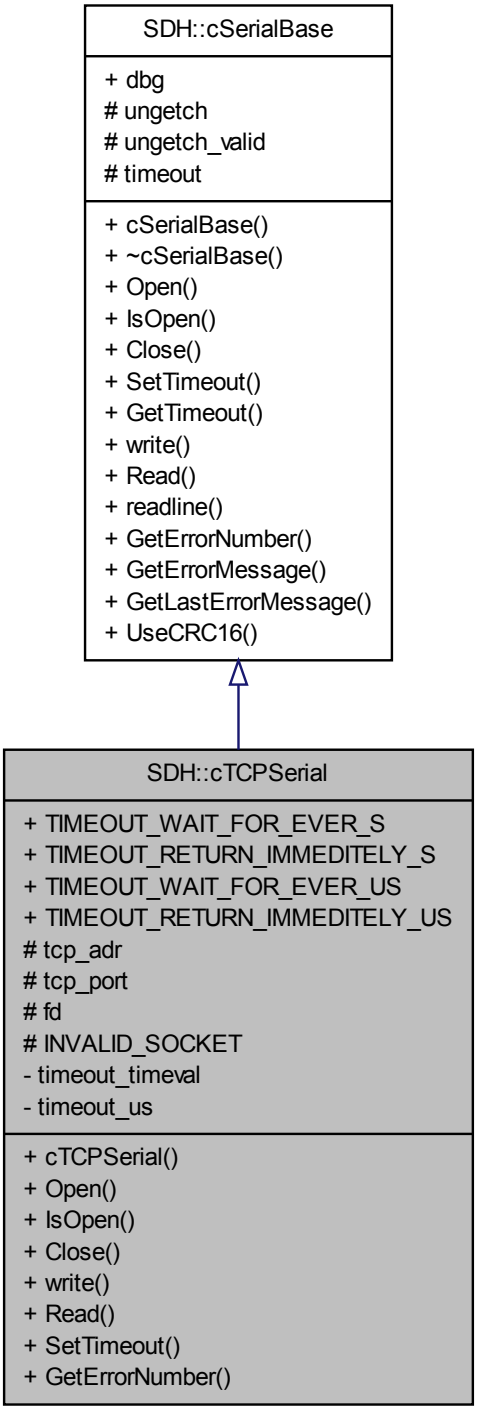
- sdh/simplevector.h

10.35 SDH::cTCPSerial Class Reference

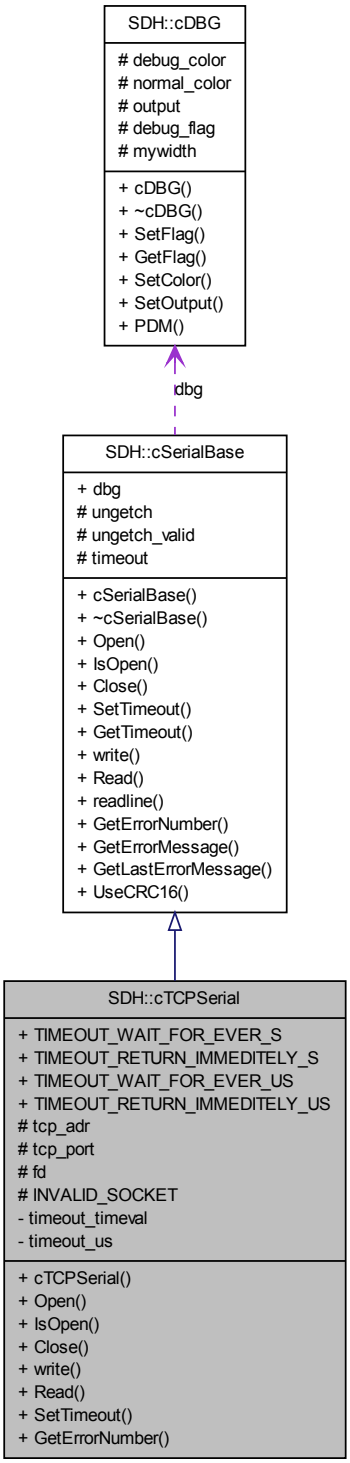
Low-level communication class to access a CAN port.

```
#include <tcpserial.h>
```

Inheritance diagram for SDH::cTCPSerial:



Collaboration diagram for SDH::cTCPSerial:



Public Member Functions

- cTCPSerial (char const *_tcp_adr, int _tcp_port, double _timeout) throw (cTCPSerialException*)
- void Open (void) throw (cTCPSerialException*)
- bool IsOpen (void) throw ()

  Return true if interface to CAN ESD is open.

- void Close (void) throw (cTCPSerialException*)

  Close the previously opened CAN ESD interface port.

- int write (char const *ptr, int len=0) throw (cTCPSerialException*)

  Write data to a previously opened port.

- ssize_t Read (void *data, ssize_t size, long timeout_us, bool return_on_less_-data) throw (cTCPSerialException*)
- void SetTimeout (double _timeout) throw (cSerialBaseException*)

  set the timeout for next readline() calls (negative value means: no timeout, wait for ever)

- virtual tErrorCode GetErrorNumber ()

Static Public Attributes

- static double const TIMEOUT_WAIT_FOR_EVER_S = -1.0
- static double const TIMEOUT_RETURN_IMMEDITELY_S = 0.0
- static long const TIMEOUT_WAIT_FOR_EVER_US = -1
- static long const TIMEOUT_RETURN_IMMEDITELY_US = 0

Protected Attributes

- std::string tcp_adr
- int tcp_port

  the TCP port to use

- int fd

  the file descriptor of the socket

Static Protected Attributes

- static const int INVALID_SOCKET = -1

10.35.1 Detailed Description

Low-level communication class to access a CAN port.

10.35.2 Constructor & Destructor Documentation

10.35.2.1 cTCPSerial::cTCPSerial (char const * _tcp_adr, int _tcp_port, double _timeout) throw (cTCPSerialException*)

Constructor: constructs an object to communicate with an SDH via TCP on *_tcp_adr* and *_tcp_port*.

Parameters

_tcp_adr	- a string describing the hostname or IP address of the SDH
_tcp_port	- the port number on the SDH
_timeout	- the timeout when receiving / sending data: • < 0.0 : no timeout = wait for ever • $== 0.0$: zero timeout = return immediately • > 0.0 : timeout in seconds

10.35.3 Member Function Documentation

10.35.3.1 void cTCPSerial::Close (void) throw (cTCPSerialException*) [virtual]

Close the previously opened CAN ESD interface port.

Implements SDH::cSerialBase.

10.35.3.2 virtual tErrorCode SDH::cTCPSerial::GetErrorNumber ( ) [inline, virtual]

Overloaded helper function that returns the last TCP error number.

Reimplemented from SDH::cSerialBase.

10.35.3.3 bool cTCPSerial::IsOpen (void) throw () [virtual]

Return true if interface to CAN ESD is open.

Implements SDH::cSerialBase.

10.35.3.4 void cTCPSerial::Open (void) throw (cTCPSerialException*) [virtual]

Open the device as configured by the parameters given to the constructor

Implements SDH::cSerialBase.

10.35.3.5 ssize_t cTCPSerial::Read (void * *data*, ssize_t *size*, long *timeout_us*, bool *return_on_less_data*) throw (cTCPSerialException*) [virtual]

Read data from device. This function waits until *max_time_us* us passed or the expected number of bytes are received via serial line. if (*return_on_less_data* is true (default value), the number of bytes that have been received are returned and the data is stored in *data* If the *return_on_less_data* is false, data is only read from serial line, if at least *size* bytes are available.

Implements SDH::cSerialBase.

10.35.3.6 void cTCPSerial::SetTimeout (double *_timeout*) throw (cSerialBaseException*) [virtual]

set the timeout for next readline() calls (negative value means: no timeout, wait for ever)

Reimplemented from SDH::cSerialBase.

10.35.3.7 int cTCPSerial::write (char const * *ptr*, int *len* = 0) throw (cTCPSerialException*) [virtual]

Write data to a previously opened port.

Write *len* bytes from *ptr* to the CAN device

Parameters

ptr	- pointer the byte array to send in memory
len	- number of bytes to send

Returns

the number of bytes actually written

Implements SDH::cSerialBase.

10.35.4 Member Data Documentation

10.35.4.1 int SDH::cTCPSerial::fd [protected]

the file descriptor of the socket

10.35.4.2 const int SDH::cTCPSerial::INVALID_SOCKET = -1 [static, protected]

10.35.4.3 std::string SDH::cTCPSerial::tcp_adr [protected]

10.35.4.4 int SDH::cTCPSerial::tcp_port [protected]

the TCP port to use

10.35.4.5 double const cTCPSerial::TIMEOUT_RETURN_IMMEDITELY_S = 0.0 [static]

10.35.4.6 long const cTCPSerial::TIMEOUT_RETURN_IMMEDITELY_US = 0 [static]

10.35.4.7 double const cTCPSerial::TIMEOUT_WAIT_FOR_EVER_S = -1.0 [static]

10.35.4.8 long const cTCPSerial::TIMEOUT_WAIT_FOR_EVER_US = -1 [static]

The documentation for this class was generated from the following files:

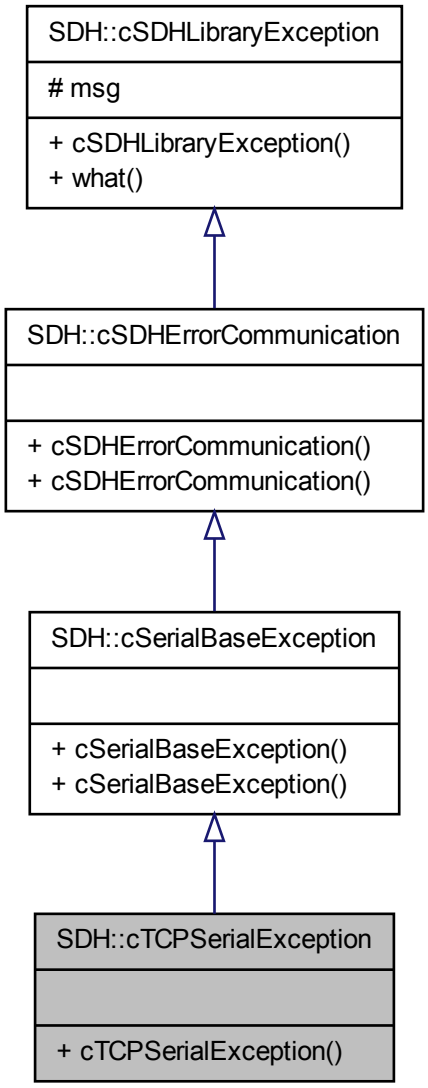
- sdh/tcpserial.h
- sdh/tcpserial.cpp

10.36 SDH::cTCPSerialException Class Reference

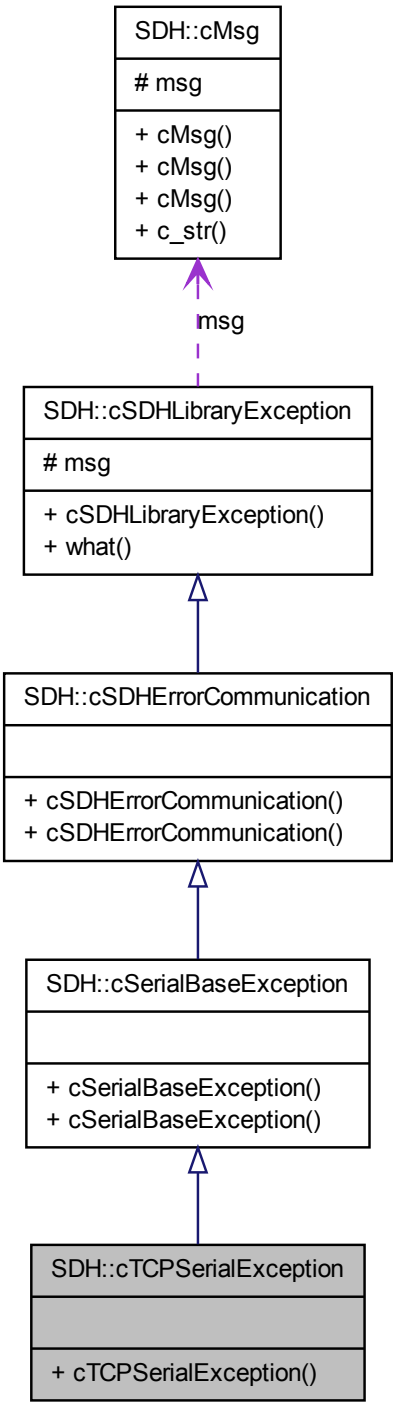
Derived exception class for low-level CAN ESD related exceptions.

`#include <tcpserial.h>`

Inheritance diagram for SDH::cTCPSerialException:



Collaboration diagram for SDH::cTCPSerialException:



Public Member Functions

- cTCPSerialException (cMsg const &_msg)

10.36.1 Detailed Description

Derived exception class for low-level CAN ESD related exceptions.

10.36.2 Constructor & Destructor Documentation

10.36.2.1 SDH::cTCPSerialException::cTCPSerialException (cMsg const & *_msg*) [inline]

The documentation for this class was generated from the following file:

- sdh/tcpserial.h

10.37 SDH::cUnitConverter Class Reference

Unit conversion class to convert values between physical unit systems.

`#include <unit_converter.h>`

Public Member Functions

- cUnitConverter (char const *_kind, char const *_name, char const *_symbol, double _factor=1.0, double _offset=0.0, int _decimal_places=1)
- double ToExternal (double internal) const
- cSimpleVector ToExternal (cSimpleVector &internal) const
- std::vector< double > ToExternal (std::vector< double > const &internal) const
- double ToInternal (double external) const
- cSimpleVector ToInternal (cSimpleVector &external) const
- std::vector< double > ToInternal (std::vector< double > const &external) const
- char const * GetKind (void) const

  Return the kind of unit converted (something like "angle" or "time")

- char const * GetName (void) const

  Return the name of the external unit (something like "degrees" or "milliseconds")

- char const * GetSymbol (void) const

  Return the symbol of the external unit (something like "deg" or "ms")

- double GetFactor (void) const

  Return the conversion factor from internal to external units.

- double GetOffset (void) const

  Return the conversion offset from internal to external units.

- int GetDecimalPlaces (void) const

  Return the number of decimal places for printing values in the external unit system.

Protected Attributes

- char const * kind

  the kind of unit to be converted (something like "angle" or "time")

- char const * name

  the name of the external unit (something like "degrees" or "milliseconds")

- char const * symbol

  the symbol of the external unit (something like "deg" or "ms")

- double factor

  the conversion factor from internal to external units

- double offset

  the conversion offset from internal to external units

- int decimal_places

  A usefull number of decimal places for printing values in the external unit system.

10.37.1 Detailed Description

Unit conversion class to convert values between physical unit systems. An object of this class can be configured to convert values of a physical unit between 2 physical unit systems. An angle value given in degrees can e.g. be converted from/to radians or vice versa by an object of this class.

10.37.2 Constructor & Destructor Documentation

10.37.2.1 cUnitConverter::cUnitConverter (char const * *_kind*, char const * *_name*, char const * *_symbol*, double *_factor* = `1.0`, double *_offset* = `0.0`, int *_decimal_places* = `1`)

Constructor of cUnitConverter class.

At construction time the conversion parameters - a *factor* and an *offset* - must be provided along with elements that describe the unit of a value

Parameters

_kind	- a string describing the kind of unit to be converted (something like "angle" or "time")
_name	- the name of the external unit (something like "degrees" or "milliseconds")
_symbol	- the symbol of the external unit (something like "deg" or "ms")
_factor	- the conversion factor from internal to external units
_offset	- the conversion offset from internal to external units
decimal-places	- A usefull number of decimal places for printing values in the external unit system

Attention

The strings given _kind, _name and _symbol are **NOT** copied, just their address is stored

10.37.3 Member Function Documentation

10.37.3.1 int cUnitConverter::GetDecimalPlaces (void) const

Return the number of decimal places for printing values in the external unit system.

10.37.3.2 double cUnitConverter::GetFactor (void) const

Return the conversion factor from internal to external units.

10.37.3.3 char const * cUnitConverter::GetKind (void) const

Return the kind of unit converted (something like "angle" or "time")

10.37.3.4 char const * cUnitConverter::GetName (void) const

Return the name of the external unit (something like "degrees" or "milliseconds")

10.37.3.5 double cUnitConverter::GetOffset (void) const

Return the conversion offset from internal to external units.

10.37.3.6 char const * cUnitConverter::GetSymbol (void) const

Return the symbol of the external unit (something like "deg" or "ms")

10.37.3.7 std::vector< double > cUnitConverter::ToExternal (std::vector< double > const & *internal*) const

Convert values in vector *internal*, each given in internal units into external units. Returns a vector with each element converted with *internal*[i] ∗ factor + offset

10.37.3.8 cSimpleVector cUnitConverter::ToExternal (cSimpleVector & *internal*) const

Convert values in simple array *internal*, each given in internal units into external units. Returns a simple array with each valid element converted with *internal*[i] ∗ factor + offset

Only valid entries of the *internal* vector are converted.

10.37.3.9 double cUnitConverter::ToExternal (double *internal*) const

Convert single value *internal* given in internal units into external units. Returns *internal* ∗ factor + offset

10.37.3.10 double cUnitConverter::ToInternal (double *external*) const

Convert value *external* given in external units into internal units. Returns (*external* - offset) / factor

10.37.3.11 cSimpleVector cUnitConverter::ToInternal (cSimpleVector & *external*) const

Convert values in simple array *external*, each given in external units into internal units. Returns a simple array with each valid element converted with *external*[i] ∗ factor + offset

Only valid entries of the *external* vector are converted.

10.37.3.12 std::vector< double > cUnitConverter::ToInternal (std::vector< double > const & *external*) const

Convert values in vector *external*, each given in external units into internal units. Returns a vector with each valid element converted with *external*[i] ∗ factor + offset

10.37.4 Member Data Documentation

10.37.4.1 int SDH::cUnitConverter::decimal_places [protected]

A usefull number of decimal places for printing values in the external unit system.

10.37.4.2 double SDH::cUnitConverter::factor [protected]

the conversion factor from internal to external units

10.37.4.3 char const* SDH::cUnitConverter::kind [protected]

the kind of unit to be converted (something like "angle" or "time")

10.37.4.4 char const* SDH::cUnitConverter::name [protected]

the name of the external unit (something like "degrees" or "milliseconds")

10.37.4.5 double SDH::cUnitConverter::offset [protected]

the conversion offset from internal to external units

10.37.4.6 char const* SDH::cUnitConverter::symbol [protected]

the symbol of the external unit (something like "deg" or "ms")
The documentation for this class was generated from the following files:

- sdh/unit_converter.h
- sdh/unit_converter.cpp

10.38 option Struct Reference

`#include <getopt.h>`

Public Attributes

- char * name
- int has_arg
- int * flag
- int val

10.38.1 Member Data Documentation

10.38.1.1 int* option::flag

10.38.1.2 int option::has_arg

10.38.1.3 char* option::name

10.38.1.4 int option::val

The documentation for this struct was generated from the following file:

- vcc/getopt.h

10.39 SDH::cDSA::sContactInfo Struct Reference

Structure to hold info about the contact of one sensor patch.

`#include <dsa.h>`

Public Attributes

- double force
  accumulated force in N
- double area
  *area of contact in mm*mm.*
- double cog_x
  center of gravity of contact in x direction of sensor patch in mm
- double cog_y
  center of gravity of contact in y direction of sensor patch in mm

10.39.1 Detailed Description

Structure to hold info about the contact of one sensor patch.

10.39.2 Member Data Documentation

10.39.2.1 double SDH::cDSA::sContactInfo::area

area of contact in mm*mm.

10.39.2.2 double SDH::cDSA::sContactInfo::cog_x

center of gravity of contact in x direction of sensor patch in mm

10.39.2.3 double SDH::cDSA::sContactInfo::cog_y

center of gravity of contact in y direction of sensor patch in mm

10.39.2.4 double SDH::cDSA::sContactInfo::force

accumulated force in N

The documentation for this struct was generated from the following file:

- sdh/dsa.h

10.40 SDH::cDSA::sControllerInfo Struct Reference

A data structure describing the controller info about the remote DSACON32m controller.

`#include <dsa.h>`

Public Attributes

- UInt16 error_code
- UInt32 serial_no
- UInt8 hw_version
- UInt16 sw_version
- UInt8 status_flags
- UInt8 feature_flags
- UInt8 senscon_type
- UInt8 active_interface
- UInt32 can_baudrate
- UInt16 can_id

10.40.1 Detailed Description

A data structure describing the controller info about the remote DSACON32m controller.

10.40.2 Member Data Documentation

10.40.2.1 UInt8 SDH::cDSA::sControllerInfo::active_interface

10.40.2.2 UInt32 SDH::cDSA::sControllerInfo::can_baudrate

10.40.2.3 UInt16 SDH::cDSA::sControllerInfo::can_id

10.40.2.4 UInt16 SDH::cDSA::sControllerInfo::error_code

10.40.2.5 UInt8 SDH::cDSA::sControllerInfo::feature_flags

10.40.2.6 UInt8 SDH::cDSA::sControllerInfo::hw_version

10.40.2.7 UInt8 SDH::cDSA::sControllerInfo::senscon_type

10.40.2.8 UInt32 SDH::cDSA::sControllerInfo::serial_no

10.40.2.9 UInt8 SDH::cDSA::sControllerInfo::status_flags

10.40.2.10 UInt16 SDH::cDSA::sControllerInfo::sw_version

The documentation for this struct was generated from the following file:

- sdh/dsa.h

10.41 SDH::cDSA::sMatrixInfo Struct Reference

A data structure describing a single sensor matrix connected to the remote DSACON32m controller.

`#include <dsa.h>`

Public Attributes

- UInt16 error_code
- float texel_width
- float texel_height
- UInt16 cells_x
- UInt16 cells_y
- UInt8 uid [6]
- UInt8 reserved [2]
- UInt8 hw_revision
- float matrix_center_x
- float matrix_center_y
- float matrix_center_z
- float matrix_theta_x

- float matrix_theta_y
- float matrix_theta_z
- float fullscale
- UInt8 feature_flags

10.41.1 Detailed Description

A data structure describing a single sensor matrix connected to the remote DSACON32m controller.

10.41.2 Member Data Documentation

10.41.2.1 UInt16 SDH::cDSA::sMatrixInfo::cells_x

10.41.2.2 UInt16 SDH::cDSA::sMatrixInfo::cells_y

10.41.2.3 UInt16 SDH::cDSA::sMatrixInfo::error_code

10.41.2.4 UInt8 SDH::cDSA::sMatrixInfo::feature_flags

10.41.2.5 float SDH::cDSA::sMatrixInfo::fullscale

10.41.2.6 UInt8 SDH::cDSA::sMatrixInfo::hw_revision

10.41.2.7 float SDH::cDSA::sMatrixInfo::matrix_center_x

10.41.2.8 float SDH::cDSA::sMatrixInfo::matrix_center_y

10.41.2.9 float SDH::cDSA::sMatrixInfo::matrix_center_z

10.41.2.10 float SDH::cDSA::sMatrixInfo::matrix_theta_x

10.41.2.11 float SDH::cDSA::sMatrixInfo::matrix_theta_y

10.41.2.12 float SDH::cDSA::sMatrixInfo::matrix_theta_z

10.41.2.13 UInt8 SDH::cDSA::sMatrixInfo::reserved[2]

10.41.2.14 float SDH::cDSA::sMatrixInfo::texel_height

10.41.2.15 float SDH::cDSA::sMatrixInfo::texel_width

10.41.2.16 UInt8 SDH::cDSA::sMatrixInfo::uid[6]

The documentation for this struct was generated from the following file:

- sdh/dsa.h

10.42 sRecordedData Struct Reference

structure to hold current hand state while recording with demo-benchmark

Public Member Functions

- sRecordedData (double _t, std::vector< double > const &_aaa, std::vector< double > const &_aav, std::vector< double > const &_atv)

Public Attributes

- double t
- std::vector< double > aaa
- std::vector< double > aav
- std::vector< double > atv

10.42.1 Detailed Description

structure to hold current hand state while recording with demo-benchmark

10.42.2 Constructor & Destructor Documentation

10.42.2.1 sRecordedData::sRecordedData (double _t, std::vector< double > const & _aaa, std::vector< double > const & _aav, std::vector< double > const & _atv) [inline]

10.42.3 Member Data Documentation

10.42.3.1 std::vector<double> sRecordedData::aaa

10.42.3.2 std::vector<double> sRecordedData::aav

10.42.3.3 std::vector<double> sRecordedData::atv

10.42.3.4 double sRecordedData::t

The documentation for this struct was generated from the following file:

- demo/demo-benchmark.cpp

10.43 SDH::cDSA::sResponse Struct Reference

data structure for storing responses from the remote DSACON32m controller

```
#include <dsa.h>
```

Public Member Functions

- sResponse (UInt8 *_payload, int _max_payload_size)

  constructor to init pointer and max size

Public Attributes

- UInt8 packet_id
- UInt16 size
- UInt8 * payload
- Int32 max_payload_size

10.43.1 Detailed Description

data structure for storing responses from the remote DSACON32m controller

10.43.2 Constructor & Destructor Documentation

10.43.2.1 SDH::cDSA::sResponse::sResponse (UInt8 * *_payload*, int *_max_payload_size*) [inline]

constructor to init pointer and max size

10.43.3 Member Data Documentation

10.43.3.1 Int32 SDH::cDSA::sResponse::max_payload_size

10.43.3.2 UInt8 SDH::cDSA::sResponse::packet_id

10.43.3.3 UInt8* SDH::cDSA::sResponse::payload

10.43.3.4 UInt16 SDH::cDSA::sResponse::size

The documentation for this struct was generated from the following file:

- sdh/dsa.h

10.44 SDH::sSDHBinaryRequest Struct Reference

data structure with binary data for request from PC to SDH

Public Member Functions

- sSDHBinaryRequest (eCommandCode command, double *value, bool use_crc16)
- tCRCValue * CRC16 () const

  return a ptr to the CRC value in parameter_bytes, assuming that nb_data_bytes is correct (including the CRC bytes)

- int GetNbBytesToSend () const

  return the total number of bytes to send

Public Attributes

- unsigned char cmd_code
- unsigned char nb_data_bytes
- unsigned char nb_valid_parameters
- union {
  float parameter [eNUMBER_OF_ELEMENTS]
  unsigned char parameter_bytes [sizeof(float)*eNUMBER_OF_ELEMENTS+sizeof(tCRCValue)]
  } __attribute__

10.44.1 Detailed Description

data structure with binary data for request from PC to SDH

10.44.2 Constructor & Destructor Documentation

10.44.2.1 sSDHBinaryRequest::sSDHBinaryRequest (eCommandCode *command*, double * *value*, bool *use_crc16*)

ctor, create a request with cmd_code *command* and eNUMBER_OF_ELEMENTS parameter from *value* or no parameters if *value* is NULL. Add crc if *use_crc16* is true and set nb_data_bytes appropriately

10.44.3 Member Function Documentation

10.44.3.1 tCRCValue* SDH::sSDHBinaryRequest::CRC16 ( ) const [inline]

return a ptr to the CRC value in parameter_bytes, assuming that nb_data_bytes is correct (including the CRC bytes)

10.44.3.2 int SDH::sSDHBinaryRequest::GetNbBytesToSend ( ) const [inline]

return the total number of bytes to send

10.44.4 Member Data Documentation

10.44.4.1 union { ... } SDH::sSDHBinaryRequest::__attribute__

10.44.4.2 unsigned char SDH::sSDHBinaryRequest::cmd_code

10.44.4.3 unsigned char SDH::sSDHBinaryRequest::nb_data_bytes

10.44.4.4 unsigned char SDH::sSDHBinaryRequest::nb_valid_parameters

10.44.4.5 float SDH::sSDHBinaryRequest::parameter[eNUMBER_OF_ELEMENTS]

10.44.4.6 unsigned char SDH::sSDHBinaryRequest::parameter_bytes[sizeof(float)*eNUMBER_OF_ELEMENTS+sizeof(tCRCValue)]

The documentation for this struct was generated from the following file:

- sdh/sdhserial.cpp

10.45 SDH::sSDHBinaryResponse Struct Reference

data structure with binary data for response from SDH to PC

Public Member Functions

- tCRCValue * CRC16 () const

  return a ptr to the CRC value in parameter_bytes, assuming that nb_data_bytes is correct (including the CRC bytes)

- void CheckCRC16 () const throw (cSDHErrorCommunication*)

  check the CRC value in parameter_bytes. Throw an exception if check fails

Public Attributes

- unsigned char cmd_code
- unsigned char nb_data_bytes
- unsigned char nb_valid_parameters
- unsigned char status_code
- union {
  float parameter [eNUMBER_OF_ELEMENTS]
  unsigned char parameter_bytes [sizeof(float)*eNUMBER_OF_ELEMENTS+sizeof(tCRCValue)]
  };

10.45.1 Detailed Description

data structure with binary data for response from SDH to PC

10.45.2 Member Function Documentation

10.45.2.1 void sSDHBinaryResponse::CheckCRC16 ( ) const throw (cSDHErrorCommunication*)

check the CRC value in parameter_bytes. Throw an exception if check fails

10.45.2.2 tCRCValue* SDH::sSDHBinaryResponse::CRC16 ( ) const [inline]

return a ptr to the CRC value in parameter_bytes, assuming that nb_data_bytes is correct (including the CRC bytes)

10.45.3 Member Data Documentation

10.45.3.1 union { ... }

10.45.3.2 unsigned char SDH::sSDHBinaryResponse::cmd_code

10.45.3.3 unsigned char SDH::sSDHBinaryResponse::nb_data_bytes

10.45.3.4 unsigned char SDH::sSDHBinaryResponse::nb_valid_parameters

10.45.3.5 float SDH::sSDHBinaryResponse::parameter[eNUMBER_OF_ELEMENTS]

10.45.3.6 unsigned char SDH::sSDHBinaryResponse::parameter_bytes[sizeof(float)*eNUMBER_OF_ELEMENTS+sizeof(tCRCValue)]

10.45.3.7 unsigned char SDH::sSDHBinaryResponse::status_code

The documentation for this struct was generated from the following file:

- sdh/sdhserial.cpp

10.46 SDH::cDSA::sSensitivityInfo Struct Reference

Structure to hold info about the sensitivity settings of one sensor patch.

`#include <dsa.h>`

Public Attributes

- UInt16 error_code

  0000h, if successful, otherwise error code

- UInt8 adj_flags
- float cur_sens
- float fact_sens

10.46.1 Detailed Description

Structure to hold info about the sensitivity settings of one sensor patch.

10.46.2 Member Data Documentation

10.46.2.1 UInt8 SDH::cDSA::sSensitivityInfo::adj_flags

Bit vector indicating the sensitivity adjustment options:

- D7...2 reserved
- D1 1: user can change the sensitivity 0: sensitivity cannot be changed by the user

10.46.2.2 float SDH::cDSA::sSensitivityInfo::cur_sens

Currently set sensitivity value. Floating point value. 0 is minimum sensitivity, 1.0 is maximum sensitivity.

10.46.2.3 UInt16 SDH::cDSA::sSensitivityInfo::error_code

0000h, if successful, otherwise error code

10.46.2.4 float SDH::cDSA::sSensitivityInfo::fact_sens

Sensitivity value that is used, if a factory restore command is issued. Floating point value. 0 is minimum sensitivity, 1.0 is maximum sensitivity.

The documentation for this struct was generated from the following file:

- sdh/dsa.h

10.47 SDH::cDSA::sSensorInfo Struct Reference

A data structure describing the sensor info about the remote DSACON32m controller.

`#include <dsa.h>`

Public Attributes

- UInt16 error_code
- UInt16 nb_matrices
- UInt16 generated_by
- UInt8 hw_revision
- UInt32 serial_no
- UInt8 feature_flags

10.47.1 Detailed Description

A data structure describing the sensor info about the remote DSACON32m controller.

10.47.2 Member Data Documentation

10.47.2.1 UInt16 SDH::cDSA::sSensorInfo::error_code

10.47.2.2 UInt8 SDH::cDSA::sSensorInfo::feature_flags

10.47.2.3 UInt16 SDH::cDSA::sSensorInfo::generated_by

10.47.2.4 UInt8 SDH::cDSA::sSensorInfo::hw_revision

10.47.2.5 UInt16 SDH::cDSA::sSensorInfo::nb_matrices

10.47.2.6 UInt32 SDH::cDSA::sSensorInfo::serial_no

The documentation for this struct was generated from the following file:

- sdh/dsa.h

10.48 SDH::cDSA::sTactileSensorFrame Struct Reference

A data structure describing a full tactile sensor frame read from the remote DSACON32m controller.

`#include <dsa.h>`

Public Member Functions

- sTactileSensorFrame (void)

  constructor

Public Attributes

- UInt32 timestamp

  the timestamp of the frame. Use GetAgeOfFrame() to set this into relation with the time of the PC.

- UInt8 flags

  internal data

- tTexel * texel

  an 2D array of tTexel elements. Use GetTexel() for easy access to specific individual elements.

10.48.1 Detailed Description

A data structure describing a full tactile sensor frame read from the remote DSACON32m controller.

Remarks

- An object of this type is stored within the cDSA object
- You can get a reference to the sTactileSensorFrame object with the GetFrame() function.
- The object must be updated manually (for now)
  - by setting an appropriate framerate with SetFramerate() once
  - by calling UpdateFrame() periodically
-

10.48.2 Constructor & Destructor Documentation

10.48.2.1 SDH::cDSA::sTactileSensorFrame::sTactileSensorFrame (void) [inline]

constructor

10.48.3 Member Data Documentation

10.48.3.1 UInt8 SDH::cDSA::sTactileSensorFrame::flags

internal data

10.48.3.2 tTexel* SDH::cDSA::sTactileSensorFrame::texel

an 2D array of tTexel elements. Use GetTexel() for easy access to specific individual elements.

10.48.3.3 UInt32 SDH::cDSA::sTactileSensorFrame::timestamp

the timestamp of the frame. Use GetAgeOfFrame() to set this into relation with the time of the PC.

The documentation for this struct was generated from the following file:

- sdh/dsa.h

Chapter 11

File Documentation

11.1 architecture.dox File Reference

Short overview of the SDHLibrary-CPP and SDH architecture.

11.1.1 Detailed Description

Short overview of the SDHLibrary-CPP and SDH architecture.

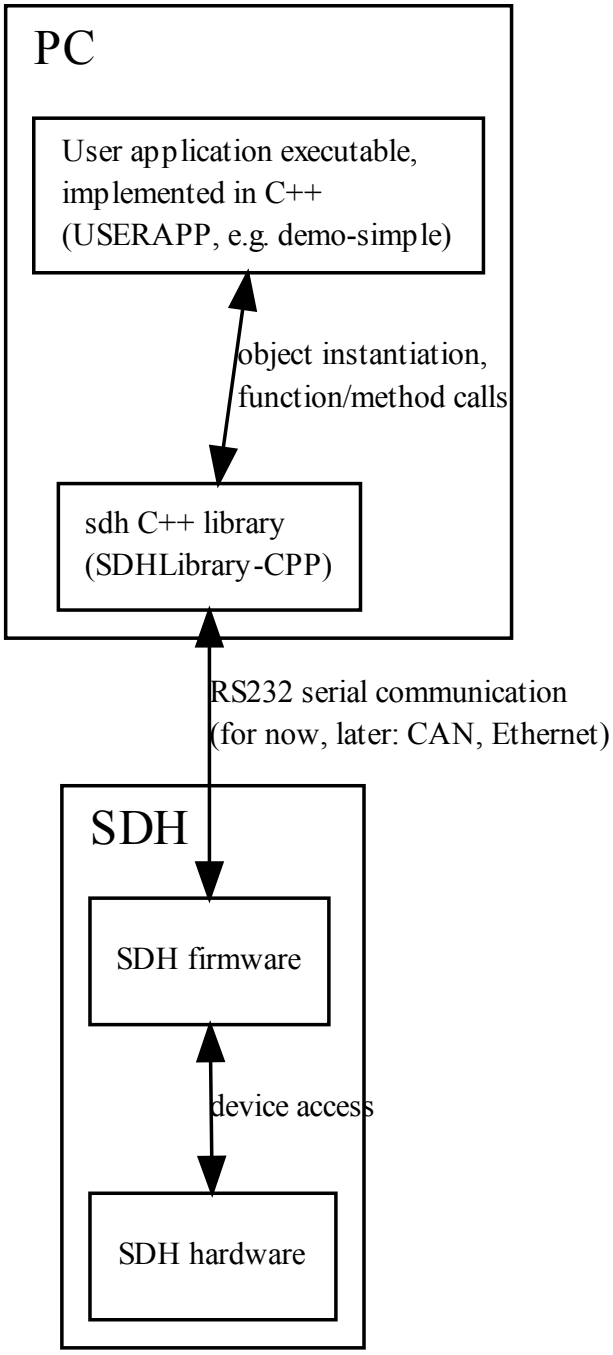
11.1.2 Overview

Naming convention:

As a convention **"SDH"** (capital letters) is used to refer to the physical device, the three fingered SCHUNK Dexterous Hand, while **"sdh"** (small letters) refers to the PC-software that communicates with the physical SDH device. Within the "sdh" PC-software further entities can be distinguished: The C++ library **SDHLibrary-CPP.so** (on Linux) or **SDHLibrary-CPP.dll** (on Windows/cygwin) that contains the complete sdh library including the user interface class **SDH::cSDH**. This SDH::cSDH class will be described in detail below.

Basic structure:

The basic structure of the components looks like this:


PC
User application executable,
implemented in C++
(USERAPP, e.g. demo-simple)
object instantiation,
function/method calls
sdh C++ library
(SDHLibrary-CPP)
RS232 serial communication
(for now, later: CAN, Ethernet)
SDH
SDH firmware
device access
SDH hardware

Basic architecture:

There are several classes defined in SDHLibrary-CPP:

- SDH::cSDH the class used to communicate with the SDH. This class provides the functional interface of the SDH. It should be used by end users, as its interface is considered more stable.
- Other classes, like cSDHBase and cSDHSerial, are used by SDH::cSDH and provide more low level services and should **NOT** be used directly, as their interfaces are subject to change in future releases.
- cSDHLibraryException and derivatives: these are used when an exception is raised

Example use:

An exemplary use of the sdh module in a user application in C++ might look like this:

```
...
// Include the cSDH interface
include <sdh.h>

// Create an instance "hand" of the class cSDH:
cSDH hand;

// Open communication to the SDH device via default serial port 0 == "COM
1"
hand.OpenRS232();

// Perform some action:
//   get the current actual axis angles of finger 0
std::vector<double> faa = hand.GetFingerActualAngle( 0 );

//   modify these by decreasing the proximal and the distal axis angles:
std::vector<double> fta = faa;
fta[1] -= 10;
fta[2] -= 10;

//   set modified angles as new target angles:
hand.SetFingerTargetAngle( 0, fta );

//   now make the finger move there:
hand.MoveFinger( 0 );

// Finally close connection to SDH again (This automatically
// switches off the axis controllers to prevent overheating):
hand.Close();
```

Real example code is available in the demo-∗.cpp code files, see e.g.

- demo-simple.cpp
- demo-temperature.cpp
- demo-GetAxisActualAngle.cpp

11.2 connectors.dox File Reference

11.2.1 Detailed Description

11.2.2 General project information

Author

Dirk Osswald

Date

2007-02-19

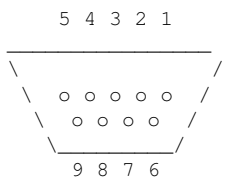
11.2.3 Purpose

This page discribes the connectors of the SDH / LWA

SDH

RS232 Communication connector cable of the SDH at the base of the LWA:

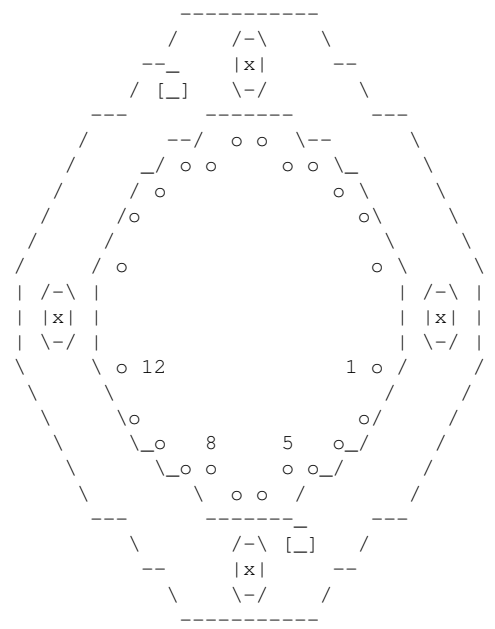
- 9pin Sub-D female connector (View from connecting side):



- 1 : here: nc, (normally: Data Carrier Detect)
- 2 : RxD of PC = TxD of SDH
- 3 : TxD 0f PC = RxD of SDH
- 4 : here: nc, (normally: Data Terminal Ready)
- 5 : GND
- 6 : here: nc, (normally: Data Set Ready)
- 7 : here: nc, (normally: Request To Send)
- 8 : here: nc, (normally: Clear To Send)
- 9 : here: nc, (Ring Indicator)

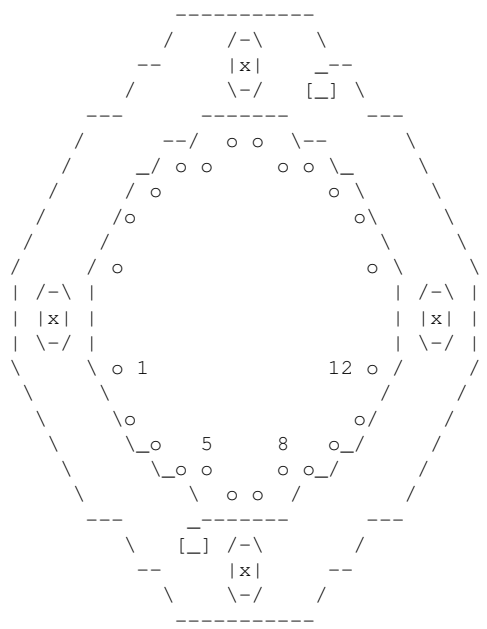
- RS232 + Power Communication connector:

- 2x12pin FWS connector, view from connecting side of FWS part mounted on LWA: only one half is used for the SDH



- 1 : Pwr (RD) 24V supply for power and logic of SDH2
- 2 : TxD (BN) RS232 TxD of PC = RxD of SDH2
- 3 : RxD (WH) RS232 RxD of PC = TxD of SDH2
- 4 : TxD2 (RD) RS232 TxD of PC = RxD of SDH2, second RS232 channel of SDH2
- 5 : RxD2 (PK) RS232 RxD of PC = TxD of SDH2, second RS232 channel of SDH2
- 6 : CAN_H (GN) CAN High
- 7 : CAN_L (YE) CAN Low
- 8 : ENET TPI+ Ethernet
- 9 : ENET TPI- Ethernet
- 10 : ENET TPO+ Ethernet
- 11 : ENET TPO- Ethernet
- 12 : GND (BK) Ground

- 2x12pin FWS connector view from connecting side of FWS part mounted on SDH: only one half is used by the SDH

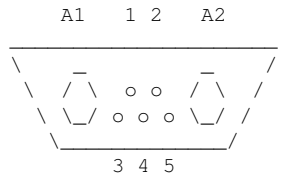


- 1 : Pwr (RD) 24V supply for power and logic of SDH2
- 2 : TxD (BN) RS232 TxD of PC = RxD of SDH2
- 3 : RxD (WH) RS232 RxD of PC = TxD of SDH2
- 4 : TxD2 (RD) RS232 TxD of PC = RxD of SDH2, second RS232 channel of SDH2
- 5 : RxD2 (PK) RS232 RxD of PC = TxD of SDH2, second RS232 channel of SDH2
- 6 : CAN_H (GN) CAN High
- 7 : CAN_L (YE) CAN Low
- 8 : ENET TPI+ Ethernet
- 9 : ENET TPI- Ethernet
- 10 : ENET TPO+ Ethernet
- 11 : ENET TPO- Ethernet
- 12 : GND (BK) Ground

LWA

Combined power / CAN connector of the LWA:

- Male connector (View from connecting side):

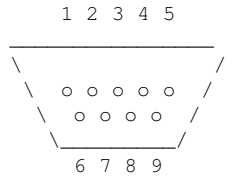


- A1 : +24V
- A2 : 0V (blue)
- 1 : CAN-High (Profibus-A1) (green)
- 2 : RxD
- 3 : CAN-Low (profibus-B1) (yellow)
- 4 : Shield
- 5 : TxD

ESD CAN-USB mini

On the PC-side CAN interface cards are often connected as follows:

- 9pin Sub-D Male connector (View from connecting side):



- 1 : reserved
- 2 : CAN_L (yellow)
- 3 : CAN_GND (blue)
- 4 : reserved
- 5 : Shield
- 6 : (CAN_GND)
- 7 : CAN_H (green)
- 8 : reserved
- 9 : reserved

11.2.4 Copyright

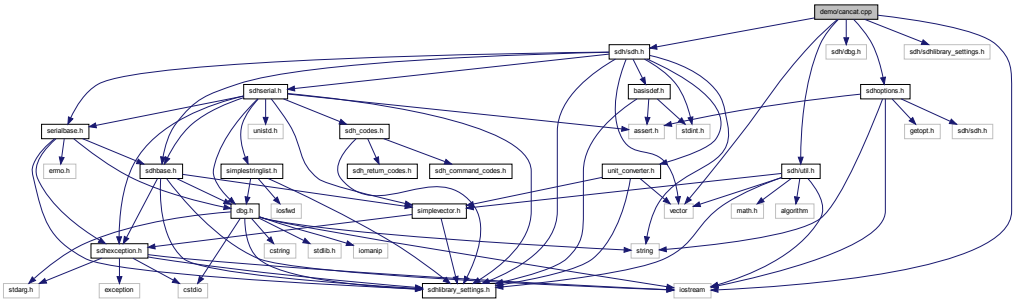
Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.3 demo/cancat.cpp File Reference

Yet incomplete tool to send and receive data via CAN. See __help__ and online help ("-h" or "--help") for available options.

```
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/dbg.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdhoptions.h"
```

Include dependency graph for cancat.cpp:



Functions

- int main (int argc, char **argv)

Variables

Some informative variables

- char const * __help__ = "Send data from command line via ESD or PEAK CAN and display replies until CTRL-C is pressed."
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"

- char const * __version__ = "$Id: cancat.cpp 9739 2013-02-04 15:39:29Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.3.1 Detailed Description

Yet incomplete tool to send and receive data via CAN. See __help__ and online help ("-h" or "--help") for available options.

11.3.2 General file information

Author

Dirk Osswald

Date

2007-01-18

11.3.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.3.4 Function Documentation

11.3.4.1 int main (int *argc*, char ** *argv*)

11.3.5 Variable Documentation

11.3.5.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.3.5.2 char const* __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.3.5.3 char const* __help__ = "Send data from command line via ESD or PEAK CAN and display replies until CTRL-C is pressed."

11.3.5.4 char const* __url__ = "http://www.schunk.com"

11.3.5.5 char const* __version__ = "$Id: cancat.cpp 9739 2013-02-04 15:39:29Z Osswald2 $"

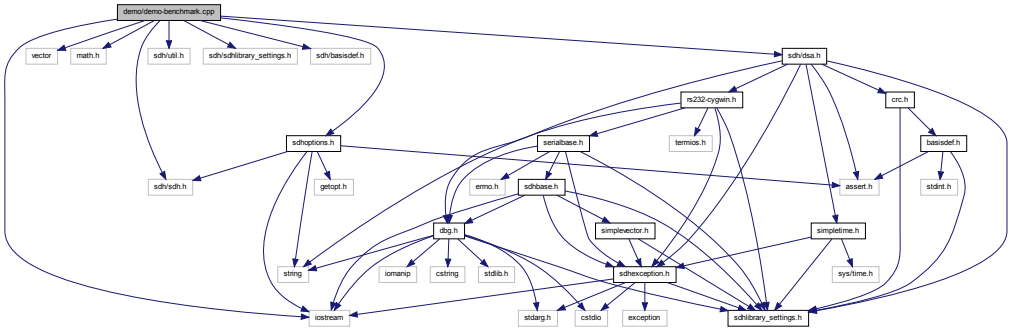
11.4 demo/demo-benchmark.cpp File Reference

Simple script to benchmark communication speed of the SDH. See __help__ and online help ("-h" or "--help") for available options.

```
#include <iostream>
```

```
#include <vector>
#include <math.h>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdh/dsa.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-benchmark.cpp:



Classes

- struct sRecordedData

  structure to hold current hand state while recording with demo-benchmark

Defines

- #define _USE_MATH_DEFINES
- #define DEMO_BENCHMARK_USE_COMBINED_SET_GET 1

Functions

- void GotoPose (cSDH &hand, std::vector< double > &ta)
- int main (int argc, char **argv)

Variables

- char const * usage = "usage: demo-benchmark [options]\n"

- cDBG cdbg (false,"red")

Some informative variables

- char const * __help__ = " > demo-benchmark --port=2 --dsaport=3 -v\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-benchmark.cpp 10895 2013-11-11 14:15:08Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.4.1 Detailed Description

Simple script to benchmark communication speed of the SDH. See __help__ and online help ("-h" or "--help") for available options.

11.4.2 General file information

Author

Dirk Osswald

Date

2011-01-31

11.4.3 Copyright

11.4.4 Define Documentation

11.4.4.1 #define _USE_MATH_DEFINES

11.4.4.2 #define DEMO_BENCHMARK_USE_COMBINED_SET_GET 1

11.4.5 Function Documentation

11.4.5.1 void GotoPose (cSDH & *hand*, std::vector< double > & *ta*)

Move all axes of *hand* to position *ta* using the coordinated pose controller

Parameters

hand	- reference to the SDH to operate on
ta	- axis target angles

11.4.5.2 int main (int *argc*, char ** *argv*)

11.4.6 Variable Documentation

11.4.6.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.4.6.2 char const* __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.4.6.3 char const* __help__ = " > demo-benchmark --port=2 --dsaport=3 -v\n"

11.4.6.4 char const* __url__ = "http://www.schunk.com"

11.4.6.5 char const* __version__ = "$Id: demo-benchmark.cpp 10895 2013-11-11 14:15:08Z Osswald2 $"

11.4.6.6 cDBG cdbg(false,"red")

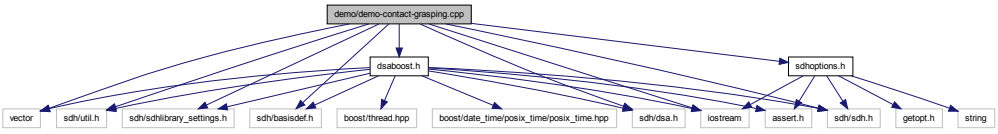
11.4.6.7 char const* usage = "usage: demo-benchmark [options]\n"

11.5 demo/demo-contact-grasping.cpp File Reference

Simple script to do grasping using tactile sensor info feedback. See __help__ and online help ("-h" or "--help") for available options.

```
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdh/dsa.h"
#include "sdhoptions.h"
#include "dsaboost.h"
```

Include dependency graph for demo-contact-grasping.cpp:



Functions

- cDBG cdbg (false,"red")
- void GotoStartPose (cSDH &hand, char const *msg)
- void AxisAnglesToFingerAngles (std::vector< double > aa, std::vector< double > &fa0, std::vector< double > &fa1, std::vector< double > &fa2)
- int main (int argc, char **argv)

Variables

- char const * usage = "usage: demo-contact-grasping [options]\n"

Some informative variables

- char const * __help__ = " > demo-contact-grasping --port=2 --dsaport=3 -v\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-contact-grasping.cpp 10894 2013-11-11 13:58:38Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.5.1 Detailed Description

Simple script to do grasping using tactile sensor info feedback. See __help__ and online help ("-h" or "--help") for available options.

11.5.2 General file information

Author

Dirk Osswald

Date

2009-08-02

11.5.3 Copyright

11.5.4 Function Documentation

11.5.4.1 void AxisAnglesToFingerAngles (std::vector< double > *aa,* std::vector< double > & *fa0,* std::vector< double > & *fa1,* std::vector< double > & *fa2*)

11.5.4.2 cDBG cdbg (false , "red")

11.5.4.3 void GotoStartPose (cSDH & *hand,* char const * *msg*)

11.5.4.4 int main (int *argc,* char ** *argv*)

finished:

11.5.5 Variable Documentation

11.5.5.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.5.5.2 char const* __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.5.5.3 char const* __help__ = " > demo-contact-grasping --port=2 --dsaport=3 -v\n"

11.5.5.4 char const* __url__ = "http://www.schunk.com"

11.5.5.5 char const* __version__ = "$Id: demo-contact-grasping.cpp 10894 2013-11-11 13:58:38Z Osswald2 $"

11.5.5.6 char const* usage = "usage: demo-contact-grasping [options]\n"

11.6 demo/demo-dsa-simple.cpp File Reference

Simple program to test class cDSA (tactile sensor reading). See __help__ and online help ("-h" or "--help") for available options.

```
#include "sdh/sdhlibrary_settings.h"
#include <iostream>
#include <fstream>
#include <string>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/dsa.h"
#include "sdh/basisdef.h"
#include "sdh/util.h"
```

Include dependency graph for demo-dsa-simple.cpp:

Functions

- int main (int argc, char **argv)

Variables

Some informative variables

Some definitions that describe the demo program

- char const * __help__ = "parameters are fixed here in the source code\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-dsa-simple.cpp 12284 2014-09-30 08:28:44Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2014 SCHUNK GmbH & Co. KG"
- char const * usage = "usage: demo-dsa-simple\n"

11.6.1 Detailed Description

Simple program to test class cDSA (tactile sensor reading). See __help__ and online help ("-h" or "--help") for available options.

11.6.2 General file information

Author

Dirk Osswald

Date

2014-04-03

11.6.3 Copyright

- Copyright (c) 2014 SCHUNK GmbH & Co. KG

11.6.4 Function Documentation

11.6.4.1 int main (int *argc*, char ** *argv*)

!!!

!!!

11.6.5 Variable Documentation

11.6.5.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.6.5.2 char const* __copyright__ = "Copyright (c) 2014 SCHUNK GmbH & Co. KG"

11.6.5.3 char const* __help__ = "parameters are fixed here in the source code\n"

11.6.5.4 char const* __url__ = "http://www.schunk.com"

11.6.5.5 char const* __version__ = "$Id: demo-dsa-simple.cpp 12284 2014-09-30 08:28:44Z Osswald2 $"

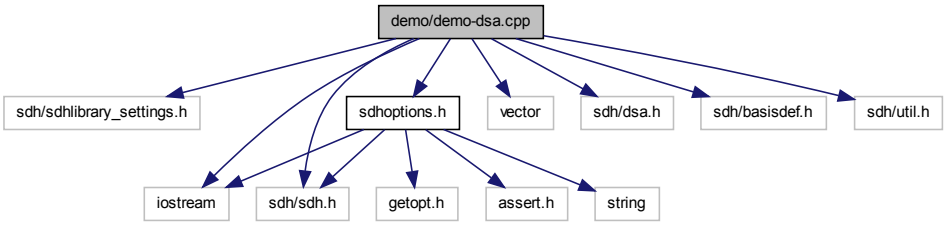
11.6.5.6 char const* usage = "usage: demo-dsa-simple\n"

11.7 demo/demo-dsa.cpp File Reference

Simple program to test class cDSA. See __help__ and online help ("-h" or "--help") for available options.

```
#include "sdh/sdhlibrary_settings.h"
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/dsa.h"
#include "sdh/basisdef.h"
#include "sdh/util.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-dsa.cpp:



Functions

- int main (int argc, char **argv)

Variables

Some informative variables

Some definitions that describe the demo program

- char const * __help__ = " documentation\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-dsa.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2008 SCHUNK GmbH & Co. KG"
- char const * usage = "usage: demo-dsa [options]\n"

11.7.1 Detailed Description

Simple program to test class cDSA. See __help__ and online help ("-h" or "--help") for available options.

11.7.2 General file information

Author

Dirk Osswald, Winfried Baum (IPA)

Date

2008-06-12

11.7.3 Copyright

- Copyright (c) 2008 SCHUNK GmbH & Co. KG

11.7.4 Function Documentation

11.7.4.1 int main (int *argc,* char ∗∗ *argv*)

11.7.5 Variable Documentation

11.7.5.1 char const∗ __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.7.5.2 char const∗ __copyright__ = "Copyright (c) 2008 SCHUNK GmbH & Co. KG"

11.7.5.3 char const∗ __help__ = " documentation\n"

11.7.5.4 char const∗ __url__ = "http://www.schunk.com"

11.7.5.5 char const∗ __version__ = "$Id: demo-dsa.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"

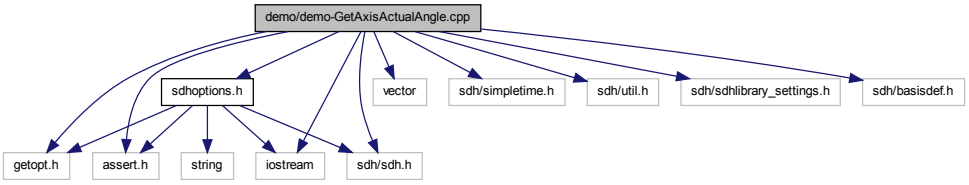
11.7.5.6 char const∗ usage = "usage: demo-dsa [options]\n"

11.8 demo/demo-GetAxisActualAngle.cpp File Reference

Print measured actual axis angles of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

```
#include <getopt.h>
#include <assert.h>
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/simpletime.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-GetAxisActualAngle.cpp:



Functions

- int main (int argc, char **argv)

Variables

- char const * usage = "usage: demo-GetAxisActualAngle [options]\n"

Some informative variables

- char const * __help__ = " > demo-GetAxisActualAngle --port=2 -v\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-GetAxisActualAngle.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.8.1 Detailed Description

Print measured actual axis angles of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

11.8.2 General file information

Author

Dirk Osswald

Date

2007-03-07

11.8.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.8.4 Function Documentation

11.8.4.1 int main (int *argc,* char ** *argv*)

11.8.5 Variable Documentation

11.8.5.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.8.5.2 char const* __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.8.5.3 char const* __help__ = " > demo-GetAxisActualAngle --port=2 -v\n"

11.8.5.4 char const* __url__ = "http://www.schunk.com"

11.8.5.5 char const* __version__ = "$Id: demo-GetAxisActualAngle.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"

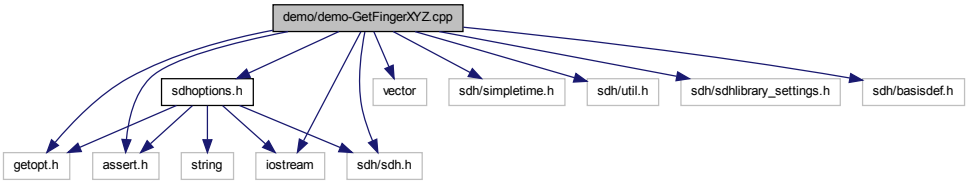
11.8.5.6 char const* usage = "usage: demo-GetAxisActualAngle [options]\n"

11.9 demo/demo-GetFingerXYZ.cpp File Reference

Print measured actual axis angles of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

```
#include <getopt.h>
#include <assert.h>
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/simpletime.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-GetFingerXYZ.cpp:



Functions

- int main (int argc, char **argv)

Variables

- char const * usage = "usage: demo-GetFingerXYZ [options]\n"

Some informative variables

- char const * __help__ = " with MS Visual Studio\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-GetFingerXYZ.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.9.1 Detailed Description

Print measured actual axis angles of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

11.9.2 General file information

Author

Dirk Osswald

Date

2007-03-07

Bug

When compiled with MS Visual Studio then using the "-R" command line parameter will make the demonstration program demo-GetFingerXYZ abort.

11.9.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.9.4 Function Documentation

11.9.4.1 int main (int *argc*, char ** *argv*)

11.9.5 Variable Documentation

11.9.5.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.9.5.2 char const* __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.9.5.3 char const* __help__ = " with MS Visual Studio\n"

11.9.5.4 char const* __url__ = "http://www.schunk.com"

11.9.5.5 char const* __version__ = "$Id: demo-GetFingerXYZ.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"

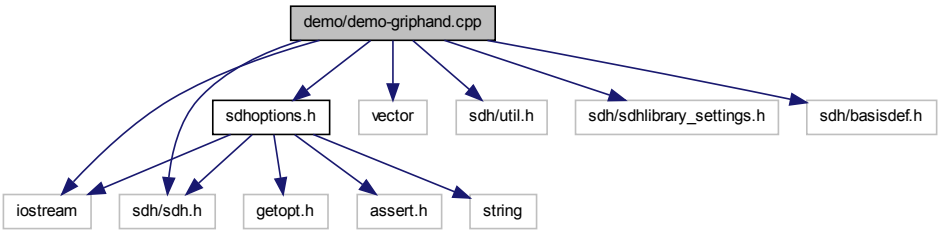
11.9.5.6 char const* usage = "usage: demo-GetFingerXYZ [options]\n"

11.10 demo/demo-griphand.cpp File Reference

Very simple demonstration program using the SDHLibrary-CPP: Demonstrate the use of the GripHand command See __help__ and online help ("-h" or "--help") for available options.

```
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-griphand.cpp:



Functions

- int main (int argc, char **argv)

Variables

- char const * usage = "usage: demo-griphand [options]\n"

Some informative variables

- char const * __help__ = " > demo-griphand --port=2 -v\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-griphand.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.10.1 Detailed Description

Very simple demonstration program using the SDHLibrary-CPP: Demonstrate the use of the GripHand command See __help__ and online help ("-h" or "--help") for available options.

11.10.2 General file information

Author

Dirk Osswald

Date

2009-12-04

Warning

The cSDH::GripHand() function is somewhat problematic (not interruptible), see its documentation.

11.10.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.10.4 Function Documentation

11.10.4.1 int main (int *argc*, char ** *argv*)

11.10.5 Variable Documentation

11.10.5.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.10.5.2 char const* __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.10.5.3 char const* __help__ = " > demo-griphand --port=2 -v\n"

11.10.5.4 char const* __url__ = "http://www.schunk.com"

11.10.5.5 char const* __version__ = "$Id: demo-griphand.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"

11.10.5.6 char const* usage = "usage: demo-griphand [options]\n"

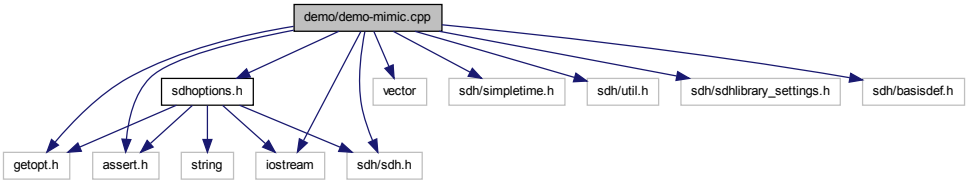
11.11 demo/demo-mimic.cpp File Reference

Print measured actual axis angles of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

```
#include <getopt.h>
#include <assert.h>
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/simpletime.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
```

```
#include "sdhoptions.h"
```

Include dependency graph for demo-mimic.cpp:



Functions

- cSDH * GetHand (cSDHOptions &options, cDBG &cdbg, int nb)
- int main (int argc, char **argv)

Variables

Some informative variables

- char const * __help__ = " \n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-mimic.cpp 6501 2011-03-01 17:35:45Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.11.1 Detailed Description

Print measured actual axis angles of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

11.11.2 General file information

Author

Dirk Osswald

Date

2007-03-07

11.11.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.11.4 Function Documentation

11.11.4.1 cSDH* GetHand (cSDHOptions & *options*, cDBG & *cdbg*, int *nb*)

11.11.4.2 int main (int *argc*, char ** *argv*)

11.11.5 Variable Documentation

11.11.5.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.11.5.2 char const* __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.11.5.3 char const* __help__ = " \n"

11.11.5.4 char const* __url__ = "http://www.schunk.com"

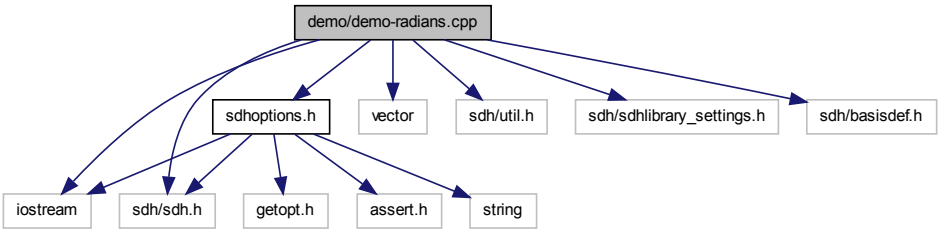
11.11.5.5 char const* __version__ = "$Id: demo-mimic.cpp 6501 2011-03-01 17:35:45Z Osswald2 $"

11.12 demo/demo-radians.cpp File Reference

Very simple demonstration program using the SDHLibrary-CPP: Make an attached SDH move one finger with "pose" controller type (coordinated position control), commanding in radians. See __help__ and online help ("-h" or "--help") for available options.

```
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-radians.cpp:



Functions

- int main (int argc, char **argv)

Variables

- char const * usage = "usage: demo-radians [options]\n"

Some informative variables

- char const * __help__ = " > demo-radians --port=2 -v\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-radians.cpp 11045 2013-11-27 15:12:49Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.12.1 Detailed Description

Very simple demonstration program using the SDHLibrary-CPP: Make an attached SDH move one finger with "pose" controller type (coordinated position control), commanding in radians. See __help__ and online help ("-h" or "--help") for available options.

11.12.2 General file information

Author

Dirk Osswald

Date

2007-01-18

This code contains only the very basicst use of the features provided by the SDHLibrary-CPP. For more sophisticated applications see the other demo-∗.cpp programms, or of course the html/pdf documentation.

11.12.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.12.4 Function Documentation

11.12.4.1 int main (int *argc,* char ∗∗ *argv*)

11.12.5 Variable Documentation

11.12.5.1 char const∗ __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.12.5.2 char const∗ __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.12.5.3 char const∗ __help__ = " > demo-radians --port=2 -v\n"

11.12.5.4 char const∗ __url__ = "http://www.schunk.com"

11.12.5.5 char const∗ __version__ = "$Id: demo-radians.cpp 11045 2013-11-27 15:12:49Z Osswald2 $"

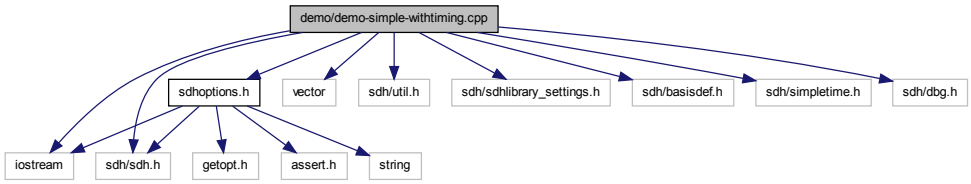
11.12.5.6 char const∗ usage = "usage: demo-radians [options]\n"

11.13 demo/demo-simple-withtiming.cpp File Reference

Very simple C++ programm to make an attached SDH move.

```
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdhoptions.h"
#include "sdh/simpletime.h"
#include "sdh/dbg.h"
```

Include dependency graph for demo-simple-withtiming.cpp:



Functions

- int main (int argc, char **argv)

Variables

- char const * usage = "usage: demo-simple-withtiming [options]\n"

Some informative variables

- char const * __help__ = "Move proximal and distal joints of finger 1 three times by 10 degrees and measure time for these actions.\n(C++ demo application using the SDHLibrary-CPP library.)"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-simple-withtiming.cpp 6265 2010-12-02 13:59:45Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.13.1 Detailed Description

Very simple C++ programm to make an attached SDH move.

11.13.2 General file information

Author

Dirk Osswald

Date

2007-01-18

This code contains only the very basicst use of the features provided by the SDHLibrary-CPP. For more sophisticated applications see the other demo-*.cpp programms, or of course the html/pdf documentation.

11.13.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.13.4 Function Documentation

11.13.4.1 int main (int *argc,* char ** *argv*)

11.13.5 Variable Documentation

11.13.5.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.13.5.2 char const* __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.13.5.3 char const* __help__ = "Move proximal and distal joints of finger 1 three times by 10 degrees and measure time for these actions.\n(C++ demo application using the SDHLibrary-CPP library.)"

11.13.5.4 char const* __url__ = "http://www.schunk.com"

11.13.5.5 char const* __version__ = "$Id: demo-simple-withtiming.cpp 6265 2010-12-02 13:59:45Z Osswald2 $"

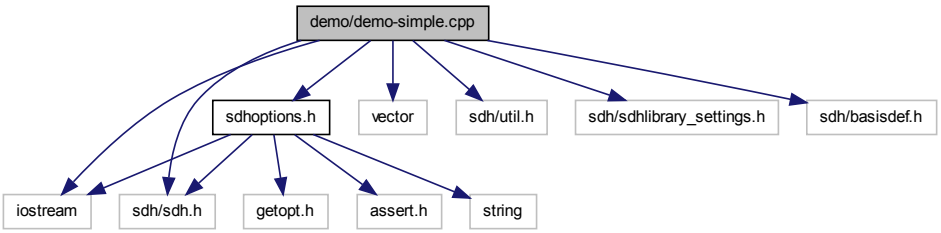
11.13.5.6 char const* usage = "usage: demo-simple-withtiming [options]\n"

11.14 demo/demo-simple.cpp File Reference

Very simple demonstration program using the SDHLibrary-CPP: Make an attached SDH move one finger with "pose" controller type (coordinated position control). See __help__ and online help ("-h" or "--help") for available options.

```
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-simple.cpp:



Functions

- int main (int argc, char **argv)

Variables

- char const * usage = "usage: demo-simple [options]\n"

Some informative variables

- char const * __help__ = " > demo-simple --port=2 -v\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-simple.cpp 11045 2013-11-27 15:12:49Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.14.1 Detailed Description

Very simple demonstration program using the SDHLibrary-CPP: Make an attached SDH move one finger with "pose" controller type (coordinated position control). See __help__ and online help ("-h" or "--help") for available options.

11.14.2 General file information

Author

Dirk Osswald

Date

2007-01-18

This code contains only the very basicst use of the features provided by the SDHLibrary-CPP. For more sophisticated applications see the other demo-∗.cpp programms, or of course the html/pdf documentation.

11.14.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.14.4 Function Documentation

11.14.4.1 int main (int *argc,* char ∗∗ *argv*)

11.14.5 Variable Documentation

11.14.5.1 char const∗ __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.14.5.2 char const∗ __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.14.5.3 char const∗ __help__ = " > demo-simple --port=2 -v\n"

11.14.5.4 char const∗ __url__ = "http://www.schunk.com"

11.14.5.5 char const∗ __version__ = "$Id: demo-simple.cpp 11045 2013-11-27 15:12:49Z Osswald2 $"

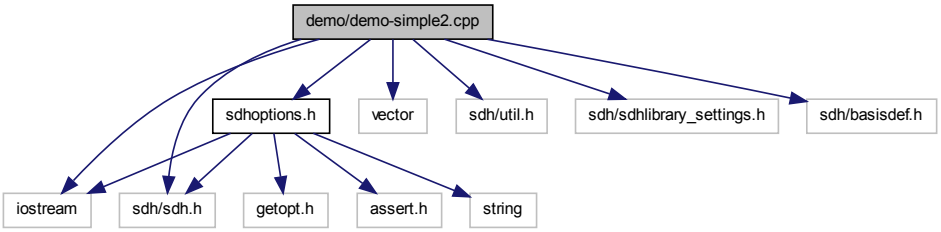
11.14.5.6 char const∗ usage = "usage: demo-simple [options]\n"

11.15 demo/demo-simple2.cpp File Reference

Very simple C++ programm to make an attached SDH move. With non-sequential call of move and Stop. See __help__ and online help ("-h" or "--help") for available options.

```
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-simple2.cpp:



Functions

- int main (int argc, char **argv)

Variables

Some informative variables

- char const * __help__ = " > demo-simple2 --port=2 -v\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-simple2.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.15.1 Detailed Description

Very simple C++ programm to make an attached SDH move. With non-sequential call of move and Stop. See __help__ and online help ("-h" or "--help") for available options.

11.15.2 General file information

Author

Dirk Osswald

Date

2007-01-18

This code contains only the very basicst use of the features provided by the SDHLibrary-CPP. For more sophisticated applications see the other demo-∗.cpp programms, or of course the html/pdf documentation.

11.15.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.15.4 Function Documentation

11.15.4.1 int main (int *argc,* char ∗∗ *argv*)

11.15.5 Variable Documentation

11.15.5.1 char const∗ __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.15.5.2 char const∗ __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.15.5.3 char const∗ __help__ = " > demo-simple2 --port=2 -v\n"

11.15.5.4 char const∗ __url__ = "http://www.schunk.com"

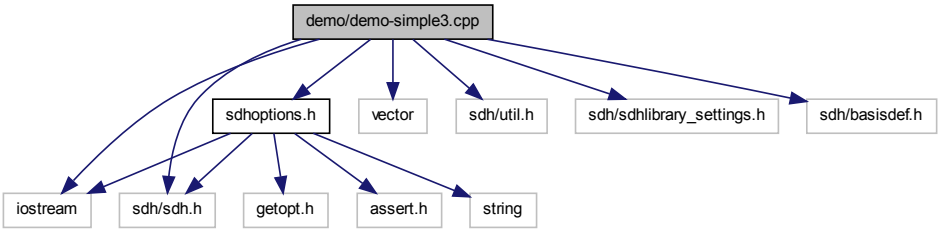
11.15.5.5 char const∗ __version__ = "$Id: demo-simple2.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"

11.16 demo/demo-simple3.cpp File Reference

Very simple C++ programm to make an attached SDH move. With non-sequential call of move and WaitAxis. See __help__ and online help ("-h" or "--help") for available options.

```
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-simple3.cpp:



Functions

- int main (int argc, char **argv)

Variables

Some informative variables

- char const * __help__ = " > demo-simple3 --port=2 -v\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-simple3.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.16.1 Detailed Description

Very simple C++ programm to make an attached SDH move. With non-sequential call of move and WaitAxis. See __help__ and online help ("-h" or "--help") for available options.

11.16.2 General file information

Author

Dirk Osswald

Date

2007-01-18

This code contains only the very basicst use of the features provided by the SDHLibrary-CPP. For more sophisticated applications see the other demo-∗.cpp programms, or of course the html/pdf documentation.

11.16.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.16.4 Function Documentation

11.16.4.1 int main (int *argc,* char ∗∗ *argv*)

11.16.5 Variable Documentation

11.16.5.1 char const∗ __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.16.5.2 char const∗ __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.16.5.3 char const∗ __help__ = " > demo-simple3 --port=2 -v\n"

11.16.5.4 char const∗ __url__ = "http://www.schunk.com"

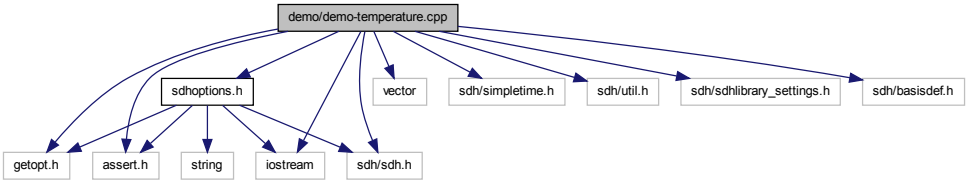
11.16.5.5 char const∗ __version__ = "$Id: demo-simple3.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"

11.17 demo/demo-temperature.cpp File Reference

Print measured temperatures of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

```
#include <getopt.h>
#include <assert.h>
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/simpletime.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-temperature.cpp:



Functions

- int main (int argc, char **argv)

Variables

Some informative variables

- char const * __help__ = " > demo-temperature --port=2 -v\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-temperature.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.17.1 Detailed Description

Print measured temperatures of an attached SDH. (C++ demo application using the SDHLibrary-CPP library.) See __help__ and online help ("-h" or "--help") for available options.

11.17.2 General file information

Author

Dirk Osswald

Date

2007-01-18

11.17.3 Copyright

11.17.4 Function Documentation

11.17.4.1 int main (int *argc*, char ** *argv*)

11.17.5 Variable Documentation

11.17.5.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.17.5.2 char const* __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.17.5.3 char const* __help__ = " > demo-temperature --port=2 -v\n"

11.17.5.4 char const* __url__ = "http://www.schunk.com"

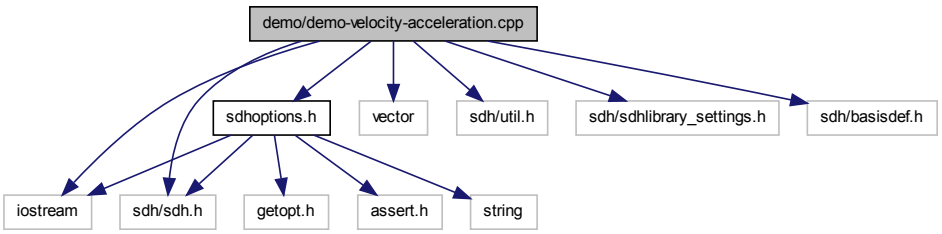
11.17.5.5 char const* __version__ = "$Id: demo-temperature.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"

11.18 demo/demo-velocity-acceleration.cpp File Reference

Very simple demonstration program using the SDHLibrary-CPP: Make an attached SDH move one finger in "velocity with acceleration ramp" control mode. See __help__ and online help ("-h" or "--help") for available options.

```
#include <iostream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdhoptions.h"
```

Include dependency graph for demo-velocity-acceleration.cpp:



Functions

- int main (int argc, char **argv)

Variables

- char const * usage = "usage: demo-velocity-acceleration [options]\n"

Some informative variables

- char const * __help__ = " > demo-velocity-acceleration --port=2 -v\n"
- char const * __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"
- char const * __url__ = "http://www.schunk.com"
- char const * __version__ = "$Id: demo-velocity-acceleration.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"
- char const * __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.18.1 Detailed Description

Very simple demonstration program using the SDHLibrary-CPP: Make an attached SDH move one finger in "velocity with acceleration ramp" control mode. See __help__ and online help ("-h" or "--help") for available options.

11.18.2 General file information

Author

Dirk Osswald

Date

2007-01-18

11.18.3 Copyright

11.18.4 Function Documentation

11.18.4.1 int main (int *argc,* char ** *argv*)

11.18.5 Variable Documentation

11.18.5.1 char const* __author__ = "Dirk Osswald: dirk.osswald@de.schunk.com"

11.18.5.2 char const* __copyright__ = "Copyright (c) 2007 SCHUNK GmbH & Co. KG"

11.18.5.3 char const* __help__ = " > demo-velocity-acceleration --port=2 -v\n"

11.18.5.4 char const* __url__ = "http://www.schunk.com"

11.18.5.5 char const* __version__ = "$Id: demo-velocity-acceleration.cpp 10351 2013-06-18 16:28:14Z Osswald2 $"

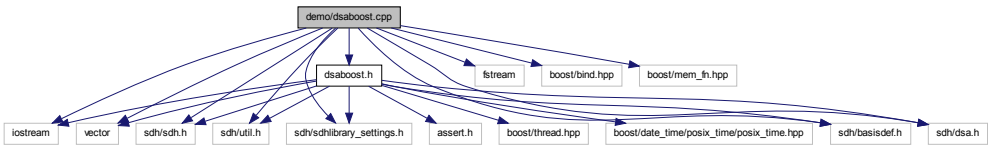
11.18.5.6 char const* usage = "usage: demo-velocity-acceleration [options]\n"

11.19 demo/dsaboost.cpp File Reference

helper stuff for the "boosted" DSA stuff

```
#include <iostream>
#include <fstream>
#include <vector>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdh/dsa.h"
#include "dsaboost.h"
#include <boost/bind.hpp>
#include <boost/mem_fn.hpp>
```

Include dependency graph for dsaboost.cpp:



Variables

- USING_NAMESPACE_SDH cDBG cdbg

11.19.1 Detailed Description

helper stuff for the "boosted" DSA stuff

11.19.2 General file information

Author

Dirk Osswald

Date

2009-08-02

11.19.3 Copyright

11.19.4 Variable Documentation

11.19.4.1 USING_NAMESPACE_SDH cDBG cdbg

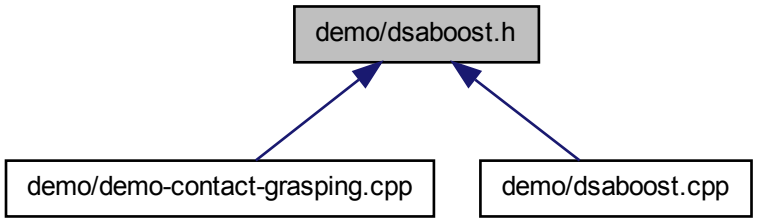
11.20 demo/dsaboost.h File Reference

helper stuff for the DSA using boost

```
#include <iostream>
#include <vector>
#include <assert.h>
#include "sdh/sdh.h"
#include "sdh/util.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/basisdef.h"
#include "sdh/dsa.h"
#include "boost/thread.hpp"
#include "boost/date_time/posix_time/posix_time.hpp"
```

Include dependency graph for dsaboost.h:

This graph shows which files directly or indirectly include this file:



Classes

- class cDSAUpdater

  Class to create an updater thread for continuously updating tactile sensor data.

- class cIsGraspedBase

  abstract base class for calculation of IsGrasped condition using tactile sensor information

- class cIsGraspedByArea

  class for calculation of IsGrasped condition using an expected area of contact measured by the tactile sensors

11.20.1 Detailed Description

helper stuff for the DSA using boost

11.20.2 General file information

Author

Dirk Osswald

Date

2009-08-03

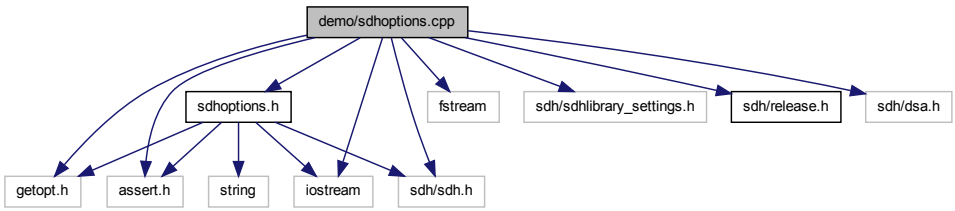
11.20.3 Copyright

11.21 demo/sdhoptions.cpp File Reference

Implementation of a class to parse common SDH related command line options.

```
#include <getopt.h>
#include <assert.h>
#include <iostream>
#include <fstream>
#include "sdh/sdh.h"
#include "sdh/sdhlibrary_settings.h"
#include "sdh/release.h"
#include "sdh/dsa.h"
#include "sdhoptions.h"
```

Include dependency graph for sdhoptions.cpp:



Defines

- #define XSTRINGIFY(_x) STRINGIFY(_x)

- #define STRINGIFY(_s) #_s
  helper macro for XSTRINGIFY, see there

Variables

- static char const * sdhusage_general = " \n"
  general options
- static char const * sdhusage_sdhcom_serial = " \n"
  RS232 communication options.
- static char const * sdhusage_sdhcom_common = " Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232\n"
  Common communication options.
- static char const * sdhusage_sdhcom_esdcan = ""
  ESD CAN communication options.
- static char const * sdhusage_sdhcom_peakcan = ""
  PEAK CAN communication options.
- static char const * sdhusage_sdhcom_cancommon = ""
  Common CAN communication options.
- static char const * sdhusage_sdhcom_tcp = " \n"
  TCP communication options.
- static char const * sdhusage_sdhother = " \n"
  Other options.
- static char const * sdhusage_dsacom = " \n"
  DSA (tactile sensor) communication options.
- static char const * sdhusage_dsaother = " This option can be used multiple times.\n"
  DSA (tactile sensor) other options.
- static char const * sdhusage_dsaadjust = " \n"
  DSA (tactile sensor) adjustment options.
- static char const * sdhoptions_short_options = "hvVd:l:p:T:b:cn:e:w:RFt:q:r:fSCM:"
  short command line options accepted by the cSDHOptions class
- static struct option sdhoptions_long_options [ ]
  long command line options accepted by the cSDHOptions class

11.21.1 Detailed Description

Implementation of a class to parse common SDH related command line options.

Author

Dirk Osswald

Date

2008-05-05

11.21.2 Copyright

11.21.3 Define Documentation

11.21.3.1 #define STRINGIFY(_s) #_s

helper macro for XSTRINGIFY, see there

11.21.3.2 #define XSTRINGIFY(_x) STRINGIFY(_x)

macro for stringification of _x
allows to stringify the **value** of a macro:

```
#define foo 4

STRINGIFY( foo ) // yields "foo"
XSTRINGIFY( foo ) // yields "4"
```

11.21.4 Variable Documentation

11.21.4.1 struct option sdhoptions_long_options[] [static]

long command line options accepted by the cSDHOptions class

11.21.4.2 char const* sdhoptions_short_options = "hvVd:l:p:T:b:cn:e:w:RFt:q:r:fSCM:" [static]

short command line options accepted by the cSDHOptions class

11.21.4.3 char const* sdhusage_dsaadjust = " \n" [static]

DSA (tactile sensor) adjustment options.

11.21.4.4 char const* sdhusage_dsacom = " \n" [static]

DSA (tactile sensor) communication options.

11.21.4.5 char const* sdhusage_dsaother = " This option can be used multiple times. \n" [static]

DSA (tactile sensor) other options.

11.21.4.6 char const* sdhusage_general = " \n" [static]

general options

11.21.4.7 char const* sdhusage_sdhcom_cancommon = "" [static]

Common CAN communication options.

11.21.4.8 char const* sdhusage_sdhcom_common = " Use BAUDRATE in bit/s for communication. Default=115200 Bit/s for RS232 \n" [static]

Common communication options.

11.21.4.9 char const* sdhusage_sdhcom_esdcan = "" [static]

ESD CAN communication options.

11.21.4.10 char const* sdhusage_sdhcom_peakcan = "" [static]

PEAK CAN communication options.

11.21.4.11 char const* sdhusage_sdhcom_serial = " \n" [static]

RS232 communication options.

11.21.4.12 char const* sdhusage_sdhcom_tcp = " \n" [static]

TCP communication options.

11.21.4.13 char const* sdhusage_sdhother = " \n" [static]

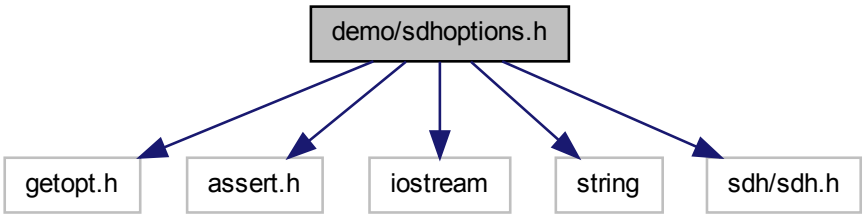
Other options.

11.22 demo/sdhoptions.h File Reference

Implementation of a class to parse common SDH related command line options.

```
#include <getopt.h>
#include <assert.h>
#include <iostream>
#include <string>
#include <sdh/sdh.h>
```

Include dependency graph for sdhoptions.h:



This graph shows which files directly or indirectly include this file:

Classes

- class cSDHOptions

  class for command line option parsing holding option parsing results

Defines

- #define SDHUSAGE_DEFAULT "general sdhcom_serial sdhcom_common sdhcom_-esdcan sdhcom_peakcan sdhcom_cancommon sdhcom_tcp"
- #define SDH_DEFAULT_TCP_ADR "192.168.1.42"
- #define SDH_DEFAULT_TCP_PORT 23
- #define DSA_DEFAULT_TCP_PORT 13000

11.22.1 Detailed Description

Implementation of a class to parse common SDH related command line options.

11.22.2 General file information

Author

Dirk Osswald

Date

2008-05-05

11.22.3 Copyright

11.22.4 Define Documentation

11.22.4.1 #define DSA_DEFAULT_TCP_PORT 13000

11.22.4.2 #define SDH_DEFAULT_TCP_ADR "192.168.1.42"

11.22.4.3 #define SDH_DEFAULT_TCP_PORT 23

11.22.4.4 #define SDHUSAGE_DEFAULT "general sdhcom_serial sdhcom_common sdhcom_esdcan sdhcom_peakcan sdhcom_cancommon sdhcom_tcp"

string defining all the usage helptexts included by default

Bug

When compiled with VCC then the macros WITH_ESD_CAN / WITH_PEAK_-CAN used above are not available since these are defined in the VCC project settings of the SDHLibrary VCC-Project. Therefore the value of SDHUSAGE_-DEFAULT is incorrect and thus the cSDHOptions will display an incomplete usage string when called with -h/--help.
Workaround: use the online help contained in the doxygen documentation: Online help of demonstration programs

11.23 doc/onlinehelp-demo-benchmark.exe.dox File Reference

11.23.1 Detailed Description

11.24 doc/onlinehelp-demo-contact-grasping.exe.dox File Reference

11.24.1 Detailed Description

11.25 doc/onlinehelp-demo-dsa-simple.exe.dox File Reference

11.25.1 Detailed Description

11.26 doc/onlinehelp-demo-dsa-simple.log.dox File Reference

11.27 doc/onlinehelp-demo-dsa.exe.dox File Reference

11.27.1 Detailed Description

11.28 doc/onlinehelp-demo-GetAxisActualAngle.exe.dox File Reference

11.28.1 Detailed Description

11.29 doc/onlinehelp-demo-GetFingerXYZ.exe.dox File Reference

11.29.1 Detailed Description

11.30 doc/onlinehelp-demo-griphand.exe.dox File Reference

11.30.1 Detailed Description

11.31 doc/onlinehelp-demo-mimic.exe.dox File Reference

11.31.1 Detailed Description

11.32 doc/onlinehelp-demo-radians.exe.dox File Reference

11.32.1 Detailed Description

11.33 doc/onlinehelp-demo-ref.exe.dox File Reference

11.33.1 Detailed Description

11.34 doc/onlinehelp-demo-simple-withtiming.exe.dox File Reference

11.34.1 Detailed Description

11.41.1 Detailed Description

Doxyfile for generating documentation for SDHLibrary cpp using doxygen.

11.41.2 General file information

Author

Dirk Osswald

Date

2007-06-14

11.41.3 Links

- The online documentation for Doxygen can be found at http://www.stack.nl/~dimitri/doxygen/

11.41.4 Copyright

11.42 Makefile File Reference

Makefile for SDH SDHLibrary C project.

11.42.1 Detailed Description

Makefile for SDH SDHLibrary C project.

11.42.2 General file information

Author

Dirk Osswald

Date

2007-01-03

This makefile can generate the C library itself, demo-programs and auxiliary stuff like doxygen documentation or generate a distribution for delivery to end users.

For a general description of the project see general project information.

11.42.3 Makefile variables

The variables defined here state project specific settings which are then used by the goals and/or by the included, more generic sub makefiles like:

- Makefile-common
- Makefile-doc
- Makefile-rules

11.42.4 Makefile targets

- **all** : generate everything
  - **build** : generate library and demo programs
  - **doc** : generate all documentation
- **clean** : clean up generated program files, but not TAGS or doxygen doc
- **mrproper** : clean up all generated files, including TAGS and doxygen doc
- **tags** : generate emacs TAGS file

11.42.5 Links

- The online documentation for gnu make can be found at http://www.gnu.org/software/make/

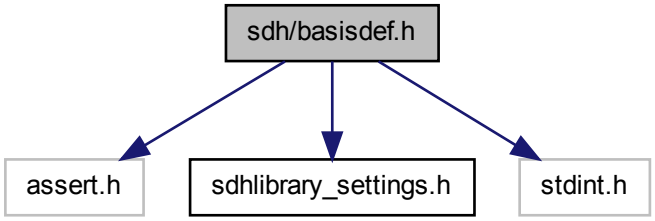
11.42.6 Copyright

11.43 sdh/basisdef.h File Reference

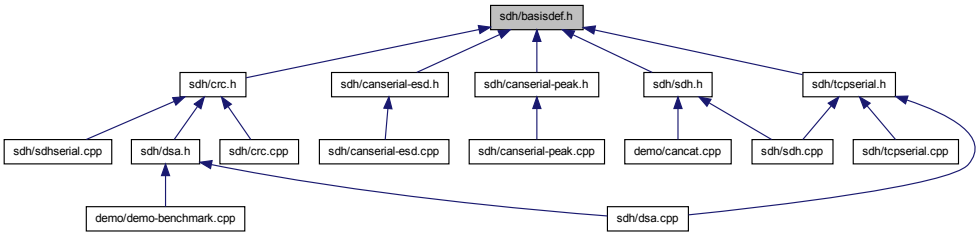
This file contains some basic definitions (defines, macros, datatypes)

```
#include <assert.h>
#include "sdhlibrary_settings.h"
#include <stdint.h>
```

Include dependency graph for basisdef.h:



This graph shows which files directly or indirectly include this file:



Namespaces

- namespace SDH

Defines

- #define SDH_ASSERT_TYPESIZES()

  macro to assert that the defined typedefs have the expected sizes

Typedefs

- typedef int8_t SDH::Int8

  signed integer, size 1 Byte (8 Bit)

- typedef uint8_t SDH::UInt8
  unsigned integer, size 1 Byte (8 Bit)
- typedef int16_t SDH::Int16
  signed integer, size 2 Byte (16 Bit)
- typedef uint16_t SDH::UInt16
  unsigned integer, size 2 Byte (16 Bit)
- typedef int32_t SDH::Int32
  signed integer, size 4 Byte (32 Bit)
- typedef uint32_t SDH::UInt32
  unsigned integer, size 4 Byte (32 Bit)

11.43.1 Detailed Description

This file contains some basic definitions (defines, macros, datatypes)

11.43.2 General file information

Author

Jan Grewe, Dirk Osswald

Date

08.10.2004

- Datatypes: SDH::Int8, SDH::UInt8, SDH::Int16, SDH::UInt16, SDH::Int32, SDH::UInt32

11.43.3 Copyright

Copyright (c) 2006 SCHUNK GmbH & Co. KG

11.43.4 Define Documentation

11.43.4.1 #define SDH_ASSERT_TYPESIZES( )

Value:

```
do {                                    \
        assert( sizeof( Int8 )   == 1 );    \
        assert( sizeof( UInt8 )  == 1 );    \
        assert( sizeof( Int16 )  == 2 );    \
        assert( sizeof( UInt16 ) == 2 );    \
```

```
        assert( sizeof( Int32 )  == 4 );    \
        assert( sizeof( UInt32 ) == 4 );    \
    } while (0)
```

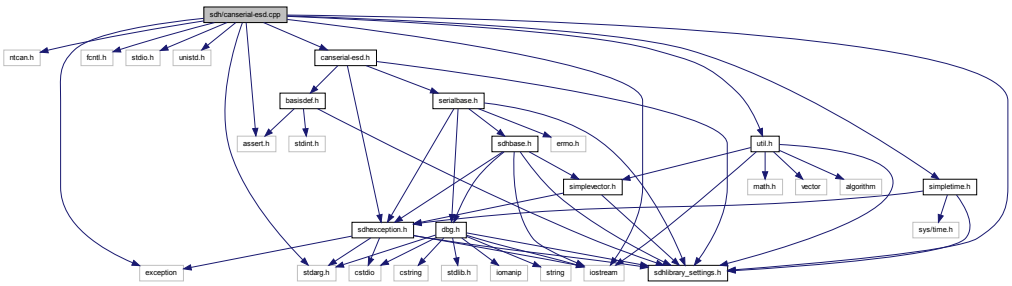
macro to assert that the defined typedefs have the expected sizes

11.44 sdh/canserial-esd.cpp File Reference

Implementation of class SDH::cCANSerial_ESD, a class to access an ESD CAN interface on cygwin/linux and Visual Studio.

```
#include "ntcan.h"
#include "sdhlibrary_settings.h"
#include <fcntl.h>
#include <stdio.h>
#include <unistd.h>
#include <iostream>
#include <exception>
#include <stdarg.h>
#include <assert.h>
#include "canserial-esd.h"
#include "simpletime.h"
#include "util.h"
```

Include dependency graph for canserial-esd.cpp:



Classes

- class SDH::cCANSerial_ESD_Internal

  internal hardware specific implementation details of the lowlevel ESD CAN interface

Namespaces

- namespace SDH

Defines

- #define SDH_CANSERIAL_ESD_DEBUG 1
- #define DBG(...)

Functions

- char const * ESD_strerror (NTCAN_RESULT rc)

11.44.1 Detailed Description

Implementation of class SDH::cCANSerial_ESD, a class to access an ESD CAN interface on cygwin/linux and Visual Studio.

11.44.2 General file information

Author

Dirk Osswald

Date

2007-02-20

11.44.3 Copyright

Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.44.4 Define Documentation

11.44.4.1 #define DBG(...)

Value:

```
do {                    \
        __VA_ARGS__;        \
    } while (0)
```

instead of guarding every debug output with #if SDH_CANSERIAL_ESD_DEBUG / #endif we use this DBG macro that expands to a stream output to a dbg object or to ";" depending on the value of SDH_CANSERIAL_ESD_DEBUG

11.44.4.2 #define SDH_CANSERIAL_ESD_DEBUG 1

Flag, if true then code for debug messages is included.

The debug messages must still be enabled at run time by setting the `some_cRS232_object.dbg.SetFlag(1)`.

This 2 level scheme is used since this is the lowlevel communication, so debug outputs might really steal some performance.

11.44.5 Function Documentation

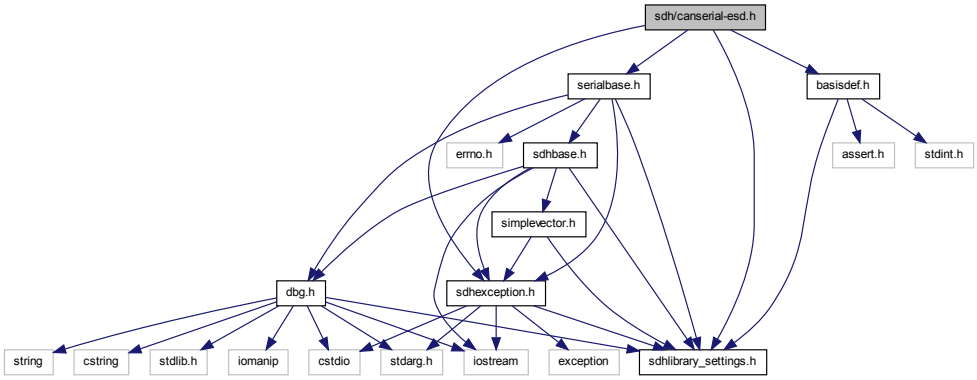
11.44.5.1 char const* ESD_strerror (NTCAN_RESULT *rc*)

11.45 sdh/canserial-esd.h File Reference

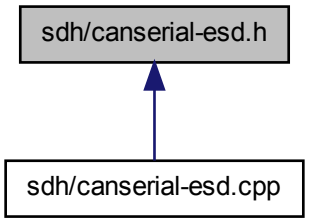
Interface of class SDH::cCANSerial_ESD, class to access CAN bus via ESD card on cygwin/linux.

```
#include "sdhexception.h"
#include "serialbase.h"
#include "basisdef.h"
#include "sdhlibrary_settings.h"
```

Include dependency graph for canserial-esd.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cCANSerial_ESDException

  Derived exception class for low-level CAN ESD related exceptions.

- class SDH::cCANSerial_ESD

  Low-level communication class to access a CAN port from company ESD (http://www.esd.eu/)

Namespaces

- namespace SDH

Defines

- #define CAN_ESD_TXQUEUESIZE 32

  transmit queue size for CAN frames

- #define CAN_ESD_RXQUEUESIZE 512

  receive queue size for CAN frames

11.45.1 Detailed Description

Interface of class SDH::cCANSerial_ESD, class to access CAN bus via ESD card on cygwin/linux.

11.45.2 General file information

Author

Dirk Osswald

Date

2008-05-02

11.45.3 Copyright

11.45.4 Define Documentation

11.45.4.1 #define CAN_ESD_RXQUEUESIZE 512

receive queue size for CAN frames

11.45.4.2 #define CAN_ESD_TXQUEUESIZE 32

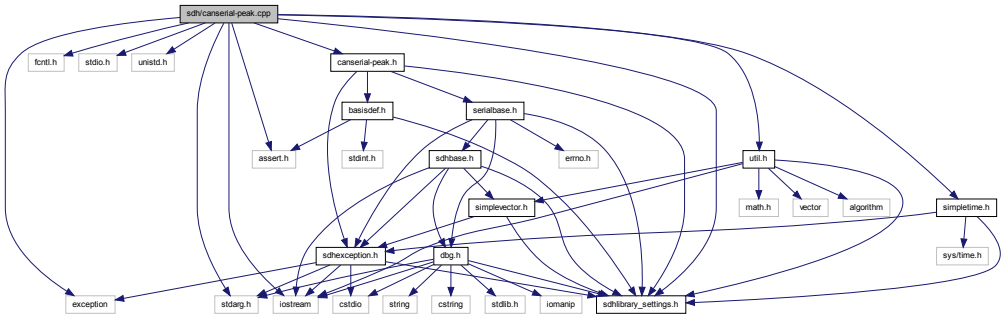
transmit queue size for CAN frames

11.46 sdh/canserial-peak.cpp File Reference

Implementation of class SDH::cCANSerial_PEAK, a class to access a PEAK CAN interface on cygwin/linux and Visual Studio.

```
#include "sdhlibrary_settings.h"
#include <fcntl.h>
#include <stdio.h>
#include <unistd.h>
#include <iostream>
#include <exception>
#include <stdarg.h>
#include <assert.h>
#include "canserial-peak.h"
#include "simpletime.h"
#include "util.h"
```

Include dependency graph for canserial-peak.cpp:



Classes

- class SDH::cCANSerial_PEAK_Internal

  internal hardware specific implementation details of the lowlevel PEAK CAN interface

Namespaces

- namespace SDH

Defines

- #define USE_HANDLES(H_)
- #define USE_HANDLE(H_)
- #define SDH_CANSERIAL_PEAK_DEBUG 1
- #define DBG(...)
- #define M_CMSG_MSG() m_cmsg

Typedefs

- typedef void * SDH::PCAN_HANDLE

  Linux libpcan uses HANDLE where Windows Pcan_usb.h uses no handle at all:

Functions

- char const * PEAK_strerror (DWORD rc)

11.46.1 Detailed Description

Implementation of class SDH::cCANSerial_PEAK, a class to access a PEAK CAN interface on cygwin/linux and Visual Studio.

11.46.2 General file information

Author

Steffen Ruehl, Dirk Osswald

Date

2009-07-29

11.46.3 Define Documentation

11.46.3.1 #define DBG(...)

Value:

```
do {                    \
        __VA_ARGS__;        \
    } while (0)
```

instead of guarding every debug output with #if SDH_CANSERIAL_PEAK_DEBUG / #endif we use this DBG macro that expands to a stream output to a dbg object or to ";" depending on the value of SDH_CANSERIAL_PEAK_DEBUG

11.46.3.2 #define M_CMSG_MSG( ) m_cmsg

11.46.3.3 #define SDH_CANSERIAL_PEAK_DEBUG 1

Flag, if true then code for debug messages is included.

The debug messages must still be enabled at run time by setting the `some_cRS232_object.dbg.SetFlag(1)`.

This 2 level scheme is used since this is the lowlevel communication, so debug outputs might really steal some performance.

11.46.3.4 #define USE_HANDLE(*H_*)

11.46.3.5 #define USE_HANDLES(*H_*)

11.46.4 Function Documentation

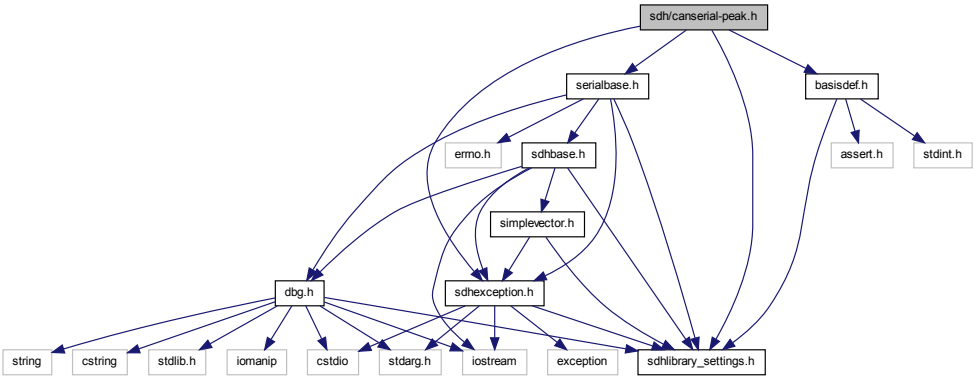
11.46.4.1 char const* PEAK_strerror (DWORD *rc*)

11.47 sdh/canserial-peak.h File Reference

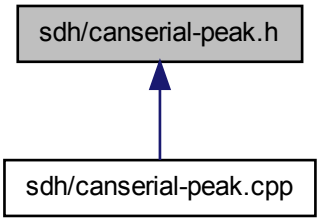
Interface of class SDH::cCANSerial_PEAK, class to access CAN bus via PEAK card on cygwin/linux.

```
#include "sdhexception.h"
#include "serialbase.h"
#include "basisdef.h"
#include "sdhlibrary_settings.h"
```

Include dependency graph for canserial-peak.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cCANSerial_PEAKException

  Derived exception class for low-level CAN PEAK related exceptions.

- class SDH::cCANSerial_PEAK

  Low-level communication class to access a CAN port from company PEAK (`http://www.peak-system.com`*)*

Namespaces

- namespace SDH

11.47.1 Detailed Description

Interface of class SDH::cCANSerial_PEAK, class to access CAN bus via PEAK card on cygwin/linux.

11.47.2 General file information

Author

Steffen Ruehl, Dirk Osswald

Date

2009-07-29

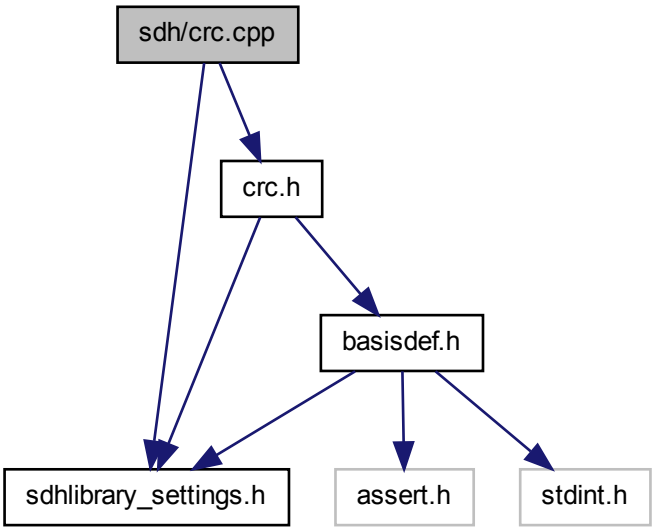
11.48 sdh/crc.cpp File Reference

Implementation of class SDH::cCRC_DSACON32m (actually only the static members all other is derived).

```
#include "sdhlibrary_settings.h"
```

```
#include "crc.h"
```

Include dependency graph for crc.cpp:



11.48.1 Detailed Description

Implementation of class SDH::cCRC_DSACON32m (actually only the static members all other is derived).

11.48.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.48.3 Copyright

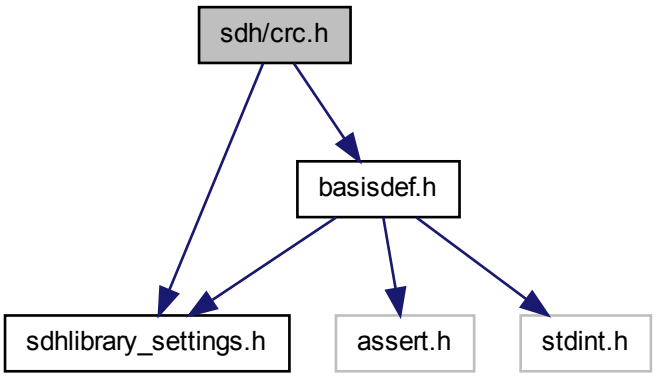
- Copyright (c) 2008 SCHUNK GmbH & Co. KG

11.49 sdh/crc.h File Reference

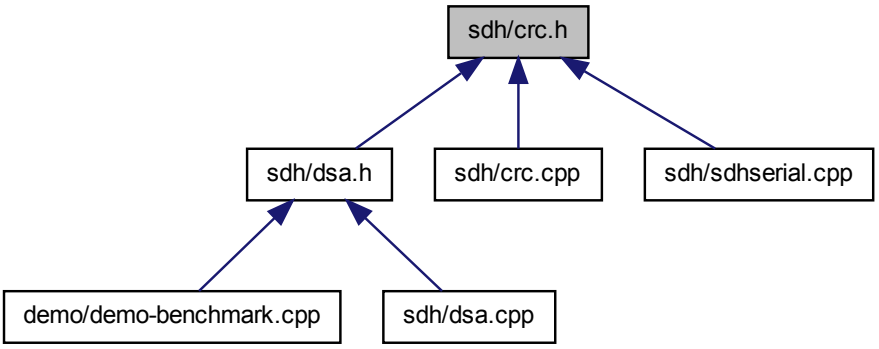
This file contains interface to cCRC, a class to handle CRC calculation.

```
#include "sdhlibrary_settings.h"
#include "basisdef.h"
```

Include dependency graph for crc.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cCRC

  Cyclic Redundancy Code checker class, used for protecting communication against transmission errors.

- class SDH::cCRC_DSACON32m

  A derived CRC class that uses a CRC table and initial value suitable for the Weiss Robotics DSACON32m controller.

- class SDH::cCRC_SDH

  A derived CRC class that uses a CRC table and initial value suitable for protecing the binary communication with SDH via RS232.

Namespaces

- namespace SDH

Typedefs

- typedef UInt16 SDH::tCRCValue

  the data type used to calculate and exchange CRC values with DSACON32m (16 bit integer)

11.49.1 Detailed Description

This file contains interface to cCRC, a class to handle CRC calculation.

11.49.2 General file information

Author

Dirk Osswald

Date

2008-06-09

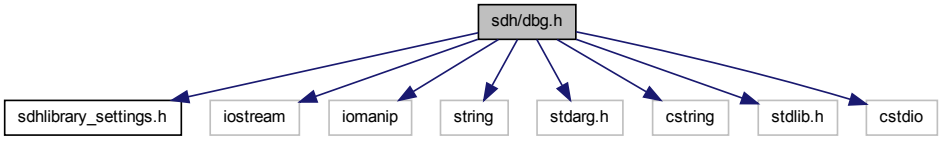
11.49.3 Copyright

11.50 sdh/dbg.h File Reference

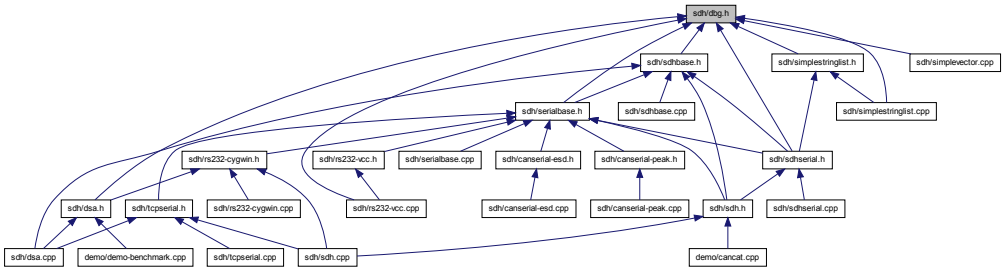
This file contains interface and implementation of class SDH::cDBG, a class for colorfull debug messages.

```
#include "sdhlibrary_settings.h"
#include <iostream>
#include <iomanip>
#include <string>
#include <stdarg.h>
#include <cstring>
#include <stdlib.h>
#include <cstdio>
```

Include dependency graph for dbg.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cDBG

  A class to print colored debug messages.

- class SDH::cHexByteString

  dummy class for (debug) stream output of bytes as list of hex values

Namespaces

- namespace SDH

Defines

- #define VAR(_d, _var) (_d) << #_var << "=’" << _var << "’\n"
- #define VAL(_var) #_var << "=’" << _var << "’ "

Functions

- VCC_EXPORT std::ostream & SDH::operator<< (std::ostream &stream, cHexByteString const &s)

  output the bytes in s to stream as a list of space separated hex bytes (without 0x prefix)

11.50.1 Detailed Description

This file contains interface and implementation of class SDH::cDBG, a class for colorfull debug messages.

11.50.2 General file information

Author

Dirk Osswald

Date

2007-02-22

11.50.3 Copyright

11.50.4 Define Documentation

11.50.4.1 #define VAL(_var) #_var << "=" << _var << " "

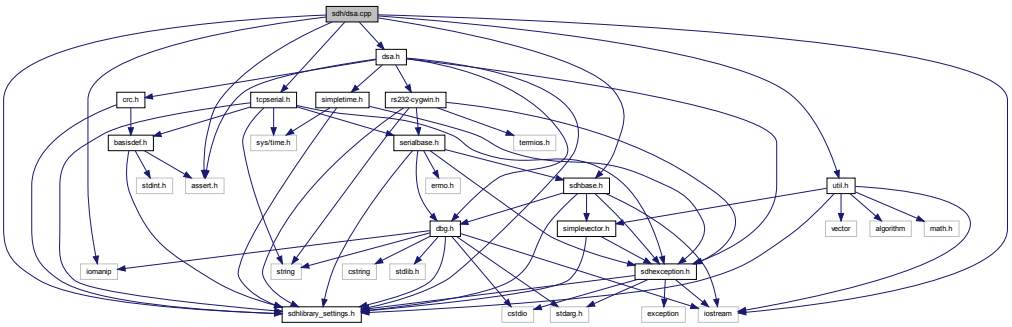
11.50.4.2 #define VAR(_d, _var) (_d) << #_var << "=" << _var << "\n"

11.51 sdh/dsa.cpp File Reference

This file contains definition of SDH::cDSA, a class to communicate with the tactile sensors of the SDH.

```
#include "sdhlibrary_settings.h"
#include <assert.h>
#include <iostream>
#include <iomanip>
#include "dsa.h"
#include "sdhbase.h"
#include "util.h"
#include "tcpserial.h"
```

Include dependency graph for dsa.cpp:



Namespaces

- namespace SDH

Defines

- #define PRINT_MEMBER(_s, _var, _member) (_s) << " " << #_member << "=" << _var._member << "\n"
- #define PRINT_MEMBER_HEX(_s, _var, _member) (_s) << " " << #_member << "=0x" << std::hex << int(_var._member) << std::dec << "\n"

Enumerations

- enum eDSAPacketID {

  eDSA_FULL_FRAME = 0x00, eDSA_QUERY_CONTROLLER_CONFIGURATION = 0x01, eDSA_QUERY_SENSOR_CONFIGURATION = 0x02, eDSA_QUERY_-MATRIX_CONFIGURATION = 0x0B,

  eDSA_CONFIGURE_DATA_ACQUISITION = 0x03, eDSA_QUERY_CONTROLLER_-FEATURES = 0x10, eDSA_READ_MATRIX_MASK = 0x04, eDSA_SET_-DYNAMIC_MASK = 0xAB,

  eDSA_READ_DESCRIPTOR_STRING = 0x05, eDSA_LOOP = 0x06, eDSA_-QUERY_CONTROLLER_STATE = 0x0a, eDSA_SET_PROPERTIES_SAMPLE_-RATE = 0x0c,

  eDSA_SET_PROPERTIES_CONTROL_VECTOR_FOR_MATRIX = 0x0d, eDSA_-GET_PROPERTIES_CONTROL_VECTOR_OF_MATRIX = 0x0e, eDSA_ADJUST_-MATRIX_SENSITIVITY = 0x0f, eDSA_GET_SENSITIVITY_ADJUSTMENT_-INFO = 0x12,

  eDSA_SET_MATRIX_THRESHOLD = 0x13, eDSA_GET_MATRIX_THRESHOLD = 0x14 }

Command ID for the DSACON32m tactile sensor controller according to DSACON32_-Command_Set_Reference_Manual.pdf.

Functions

- std::ostream & SDH::operator<< (std::ostream &stream, cDSA::sResponse const &response)

11.51.1 Detailed Description

This file contains definition of SDH::cDSA, a class to communicate with the tactile sensors of the SDH.

11.51.2 General file information

Author

Dirk Osswald

Date

2008-06-09

11.51.3 Copyright

11.51.4 Define Documentation

11.51.4.1 #define PRINT_MEMBER(_s, _var, _member) (_s) << " " << #_member << "=" << _var._member << "\n"

11.51.4.2 #define PRINT_MEMBER_HEX(_s, _var, _member) (_s) << " " << #_member << "=0x" << std::hex << int(_var._member) << std::dec << "\n"

11.51.5 Enumeration Type Documentation

11.51.5.1 enum eDSAPacketID

Command ID for the DSACON32m tactile sensor controller according to DSACON32_-Command_Set_Reference_Manual.pdf.

Enumerator:

eDSA_FULL_FRAME

eDSA_QUERY_CONTROLLER_CONFIGURATION

eDSA_QUERY_SENSOR_CONFIGURATION

eDSA_QUERY_MATRIX_CONFIGURATION

eDSA_CONFIGURE_DATA_ACQUISITION

eDSA_QUERY_CONTROLLER_FEATURES

eDSA_READ_MATRIX_MASK

eDSA_SET_DYNAMIC_MASK

eDSA_READ_DESCRIPTOR_STRING

eDSA_LOOP

eDSA_QUERY_CONTROLLER_STATE

eDSA_SET_PROPERTIES_SAMPLE_RATE

eDSA_SET_PROPERTIES_CONTROL_VECTOR_FOR_MATRIX

eDSA_GET_PROPERTIES_CONTROL_VECTOR_OF_MATRIX

eDSA_ADJUST_MATRIX_SENSITIVITY

eDSA_GET_SENSITIVITY_ADJUSTMENT_INFO

eDSA_SET_MATRIX_THRESHOLD

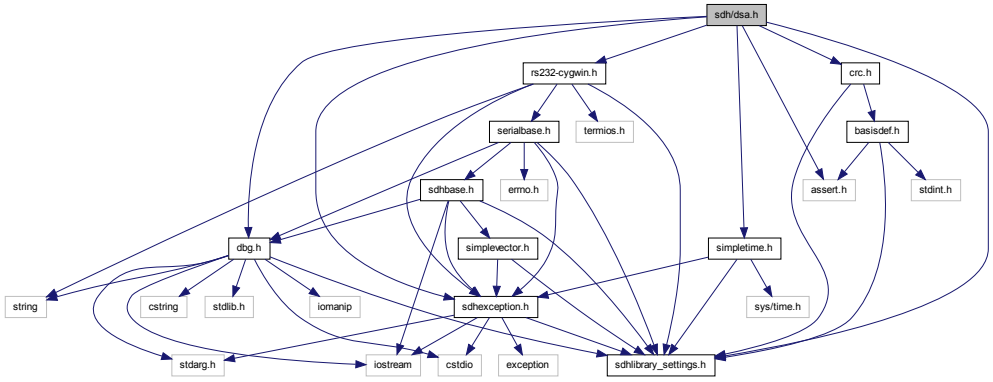
eDSA_GET_MATRIX_THRESHOLD

11.52 sdh/dsa.h File Reference

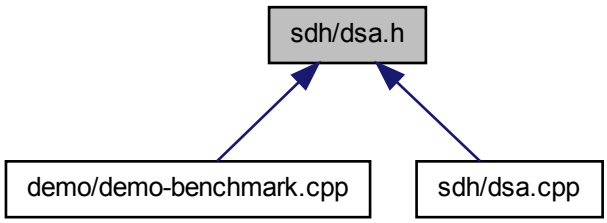
This file contains interface to SDH::cDSA, a class to communicate with the tactile sensors of the SDH.

```
#include "sdhlibrary_settings.h"
#include <assert.h>
#include "sdhexception.h"
#include "dbg.h"
#include "rs232-cygwin.h"
#include "simpletime.h"
#include "crc.h"
```

Include dependency graph for dsa.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cDSAException

  Derived exception class for low-level DSA related exceptions.

- class SDH::cDSA

  SDH::cDSA is the end user interface class to access the DSACON32m, the tactile sensor controller of the SDH.

- struct SDH::cDSA::sControllerInfo

  A data structure describing the controller info about the remote DSACON32m controller.

- struct SDH::cDSA::sSensorInfo

  A data structure describing the sensor info about the remote DSACON32m controller.

- struct SDH::cDSA::sMatrixInfo

  A data structure describing a single sensor matrix connected to the remote DSACON32m controller.

- struct SDH::cDSA::sSensitivityInfo

  Structure to hold info about the sensitivity settings of one sensor patch.

- struct SDH::cDSA::sTactileSensorFrame

  A data structure describing a full tactile sensor frame read from the remote DSACON32m controller.

- struct SDH::cDSA::sContactInfo

  Structure to hold info about the contact of one sensor patch.

- struct SDH::cDSA::sResponse

  data structure for storing responses from the remote DSACON32m controller

Namespaces

- namespace SDH

Defines

- #define DSA_MAX_PREAMBLE_SEARCH (2∗3∗(6∗(14+13)) + 16)

Functions

- sResponse (UInt8 ∗_payload, int _max_payload_size)

  constructor to init pointer and max size

- VCC_EXPORT std::ostream & SDH::operator<< (std::ostream &stream, cDSA::sControllerInfo const &controller_info)
- VCC_EXPORT std::ostream & SDH::operator<< (std::ostream &stream, cDSA::sSensorInfo const &sensor_info)
- VCC_EXPORT std::ostream & SDH::operator<< (std::ostream &stream, cDSA::sMatrixInfo const &matrix_info)
- std::ostream & SDH::operator<< (std::ostream &stream, cDSA::sResponse const &response)
- VCC_EXPORT std::ostream & SDH::operator<< (std::ostream &stream, cDSA const &dsa)

Variables

- UInt16 error_code

  0000h, if successful, otherwise error code

- UInt32 serial_no
- UInt8 hw_version
- UInt16 sw_version
- UInt8 status_flags
- UInt8 feature_flags
- UInt8 senscon_type
- UInt8 active_interface
- UInt32 can_baudrate
- UInt16 can_id
- UInt16 nb_matrices
- UInt16 generated_by
- UInt8 hw_revision
- float texel_width
- float texel_height
- UInt16 cells_x
- UInt16 cells_y
- UInt8 uid [6]
- UInt8 reserved [2]
- float matrix_center_x
- float matrix_center_y
- float matrix_center_z
- float matrix_theta_x
- float matrix_theta_y
- float matrix_theta_z
- float fullscale
- UInt8 adj_flags
- float cur_sens
- float fact_sens
- UInt8 packet_id
- UInt16 size
- UInt8 * payload
- Int32 max_payload_size

11.52.1 Detailed Description

This file contains interface to SDH::cDSA, a class to communicate with the tactile sensors of the SDH.

11.52.2 General file information

Author

Dirk Osswald

Date

2008-06-09

11.52.3 Copyright

11.52.4 Define Documentation

11.52.4.1 #define DSA_MAX_PREAMBLE_SEARCH (2∗3∗(6∗(14+13)) + 16)

11.52.5 Function Documentation

11.52.5.1 SDH__attribute__::sResponse (UInt8 ∗ *_payload,* int *_max_payload_size*)

constructor to init pointer and max size

11.52.6 Variable Documentation

11.52.6.1 UInt8 active_interface

11.52.6.2 UInt8 adj_flags

Bit vector indicating the sensitivity adjustment options:

- D7...2 reserved
- D1 1: user can change the sensitivity 0: sensitivity cannot be changed by the user

11.52.6.3 UInt32 can_baudrate

11.52.6.4 UInt16 can_id

11.52.6.5 UInt16 cells_x

11.52.6.6 UInt16 cells_y

11.52.6.7 float cur_sens

Currently set sensitivity value. Floating point value. 0 is minimum sensitivity, 1.0 is maximum sensitivity.

11.52.6.8 UInt16 error_code

0000h, if successful, otherwise error code

11.52.6.9 float fact_sens

Sensitivity value that is used, if a factory restore command is issued. Floating point value. 0 is minimum sensitivity, 1.0 is maximum sensitivity.

11.52.6.10 UInt8 feature_flags

11.52.6.11 float fullscale

11.52.6.12 UInt16 generated_by

11.52.6.13 UInt8 hw_revision

11.52.6.14 UInt8 hw_version

11.52.6.15 float matrix_center_x

11.52.6.16 float matrix_center_y

11.52.6.17 float matrix_center_z

11.52.6.18 float matrix_theta_x

11.52.6.19 float matrix_theta_y

11.52.6.20 float matrix_theta_z

11.52.6.21 Int32 max_payload_size

11.52.6.22 UInt16 nb_matrices

11.52.6.23 UInt8 packet_id

11.52.6.24 UInt8* payload

11.52.6.25 UInt8 reserved[2]

11.52.6.26 UInt8 senscon_type

11.52.6.27 UInt32 serial_no

11.52.6.28 UInt16 size

11.52.6.29 UInt8 status_flags

11.52.6.30 UInt16 sw_version

11.52.6.31 float texel_height

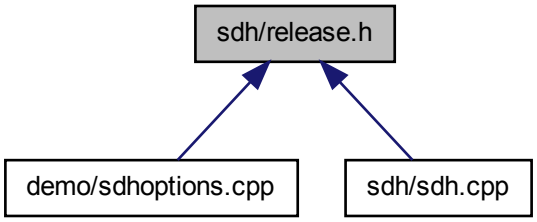
11.52.6.32 float texel_width

11.52.6.33 UInt8 uid[6]

11.53 sdh/release.h File Reference

This file contains nothing but C/C++ defines with the name of the project itself (PROJECT_NAME) and the name of the release (PROJECT_RELEASE) of the whole project.

This graph shows which files directly or indirectly include this file:



Defines

- #define PROJECT_NAME "SDHLibrary-CPP"

  Name of the software project.

- #define FIRMWARE_RELEASE_RECOMMENDED "0.0.3.3"
- #define PROJECT_RELEASE "0.0.2.10"

  Release name of the whole software project (a.k.a. as the "version" of the project).

- #define PROJECT_DATE "2014-02-28"

  Date of the release of the software project.

- #define PROJECT_COPYRIGHT "(c) SCHUNK GmbH & Co. KG, 2007-2014"

11.53.1 Detailed Description

This file contains nothing but C/C++ defines with the name of the project itself (PROJECT_-NAME) and the name of the release (PROJECT_RELEASE) of the whole project.

11.53.2 General file information

Author

Dirk Osswald

Date

2006-11-30

For a general description of the project see general project information.

11.53.3 Copyright

Copyright (c) 2014 SCHUNK GmbH & Co. KG

11.53.4 Define Documentation

11.53.4.1 #define FIRMWARE_RELEASE_RECOMMENDED "0.0.3.3"

The recommended release of the firmware of an SDH used by this library

11.53.4.2 #define PROJECT_COPYRIGHT "(c) SCHUNK GmbH & Co. KG, 2007-2014"

11.53.4.3 #define PROJECT_DATE "2014-02-28"

Date of the release of the software project.

The date of the release of the project.

11.53.4.4 #define PROJECT_NAME "SDHLibrary-CPP"

Name of the software project.

The name of the "SDHLibrary-CPP" (C Library for accessing SDH from a PC) project.

11.53.4.5 #define PROJECT_RELEASE "0.0.2.10"

Release name of the whole software project (a.k.a. as the *"version"* of the project).

The release name of the "SDHLibrary-CPP" project. The doxygen comment below contains the changelog of the project.

A suffix of "-dev" indicates a work in progress, i.e. a not yet finished release. A suffix of "-a", "-b", ... indicates a bugfix release.

From newest to oldest the releases have the following names and features:

- **0.0.2.10**: 2014-02-28
  - bugfix for bug 1517: Bug: assertion failure in util.cpp:207 in NumerifyRelease()
- **0.0.2.9**: 2013-11-27
  - bugfix for bug 1462: Bug: limit checking is buggy when using radians https://192.168.101.101/mechatronik/show_bug.cgi?id=1462
    - fixed limit checking for angles, angular velcities and angular accelerations when using SDHLibrary with "Radians" as unit system, according to a bug report from Matei Ciocalie. Thanks.

- **0.0.2.8**: 2013-11-11
  - bugfix for bug 1440: Bug: communication via RS232 cannot be established from library due to write return -1 https://192.168.101.101/mechatronik/show_bug.cgi?id=1440
  - incorporating patches suggested from GeorgiaTech (for ESD-CAN on Linux)

- **0.0.2.7**: 2013-06-18
  - first version with recommended firmware 0.0.3.2 with ethernet TCP/IP support for tactile sensor data

- **0.0.2.6**: 2013-02-04
  - first version with recommended firmware 0.0.3.1 with ethernet TCP/IP support

- **0.0.2.5**: 2012-05-08
  - bugfixes 1153: Bug: Speicherzugriffsprobleme in dsa.cpp https://192.168.101.101/mechbug.cgi?id=1153
    - fixed possible memory corruption issues according to a bug report from Fraunhofer IFF. Thanks.

- **0.0.2.4**: 2012-02-18
  - added bug description for 1020: bug 1020 velocity control with acceleration ramp stops other axes when only a single one is addressed
  - Enhancement Bug 1088: Task: Implement functions to check compatibility of SDH firmware
    - added SDH::cSDH::CheckFirmwareRelease() and SDH::cSDH::GetFirmwareReleaseRecomme to be able to check the actual versus the recommended SDH firmware release. Needed for the new SDH driver for ROS, see http://www.ros.org/doc/api/csdh/html/index.html

- **0.0.2.3**: 2011-05-11
  - working Bug 1012: Bug: cannot communicate with SDH via PEAK-CAN on Linux => testing compliance of SDHLibrary with PEAK CAN driver v7.1 for Linux
    - cannot be confirmed as a bug
    - minor bug in cCANSerial_PEAK::Open() now only the read-ID is filtered instead of both write and read
    - slightly improved cancat
    - improved debug output cCANSerial_PEAK and cCANSeral_ESD while

- **0.0.2.2**: 2011-04-27

  - fixed Bug 1011: Bug: Binary communication does not work via RS232 on Linux The ISTRIP (Strip parity bits) bit MUST NOT be set on linux. If set then the MSbit of received bytes is set to 0 always... (Thanks to the hints of M. Schoepfer from Uni Bielefeld!)
  - In distribution CAN bus and boost support is now disabled by default. (Can be enabled in Makefile-settings, see WITH_ESD_CAN, WITH_PEAK_CAN, HAVE_BOOST)

- **0.0.2.1**: 2011-03-09
  - fixed Bug 844: Bug: Korean windows cannot handle specific unit characters like ï¿½ and ï¿½ The non ASCII string literals for degrees and squared were replaced by ASCII literals
  - added Bug 996: Task: Version numbering of DSACON32m firmware has changed since 2011-02-15 software version numbers for DSACON32m are reported correctly for the new firmwares
  - fixed Bug 703: Bug: Tactile sensor frames cannot be read reliably in single frame mode
    * Some firmware versions of the DSACON32m are not able to do single frame acquisition and enter push-mode. This might fill up the RS232 input buffer and leads to problems like reading of outdated frames or frame loss.
    * Added workaround to stop push mode immediately after it was entered unintentionally
    * made debug output of communication functions (RS232 and CAN and TCP) more concise
  - Enhancement Bug 985: Task: Get Visual Studio to compile SDHLibrary-c++ as DLL
    * The Visual Studio projects now generate and use a DLL version of the SDHLibrary

- **0.0.2.0**: 2011-02-08
  - added new documentation file SDH2_exchanging_tactile_sensor_controller
  - added support for communication via TCP (requires at least SDH firmware 0.0.3.0)
    * enhancement Bug 874: Task: Enable TCP communication in SDHLibrary
    * refactoring Bug 918: Task: Refactor generation of error messages
  - added properties for "Release" configuration in VCC project files
  - bugifx Bug 959: Bug: SDHLibrary does not compile in new cygwin-1.7 environment
    * refactored device driver specific CAN stuff from headers into code files

  - added demo-benchmark for measuring communication performance Bug 963: Task: implement benchmark for measuring communication rate
  - added support for fast binary communication with CRC protection Bug 964: Task: implement new binary communication in SDHLibrary
  - added commands to set target angles/velocities and get actual angles/velocities in one command, see cSDH::SetAxisTargetGetAxisActualAngle() and cSDH::SetAxisTargetGetAxisActualVelocity()
  - **These last two points along with the accompanying changes in the firmware boost the communication speed significantly!**
    * For RS232 the communication cycles per second rise from ca. 30 to 75 Hz (according to demo-benchmark)
    * For CAN the improvement goes even higher to ca. 160 Hz (according to demo-benchmark)
  - Doxygen documentation is now generated with doxygen-1.7.3 with included javascript search engine

- **0.0.1.18**:
  - added bug description for Bug 822: Online help of C++ demo programs compiled with VCC misses description for CAN parameters
  - added new documentation file SDH2_FingerDimensions

- **0.0.1.17**: (2010-05-11)
  - enhancement Task: Reorganise Makefiles to simplify making of user provided demo-programs extracted common Makefile settings to Makefile-settings for better maintenance and extensibility,
  - Enhancement made acquiring of single tactile sensor frames available

- **0.0.1.16**: (2010-04-12)
  - bugfix: Bug 680: cDSA fails to communicate with Release 276 of DSACON32m Firmware

- **0.0.1.15**: (2010-03-05)
  - enhancement: Bug 482: add support for adjusting sensitivity and threshold in SDHLibrary-CPP
    * added cDSA.SetMatrixSensitivity() cDSA.GetMatrixSensitivity() cDSA.SetMatrixThreshold() cDSA.GetMatrixThreshold()
    * the sensitivity and the threshold can now be changed and saved temporarily or persistently to configuration memory of the DSACON32m
    * added command line options to demo-dsa to adjust matrix sensitivity and threshold (needs DSACON32m Firmware >= R268)

- **0.0.1.14**: (2010-02-19)
  - added doucmentation file SDH2_exchanging_tactile_sensors.pdf to distribution
  - added doucmentation file SDH2_wiring_test_board.pdf to distribution
  - added doucmentation file SDH training.pdf to distribution
  - updated doucmentation file SDH2_configuration-and-update.pdf

- **0.0.1.13**: (2010-02-02)
  - bugfix (firmware 0.0.2.10): Bug 630: Bug: setting of pid parameters does not work

- **0.0.1.12**: (2009-12-04)
  - bugfix: Bug 575: grip related commands do not work properly
    - the actual answers for selgrip/grip from the SDH were different from the expected ones in sdhserial
    - there was a problem with the read ahead data in readline in serialbase
  - bugfix: Bug 470: made demo-contact-grasping.cpp actually work

- **0.0.1.11**: (2009-12-01)
  - added support for CAN devices from PEAK, kindly provided by Steffen Ruehl and Zhixing Xue
    - this caused some changes and additions in the command line option handling
    - made the "Linux-only" PEAK port work on Windows as well
  - fixed bug in both ESD and PEAK CAN support that might prevent proper access to several SDHs on same CAN interface from the same process. (Problem was static data in communication classes)
  - added online help of demonstration programs to doxygen documentation
  - changed Makefile to use 'uname' instead of unreliable OSTYPE to determine OSNAME
  - added demo-contact-grasping to show how to do very basic reactive grasping (using boost::threads to evaluate tactile sensor data concurrently)
  - added demo-mimic to show how to access 2 SDHs, one mimicing the movements of the other
  - bugfix: Bug 561: SDHLibray does not compile with VCC
    - the pragma pack was not used correctly, i.e. packing was not reset to normal after the structs to pack tightly
  - bugfix: Bug 568: option -M causes segfault on demo-dsa
  - enhancement: Bug 480: Include DSACON32 firmware within distribution

- **0.0.1.10**: (unofficial release 2009-10-05)
  - added troubleshooting section to the CD contents in troubleshooting.html
  - corrected checking of environment variable "OS" for the automatic disabling of the use of color in output. OS is "WINNT" on German windows XP, but "Windows_NT" on US-english Windows XP... Phhh
  - while fixing Bug 452: current demo-gui.py fails when connected to an old SDH v0.0.2.0 added firmware version specific code to make cSDH::GetAxisLimitVelocity() and cSDH::GetAxisLimitAcceleration() work on older firmwares
  - made all operator<< receive a const reference as parameter. This should improve performance especially for the cDBG::operator<<
  - bugfix: trying to connect to the tactile sensors of an SDH that is missing or switched off caused an infinite retry loop
  - Bugfix: Bug 351: make does not work recursively reopend and fixed again since still had problems on Linux where the shell command "test" or "[ ]" is somewhat picky about comparing strings ("==" is not understood)
  - bugfix: Bug 471: Incorporate feedback for 64 bit compatibility changes to make compilation work on 64 bit systems according to feedback from Niklas Bergstroem.
  - enhancement: Added possibility to set the RS232 device name format string (e.g. to use /dev/ttyUSBd like devices)
  - bugfix: Bug 469: make clean funktioniert unter Linux nicht
  - enhancement: Bug 472: Objects of type cDSA should be able to recover from power cycling There is now a cDSA::Open() member to reopen the connection to the DSA controller after a failure
  - bugfix: <a href="https://192.168.101.101/mechatronik/show_bug.cgi?id=478>Bug 478: Online help of C++ demo programs is incorrect
  - modified Makefile-doc, Makefile, Doxyfile to be able to use target specific variables to exclude/include files from documentation depending on whether internal or external docu is generated

- **0.0.1.9**: 2009-06-17
  - added missing includes of cstdio for gcc-4.4 as reported by Hannes Saal.
  - while adding webcheck to check the generated html files:
    - corrected settings in Doxyfile so that tagfiles not available for customer are no longer used in distribution
    - corrected broken/missing links in the distribution html files according to webcheck
  - added forgotten demo-velocity-acceleration project for VCC

  - bugfix: Bug 433: Invalid negative velocities remain set when switching from speed based controllers back to pose controller Adjusted documentation for SetController() accordingly
  - adjusted Library for new behaviour of firmware 0.0.2.7 in eCT_VELOCITY_ACCELERATION controller type:
    * acceleration must no longer be given with correct sign. The sign of the acceleration is now determined automatically from the signs and magniturdes of the current reference velocity and the target velocity
    * Adjusted WaitAxis() since the state is now reported correctly by the firmware, even if in a speed based controller mode
    * adjusted doxygen documentation and demo-velocity-acceleration.cpp
    * current controller_type is now cached in cSDH object
    * Now using the same acceleration limits as the firmware
  - Date of library is now reported as well for option -v in the demo programs
  - corrected doxygen description of GetTemperature()
  - enhancement: Bug 442: acceleration limits cannot be queried from the firmware
    * added new commands to read acceleration limits from firmware
  - bugfix: Bug 432: temperature output does not respect the -F Fahrenheit switch from the comand line
  - enhancement: updated / corrected doxygen comments
    * updated known bugs
    * guarded text "SDH" with "%SDH" in doxygen comments to prevent doxygen from auto-linking to SDH namespaceup

- **0.0.1.8**: 2009-05-18
  - enhancement: Enhancement 263: Provide access to speed controller of SDH joints
    * provide access to the 2 additional controller types eCT_VELOCITY and eCT_VELOCITY_ACCELERATION which are provided by the firmware 0.0.2.6
    * added new command cSDH.GetAxisReferenceVelocity() to access the internal reference velocity of the eCT_VELOCITY_ACCELERATION controller type
    * added new demonstration script demo-velocity-acceleration.cpp
    * the allowed lower limits for velocity and acceleration now have to be adjusted when the controller type changes.
  - enhancement Enhancement 384: Make doxygen documentation match for SDHLibrary-CPP and SDHLibrary-python
    * added group with all demonstration programs
    * included description of all known bugs

- **0.0.1.7**: 2009-05-05

- Enhancement: added CAD Datafiles to distribution CD
- Bugfix: Bug 341: new gcc-4.x capable Makefile does not work in Linux Linux gcc does not know option --enable-auto-import, added cygwin specific code to Makefile
- Bugfix: Bug 351: make does not work recursively building the library did not work in one go since make did not work recursively due to errors in Makefile-subdir PIPESTATUS was used which is an automatic variable of the bash shell. So if another shell is used then PIPESTATUS cannot be used to determine if the recursively called make succeded. Therefore we now export PIPESTATUS="0" (which means 'true' for shells) to keep make going on non bash shells.
- bugfix: Bug 342: RS232 communication does not work any more when compiled with MS-Visual Studio on Windows Resolved, parameters like bits per byte were not set explicitly, so the code worked with some interfaces only, depending on the default settings of the interface
- bugfix: Bug 361: No proper RS232 communication in C++ version of SDHLibrary Resolved, timeout handling improved
- bugfix: Bug 364: Remove ancient, no current stuff from the distribution; Separate build target into build_-lib build_demo (and build_test)
- bugfix: Bug 366: demo-dsa.exe does not respect --debuglog
- bugfix: corrected output of internal datatypes memebers of type UInt8. These are now printed as hex instead of as char
- enhancement: debug outputs of low level communication in rs232-cygwin.cpp and rs232-vcc.cpp can be included / excluded at compile time using the SDH_RS232_CYGWIN_DEBUG / SDH_RS232_VCC_DEBUG macros. If included the debug messages can be enabled / disabled at runtime with the usual -d LEVEL parameter. (Level 4 is needed for these in the demos)
- bugfix: Bug 372: Disabled colored debug output on windows consoles for better readability
- bugfix: Bug 370: First call to demo-dsa after powering SDH fails The problem is related to the tactile sensor controller DSACON32m within the SDH. This controller needs approximately 8 seconds to "boot" up, and during that time it will not answer to requests from the SDHLibrary. Unfortunately the timeout mechanism of the SDHLibrary for Windows also had a bug which then made it wait forever for answers that would never come.
- bugfix: Bug 373: EmergencyStop did not work Fixed (copy & paste error while porting from python to C++)
- bugfix: Bug 379: invalid command line parameters cause segv in demo-dsa Fixed, missing ':' in option definition string
- bugfix: Bug 386: demo-simple2.cpp does not behave as expected Fixed, some code was commented out
- velocity and acceleration for virtual axis is no longer limited to [0..0], since that makes SetAxisTargetVelocity(All, x) and SetAxisTargetAcceleration(All, x) invalid for all x != 0.0

- **0.0.1.6**:
  - extracted generation of distribution stuff from Makefile to Makefile-dist (since not needed by customer)
  - corrected use of CC and CPPC variables in Makefiles. Now these can be set from the environment. Needed to test compilation with alternative compilers like gcc-4.x instead of std gcc-3.x
  - corrected copy & paste errors in doxygen comments of cSDH::GetAxisMaxVelocity()
  - Bugfix `Bug 333: Invalid default parameters and documentation for OpenESD_CAN` Mix-up of hex and dec representation of the default IDs used for CAN communication
  - made compilation work without errors and warnings with gcc-4.3.2:
    - added additional includes like "cstring"
    - changed many char* to char const* to get rid of deprecation warnings
  - changed generation of distribution:
    - modified Doxyfile is now included so that user can generate documentation by himself
    - doc target is no longer a subtarget of all target in distributed Makefile (user will most likely not want to regenerate the docu)
  - updated links to misc packages and Weiss documentation in index-overview.html in distribution

- **0.0.1.5**: 2009-02-11
  - bugfix: `Bug 322: AxisTargetVelocity cannot be set higher than 100 deg/s`
  - bugfix: `Bug 323: SDHLibrary exceptions not deleted correctly when caught and handled`
  - enhancement: `Enhancement 315: Add documentation files to distribution`

- **0.0.1.4**:
  - bugfix: `Bug 267: SDHlib cannot be compiled on Linux`

- **0.0.1.3**: 2008-10-16
  - bugfix: `Bug 266: demo-dsa does not work in the VCC version`

- **0.0.1.2**: 2008-10-14
  - bugfix: target cancat is now only added in the Makefile if WITH_ESD_CAN is 1
  - bugfix: corrected copy/paste error: removed class qualifiers from member declarations since newer gccs do not accept fully qualified member names within class declarations (like aClass::aMember())

- bugfix: corrected parameter checking of cSDHSerial::vp()
- bugfix: corrected error in apply() in util.h (correct result was calculated only locally)
- made generation of Doxygen-doku work with Doxygen v1.5.5
- fixed bug in option detection
- made output of version info more verbose (with SOC and dates)
- implemented cRS232::Read()
- made dsa.cpp/h work with VCC
- corrected TCP calculation: corrected limb lengths and changed coordinate system from left to right handed
- added cSDH::GetInfo
- added cSDHSerial::vlim() and cSDH::GetAxisLimitVelocity() to read velocity limits
- bugfix: `Bug 134: cannot generate doxygen documentation if SDH namespace is used`
- bugfix: `Bug 261: Header file problems with SDHLibrary-CPP on Linux`
- bugfix: `Bug 260: CAN access problems with SDHLibrary-CPP on Linux`
- enhancement: Enable debugging to logfile in SDHLibrary-cpp
- enhancement: reduced overhead in cDBG::operator<<, no more searching for color strings on each call
- added demo-simple-withtiming to perform some simple OS-level time measurement
- change: changed parent class of cSerialBaseException to cSDHErrorCommunication to make the hierarchy more consistent

- **0.0.1.1**:
  - added cancat program for sending inaccessible commands like change_rs232 via CAN
  - added info commands corresponding to new info commands in firmware:
    - in sdhserial:
      - soc - to read the SoC ID
      - soc_date : to read the date string of the SoC
      - ver_date : to read the release date of the firmware
    - in sdh:
      - enhanced GetInfo to read all the above also
    - in the option parser in auxilliary all the info is now printed if "-v" is given
  - added GetDuration command: returns the calculate duration of the currently configured movement (target angle, velocity, acceleration, velocity profile) but does not execute the movement. This simplifies scripts like sdhrecord.py a great deal.

  - made py.test test_sdh work again.
  - while working on Bug 224: Positioning delay of 5s when using SDHLibrary-CPP
    * removed call to SleepSec() in loop in serial for VCC, needed to get rid of delays
    * implemented cSimpleTime in VCC version
  - added support for new firmware v0.0.2.0 commands
    * soc, soc_date, ver_date
    * GetDuration

- **0.0.1.0**: 2008-06-13
  - added basic support for the tactile sensors,
    * new library classes cDSA, cCRC
    * new demo program demo-dsa

- **0.0.0.9**: 2008-06-06
  - added missing files for vcc compilation in distribution
  - removed error in overloaded Sleep function. Internal version renamed to SleepSec.
  - made demo-GetAxisActualAngle and demo-temperature work in periodic mode in Visual Studio
  - untabified all source and header files for use with Visual Studio
  - autostart feature for distribution CD

- **0.0.0.8-a**:
  - added project files for the demo-∗ programs to the Visual Studio solutions file to make the demo programs available under VCC too
  - added forgotten WITH_ESD_CAN=1 to Visual Studio project file for SDHLibrary
  - workaround for accessing RS232 from VCC (WriteFile() does not return number of bytes sent)
  - With VCC the communication via RS232 still has some bugs: long pauses and timeouts,
  - With VCC the "-t" parameter for periodic replies in demos does not work yet

- **0.0.0.8**: 2008-05-26
  - added compatibility code for MS Visual C++ Compiler (VCC)
    * sdhlibrary_defines with compatibility macros
    * pragmas for VCC
    * _attribute_ are switched off for VCC

    * all SDH specific classes can be put in a namespace called "SDH"
  - added index-overview.html with overview of distributed files
  - index.html files in distribution are parsed for ${PROJECT_*}

- **0.0.0.7-b**: 2008-05-21
  - CAN timeout is now correctly set
  - fixed bug in cpp/Makefile: OSNAME_LINUX=1 was always appended to EXTRACPPFLAGS no matter what OS was used
  - renamed interace member to comm_interface

- **0.0.0.7-a**: 2008-05-17
  - bug fix: minor changes to make compilation work on Linux. (ESDs ntcan.h for Windows is different from that for Linux)
  - still contains a bug that can be fixed without recompilation:
    * The Linux version of ntcan canOpen does not accept timeout values < 0
    * Workaround for demo programs: Use an additional "-T 0.0" command line parameter

- **0.0.0.7**: 2008-05-16
  - added C++ support for CAN using ESD cards
    * restructured low level communication:
      · new base class cSerialBase (+new exception classes cSerialBase-Exception, cCANSerialESDException)
  - added support for variable baudrate for RS232 communication
  - made command line option handling in c++ demo programs more generic
  - corrected a bug in SDHLibrary-CPP that caused a SEGV (empty throw statement outside of a catch block)

- **0.0.0.6**: 2007-12-27
  - release for RoboCluster, Denmark
    * added ref command and demo-ref program (needed for SDH-003)
    * corrected minor errors to make the above work

- **0.0.0.5-a**: 2007-06-06
  - Included bugfixes from release 0.0.0.3-a (bugfix release for Uni Wales, see below) into release for care-o-bot

- **0.0.0.5**: 2007-05-24
  - Release for care-o-bot (IPA, Stuttgart), mai 2007

  - Restructured files: library stuff into sdh/ and demo programs in demo/ to ease installation on user platform
  - Added library support for the new firmware features:
    * cSDHSerial: a() vp(), vel()
    * cSDH: Get/SetAxisAcceleration(), GetAxisMaxAcceleration(), Get/SetVelocityProfile(), GetAxisCurrentVelocity()
  - while preparing release for IPA care-o-bot:
    * since line endings are corrected in firmware now removed the special EOL treatmnt in readline
    * enhanced generation of distribution
    * extended README files
    * added demo-simple3 in cpp and python
    * made compilation work on linux without warnings (SuSE 8.1 and Knoppix_v5.1.1)
    * added requested functions GetAxisActualState() and WaitAxis() in cpp and python library
    * added eAxisState enums from firmware
    * corrected some yet undetected errors
    * corrected / enhanced some doxygen comments
    * tried to find bug:
      · firmware not moving from 5,-5,0,0,0,0,0 to 20,0,0,0,0,0,0:
      · axis 1 is stuck at 1.4...
      · bug could not be resolved (does not happen for for larger movements)

- **0.0.0.4**: 2007-03-19
  - Release for demo at NASA, march 2007
    * adjusted expected lines for "m" command (it now prints one line debug output for every axis)

- **0.0.0.3-a**: 2007-06-05
  - Release modified according to bug report from Martin Huelse
    * A cSDH object could be opened successfully even if no SDH was connected or was connected but not powered:
      · added demo-test program to verify erroneous / repaired behaviour
      · added SetTimeout and GetTimeout to cRS232 class
      · made the code to verify proper connection to SDH work
    * Exceptions could not be caught properly:
      · corrected some real printf-style format string related problems in creations of exceptions
      · added gcc style printf-style format string checking (to enable the compiler to detect errors like the above at compile time)

        - The following piece of information from the C++ Annotations was not considered properly. See http://www.icce.rug.nl/documents/cplusplus "A function for which a function throw list is specified may not throw other types of exceptions. A run-time error occurs if it tries to throw other types of exceptions than those mentioned in the function throw list."
        - corrected the function throw lists/exception specification lists so that the most generic type thrown was listed. Thus all the user-level functions now just mention cSDHLibraryException* in their function throw list as all thrown exceptions are derived from it.
    - Further changes
        - added further function throw lists/exception specification lists
        - merged in some changes from newer releases (up to 0.0.0.5):
            - retrying of sending in case of transmission errors
            - naming of sequential / non sequential (formerly called synchronous/asynchronous)
            - fixed many typos in doxygen comments

- **0.0.0.3**: 2007-03-09
    - Release modified at visit Uni-Wales
        - Changes to make everything work on Ubuntu-Linux
        - Enhanced Makefile a little bit to be more comfortable for the end user

- **0.0.0.2**: 2007-03-07
    - release, for Uni-Wales

- **0.0.0.1**
    - initial release, works for the first time, but not reliably

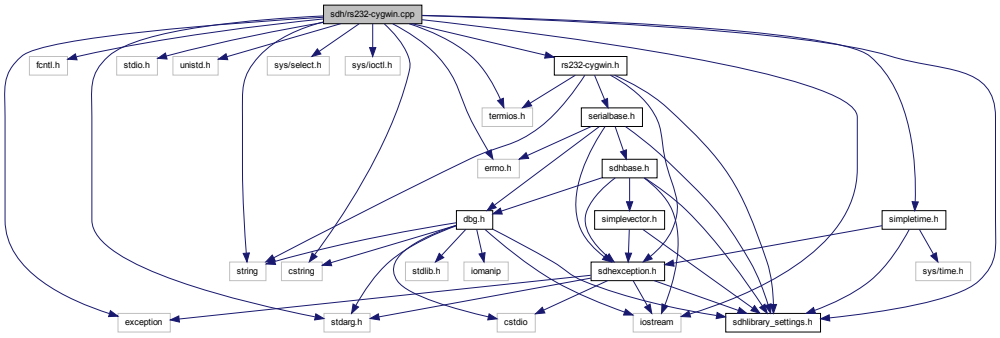
11.54 sdh/rs232-cygwin.cpp File Reference

Implementation of class SDH::cRS232, a class to access serial RS232 port on cygwin/linux.

```
#include "sdhlibrary_settings.h"
#include <fcntl.h>
#include <termios.h>
#include <stdio.h>
#include <unistd.h>
#include <errno.h>
#include <sys/select.h>
```

```
#include <sys/ioctl.h>
#include <iostream>
#include <exception>
#include <string>
#include <stdarg.h>
#include <cstring>
#include "rs232-cygwin.h"
#include "simpletime.h"
```

Include dependency graph for rs232-cygwin.cpp:



Defines

- #define SDH_RS232_CYGWIN_DEBUG 1
- #define DBG(...)

Functions

- char * StrDupNew (char *const s)

  helper function, duplicate string s into a char array allocated with new[]

11.54.1 Detailed Description

Implementation of class SDH::cRS232, a class to access serial RS232 port on cygwin/linux.

11.54.2 General file information

Author

Dirk Osswald

Date

2007-02-20

11.54.3 Copyright

11.54.4 Define Documentation

11.54.4.1 #define DBG(...)

Value:

```
do {                    \
        __VA_ARGS__;        \
    } while (0)
```

instead of guarding every debug output with #if SDH_RS232_CYGWIN_DEBUG / #endif we use this DBG macro that expands to a stream output to a dbg object or to ";" depending on the value of SDH_RS232_CYGWIN_DEBUG

11.54.4.2 #define SDH_RS232_CYGWIN_DEBUG 1

Flag, if true then code for debug messages is included.

The debug messages must still be enabled at run time by setting the `some_cRS232_object.dbg.SetFlag(1)`.

This 2 level scheme is used since this is the lowlevel communication, so debug outputs might really steal some performance.

11.54.5 Function Documentation

11.54.5.1 char* StrDupNew (char *const s)

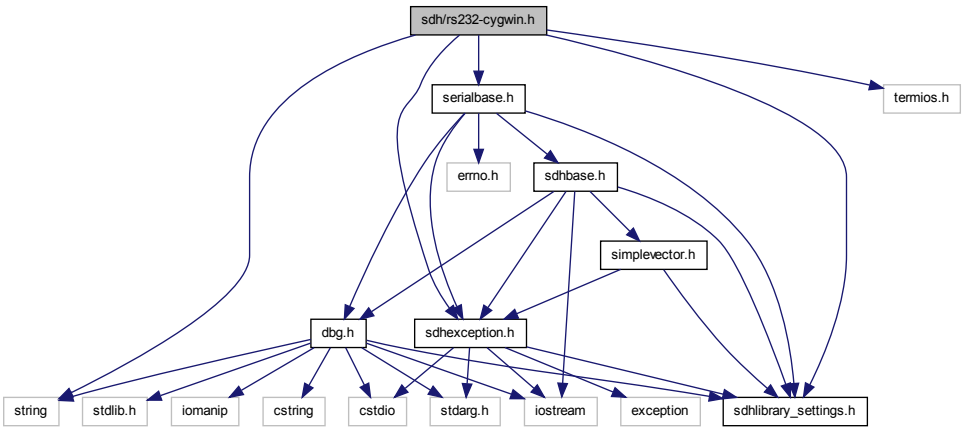
helper function, duplicate string s into a char array allocated with new[]

11.55 sdh/rs232-cygwin.h File Reference

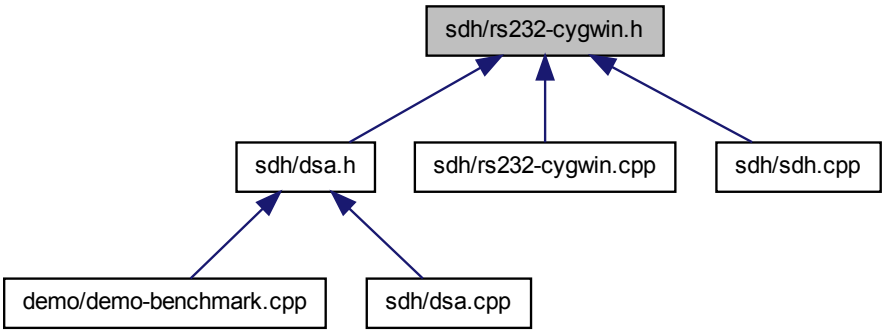
Interface of class SDH::cRS232, a class to access serial RS232 port on cygwin/linux.

```
#include <string>
#include <termios.h>
#include "sdhexception.h"
#include "serialbase.h"
#include "sdhlibrary_settings.h"
```

Include dependency graph for rs232-cygwin.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cRS232Exception

  Derived exception class for low-level RS232 related exceptions.

- class SDH::cRS232

  Low-level communication class to access a serial port on Cygwin and Linux.

Namespaces

- namespace SDH

Variables

- SDH::cRS232Exception SDH::SDH__attribute__

11.55.1 Detailed Description

Interface of class SDH::cRS232, a class to access serial RS232 port on cygwin/linux.

11.55.2 General file information

Author

Dirk Osswald

Date

2007-02-20

11.55.3 Copyright

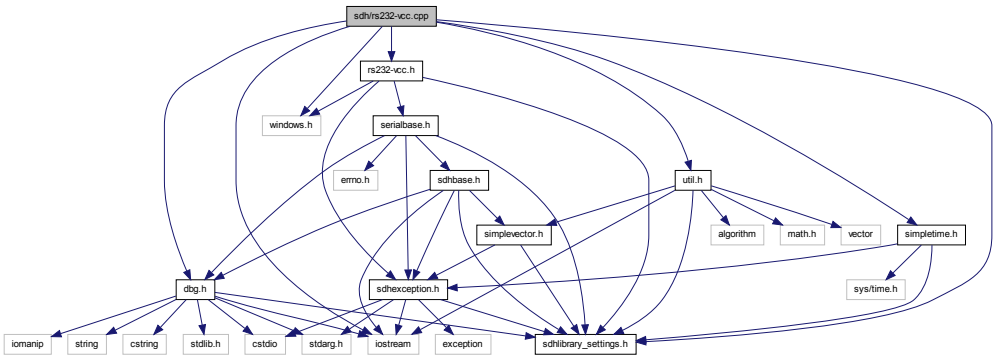
11.56 sdh/rs232-vcc.cpp File Reference

Implementation of class SDH::cRS232, a class to access serial RS232 port with VCC compiler on Windows.

```
#include "iostream"
#include <windows.h>
#include "rs232-vcc.h"
#include "simpletime.h"
```

```
#include "sdhlibrary_settings.h"
#include "util.h"
#include "dbg.h"
```

Include dependency graph for rs232-vcc.cpp:



Defines

- #define _CRT_SECURE_NO_WARNINGS 1
- #define SDH_RS232_VCC_DEBUG 1
- #define DBG(...)

11.56.1 Detailed Description

Implementation of class SDH::cRS232, a class to access serial RS232 port with VCC compiler on Windows.

11.56.2 General file information

Author

Martin

Date

2008-05-23

11.56.3 Copyright

Code kindly provided by Martin from the RoboCluster project Denmark.

11.56.4 Define Documentation

11.56.4.1 #define _CRT_SECURE_NO_WARNINGS 1

11.56.4.2 #define DBG(...)

Value:

```
do {                    \
        __VA_ARGS__;        \
    } while (0)
```

11.56.4.3 #define SDH_RS232_VCC_DEBUG 1

Flag, if true then code for debug messages is included.

The debug messages must still be enabled at run time by setting the some_cRS232_-object.dbg.SetFlag(1).

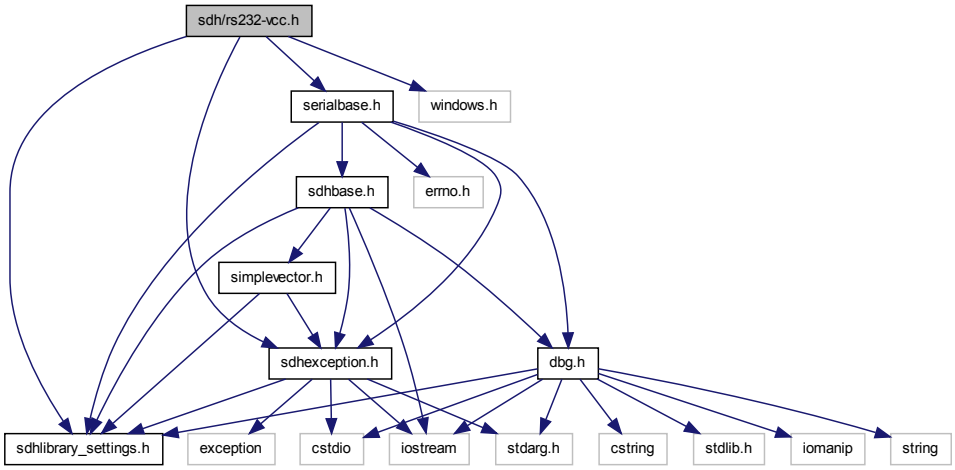
This 2 level scheme is used since this is the lowlevel communication, so debug outputs might really steal some performance.

11.57 sdh/rs232-vcc.h File Reference

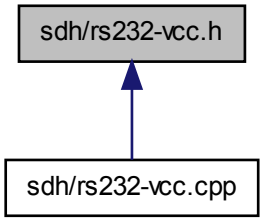
Implementation of class SDH::cRS232, a class to access serial RS232 port with VCC compiler on Windows.

```
#include "sdhlibrary_settings.h"
#include <windows.h>
#include "sdhexception.h"
#include "serialbase.h"
```

Include dependency graph for rs232-vcc.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cRS232Exception

  Derived exception class for low-level RS232 related exceptions.

- class SDH::cRS232

  Low-level communication class to access a serial port on Cygwin and Linux.

Namespaces

- namespace SDH

Defines

- #define SDH_RS232_VCC_ASYNC 0

11.57.1 Detailed Description

Implementation of class SDH::cRS232, a class to access serial RS232 port with VCC compiler on Windows.

11.57.2 General file information

Author

Martin

Date

2008-05-23

11.57.3 Copyright

Code kindly provided by Martin from the RoboCluster project Denmark.

11.57.4 Define Documentation

11.57.4.1 #define SDH_RS232_VCC_ASYNC 0

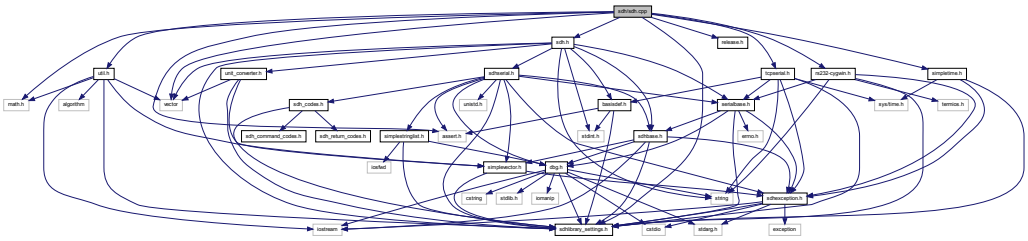
11.58 sdh/sdh.cpp File Reference

This file contains the interface to class SDH::cSDH, the end user class to access the SDH from a PC.

```
#include <math.h>
#include "sdhlibrary_settings.h"
#include <assert.h>
#include <vector>
#include "sdh.h"
#include "util.h"
#include "release.h"
```

```
#include "simpletime.h"
#include "rs232-cygwin.h"
#include "tcpserial.h"
```

Include dependency graph for sdh.cpp:



Defines

- #define _USE_MATH_DEFINES

11.58.1 Detailed Description

This file contains the interface to class SDH::cSDH, the end user class to access the SDH from a PC.

11.58.2 General file information

Author

Dirk Osswald

Date

2007-02-20

11.58.3 Copyright

11.58.4 Define Documentation

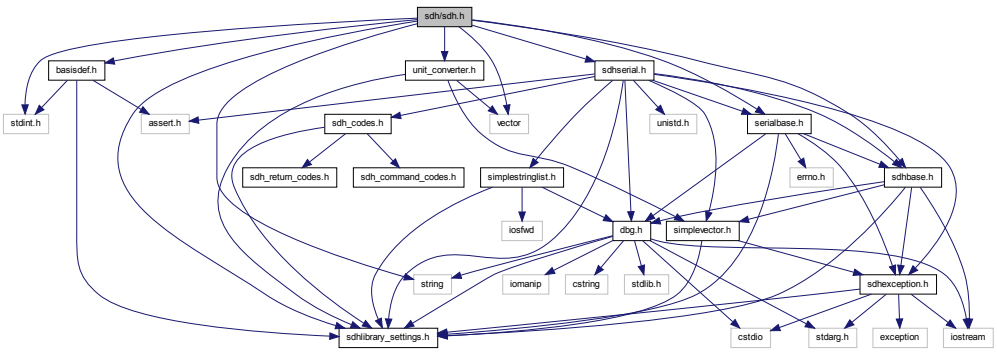
11.58.4.1 #define _USE_MATH_DEFINES

11.59 sdh/sdh.h File Reference

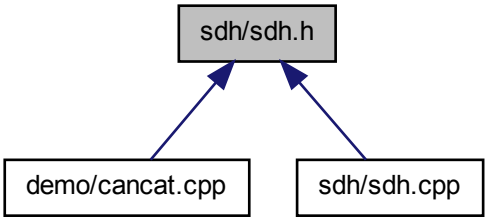
This file contains the interface to class SDH::cSDH, the end user class to access the SDH from a PC.

```
#include "sdhlibrary_settings.h"
#include <stdint.h>
#include "basisdef.h"
#include <vector>
#include <string>
#include "sdhbase.h"
#include "sdhserial.h"
#include "unit_converter.h"
#include "serialbase.h"
```

Include dependency graph for sdh.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cSDH

  SDH::cSDH is the end user interface class to control a SDH (SCHUNK Dexterous Hand).

Namespaces

- namespace SDH

11.59.1 Detailed Description

This file contains the interface to class SDH::cSDH, the end user class to access the SDH from a PC.

11.59.2 General file information

Author

Dirk Osswald

Date

2007-02-20

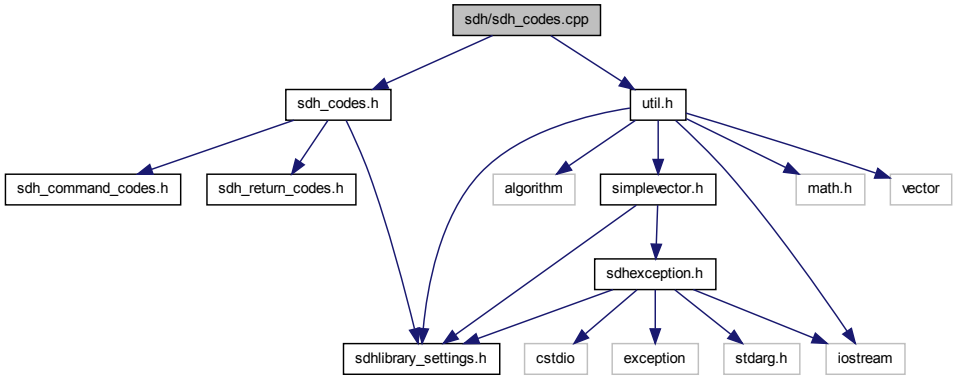
11.59.3 Copyright

11.60 sdh/sdh_codes.cpp File Reference

This file contains function to convert the binary command and return codes of the SDH to strings.

```
#include "sdh_codes.h"
#include "util.h"
```

Include dependency graph for sdh_codes.cpp:



11.60.1 Detailed Description

This file contains function to convert the binary command and return codes of the SDH to strings.

11.60.2 General file information

Author

Dirk Osswald

Date

2011-02-04

11.60.3 Copyright

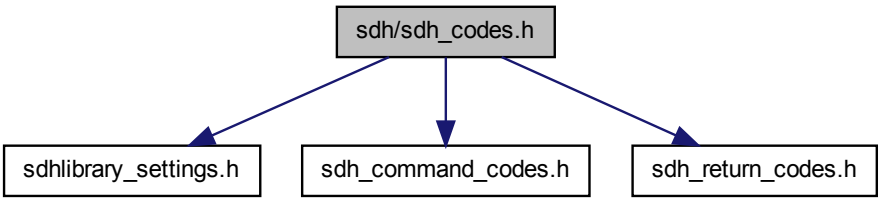
- Copyright (c) 2011 SCHUNK GmbH & Co. KG

11.61 sdh/sdh_codes.h File Reference

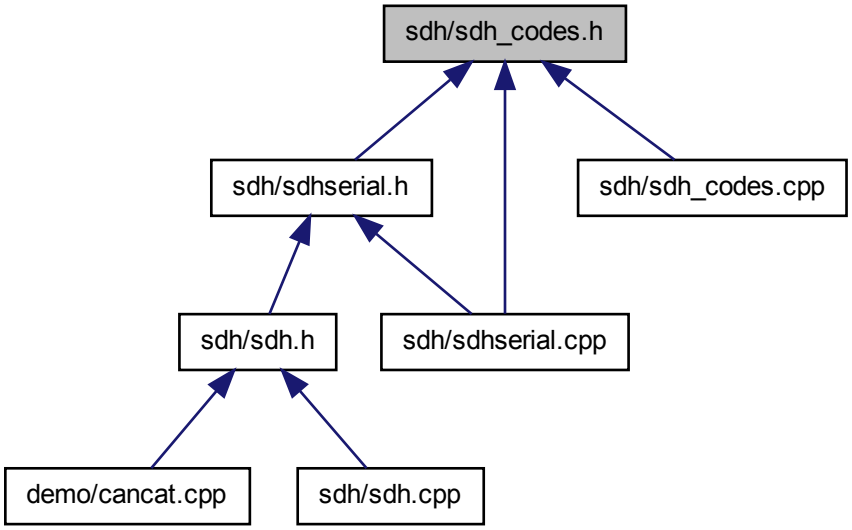
This file contains function to convert the binary command codes of the SDH. To use this from a non gcc compiler you might have to define SDH__attribute__ to nothing and SDH_USE_VCC to 1.

```
#include "sdhlibrary_settings.h"
#include "sdh_command_codes.h"
#include "sdh_return_codes.h"
```

Include dependency graph for sdh_codes.h:



This graph shows which files directly or indirectly include this file:



Namespaces

- namespace SDH

Functions

- char const * SDH::SDHCommandCodeToString (eCommandCode cc)
- char const * SDH::SDHReturnCodeToString (eReturnCode rc)

11.61.1 Detailed Description

This file contains function to convert the binary command codes of the SDH. To use this from a non gcc compiler you might have to define SDH__attribute__ to nothing and SDH_USE_VCC to 1.

11.61.2 General file information

Author

Dirk Osswald

Date

2011-02-04

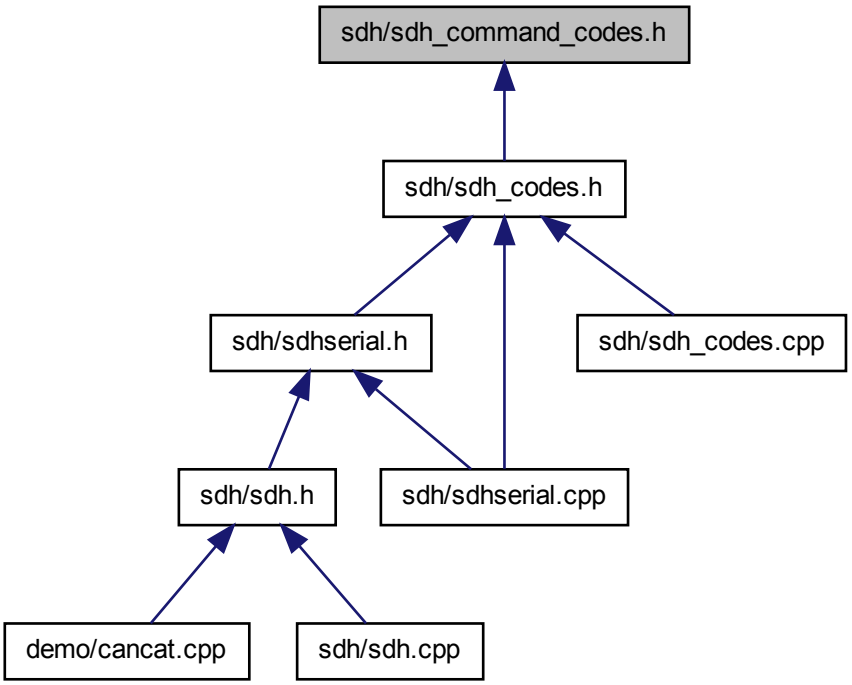
11.61.3 Copyright

- Copyright (c) 2003 IPR, University of Karlsruhe (TH), all rights reserved
- Copyright (c) 2008 SCHUNK GmbH & Co. KG

11.62 sdh/sdh_command_codes.h File Reference

This file contains the binary command codes of the SDH. To use this from a non gcc compiler you might have to define SDH__attribute__ to nothing and SDH_USE_VCC to 1.

This graph shows which files directly or indirectly include this file:



Defines

- #define USE_CMD_TEST 0
- #define SDH__attribute__(...) __attribute__(__VA_ARGS__)
- #define SDH_USE_VCC 0

Typedefs

- typedef enum eCommandCodeEnum eCommandCode

  typedef for eCommandCodeEnum, see there

Enumerations

- enum eCommandCodeEnum

Functions

- enum eCommandCodeEnum __attribute__ ((packed))

Variables

- CMDC_V = 128
- CMDC_VEL
- CMDC_RVEL
- CMDC_POS
- CMDC_STATE
- CMDC_P
- CMDC_A
- CMDC_M
- CMDC_STOP
- CMDC_VP
- CMDC_CON
- CMDC_TPAP
- CMDC_TVAV
- CMDC_VLIM
- CMDC_ALIM
- CMDC_POS_SAVE
- CMDC_REF
- CMDC_TEMP
- CMDC_ID
- CMDC_SN
- CMDC_VER
- CMDC_VER_DATE
- CMDC_SOC

- CMDC_SOC_DATE
- CMDC_NUMAXIS
- CMDC_P_MIN
- CMDC_P_MAX
- CMDC_P_OFFSET
- CMDC_GET_DURATION
- CMDC_IGRIP
- CMDC_IHOLD
- CMDC_SELGRIP
- CMDC_GRIP
- CMDC_PID
- CMDC_KV
- CMDC_ILIM
- CMDC_POWER
- CMDC_DEMO
- CMDC_USER_ERRORS
- CMDC_TERMINAL
- CMDC_DEBUG
- CMDC_USE_FIXED_LENGTH
- CMDC_CHANGE_RS232
- CMDC_CHANGE_CHANNEL

11.62.1 Detailed Description

This file contains the binary command codes of the SDH. To use this from a non gcc compiler you might have to define SDH__attribute__ to nothing and SDH_USE_VCC to 1.

11.62.2 General file information

Author

Ilshat Mamaev, Dirk Osswald

Date

2011-02-01

11.62.3 Copyright

11.62.4 Define Documentation

11.62.4.1 #define SDH__attribute__(...) __attribute__(__VA_ARGS__)

11.62.4.2 #define SDH_USE_VCC 0

11.62.4.3 #define USE_CMD_TEST 0

11.62.5 Typedef Documentation

11.62.5.1 typedef enum eCommandCodeEnum eCommandCode

typedef for eCommandCodeEnum, see there

11.62.6 Enumeration Type Documentation

11.62.6.1 enum eCommandCodeEnum

Packed (1 Byte) enum with binary command codes used to indicate the command sent in the binary communiation request or response.

Remarks

- Not all commands are implemented as binary commands
- To make this definition work with both C (nios-gcc) and C++ (std gcc/VCC) we have to separate the enum definition from the typedef.
- You may use the corresponding typedef eCommandCode

11.62.7 Function Documentation

11.62.7.1 enum eCommandCodeEnum __attribute__ ((packed))

11.62.8 Variable Documentation

11.62.8.1 CMDC_A

11.62.8.2 CMDC_ALIM

11.62.8.3 CMDC_CHANGE_CHANNEL

11.62.8.4 CMDC_CHANGE_RS232

11.62.8.5 CMDC_CON

11.62.8.6 CMDC_DEBUG

11.62.8.7 CMDC_DEMO

11.62.8.8 CMDC_GET_DURATION

11.62.8.9 CMDC_GRIP

11.62.8.10 CMDC_ID

11.62.8.11 CMDC_IGRIP

11.62.8.12 CMDC_IHOLD

11.62.8.13 CMDC_ILIM

11.62.8.14 CMDC_KV

11.62.8.15 CMDC_M

11.62.8.16 CMDC_NUMAXIS

11.62.8.17 CMDC_P

11.62.8.18 CMDC_P_MAX

11.62.8.19 CMDC_P_MIN

11.62.8.20 CMDC_P_OFFSET

11.62.8.21 CMDC_PID

11.62.8.22 CMDC_POS

11.62.8.23 CMDC_POS_SAVE

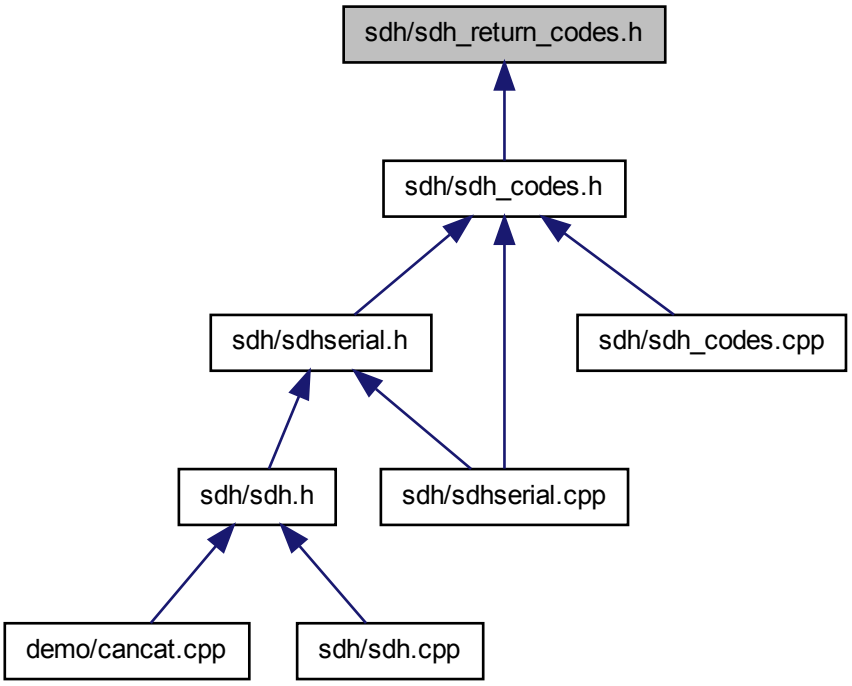
11.62.8.24 CMDC_POWER

11.62.8.25 CMDC_REF

11.62.8.26 CMDC_RVEL

11.62.8.27 CMDC_SELGRIP

This graph shows which files directly or indirectly include this file:



Defines

- #define SDH__attribute__(...) __attribute__(__VA_ARGS__)
- #define SDH_USE_VCC 0

Typedefs

- typedef enum eReturnCodeEnum eReturnCode

  typedef for eCommandCodeEnum, see there

Enumerations

- enum eReturnCodeEnum

Functions

- enum eReturnCodeEnum SDH__attribute__ ((__packed__))

Variables

- RC_OK = 0

  Success, no error.

- RC_NOT_AVAILABLE

  Error: An accessed ressource is not available.

- RC_NOT_INITIALIZED

  Error: An accessed ressource has not been initialized.

- RC_ALREADY_RUNNING

  Error: Data acquisition: the acquisition loop is already running.

- RC_FEATURE_NOT_SUPPORTED
- RC_INCONSISTENT_DATA
- RC_TIMEOUT

  Error: timeout occured.

- RC_READ_ERROR

  Error: could not read.

- RC_WRITE_ERROR

  Error: could not write.

- RC_INSUFFICIENT_RESOURCES

  Error: Insufficient ressources.

- RC_CHECKSUM_ERROR
- RC_NOT_ENOUGH_PARAMS

  Error: not enough parameters on command line.

- RC_NO_PARAMS_EXPECTED
- RC_CMD_UNKNOWN

  Error: unknown command on command line.

- RC_CMD_FORMAT_ERROR

  Error: invalid format of command line parameters.

- RC_ACCESS_DENIED
- RC_ALREADY_OPEN
- RC_CMD_FAILED

- RC_CMD_ABORTED
- RC_INVALID_HANDLE
- RC_DEVICE_NOT_FOUND
- RC_DEVICE_NOT_OPENED
- RC_IO_ERROR

  Error: Input/Output error like bus-off detected.

- RC_INVALID_PARAMETER

  Error: invalid parameter on command line.

- RC_RANGE_ERROR
- RC_NO_DATAPIPE
- RC_INDEX_OUT_OF_BOUNDS

  Error: A given index parameter is invalid.

- RC_HOMING_ERROR
- RC_AXIS_DISABLED
- RC_OVER_TEMPERATURE
- RC_MAX_COMMANDS_EXCEEDED

  Error: cannot add more than CI_MAX_COMMANDS to interpreter / POSCON_-MAX_OSCILLOSCOPE parameters to oscilloscope.

- RC_INVALID_PASSWORD

  Error: invalid password given for change user command.

- RC_MAX_COMMANDLINE_EXCEEDED

  Error: the command line given is too long.

- RC_CRC_ERROR

  Cyclic Redundancy Code error while receiving binary input.

- RC_NO_COMMAND

  Not really an error: reading input did not yield a new command.

- RC_INTERNAL

  Error: callback function reports internal error.

- RC_UNKNOWN_ERROR

  Error: unknown error.

- RC_DIMENSION

  < End marker and dimension

11.63.1 Detailed Description

This file contains a typedef for a common Return Codes enum.

11.63.2 General file information

Author

Dirk Osswald

Date

2011-02-04

11.63.3 Copyright

11.63.4 Define Documentation

11.63.4.1 #define SDH__attribute__(...) __attribute__((__VA_ARGS__))

11.63.4.2 #define SDH_USE_VCC 0

11.63.5 Typedef Documentation

11.63.5.1 typedef enum eReturnCodeEnum eReturnCode

typedef for eCommandCodeEnum, see there

11.63.6 Enumeration Type Documentation

11.63.6.1 enum eReturnCodeEnum

Packed (1 Byte) enum with binary return codes used to indicate the status of the SDH sent in the binary communiation request or response.

Remarks

- To make this definition work with both C (nios-gcc) and C++ (std gcc/VCC) we have to separate the enum definition from the typedef.
- You may use the corresponding typedef eReturnCode

11.63.7 Function Documentation

11.63.7.1 enum eReturnCodeEnum SDH__attribute__ ((__packed__))

11.63.8 Variable Documentation

11.63.8.1 RC_ACCESS_DENIED

11.63.8.2 RC_ALREADY_OPEN

11.63.8.3 RC_ALREADY_RUNNING

Error: Data acquisition: the acquisition loop is already running.

11.63.8.4 RC_AXIS_DISABLED

11.63.8.5 RC_CHECKSUM_ERROR

11.63.8.6 RC_CMD_ABORTED

11.63.8.7 RC_CMD_FAILED

11.63.8.8 RC_CMD_FORMAT_ERROR

Error: invalid format of command line parameters.

11.63.8.9 RC_CMD_UNKNOWN

Error: unknown command on command line.

11.63.8.10 RC_CRC_ERROR

Cyclic Redundancy Code error while receiving binary input.

11.63.8.11 RC_DEVICE_NOT_FOUND

11.63.8.12 RC_DEVICE_NOT_OPENED

11.63.8.13 RC_DIMENSION

< End marker and dimension

End marker and dimension.

11.63.8.14 RC_FEATURE_NOT_SUPPORTED

11.63.8.15 RC_HOMING_ERROR

11.63.8.16 RC_INCONSISTENT_DATA

11.63.8.17 RC_INDEX_OUT_OF_BOUNDS

Error: A given index parameter is invalid.

11.63.8.18 RC_INSUFFICIENT_RESOURCES

Error: Insufficient ressources.

11.63.8.19 RC_INTERNAL

Error: callback function reports internal error.

11.63.8.20 RC_INVALID_HANDLE

11.63.8.21 RC_INVALID_PARAMETER

Error: invalid parameter on command line.

11.63.8.22 RC_INVALID_PASSWORD

Error: invalid password given for change user command.

11.63.8.23 RC_IO_ERROR

Error: Input/Output error like bus-off detected.

11.63.8.24 RC_MAX_COMMANDLINE_EXCEEDED

Error: the command line given is too long.

11.63.8.25 RC_MAX_COMMANDS_EXCEEDED

Error: cannot add more than CI_MAX_COMMANDS to interpreter / POSCON_-MAX_OSCILLOSCOPE parameters to oscilloscope.

11.63.8.26 RC_NO_COMMAND

Not really an error: reading input did not yield a new command.

11.63.8.27 RC_NO_DATAPIPE

11.63.8.28 RC_NO_PARAMS_EXPECTED

11.63.8.29 RC_NOT_AVAILABLE

Error: An accessed ressource is not available.

11.63.8.30 RC_NOT_ENOUGH_PARAMS

Error: not enough parameters on command line.

11.63.8.31 RC_NOT_INITIALIZED

Error: An accessed ressource has not been initialized.

11.63.8.32 RC_OK = 0

Success, no error.

11.63.8.33 RC_OVER_TEMPERATURE

11.63.8.34 RC_RANGE_ERROR

11.63.8.35 RC_READ_ERROR

Error: could not read.

11.63.8.36 RC_TIMEOUT

Error: timeout occured.

11.63.8.37 RC_UNKNOWN_ERROR

Error: unknown error.

11.63.8.38 RC_WRITE_ERROR

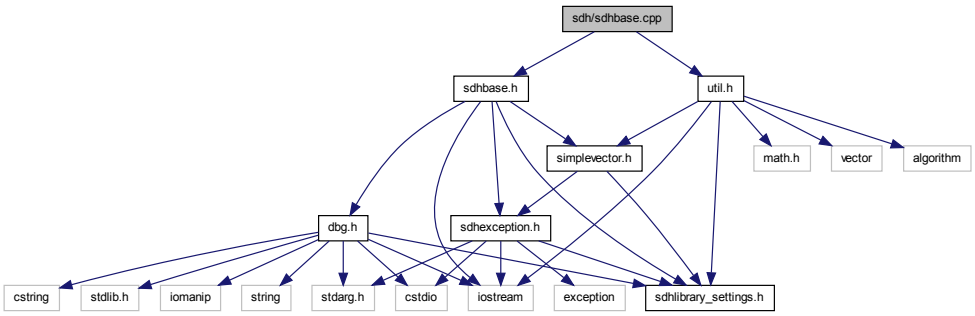
Error: could not write.

11.64 sdh/sdhbase.cpp File Reference

Implementation of class SDH::cSDHBase.

```
#include "sdhbase.h"
#include "util.h"
```

Include dependency graph for sdhbase.cpp:



Namespaces

- namespace SDH

Variables

- std::ostream * SDH::g_sdh_debug_log = &std::cerr

11.64.1 Detailed Description

Implementation of class SDH::cSDHBase.

11.64.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.64.3 Copyright

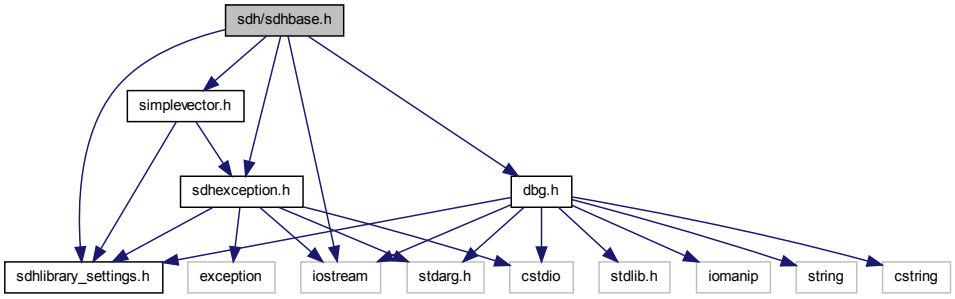
- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.65 sdh/sdhbase.h File Reference

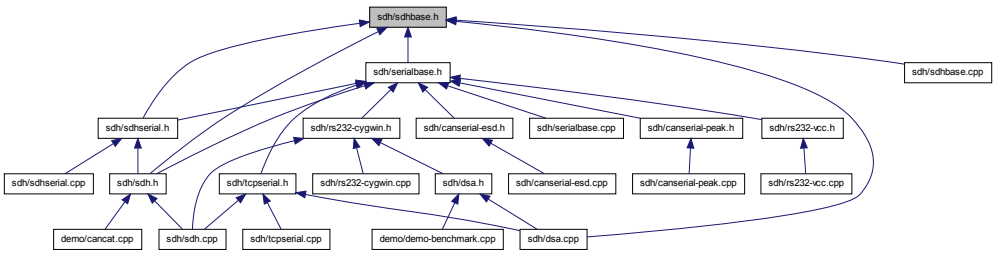
Interface of class SDH::cSDHBase.

```
#include "sdhlibrary_settings.h"
#include "iostream"
#include "dbg.h"
#include "sdhexception.h"
#include "simplevector.h"
```

Include dependency graph for sdhbase.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cSDHErrorInvalidParameter

  Derived exception class for exceptions related to invalid parameters.

- class SDH::cSDHBase

The base class to control the SCHUNK Dexterous Hand.

Namespaces

- namespace SDH

11.65.1 Detailed Description

Interface of class SDH::cSDHBase.

11.65.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.65.3 Copyright

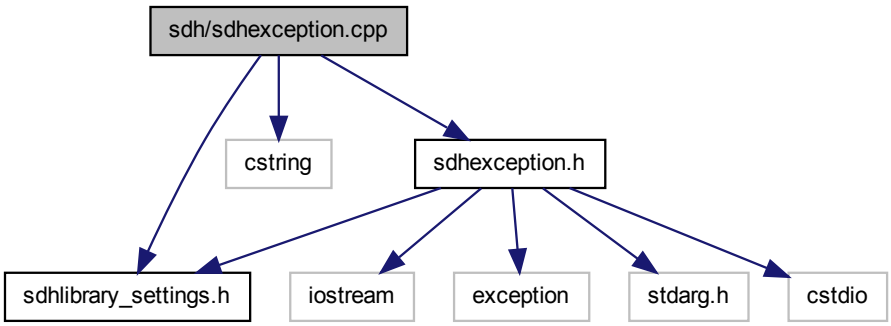
- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.66 sdh/sdhexception.cpp File Reference

Implementation of the exception base class SDH::cSDHLibraryException and SDH::cMsg.

```
#include "sdhlibrary_settings.h"
#include <cstring>
#include "sdhexception.h"
```

Include dependency graph for sdhexception.cpp:



Namespaces

- namespace SDH

Functions

- std::ostream & SDH::operator<< (std::ostream &stream, cMsg const &msg)
- std::ostream & SDH::operator<< (std::ostream &stream, cSDHLibraryException const &e)

11.66.1 Detailed Description

Implementation of the exception base class SDH::cSDHLibraryException and SDH::cMsg.

11.66.2 General file information

Author

Dirk Osswald

Date

2007-02-22

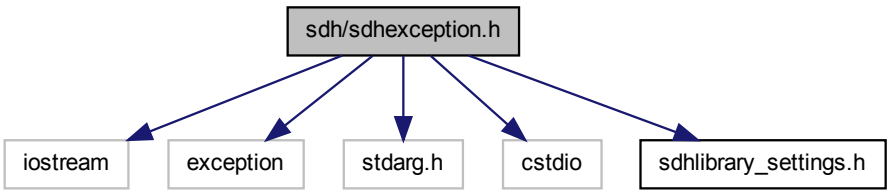
11.66.3 Copyright

11.67 sdh/sdhexception.h File Reference

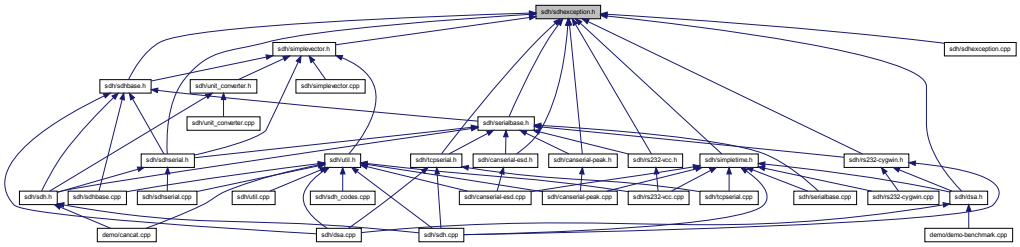
Interface of the exception base class SDH::cSDHLibraryException and SDH::cMsg.

```
#include <iostream>
#include <exception>
#include <stdarg.h>
#include <cstdio>
#include "sdhlibrary_settings.h"
```

Include dependency graph for sdhexception.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cMsg

  Class for short, fixed maximum length text messages.

- class SDH::cSDHLibraryException

  Base class for exceptions in the SDHLibrary-CPP.

- class SDH::cSDHErrorCommunication

  Derived exception class for exceptions related to communication between the SDHLibrary and the SDH.

Namespaces

- namespace SDH

Functions

- std::ostream & SDH::operator<< (std::ostream &stream, cMsg const &msg)
- std::ostream & SDH::operator<< (std::ostream &stream, cSDHLibraryException const &e)

11.67.1 Detailed Description

Interface of the exception base class SDH::cSDHLibraryException and SDH::cMsg.

11.67.2 General file information

Author

Dirk Osswald

Date

2007-02-22

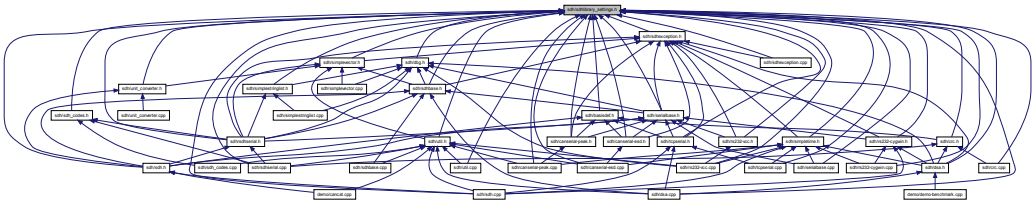
11.67.3 Copyright

11.68 sdh/sdhlibrary_settings.h File Reference

This file contains settings to make the SDHLibrary compile on differen systems:

- gcc/Cygwin/Windows
- gcc/Linux
- VisualC++/Windows.

This graph shows which files directly or indirectly include this file:



Defines

- #define SDH_USE_NAMESPACE 1

  Flag, if 1 then all classes are put into a namespace called SDH. If 0 then the classes are left outside any namespace.

- #define SDH_USE_BINARY_COMMUNICATION 1

  Flag, if 1 then binary communication is used where possible for better performance (requires at least firmware 0.0.2.15)

- #define NAMESPACE_SDH_START namespace SDH {
- #define NAMESPACE_SDH_END }
- #define USING_NAMESPACE_SDH using namespace SDH;
- #define NS_SDH SDH::

11.68.1 Detailed Description

This file contains settings to make the SDHLibrary compile on differen systems:

- gcc/Cygwin/Windows
- gcc/Linux
- VisualC++/Windows.

11.68.2 General file information

Author

Dirk Osswald

Date

2008-05-20

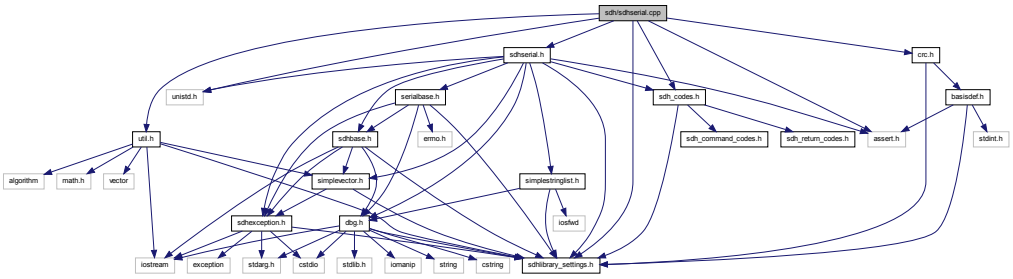
11.68.3 Copyright

11.69 sdh/sdhserial.cpp File Reference

Interface of class SDH::cSDHSerial.

```
#include "sdhlibrary_settings.h"
#include <assert.h>
#include <unistd.h>
#include "util.h"
#include "sdhserial.h"
#include "crc.h"
#include "sdh_codes.h"
```

Include dependency graph for sdhserial.cpp:



Classes

- struct SDH::sSDHBinaryRequest

  data structure with binary data for request from PC to SDH

- struct SDH::sSDHBinaryResponse

  data structure with binary data for response from SDH to PC

Namespaces

- namespace SDH

Enumerations

- enum { SDH::eNUMBER_OF_ELEMENTS = cSimpleVector::eNUMBER_OF_-ELEMENTS }

Functions

- struct SDH::sSDHBinaryRequest SDH::__attribute__ ((packed))
- sSDHBinaryRequest (eCommandCode command, double *value, bool use_crc16)
- tCRCValue * CRC16 () const

  return a ptr to the CRC value in parameter_bytes, assuming that nb_data_bytes is correct (including the CRC bytes)

- int GetNbBytesToSend () const

  return the total number of bytes to send

- void CheckCRC16 () const throw (cSDHErrorCommunication*)

  check the CRC value in parameter_bytes. Throw an exception if check fails

- std::ostream & SDH::operator<< (std::ostream &stream, sSDHBinaryRequest const &request)

  helper functions to insert a human readable form of the request into stream

- std::ostream & SDH::operator<< (std::ostream &stream, sSDHBinaryResponse const &response)

  helper functions to insert a human readable form of the restore into stream

Variables

- unsigned char cmd_code
- unsigned char nb_data_bytes
- unsigned char nb_valid_parameters
- union {
  float parameter [eNUMBER_OF_ELEMENTS]
  unsigned char parameter_bytes [sizeof(float)*eNUMBER_OF_ELEMENTS+sizeof(tCRCValue)]
  };
- unsigned char status_code
- union {
  float parameter [eNUMBER_OF_ELEMENTS]
  unsigned char parameter_bytes [sizeof(float)*eNUMBER_OF_ELEMENTS+sizeof(tCRCValue)]
  };

11.69.1 Detailed Description

Interface of class SDH::cSDHSerial.

11.69.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.69.3 Copyright

11.69.4 Function Documentation

11.69.4.1 void __attribute__::CheckCRC16 ( ) const throw (cSDHErrorCommunication*)

check the CRC value in parameter_bytes. Throw an exception if check fails

11.69.4.2 tCRCValue * CRC16 ( ) const

return a ptr to the CRC value in parameter_bytes, assuming that nb_data_bytes is correct (including the CRC bytes)

11.69.4.3 int __attribute__::GetNbBytesToSend ( ) const

return the total number of bytes to send

11.69.4.4 __attribute__::sSDHBinaryRequest (eCommandCode *command*, double * *value*, bool *use_crc16*)

ctor, create a request with cmd_code *command* and eNUMBER_OF_ELEMENTS parameter from *value* or no parameters if *value* is NULL. Add crc if *use_crc16* is true and set nb_data_bytes appropriately

11.69.5 Variable Documentation

11.69.5.1 union { ... }

11.69.5.2 union { ... }

11.69.5.3 unsigned char cmd_code

11.69.5.4 unsigned char nb_data_bytes

11.69.5.5 unsigned char nb_valid_parameters

11.69.5.6 float parameter[eNUMBER_OF_ELEMENTS]

11.69.5.7 unsigned char parameter_bytes[sizeof(float)*eNUMBER_OF_ELEMENTS+sizeof(tCRCValue)]

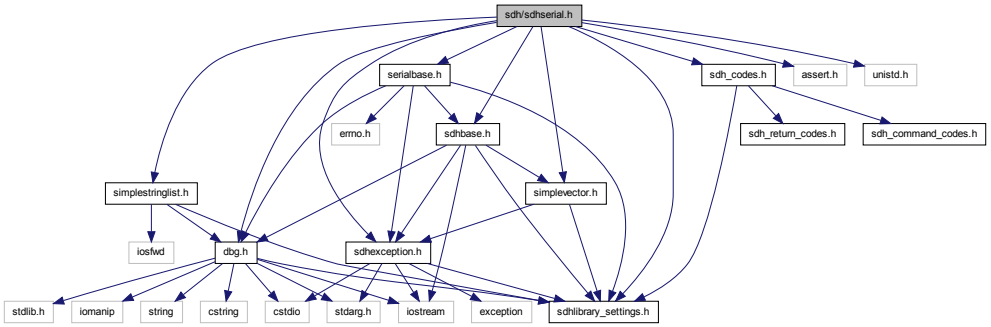
11.69.5.8 unsigned char status_code

11.70 sdh/sdhserial.h File Reference

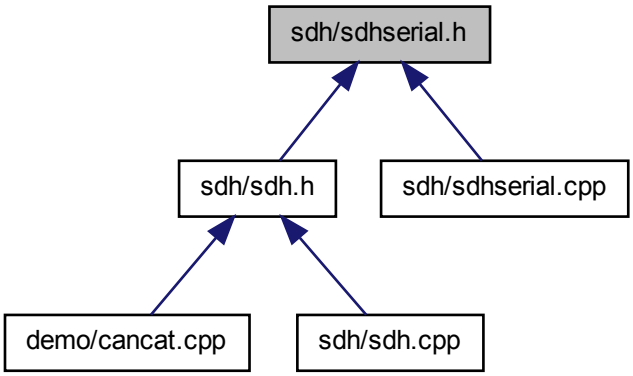
Interface of class SDH::cSDHSerial.

```
#include "sdhlibrary_settings.h"
#include <assert.h>
#include <unistd.h>
#include "dbg.h"
#include "sdhexception.h"
#include "simplevector.h"
#include "simplestringlist.h"
#include "sdhbase.h"
#include "serialbase.h"
#include "sdh_codes.h"
```

Include dependency graph for sdhserial.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cSDHSerial

  The class to communicate with a SDH via RS232.

Namespaces

- namespace SDH

Typedefs

- typedef cSimpleVector(cSDHSerial::* SDH::pSetFunction)(int, double *)

  Type of a pointer to a "set-axis-values" function like cSDHSerial::p, cSDHSerial::pos, ..., cSDHSerial::igrip, cSDHSerial::ihold or cSDHSerial::ilim.

- typedef cSimpleVector(cSDHSerial::* SDH::pGetFunction)(int, double *)

  Type of a pointer to a "get-axis-values" function like cSDHSerial::p, cSDHSerial::pos, ..., cSDHSerial::igrip, cSDHSerial::ihold or cSDHSerial::ilim.

11.70.1 Detailed Description

Interface of class SDH::cSDHSerial.

11.70.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.70.3 Copyright

- Copyright (c) 2007 SCHUNK GmbH & Co. KG

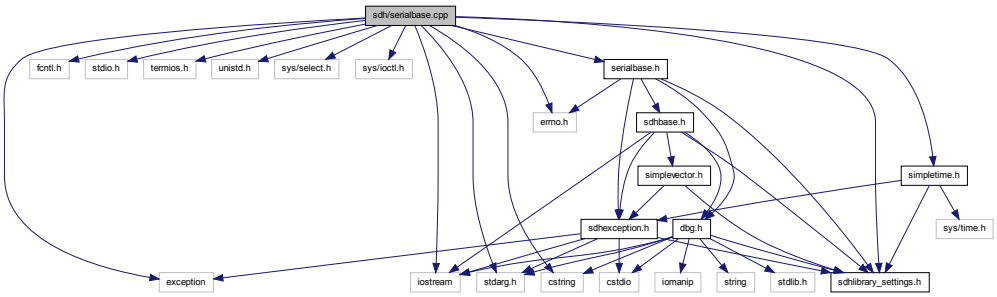
11.71 sdh/serialbase.cpp File Reference

Implementation of class SDH::cSerialBase, a virtual base class to access serial interfaces like RS232 or CAN.

```
#include "sdhlibrary_settings.h"
#include <fcntl.h>
#include <stdio.h>
#include <termios.h>
#include <unistd.h>
#include <sys/select.h>
#include <sys/ioctl.h>
#include <errno.h>
#include <iostream>
```

```
#include <exception>
#include <stdarg.h>
#include <cstring>
#include "serialbase.h"
#include "simpletime.h"
```

Include dependency graph for serialbase.cpp:



11.71.1 Detailed Description

Implementation of class SDH::cSerialBase, a virtual base class to access serial interfaces like RS232 or CAN.

11.71.2 General file information

Author

Dirk Osswald

Date

2007-02-20

11.71.3 Copyright

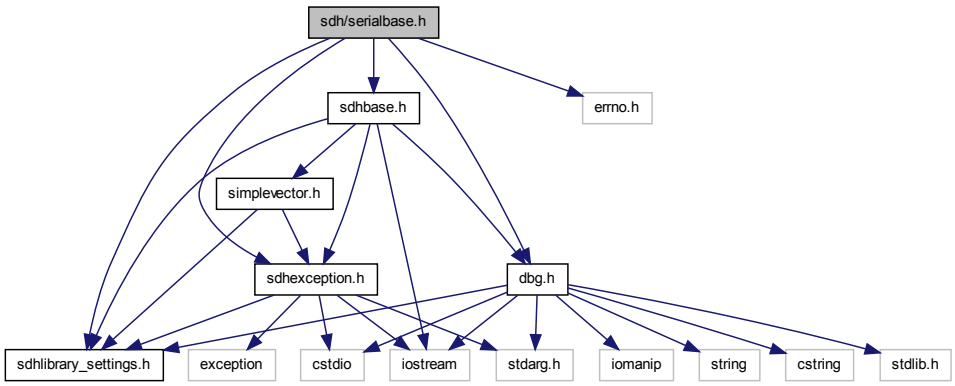
11.72 sdh/serialbase.h File Reference

Interface of class SDH::cSerialBase, a virtal base class to access serial communication channels like RS232 or CAN.

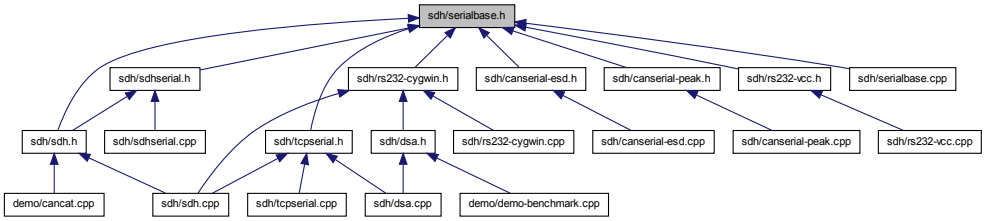
```
#include "sdhlibrary_settings.h"
```

```
#include <errno.h>
#include "sdhexception.h"
#include "dbg.h"
#include "sdhbase.h"
```

Include dependency graph for serialbase.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cSerialBaseException

  Derived exception class for low-level serial communication related exceptions.

- class SDH::cSerialBase

  Low-level communication class to access a serial port.

- class SDH::cSerialBase::cSetTimeoutTemporarily

helper class to set timeout of _serial_base on construction and reset to previous value on destruction. (RAII-idiom)

Namespaces

- namespace SDH

Typedefs

- typedef void * SDH::tDeviceHandle

  generic device handle for CAN devices

11.72.1 Detailed Description

Interface of class SDH::cSerialBase, a virtal base class to access serial communication channels like RS232 or CAN.

11.72.2 General file information

Author

Dirk Osswald

Date

2008-05-02

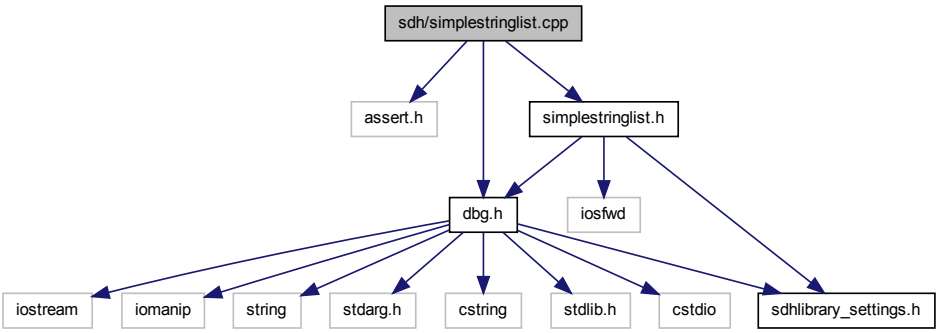
11.72.3 Copyright

11.73 sdh/simplestringlist.cpp File Reference

Implementation of class SDH::cSimpleStringList.

```
#include <assert.h>
#include "dbg.h"
#include "simplestringlist.h"
```

Include dependency graph for simplestringlist.cpp:



Namespaces

- namespace SDH

Functions

- std::ostream & SDH::operator<< (std::ostream &stream, cSimpleStringList const &ssl)

  Output of cSimpleStringList objects in 'normal' output streams.

11.73.1 Detailed Description

Implementation of class SDH::cSimpleStringList.

11.73.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.73.3 Copyright

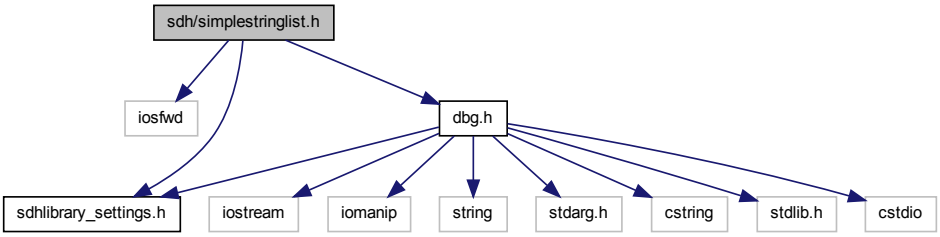
- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.74 sdh/simplestringlist.h File Reference

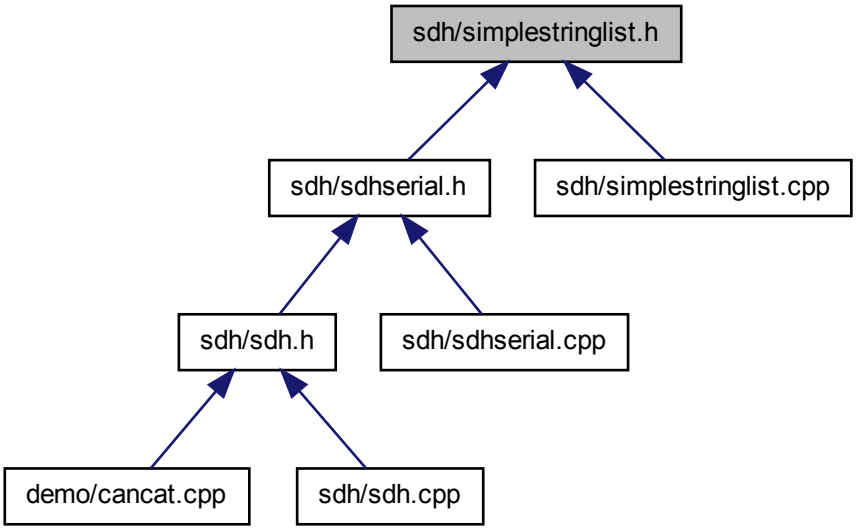
Interface of class SDH::cSimpleStringList.

```
#include <iosfwd>
#include "dbg.h"
#include "sdhlibrary_settings.h"
```

Include dependency graph for simplestringlist.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cSimpleStringList

  A simple string list. (Fixed maximum number of strings of fixed maximum length)

Namespaces

- namespace SDH

Functions

- std::ostream & SDH::operator<< (std::ostream &stream, cSimpleStringList const &ssl)

  Output of cSimpleStringList objects in 'normal' output streams.

11.74.1 Detailed Description

Interface of class SDH::cSimpleStringList.

11.74.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.74.3 Copyright

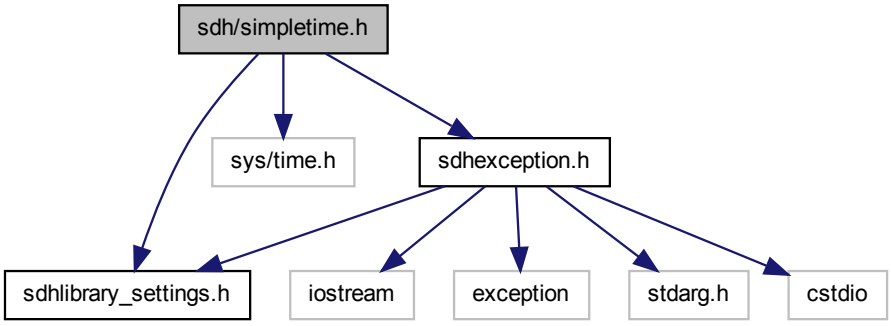
- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.75 sdh/simpletime.h File Reference

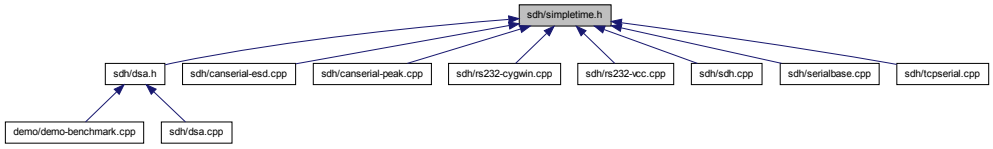
Interface of auxilliary utility functions for SDHLibrary-CPP.

```
#include "sdhlibrary_settings.h"
#include <sys/time.h>
#include "sdhexception.h"
```

Include dependency graph for simpletime.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cSimpleTime

  Very simple class to measure elapsed time.

Namespaces

- namespace SDH

Typedefs

- typedef time_t SDH::tTimevalSec
- typedef suseconds_t SDH::tTimevalUSec

11.75.1 Detailed Description

Interface of auxilliary utility functions for SDHLibrary-CPP.

11.75.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.75.3 Copyright

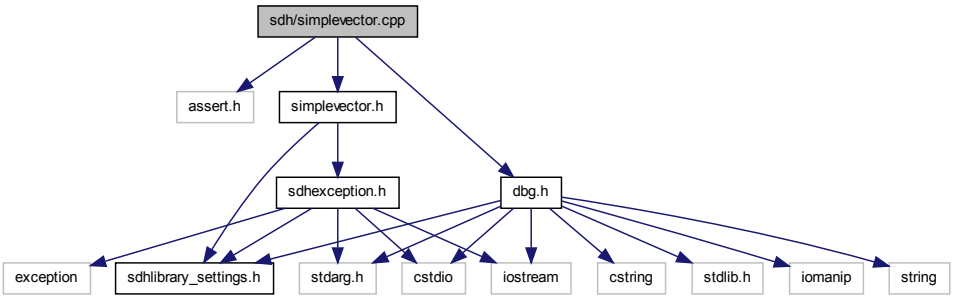
- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.76 sdh/simplevector.cpp File Reference

Implementation of class SDH::cSimpleVector.

```
#include <assert.h>
#include "dbg.h"
#include "simplevector.h"
```

Include dependency graph for simplevector.cpp:



11.76.1 Detailed Description

Implementation of class SDH::cSimpleVector.

11.76.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.76.3 Copyright

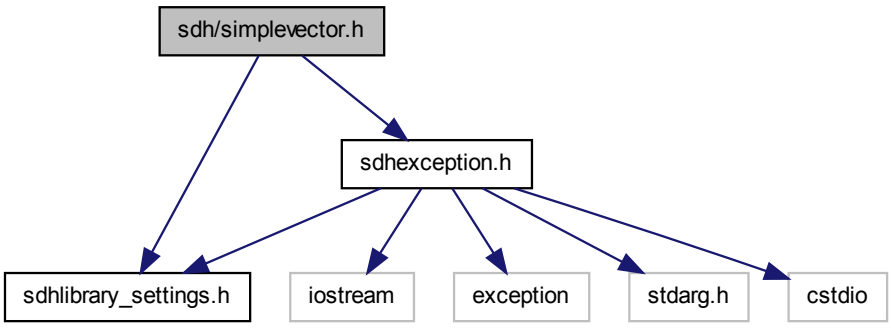
- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.77 sdh/simplevector.h File Reference

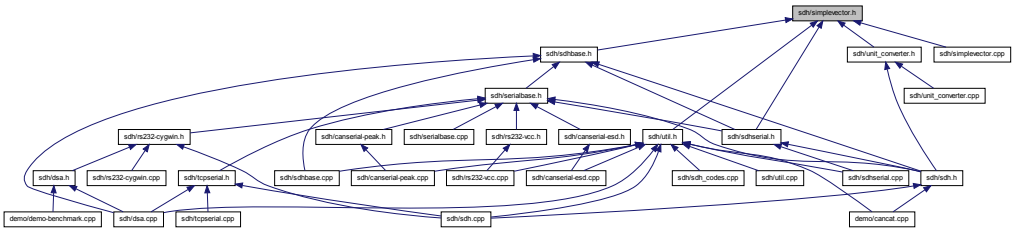
Interface of class SDH::cSimpleVector.

```
#include "sdhlibrary_settings.h"
#include "sdhexception.h"
```

Include dependency graph for simplevector.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cSimpleVectorException

  Derived exception class for low-level simple vector related exceptions.

- class SDH::cSimpleVector

  A simple vector implementation.

Namespaces

- namespace SDH

11.77.1 Detailed Description

Interface of class SDH::cSimpleVector.

11.77.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.77.3 Copyright

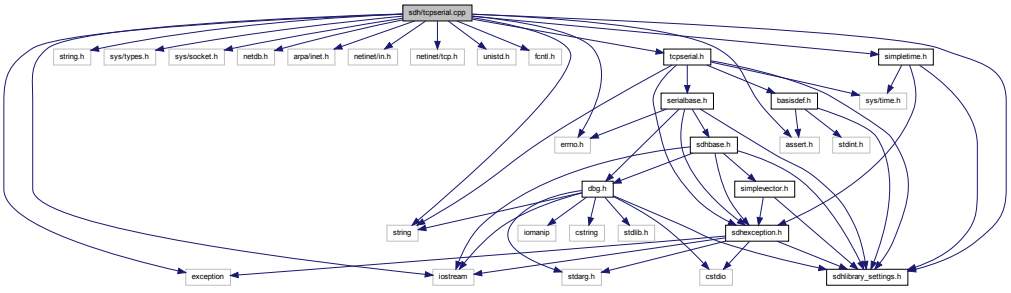
- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.78 sdh/tcpserial.cpp File Reference

Implementation of class SDH::cTCPSerial, a class to access a TCP port on cygwin/linux and Visual Studio.

```
#include "sdhlibrary_settings.h"
#include <errno.h>
#include <string.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netdb.h>
#include <arpa/inet.h>
#include <netinet/in.h>
#include <netinet/tcp.h>
#include <unistd.h>
#include <fcntl.h>
#include <iostream>
#include <exception>
#include <string>
#include <assert.h>
#include "tcpserial.h"
#include "simpletime.h"
```

Include dependency graph for tcpserial.cpp:



Defines

- #define SDH_TCP_DEBUG 1
- #define DBG(...)

11.78.1 Detailed Description

Implementation of class SDH::cTCPSerial, a class to access a TCP port on cygwin/linux and Visual Studio.

11.78.2 General file information

Author

Dirk Osswald

Date

2010-10-30

11.78.3 Copyright

11.78.4 Define Documentation

11.78.4.1 #define DBG(...)

Value:

```
do {                    \
        __VA_ARGS__;        \
    } while (0)
```

instead of guarding every debug output with #if SDH_TCP_DEBUG / #endif we use this DBG macro that expands to a stream output to a dbg object or to ";" depending on the value of SDH_TCP_DEBUG

11.78.4.2 #define SDH_TCP_DEBUG 1

Flag, if true then code for debug messages is included.

The debug messages must still be enabled at run time by setting the `some_cTCPSerial_object.dbg.SetFlag(1)`.

This 2 level scheme is used since this is the lowlevel communication, so debug outputs might really steal some performance.

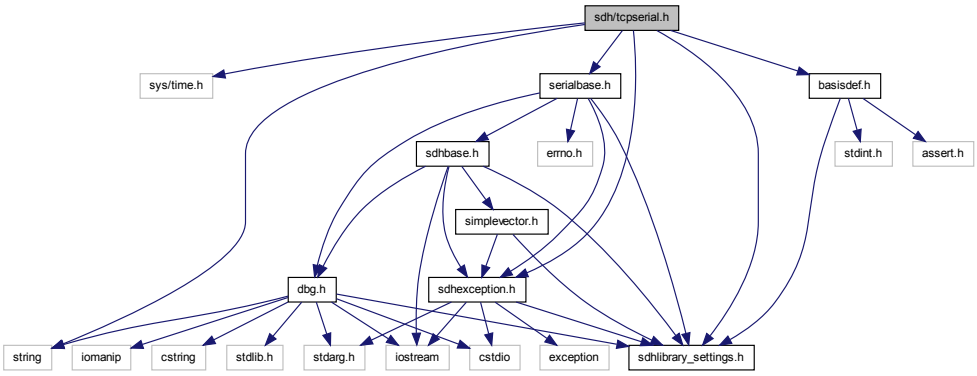
11.79 sdh/tcpserial.h File Reference

Interface of class SDH::cTCPSerial, class to access TCP port cygwin/linux.

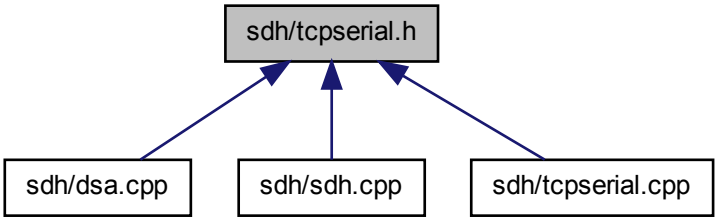
```
#include <sys/time.h>
```

```
#include <string>
#include "sdhexception.h"
#include "serialbase.h"
#include "basisdef.h"
#include "sdhlibrary_settings.h"
```

Include dependency graph for tcpserial.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cTCPSerialException

  Derived exception class for low-level CAN ESD related exceptions.

- class SDH::cTCPSerial

  Low-level communication class to access a CAN port.

Namespaces

- namespace SDH

11.79.1 Detailed Description

Interface of class SDH::cTCPSerial, class to access TCP port cygwin/linux.

11.79.2 General file information

Author

Dirk Osswald

Date

2010-10-30

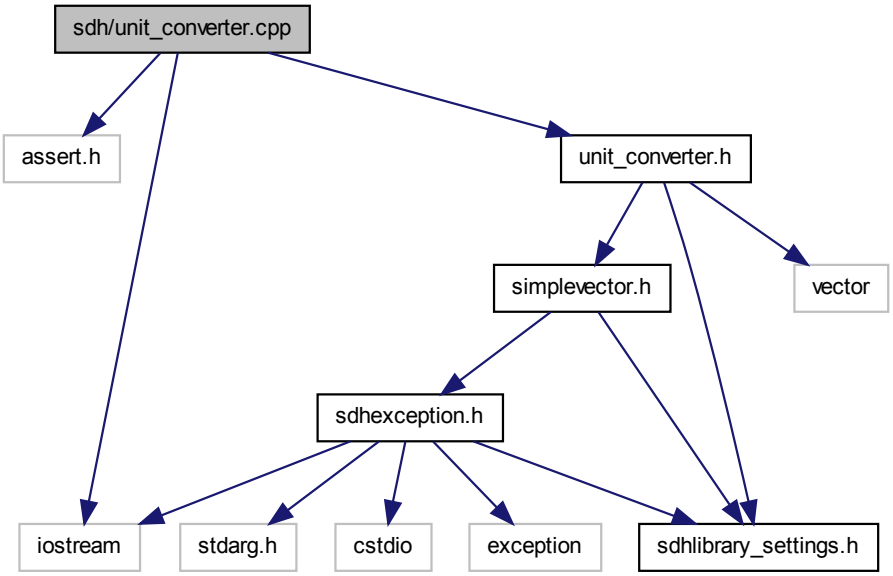
11.79.3 Copyright

11.80 sdh/unit_converter.cpp File Reference

Implementation of class SDH::cUnitConverter.

```
#include <assert.h>
#include <iostream>
#include "unit_converter.h"
```

Include dependency graph for unit_converter.cpp:



Namespaces

- namespace SDH

Variables

- cUnitConverter const SDH::uc_identity ("any","any","?", 1.0, 0.0, 4)

  Identity converter (internal = external)

11.80.1 Detailed Description

Implementation of class SDH::cUnitConverter.

11.80.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.80.3 Copyright

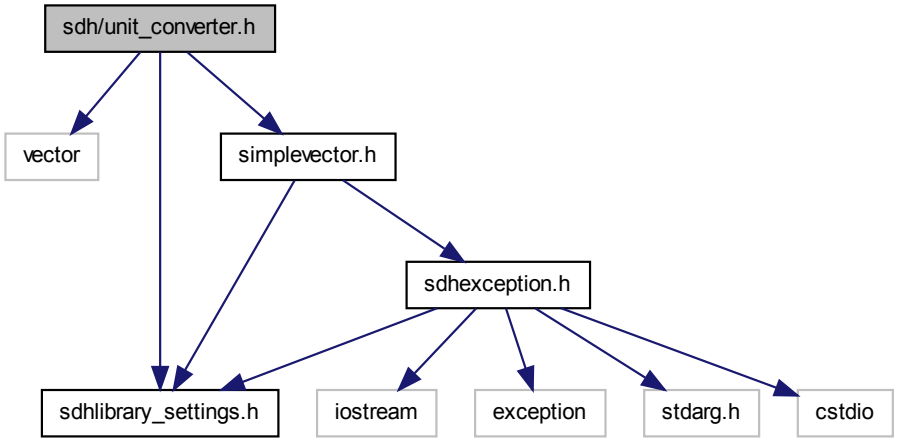
- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.81 sdh/unit_converter.h File Reference

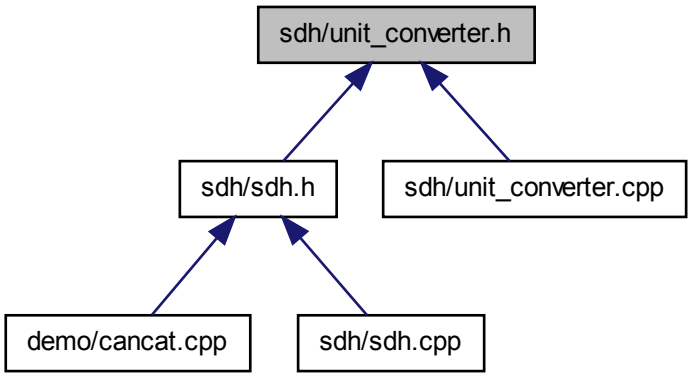
Interface of class SDH::cUnitConverter.

```
#include <vector>
#include "simplevector.h"
#include "sdhlibrary_settings.h"
```

Include dependency graph for unit_converter.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cUnitConverter

  Unit conversion class to convert values between physical unit systems.

Namespaces

- namespace SDH

Typedefs

- typedef double(cUnitConverter::∗ SDH::pDoubleUnitConverterFunction)(double) const

  Type of a pointer to a function like 'double SDH::cUnitConverter::ToExternal(double) const' or 'double SDH::cUnitConverter::ToInternal(double) const'.

11.81.1 Detailed Description

Interface of class SDH::cUnitConverter.

11.81.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.81.3 Copyright

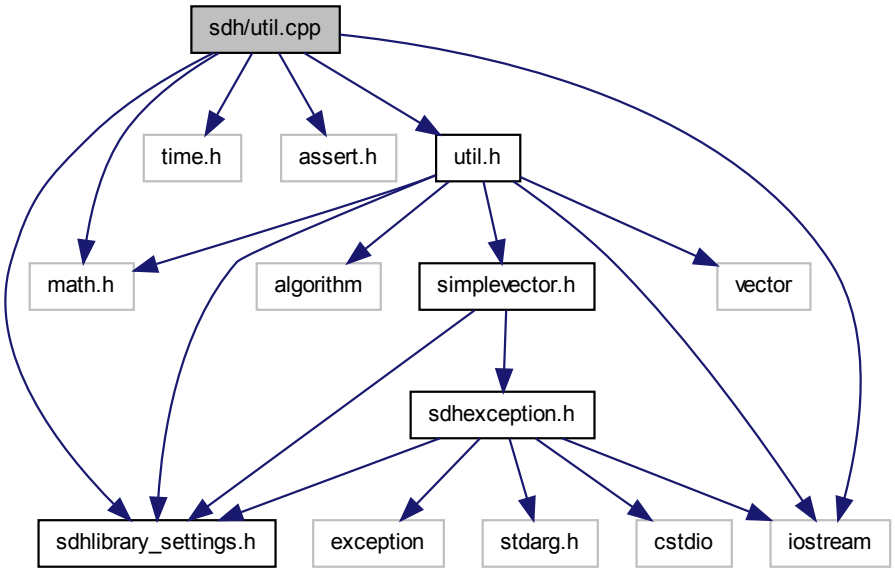
- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.82 sdh/util.cpp File Reference

Implementation of auxilliary utility functions for SDHLibrary-CPP.

```
#include "sdhlibrary_settings.h"
#include <math.h>
#include <time.h>
#include <assert.h>
#include <iostream>
#include "util.h"
```

Include dependency graph for util.cpp:



Namespaces

- namespace SDH

Defines

- #define _USE_MATH_DEFINES

Functions

- std::vector< int > SDH::NumerifyRelease (char const *rev)

Auxiliary functions

- bool SDH::InIndex (int v, int max)
- bool SDH::InRange (double v, double min, double max)
- bool SDH::InRange (int n, double const *v, double const *min, double const *max)
- double SDH::ToRange (double v, double min, double max)
- void SDH::ToRange (int n, double *v, double const *min, double const *max)

- void SDH::ToRange (std::vector< double > &v, std::vector< double > const &min, std::vector< double > const &max)
- void SDH::ToRange (cSimpleVector &v, std::vector< double > const &min, std::vector< double > const &max)
- double SDH::Approx (double a, double b, double eps)
- bool SDH::Approx (int n, double *a, double *b, double *eps)
- double SDH::DegToRad (double d)
- double SDH::RadToDeg (double r)
- void SDH::SleepSec (double t)
- int SDH::CompareReleases (char const *rev1, char const *rev2)
  compare release strings

11.82.1 Detailed Description

Implementation of auxilliary utility functions for SDHLibrary-CPP.

11.82.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.82.3 Copyright

- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.82.4 Define Documentation

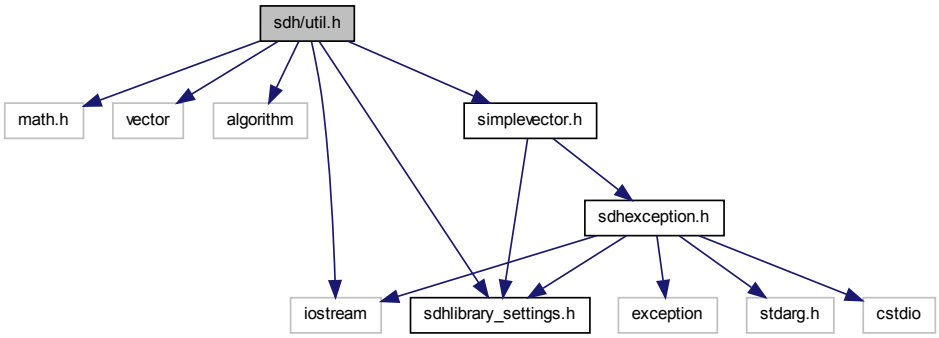
11.82.4.1 #define _USE_MATH_DEFINES

11.83 sdh/util.h File Reference

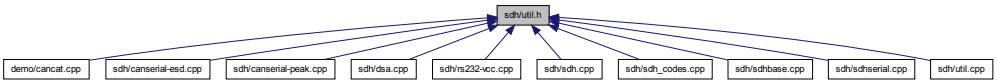
Interface of auxilliary utility functions for SDHLibrary-CPP.

```
#include <math.h>
#include <vector>
#include <algorithm>
#include <iostream>
#include "sdhlibrary_settings.h"
#include "simplevector.h"
```

Include dependency graph for util.h:



This graph shows which files directly or indirectly include this file:



Classes

- class SDH::cSetValueTemporarily< T >

  helper class to set value on construction and reset to previous value on destruction. (RAII-idiom)

Namespaces

- namespace SDH

Auxiliary functions

- #define DEFINE_TO_CASECOMMAND(_c) case _c: return (#_c)
- #define DEFINE_TO_CASECOMMAND_MSG(_c,...) case _c: return (#_c ": " __VA_ARGS__)
- bool SDH::InIndex (int v, int max)
- bool SDH::InRange (double v, double min, double max)

- bool SDH::InRange (int n, double const *v, double const *min, double const *max)
- double SDH::ToRange (double v, double min, double max)
- void SDH::ToRange (int n, double *v, double const *min, double const *max)
- void SDH::ToRange (std::vector< double > &v, std::vector< double > const &min, std::vector< double > const &max)
- void SDH::ToRange (cSimpleVector &v, std::vector< double > const &min, std::vector< double > const &max)
- double SDH::Approx (double a, double b, double eps)
- bool SDH::Approx (int n, double *a, double *b, double *eps)
- double SDH::DegToRad (double d)
- double SDH::RadToDeg (double r)
- void SDH::SleepSec (double t)
- template<typename Function , typename Tp >
  void SDH::apply (Function f, Tp &sequence)
- template<typename Function , typename InputIterator >
  Function SDH::apply (Function f, InputIterator first, InputIterator last)
- template<typename Function , typename Tp >
  Tp SDH::map (Function f, Tp sequence)
- template<typename T >
  std::ostream & SDH::operator<< (std::ostream &stream, std::vector< T > const &v)
- int SDH::CompareReleases (char const *rev1, char const *rev2)

  compare release strings

11.83.1 Detailed Description

Interface of auxilliary utility functions for SDHLibrary-CPP.

11.83.2 General file information

Author

Dirk Osswald

Date

2007-02-19

11.83.3 Copyright

- Copyright (c) 2007 SCHUNK GmbH & Co. KG

11.83.4 Define Documentation

11.83.4.1 #define DEFINE_TO_CASECOMMAND(_c) case _c: return (#_c)

Just a macro for the very lazy programmer to convert an enum or a DEFINE macro into a case command that returns the name of the macro as string.

Usage:

```
char const* eSomeEnumType_ToString( eSomeEnumType rc )
{
  switch (rc)
  {
  DEFINE_TO_CASECOMMAND( AN_ENUM );
  DEFINE_TO_CASECOMMAND( AN_OTHER_ENUM );
  ...
  default:               return "unknown return code";
  }
}
```

Remarks

You must use the enum or macro directly (not a variable with that value) since CPP-stringification is used.

See also DEFINE_TO_CASECOMMAND_MSG

11.83.4.2 #define DEFINE_TO_CASECOMMAND_MSG(_c, ...) case _c: return (#_c ": " __VA_ARGS__)

Just a macro for the very lazy programmer to convert an enum or a DEFINE macro and a message into a case command that returns the name of the macro and the message as string.

Usage:

```
char const* eSomeEnumType_ToString( eSomeEnumType rc )
{
  switch (rc)
  {
  DEFINE_TO_CASECOMMAND_MSG( AN_ENUM, "some mighty descriptive message" );
  DEFINE_TO_CASECOMMAND_MSG( AN_OTHER_ENUM, "guess what" );
  ...
  default:               return "unknown return code";
  }
}
```

Remarks

You must use the enum or macro directly (not a variable with that value) since CPP-stringification is used.

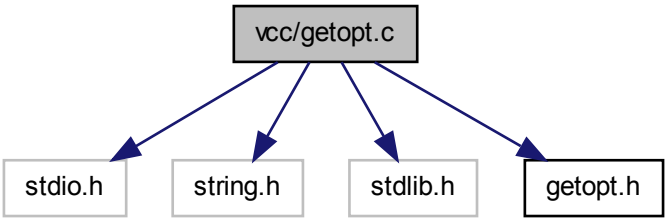
See also DEFINE_TO_CASECOMMAND

11.84 sdhlibrary_cpp.dox File Reference

11.85 vcc/getopt.c File Reference

```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include "getopt.h"
```

Include dependency graph for getopt.c:



Defines

- #define _NO_PROTO
- #define GETOPT_INTERFACE_VERSION 2
- #define _(msgid) (msgid)
- #define SWAP_FLAGS(ch1, ch2)
- #define NONOPTION_P (argv[optind][0] != '-' || argv[optind][1] == '\0')

Enumerations

- enum { REQUIRE_ORDER, PERMUTE, RETURN_IN_ORDER }

Functions

- static char * my_index (const char *str, int chr)
- static void exchange (char **argv)
- static const char * _getopt_initialize (int argc, char *const *argv, const char *optstring)

- int _getopt_internal (int argc, char ∗const ∗argv, const char ∗optstring, const struct option ∗longopts, int ∗longind, int long_only)
- int getopt (int argc, char ∗const ∗argv, const char ∗optstring)

Variables

- char ∗ optarg = NULL
- int optind = 1
- int __getopt_initialized = 0
- static char ∗ nextchar
- int opterr = 1
- int optopt = '?'
- static enum { ... } ordering
- static char ∗ posixly_correct
- static int first_nonopt
- static int last_nonopt

11.85.1 Define Documentation

11.85.1.1 #define _(*msgid*) (msgid)

11.85.1.2 #define _NO_PROTO

11.85.1.3 #define GETOPT_INTERFACE_VERSION 2

11.85.1.4 #define NONOPTION_P (argv[optind][0] != '-' || argv[optind][1] == '\0')

11.85.1.5 #define SWAP_FLAGS(*ch1*, *ch2*)

11.85.2 Enumeration Type Documentation

11.85.2.1 anonymous enum

Enumerator:

REQUIRE_ORDER

PERMUTE

RETURN_IN_ORDER

11.85.3 Function Documentation

11.85.3.1 static const char* _getopt_initialize (int *argc,* char *const * *argv,* const char * *optstring*) [static]

11.85.3.2 int _getopt_internal (int *argc,* char *const * *argv,* const char * *optstring,* const struct option * *longopts,* int * *longind,* int *long_only*)

11.85.3.3 static void exchange (char ** *argv*) [static]

11.85.3.4 int getopt (int *argc,* char *const * *argv,* const char * *optstring*)

11.85.3.5 static char* my_index (const char * *str,* int *chr*) [static]

11.85.4 Variable Documentation

11.85.4.1 int __getopt_initialized = 0

11.85.4.2 int **first_nonopt** [static]

11.85.4.3 int **last_nonopt** [static]

11.85.4.4 char* **nextchar** [static]

11.85.4.5 char* **optarg** = NULL

11.85.4.6 int **opterr** = 1

11.85.4.7 int **optind** = 1

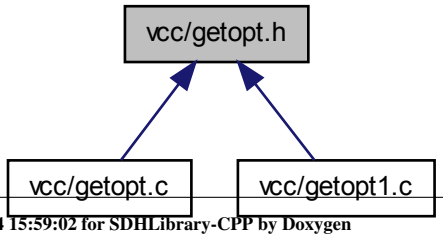
11.85.4.8 int **optopt** = '?'

11.85.4.9 enum { ... } **ordering** [static]

11.85.4.10 char* **posixly_correct** [static]

11.86 vcc/getopt.h File Reference

This graph shows which files directly or indirectly include this file:



Classes

- struct option

Defines

- #define no_argument 0
- #define required_argument 1
- #define optional_argument 2

Functions

- int getopt ()
- int getopt_long (int argc, char ∗const ∗argv, const char ∗shortopts, const struct option ∗longopts, int ∗longind)
- int getopt_long_only (int argc, char ∗const ∗argv, const char ∗shortopts, const struct option ∗longopts, int ∗longind)
- int _getopt_internal (int argc, char ∗const ∗argv, const char ∗shortopts, const struct option ∗longopts, int ∗longind, int long_only)

Variables

- char ∗ optarg
- int optind
- int opterr
- int optopt

11.86.1 Define Documentation

11.86.1.1 #define no_argument 0

11.86.1.2 #define optional_argument 2

11.86.1.3 #define required_argument 1

11.86.2 Function Documentation

11.86.2.1 int _getopt_internal (int *argc,* char ∗const ∗ *argv,* const char ∗ *shortopts,* const struct option ∗ *longopts,* int ∗ *longind,* int *long_only*)

11.86.2.2 int getopt ( )

11.86.2.3 int getopt_long (int *argc,* char ∗const ∗ *argv,* const char ∗ *shortopts,* const struct option ∗ *longopts,* int ∗ *longind*)

11.86.2.4 int getopt_long_only (int *argc,* char ∗const ∗ *argv,* const char ∗ *shortopts,* const struct option ∗ *longopts,* int ∗ *longind*)

11.86.3 Variable Documentation

11.86.3.1 char∗ optarg

11.86.3.2 int opterr

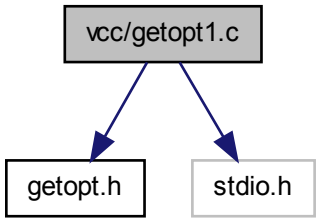
11.86.3.3 int optind

11.86.3.4 int optopt

11.87 vcc/getopt1.c File Reference

```
#include "getopt.h"
#include <stdio.h>
```

Include dependency graph for getopt1.c:



Defines

- #define GETOPT_INTERFACE_VERSION 2
- #define NULL 0

Functions

- int getopt_long (int argc, char ∗const ∗argv, const char ∗options, const struct option ∗long_options, int ∗opt_index)
- int getopt_long_only (int argc, char ∗const ∗argv, const char ∗options, const struct option ∗long_options, int ∗opt_index)

11.87.1 Define Documentation

11.87.1.1 #define GETOPT_INTERFACE_VERSION 2

11.87.1.2 #define NULL 0

11.87.2 Function Documentation

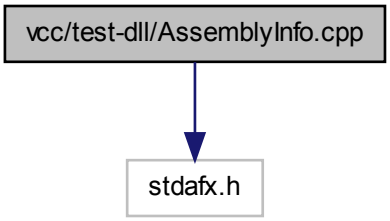
11.87.2.1 int getopt_long (int *argc*, char ∗const ∗ *argv*, const char ∗ *options*, const struct option ∗ *long_options*, int ∗ *opt_index*)

11.87.2.2 int getopt_long_only (int *argc*, char ∗const ∗ *argv*, const char ∗ *options*, const struct option ∗ *long_options*, int ∗ *opt_index*)

11.88 vcc/test-dll/AssemblyInfo.cpp File Reference

```
#include "stdafx.h"
```

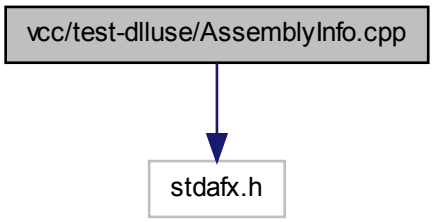
Include dependency graph for AssemblyInfo.cpp:



11.89 vcc/test-dlluse/AssemblyInfo.cpp File Reference

```
#include "stdafx.h"
```

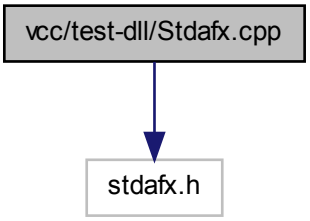
Include dependency graph for AssemblyInfo.cpp:



11.90 vcc/test-dll/Stdafx.cpp File Reference

```
#include "stdafx.h"
```

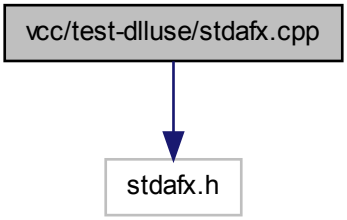
Include dependency graph for Stdafx.cpp:



11.91 vcc/test-dlluse/stdafx.cpp File Reference

```
#include "stdafx.h"
```

Include dependency graph for stdafx.cpp:



Index