HEIDENHAIN


Operating Instructions

# MSElibrary Software

**v2.1.x**

**English (en)**
**7/2015**

# Firmware version

This document describes MSEfirmware.dat v2.1.1 (ID 1090899-03) and MSElibrary v2.1.1 (ID 781598-05) and older.

# Fonts used in these instructions

Items of special interest or concepts that are emphasized to the user are shown in **bold** type.

# Modules

| Module | | Type | Description | ID |
|---|---|---|---|---|
| Required* | **MSE 1114** | Base module | 4 axes, EnDat22 | 747499-01 |
| | **MSE 1124** | Base module | 4 axes, TTL | 747511-01 |
| | **MSE 1184** | Base module | 4 axes, 1 Vpp | 747500-01 |
| | **MSE 1201** | Power supply module | AC 100 V … 240 V, power plug | 747501-01 |
| | **MSE 1201** | Power supply module | AC 100 V … 240 V, Cable 2 m with cable gland | 747501-02 |
| | **MSE 1202** | Power supply module | DC 24 V M8, 3-pin female | 747502-01 |
| Optional | **MSE 1314** | Axis module | 4 axes, EnDat22 | 747503-01 |
| | **MSE 1318** | Axis module | 8 axes, EnDat22 | 747504-01 |
| | **MSE 1324** | Axis module | 4 axes, TTL | 747512-01 |
| | **MSE 1328** | Axis module | 8 axes, TTL | 747513-01 |
| | **MSE 1332** | Analog module | Analog input | 747509-01 |
| | **MSE 1358** | Axis module | 8 axes, Solartron and Tesa half-bridge transducers | 747514-01 |
| | **MSE 1358** | Axis module | 8 axes, Mahr half-bridge and LVDT transducers | 747514-02 |
| | **MSE 1358** | Axis module | 8 axes, Marposs LVDT transducers | 747514-03 |
| | **MSE 1384** | Axis module | 4 axes, 1 Vpp | 747505-01 |
| | **MSE 1388** | Axis module | 8 axes, 1 Vpp | 747506-01 |
| | **MSE 1401** | I/O-module | 4 inputs/4 outputs | 747507-01 |
| | **MSE 1401** | I/O-module | 4 inputs/4 outputs, M8 connectors | 747507-02 |
| | **MSE 1501** | Compressed-air module | 1 channel | 747508-01 |

*One Base module, one Power supply module required

# Firmware version

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# 1

# Configuring the MSE 1000

## 1.1 Ethernet cable

A MDI-X enabled router, switch, or network interface card (NIC) is required to utilize a straight through Cat5 ethernet cable. If not using a MDI-X device a crossover cable is required.

## 1.2 Initial IP address

Each module defaults to DHCP. If a DHCP server is not found, the static IP address of 172.31.46.1 is used for each non power supply module. The power supply module defaults to 172.31.46.2. This will cause an IP conflict until the static IP addresses of the modules are changed.

## 1.3 Changing a modules IP address

The IP address of each non power supply module defaults to 172.31.46.1. The port is always 27015. Communication to the MSE will fail if the IP address for each module in the chain has not been changed to a unique value.

Do not plug or unplug modules under power.
Damage may occur to internal components.

To configure a unique IP address for each module in a chain:

- Power off the MSE
- Unplug all modules in the chain
- Connect the base module to the power supply module
- Power up the MSE
- Change the base module to a unique IP address following the example below
- Power off the MSE
- Add a new module
- Power up the base module and the module added in the previous step
- Change the IP address of the new module following the example below
- Repeat this process until all modules in the chain have been configured with a unique IP address

## C++ example

Change IP address:

- Include the headers and instantiate the MseInterface class.

```
#include "MseInterface.h"
MseInterface mse;
```

- Create the MSE chain by calling createChain() with the IP address and base port to use for the client PC (this is what the MSE modules will use for responses).

```
MseResults retVal = mse.createChain("172.31.46.3",27016,false, "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
    std::cout << "handle error" << std::endl;
```

- Get a reference to the desired module to change the IP address

```
MseModule* module = mse.getModule(0);
if(0 == module)
    std::cout << "handle error" << std::endl;
```

- Change the IP address and netmask

```
retVal = module->setIp("172.31.46.4", "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
    std::cout << "handle error" << std::endl;
```

- Reset the module and wait for it to complete

```
module->resetMse1000();
// Sleep for 10 seconds
```

- Recreate the chain because the UDP connections have changed

```
MseResults retVal = mse.createChain("172.31.46.3",27016,false, "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
    std::cout << "handle error" << std::endl;
```

## 1.4 Changing DHCP

The MSE modules are configured for DHCP. If a DHCP server is not found during startup, the modules will default to the IP configured in **Changing a modules IP address**. If DHCP is not needed, the time needed to look for a DHCP server can be eliminated by disabling DHCP. Modules that have DHCP disabled can be re-enabled.

If there is no DHCP server the PC using the library should have its network card connected to the 172.31.46 domain. Do not use an IP address that is the same as one set in the **Changing a modules IP address** section..

To disable DHCP:

- Include the headers and instantiate the MseInterface class.

```
#include "MseInterface.h"
MseInterface mse;
```

- Create the MSE chain by calling createChain() with the IP address and base port to use for the client PC (this is what the MSE modules will use for responses).

```
MseResults retVal = mse.createChain("172.31.46.3",27016,false, "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
    std::cout << "handle error" << std::endl;
```

- Get a reference to the desired module to change the DHCP usage

```
MseModule* module = mse.getModule(0);
if(0 == module)
    std::cout << "handle error" << std::endl;

retVal = module->setDhcp(0);
if(RESPONSE_OK != retVal.getCode())
    std::cout << "handle error" << std::endl;

// Repeat for each module in the chain
```

- Reset the module and wait for it to complete

```
module->resetMse1000();
// Sleep for 10 seconds
```

- Recreate the chain after the DHCP settings have changed

```
MseResults retVal = mse.createChain("172.31.46.3",27016,false, "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
    std::cout << "handle error" << std::endl;
```

# 2

# Library software

## 2.1 General information

Functions are provided for accessing MSE modules from a software application. This group of functions is supplied as a DLL for Microsoft Windows systems.

The following operating systems are supported:

- Windows XP
- Windows Vista
- Windows 7

The MSElibrary is compiled for a 32 bit processor and can be used on 64 bit Windows Vista and 64 bit Windows 7 machines.

In addition to the libraries, header files that enable the functions to be integrated into C/C++ programs are supplied. To create a program, the library must be incorporated into the project. This document groups the C++ and C functions in their own sections and refers to the C++ member functions as methods for clarity. Refer to "C++ examples" on page 239 and "C examples" on page 253.

LabVIEW VI wrappers and an example are provided with MSElibrary. Refer to "LabVIEW" on page 261.

## 2.2 Installation instructions

The MSElibrary has been tested with Microsoft Visual Basic 6.0, Microsoft Visual Basic 2010, LabVIEW 2012, and Delphi XE3 to show compatibility with C applications.

The MSElibrary Installer saves the tools needed to use the library in the MSElibrary directory and the user's document directory.

| **Operating system** | | **MSElibrary directory** |
|---|---|---|
| Windows XP | 32 bit | "C:\Program files\HEIDENHAIN" |
| Windows Vista | 32 bit | "C:\Program files\HEIDENHAIN" |
| | 64 bit | "C:\Program files (x86)\HEIDENHAIN" |
| Windows 7 | 32 bit | "C:\Program files\HEIDENHAIN" |
| | 64 bit | "C:\Program files (x86)\HEIDENHAIN" |

| **Operating system** | | **Users document directory** |
|---|---|---|
| Windows XP | 32 bit | "C:\Documents and Settings*CurrentUser*\My Documents\HEIDENHAIN" |
| Windows Vista | 32 bit, 64 bit | "C:\Users*CurrentUser*\My Documents\HEIDENHAIN" |
| Windows 7 | 32 bit, 64 bit | "C:\Users*CurrentUser*\My Documents\HEIDENHAIN" |

"C:\Program Files" and "C:\Program Files (x86)" are write protected folders in Windows 7, requiring the configurable data to be stored in the user's data directory.

"C:\Program Files\HEIDENHAIN\MSElibrary" or "C:\Program Files (x86)\HEIDENHAIN\MSElibrary" folder contains:

| **File** | **Description** |
|---|---|
| MSElibrary.lib | The .lib file required when linking against the library. The MSElibrary.lib file has the stubs needed to call the functions in the dll. |
| MSElibrary.dll | The .dll file is needed during runtime. This is where the functions linked against are located. |
| QtCore4.dll | The .dll file needed for using the core Qt methods. Qt is used for the XML reader and writer. |
| QtXml4.dll | The .dll file needed for using the Qt XML methods. |
| "\Docs" | The "\Docs" directory contains this file. |
| "\Headers" | The "\Headers" folder contains the MSElibrary headers for including into source code to utilize the Mselibrary. |

"C:\Documents and Settings*CurrentUser*\My Documents\HEIDENHAIN\MSElibrary" or
"C:\Users*CurrentUser*\My Documents\HEIDENHAIN" folder contains:

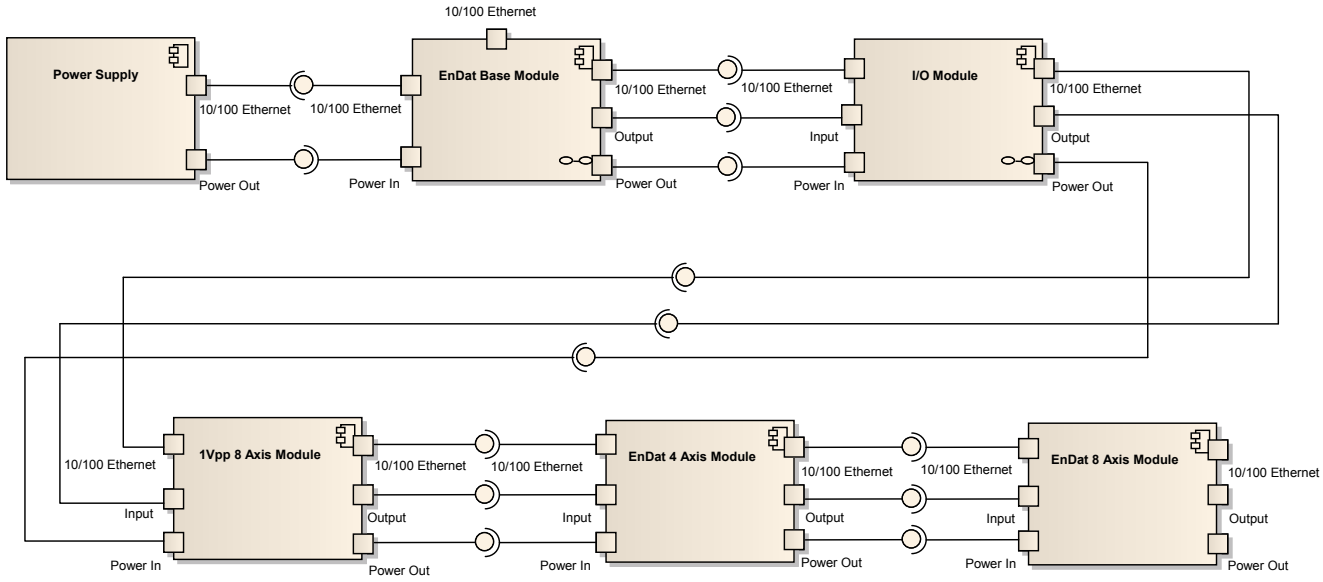
| **Folder** | **Description** |
|---|---|
| "\Examples" | The "\Examples" folder contains the "\C++", "\C", "Delphi", "LabVIEW", and "VisualBasic" subfolders. The "\C++" subfolder contains the C++ MSElibraryCppExample.sln VisualStudio 2010 example solution and source code. The "\C" subfolder contains the C++ MSElibraryCExample.sln VisualStudio 2010 example solution and source code. The MSElibraryCExample.sln utilizes the VisualStudio 2010 C++ compiler but makes C function calls into the MSElibrary.dll to show how the C wrappers are used. The "\Delphi" subfolder contains the Delphi Mse.dproj XE3 example project and source code. The "\LabVIEW" subfolder contains the LabVIEW "LabView MSE 1000 DAQ Utility v100.lvproj" example project and VIs. The "\VisualBasic" subfolder contains the VisualBasic MSEtestbed.sln VisualStudio 2010 example solution and source code. |
| "\LabVIEW" | The "\LabVIEW" folder contains the LabVIEW VI's that are needed to interface with the MSElibrary.dll. |

# 2.3 Overview

This document is a guide for using the MSElibrary. This document covers the basics needed for initializing the interface to the MSE, setting the encoder parameters, getting counts and positions, programming the firmware, and setting the IP address for the modules.

## Modules

The MSElibrary uses a common design for the base of all the modules. This allows for re-use of most commands as well as the UDP.




Module component diagram

## Definitions

MSE Chain — Refers to all of the modules in the MSE arrayed sequentially starting from an index of 0.

## Prerequisites

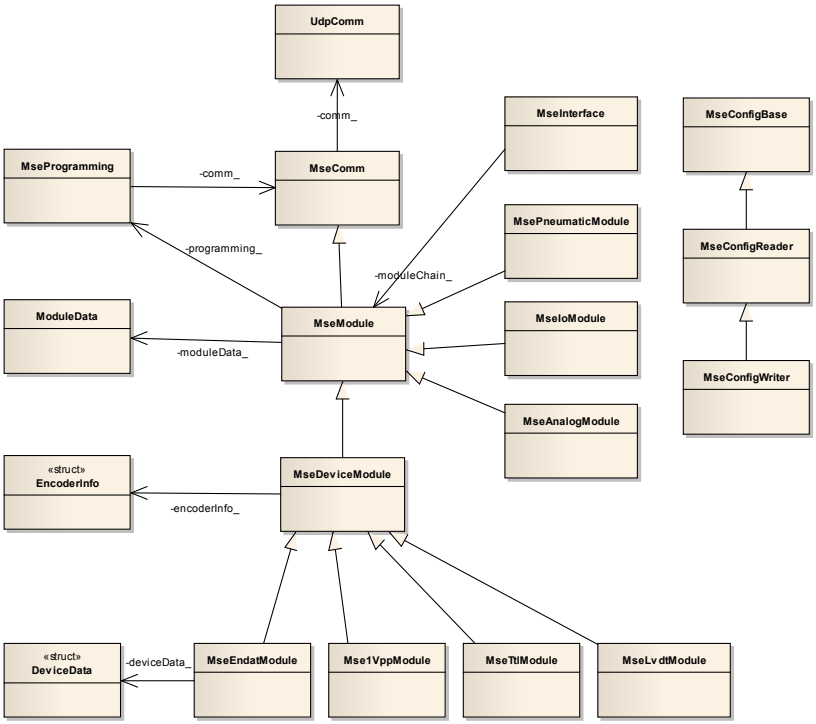
The MSElibrary example code requires Microsoft Windows compatible development tools and has been verified with Microsoft Visual Studio 2010.

## Methods and functions

Most of the methods and functions in the MSElibrary (MSElibrary.dll) are made available to the user of the library. This document describes the methods and functions for using the library.

The MSElibrary is written in C++. There are C wrappers for all of the necessary C++ methods in order to expose the calls as C functions. The C wrappers allow programs such as Visual Basic, Delphi, and LabVIEW to utilize the MSElibrary.

## Classes




Basic class diagram

| Class | Description |
|---|---|
| UdpComm | The UdpComm class is used for the operating system specific UDP code. |
| MseComm | The MseComm class has the common UDP implementation as well as the commands for setting the IP address and enabling or disabling DHCP for the module. |
| MseModule | The MseModule class is derived from the MseComm class. The MseModule class has methods for determining the module's type, getting the number of channels and getting the counts. The MseModule class also contains a class used for programming the firmware of a module. The initialization of an MseModule object will connect to a module over UDP and retrieve all of the information from the module and store it. |
| MseDeviceModule | The MseDeviceModule class is derived from MseModule and has functionality specific to modules with encoders including scaling and retrieving position data. |
| MseEndatModule | The MseEndatModule class is derived from MseDeviceModule and has EnDat specific initialization and functionality including warning, error, and device. |
| Mse1VppModule | The Mse1VppModule class is derived from MseDeviceModule and is used in case 1Vpp specific functionality is needed. |
| MseIoModule | The MseIoModule class is derived from MseModule and has functionality specific to modules with input and output functionality. |
| MsePneumaticModule | The MsePneumaticModule class is derived from the MseModule and has functionality specific to modules with pneumatic control functionality. |
| MseAnalogModule | The MseAnalogModule class is derived from MseModule and has functionality specific to modules with analog functionality |
| MseLvdtModule | The MseLvdtModule class is derived from MseDeviceModule and has functionality specific to modules with LVDT functionality. |
| MseTtlModule | The MseTtlModule class is derived from the MseDeviceModule and has functionality specific to modules with TTL functionality. |
| MseInterface | The MseInterface is the main class used for access of all the MSE features. It provides the ability to create a chain of modules that can be accessed without having to manually instantiate objects and create separate arrays. It is possible to skip using MseInterface and manually instantiate and use any of the exposed library calls of other classes. |
| MseConfigBase | The MseConfigBase class is a base class used by the MseConfigReader that contains the MSE_XML_RETURN and MSE_XML_ELEMENTS enumerations as well as the methods needed for loading the XML file into memory and decoding the enumerations. |

| | |
|---|---|
| MseConfigReader | The MseConfigReader is derived from the MseConfigBase class. This class is used for reading from the ModuleConfig.xml file that is generated from the MSEsetup application. |
| MseConfigWriter | The MseConfigWriter is derived from the MseConfigReader class. This class is used for writing to the ModuleConfig.xml file that is generated from the MSEsetup application. The MseConfigWriter is derived from the MseConfigReader class for convenience in order to utilize read functions without having to instantiate two separate classes. |

## Wrappers

There are 9 header files that contain the C functions that are used to access the library from C applications. The C functions cannot use inheritance and so must have their own calls into the base classes.

| | |
|---|---|
| MseModuleWrapper | Provides functions to access the C++ methods that are common to all modules. |
| MseEndatModuleWrapper | Provides functions to access the C++ methods that are specific to the EnDat module. |
| Mse1VppModuleWrapper | Provides functions to access the C++ methods that are specific to the 1Vpp module. |
| MseIoModuleWrapper | Provides functions to access the C++ methods that are specific to the I/O module. |
| MsePneumaticModuleWrapper | Provides functions to access the C++ methods that are specific to the pneumatic module. |
| MseConfigFileWrapper | Provides functions to access the C++ methods that are specific to the configuration file reader and writer. |
| MseAnalogModuleWrapper | Provides functions to access the C++ methods that are specific to the analog module. |
| MseTtlModuleWrapper | Provides functions to access the C++ methods that are specific to the TTL module. |
| MseLvdtModuleWrapper | Provides functions to access the C++ methods that are specific to the LVDT module. |

## Module Communication

The modules use UDP for network communication. UDP is non-guaranteed communication. If a message is missed, it can be resent after the timeout period. The timeout period can be modified with the setUdpTimeout method.

The MSElibrary is not threadsafe. This means that multiple threads should not call MSElibrary methods or functions at the same time.

## 2.4 Data Types

The following table shows the size of the data types used in the MSElibrary. Calls into the library must make sure that the parameters and return types match the size of the data type.

| Name | Size |
|---|---|
| Enumeration (like UOM and MODULE_ID) | signed 32 bit integer (4 bytes) |
| char | signed 8 bit integer (1 byte) |
| unsigned char | unsigned 8 bit integer (1 byte) |
| short | signed 16 bit integer (2 bytes) |
| unsigned short | unsigned 16 bit integer (2 bytes) |
| int | signed 32 bit integer (4 bytes) |
| unsigned int | unsigned 32 bit integer (4 bytes) |
| long | signed 32 bit integer (4 bytes) |
| unsigned long | unsigned 32 bit integer (4 bytes) |
| bool | 8 bit integer (1 byte) |
| double | 64 bit floating point number (8 bytes) |
| Mse1VppModulePtr | signed 32 bit integer (4 bytes) |
| MseAnalogModulePtr | signed 32 bit integer (4 bytes) |
| MseConfigFilePtr | signed 32 bit integer (4 bytes) |
| MseEndatModulePtr | signed 32 bit integer (4 bytes) |
| MseIoModulePtr | signed 32 bit integer (4 bytes) |
| MseLvdtModulePtr | signed 32 bit integer (4 bytes) |
| MseModulePtr | signed 32 bit integer (4 bytes) |
| MsePneumaticModulePtr | signed 32 bit integer (4 bytes) |
| MseTtlModulePtr | signed 32 bit integer (4 bytes) |

# 2.5 Enumerations

## MSE_CHAIN_CREATION_STATE

The MSE_CHAIN_CREATION_STATE enumeration is used to determine the state of the createChain method.

**Enumeration**

```
MSE_CHAIN_CREATION_STATE
                {
                        MSE_CHAIN_CREATION_IDLE = 0,
                        MSE_CHAIN_CREATION_START,
                        MSE_CHAIN_CREATION_ORDERING,
                        MSE_CHAIN_CREATION_FINISHED,
                        MSE_CHAIN_CREATION_FAILED
                };
```

**Parameters**

| | |
|---|---|
| MSE_CHAIN_CREATION_IDLE | The chain creation has not started |
| MSE_CHAIN_CREATION_START | The broadcast is binding to a socket, sending out the UDP_OPEN broadcast, and receiving responses to the UDP_OPEN command on the bound socket |
| MSE_CHAIN_CREATION_ ORDERING | The responses have been received and the modules are being ordered based on control of the output/input pins |
| MSE_CHAIN_CREATION_ FINISHED | The chain creation has finished successfully |
| MSE_CHAIN_CREATION_FAILED | The chain creation has failed |

## UOM

The UOM enumeration specifies the unit of measurement for the position.

**Enumeration**

```
UOM
                {
                        UOM_UNDEFINED = 0,
                        UOM_RAW_COUNTS,
                        UOM_INCHES,
                        UOM_MM,
                        UOM_DEGREES,
                        UOM_COUNT
                };
```

**Parameters**

| | |
|---|---|
| UOM_UNDEFINED = 0 | Undefined unit of measurement |
| UOM_RAW_COUNTS | Raw counts from a device |
| UOM_INCHES | Inches |
| UOM_MM | Millimeters |
| UOM_DEGREES | Decimal degrees |
| UOM_COUNT | The number of values in the enumeration |

## MODULE_ID

The MODULE_ID enumeration specifies the module ID for the module. The module ID can also be found on the module casing and can be retrieved with the showModuleId() method from the MseModule. The showModuleType() method can be used to show the type that is on the module casing.

**Enumeration**

```
MODULE_ID
        {
                MODULE_ID_NONE          = 0x000000,
                MODULE_ID_ENDAT_BASE    = 74749901,
                MODULE_ID_1VPP_BASE     = 74750001,
                MODULE_ID_PS_120_IP40   = 74750101,
                MODULE_ID_PS_120_IP65   = 74750102,
                MODULE_ID_PS_24         = 74750201,
                MODULE_ID_ENDAT_4X      = 74750301,
                MODULE_ID_ENDAT_8X      = 74750401,
                MODULE_ID_1VPP_4X       = 74750501,
                MODULE_ID_1VPP_8X       = 74750601,
                MODULE_ID_IO_IP40       = 74750701,
                MODULE_ID_IO_IP65       = 74750702,
                MODULE_ID_PNEUMATIC     = 74750801,
                MODULE_ID_ANALOG        = 74750901,
                MODULE_ID_TTL_BASE      = 74751101,
                MODULE_ID_TTL_4X        = 74751201,
                MODULE_ID_TTL_8X        = 74751301,
                MODULE_ID_HBT           = 74751401,
                MODULE_ID_VLDT          = 74751402,
                MODULE_ID_LVDT          = 74751403
        };
```

**Parameters**

| | | |
|---|---|---|
| MODULE_ID_NONE | = 0x000000 | Default case, Only should happen if no firmware is loaded |
| MODULE_ID_ENDAT_BASE | = 74749901 | EnDat module with ethernet, serial, and 4 channels |
| MODULE_ID_1VPP_BASE | = 74750001 | 1 Vpp module with ethernet, serial and 4 channels |
| MODULE_ID_PS_120_IP40 | = 74750101 | 120/240 Vac Power Supply IP40 version |
| MODULE_ID_PS_120_IP65 | = 74750102 | 120/240 Vac Power Supply IP65 version |
| MODULE_ID_PS_24 | = 74750201 | 24 Vdc Power Supply |
| MODULE_ID_ENDAT_4X | = 74750301 | The EnDat module with 4 channels |
| MODULE_ID_ENDAT_8X | = 74750401 | EnDat module with 8 channels |
| MODULE_ID_1VPP_4X | = 74750501 | 1 Vpp module with 4 channels |
| MODULE_ID_1VPP_8X | = 74750601 | 1 Vpp module with 8 channels |
| MODULE_ID_IO_IP40 | = 74750701 | I/O module IP40 version |
| MODULE_ID_IO_IP65 | = 74750702 | I/O module IP65 version |
| MODULE_ID_PNEUMATIC | = 74750801 | Pneumatic |
| MODULE_ID_ANALOG | = 74750901 | Analog module |
| MODULE_ID_TTL_BASE | = 74751101 | TTL module with ethernet, serial, and 4 channels |
| MODULE_ID_TTL_4X | = 74751201 | TTL module with 4 channels |
| MODULE_ID_TTL_8X | = 74751301 | TTL module wih 8 channels |
| MODULE_ID_HBT | = 74751401 | LVDT module with 8 channels for Solatron compatible half bridge sensors |
| MODULE_ID_VLDT | = 74751402 | LVDT module with 8 channels for Mahr compatible VLDT (Very Linear Differential Transducer) sensors |
| MODULE_ID_LVDT | = 74751403 | LVDT module with 8 channels for Marposs compatible full bridge sensors |

## ENDAT_ERROR_RESULT

The ENDAT_ERROR_RESULT enumeration is for the error and warning values specific to the EnDat encoders that can be obtained from the MSE over UDP.

**Enumeration**

```
ENDAT_ERROR_RESULT
                    {
                        EET_OK = 0,
                        EET_BAD,
                        EET_NOT_SUPPORTED,
                        EET_COUNT
                    };
```

**Parameters**

| | |
|---|---|
| EET_OK = 0 | There is currently no error or warning |
| EET_BAD | There is currently an error or warning |
| EET_NOT_SUPPORTED | The warning or error information is not supported |
| EET_COUNT | The number of values in the enumeration |

## ENDAT_ERRORS

The ENDAT_ERRORS enumeration is for the EnDat errors.

**Enumeration**

```
ENDAT_ERRORS
                {
                        ENDAT_ERRORS_LIGHT,
                        ENDAT_ERRORS_SIGNALAMP,
                        ENDAT_ERRORS_POSVALUE,
                        ENDAT_ERRORS_OVERVOLT,
                        ENDAT_ERRORS_UNDERVOLT,
                        ENDAT_ERRORS_OVERCUR,
                        ENDAT_ERRORS_BATTERY
                };
```

**Parameters**

| | |
|---|---|
| ENDAT_ERRORS_LIGHT= 0 | Light |
| ENDAT_ERRORS_SIGNALAMP | Signal amplitude |
| ENDAT_ERRORS_POSVALUE | Position value |
| ENDAT_ERRORS_OVERVOLT | Over voltage |
| ENDAT_ERRORS_UNDERVOLT | Under voltage |
| ENDAT_ERRORS_OVERCUR | Over current |
| ENDAT_ERRORS_BATTERY | Battery |

## NUM_ENDAT_ERRORS

The NUM_ENDAT_ERRORS enumeration is for the number of ENDAT errors that are enumerated in ENDAT_ERRORS.

**Enumeration**

```
NUM_ENDAT_ERRORS = 7;
```

## ENDAT_WARNINGS

The ENDAT_WARNINGS enumeration is for the EnDat warning.

**Enumeration**

```
ENDAT_WARNINGS
                {
                        ENDAT_WARNING_FREQCOLLISION = 0,
                        ENDAT_WARNING_TEMPEXCEEDED,
                        ENDAT_WARNING_LIGHT_RESERVE,
                        ENDAT_WARNING_BATTERYCHARGE,
                        ENDAT_WARNING_TRAVERSEREFPT
                };
```

**Parameters**

| | |
|---|---|
| ENDAT_WARNING_FREQCOLLISION = 0 | Frequency Collision |
| ENDAT_WARNING_TEMPEXCEEDED | Temperature warning range has been exceeded |
| ENDAT_WARNING_LIGHTREVERSE | Light source control reserve |
| ENDAT_WARNING_BATTERYCHARGE | Battery charge |
| ENDAT_WARNING_TRAVERSEREFPT | Traverse Reference Point |

## NUM_ENDAT_WARNINGS

The NUM_ENDAT_WARNINGS enumeration is the number of ENDAT warnings that are enumerated in ENDAT_WARNINGS.

**Enumeration**

```
NUM_ENDAT_WARNINGS = 5;
```

## ENDAT_DIAG

The ENDAT_DIAG enumeration is for the EnDat diagnostic. The getDiag method of the MseEndatModule class fills in the parameter diagVals with an array of unsigned chars. This array can be indexed by this enumeration to access the desired EnDat diagnostic value.

**Enumeration**

```
ENDAT_DIAG
                {
                        ENDAT_DIAG_ABS_TRACK_SUPPORTED,
                        ENDAT_DIAG_ABS_TRACK_VALUE,
                        ENDAT_DIAG_ABS_TRACK_MIN,
                        ENDAT_DIAG_INC_TRACK_SUPPORTED,
                        ENDAT_DIAG_INC_TRACK_VALUE,
                        ENDAT_DIAG_INC_TRACK_MIN,
                        ENDAT_DIAG_POS_VAL_CALC_SUPPORTED,
                        ENDAT_DIAG_POS_VAL_CALC_VALUE,
                        ENDAT_DIAG_POS_VAL_CALC_MIN,
                        ENDAT_DIAG_COUNT
                };
```

**Parameters**

| | |
|---|---|
| ENDAT_DIAG_ABS_TRACK_SUPPORTED | Absolute tracking function reserves supported. This value will be either EET_OK or EET_NOT_SUPPORTED which are members of the ENDAT_ERROR_RESULT enumeration. |
| ENDAT_DIAG_ABS_TRACK_VALUE | Absolute tracking function reserves value |
| ENDAT_DIAG_ABS_TRACK_MIN | The minimum recorded absolute tracking function reserve value |
| ENDAT_DIAG_INC_TRACK_SUPPORTED | Incremental tracking function reserves supported. This value will be either EET_OK or EET_NOT_SUPPORTED which are members of the ENDAT_ERROR_RESULT enumeration. |
| ENDAT_DIAG_INC_TRACK_VALUE | Incremental tracking function reserves value |
| ENDAT_DIAG_INC_TRACK_MIN | The minimum recorded incremental tracking function reserve value |
| ENDAT_DIAG_POS_VAL_CALC_SUPPORTED | Position value calculation function reserves supported. This value will be either EET_OK or EET_NOT_SUPPORTED which are members of the ENDAT_ERROR_RESULT enumeration. |
| ENDAT_DIAG_POS_VAL_CALC_VALUE | Position value calculation function reserves value |
| ENDAT_DIAG_POS_VAL_CALC_MIN | The minimum recorded position value calculation function reserve value |
| ENDAT_DIAG_COUNT | The number of values in the enumeration |

## MSE_RESPONSE_CODE

The MSE_RESPONSE_CODE enumeration is for the error and warning values that can be obtained from the MSE over UDP.

**Enumeration**

```
MSE_RESPONSE_CODE
        {
                RESPONSE_OK = 0,
                RESPONSE_TIMEOUT,
                RESPONSE_TYPE_INVALID,
                RESPONSE_RANGE_MODULE_INVALID,
                RESPONSE_TYPE_MISMATCH,
                RESPONSE_PARAMETER_COUNT_ZERO,
                RESPONSE_PARAMETER_COUNT_MISMATCH,
                RESPONSE_PARAMETER_SEND_SIZE_MISMATCH,
                RESPONSE_PARAMETER_SIZE_MISMATCH,
                RESPONSE_PARAMETER_INVALID_CHANNEL,
                RESPONSE_BROADCAST_SEND_FAILED,
                RESPONSE_BROADCAST_NO_RESPONSE,
                RESPONSE_UDP_SOCKET_BIND_FAILED,
                RESPONSE_UDP_SERVER_CREATION_FAILED,
                RESPONSE_UDP_READ_FLUSH_FAILED,
                RESPONSE_UDP_SEND_FAILED,
                RESPONSE_UDP_READ_FAILED,
                RESPONSE_UDP_RECV_PORT_INVALID,
                RESPONSE_ASYNC_RECV_FAILED,
                RESPONSE_DOWNLOAD_ENDED_OK,
                RESPONSE_COMM_NOT_INITIALIZED,
                RESPONSE_MODULE_NOT_INITIALIZED,
                RESPONSE_IP_ALREADY_USED,
                RESPONSE_MODULE_ALREADY_CREATED,
                RESPONSE_IP_MALFORMED,
                RESPONSE_NETMASK_MALFORMED,
                RESPONSE_IP_MISMATCH,
                RESPONSE_PROGRAM_FILE_PREPARE_FAILED,
                RESPONSE_MODULE_NULL,
                RESPONSE_MODULE_MISMATCH,
                RESPONSE_MODULE_NOT_CONNECTED,
                RESPONSE_MODULE_FIRST_NOT_FOUND,
                RESPONSE_POINTER_PARAMETER_NULL,
                RESPONSE_RANGE_ERROR,
                RESPONSE_FRAM_ERROR,
                RESPONSE_FILE_OPEN_FAILED,
                RESPONSE_FILE_READ_ERROR,
                RESPONSE_MODULE_NOT_IN_BOOTLOADER,
                RESPONSE_ERROR,
                RESPONSE_INVALID_REVISION,
                RESPONSE_INVALID_IMAGE,
                RESPONSE_CHECKSUM_FAILED,
                RESPONSE_FIRMWARE_NOT_LOADED,
                RESPONSE_CANT_PROGRAM_WHILE_DHCP,
                RESPONSE_COUNT
        };
```

**Parameters**

| | |
|---|---|
| RESPONSE_OK = 0 | Used to represent a good response |
| RESPONSE_TIMEOUT | A timeout occurred waiting for the response |
| RESPONSE_TYPE_INVALID | An invalid response type was received |
| RESPONSE_RANGE_MODULE_INVALID | A module was requested that is out of range |
| RESPONSE_TYPE_MISMATCH | A response type different from what was expected was received |
| RESPONSE_PARAMETER_COUNT_ZERO | The number of parameters received is zero but this is not what was expected |
| RESPONSE_PARAMETER_COUNT_MISMATCH | The number of parameters received does not match what was expected |
| RESPONSE_PARAMETER_SEND_SIZE_MISMATCH | The command to send was passed in invalid data |
| RESPONSE_PARAMETER_SIZE_MISMATCH | The size of the data received is not what was expected |
| RESPONSE_PARAMETER_INVALID_CHANNEL | The channel received is not what was expected |

| | |
|---|---|
| RESPONSE_BROADCAST_SEND_FAILED | The broadcast command could not be sent out the network correctly |
| RESPONSE_BROADCAST_NO_RESPONSE | Broadcast failed to get a response |
| RESPONSE_UDP_SOCKET_BIND_FAILED | The binding of the UDP socket failed. |
| RESPONSE_UDP_SERVER_CREATION_FAILED | The creation of the UDP server failed |
| RESPONSE_UDP_READ_FLUSH_FAILED | The flush of the UDP read buffer failed |
| RESPONSE_UDP_SEND_FAILED | The sending of the UDP datagram failed |
| RESPONSE_UDP_READ_FAILED | The reading of the UDP datagram failed |
| RESPONSE_UDP_RECV_PORT_INVALID | The UDP port for receiving MSE responses is invalid |
| RESPONSE_ASYNC_RECV_FAILED | Currently not utilized |
| RESPONSE_DOWNLOAD_ENDED_OK | Used to distinguish from a RESPONSE_OK, because downloading the program requires multiple segments |
| RESPONSE_COMM_NOT_INITIALIZED | The communication to the module has not been initialized |
| RESPONSE_MODULE_NOT_INITIALIZED | The module data has not been initialized |
| RESPONSE_IP_ALREADY_USED | The IP address is used by another module |
| RESPONSE_MODULE_ALREADY_CREATED | The module cannot be created twice |
| RESPONSE_IP_MALFORMED | The IP address is not in the correct format |
| RESPONSE_NETMASK_MALFORMED | The netmask is not in the correct format |
| RESPONSE_IP_MISMATCH | The IP address in the return packet does not match the module that sent the command |
| RESPONSE_PROGRAM_FILE_PREPARE_FAILED | The file preparation for the programming of the module failed |
| RESPONSE_MODULE_NULL | A NULL pointer was returned when trying to request a module |
| RESPONSE_MODULE_MISMATCH | The module requested is not the same as the one in the MSE |
| RESPONSE_MODULE_NOT_CONNECTED | The IS_CONNECT_IN_SET pin used for ordering the modules after a broadcast did not go high when expected |
| RESPONSE_MODULE_FIRST_NOT_FOUND | The first module could not be identified |
| RESPONSE_POINTER_PARAMETER_NULL | A NULL pointer was passed into a function |
| RESPONSE_RANGE_ERROR | A parameter value is out of range |
| RESPONSE_FRAM_ERROR | The FRAM request returned an error |
| RESPONSE_FILE_OPEN_FAILED | The file requested could not be opened |
| RESPONSE_FILE_READ_ERROR | The file requested could not be read |
| RESPONSE_MODULE_NOT_IN_BOOTLOADER | The module is not in the bootloader |
| RESPONSE_ERROR | An unknown error |
| RESPONSE_INVALID_REVISION | The revision of the firmware is invalid |
| RESPONSE_INVALID_IMAGE | The image selected for programming a module is invalid |
| RESPONSE_CHECKSUM_FAILED | The checksum has failed |
| RESPONSE_FIRMWARE_NOT_LOADED | The firmware is not loaded in the module |
| RESPONSE_CANT_PROGRAM_WHILE_DHCP | The bootloader and firmware cannot be programmed while a module is configured for DHCP |
| RESPONSE_COUNT | The number of values in the enumeration |

## LATCH_OPTIONS

The LATCH_OPTIONS enumeration is used to select the latching option.

**Enumeration**

```
LATCH_OPTIONS
                {
                        LATCH_COUNT_SET = 0,
                        LATCH_COUNT_RESET
                };
```

**Parameters**

| | |
|---|---|
| LATCH_COUNT_SET | The latching is set (activated) |
| LATCH_COUNT_RESET | The latching is reset (deactivated) |

## LATCH_CHOICE

The LATCH_CHOICE enumeration is used to select the latch to trigger. There are 5 latch lines. The first 3 are used for software latches. The last 2 are for the footswitches. The footswitch lines can be simulated with a software command. The enumeration LATCH_CHOICE_ALL is currently used as a way to clear all latches at one time with the setLatch method.

**Enumeration**

```
LATCH_CHOICE
                {
                        LATCH_CHOICE_SOFTWARE_1 = 0,
                        LATCH_CHOICE_SOFTWARE_2,
                        LATCH_CHOICE_SOFTWARE_3,
                        LATCH_CHOICE_FOOTSWITCH_1,
                        LATCH_CHOICE_FOOTSWITCH_2,
                        LATCH_CHOICE_ALL,
                        LATCH_CHOICE_NONE
                };
```

**Parameters**

| | |
|---|---|
| LATCH_CHOICE_SOFTWARE_1 | The first trigger line |
| LATCH_CHOICE_SOFTWARE_2 | The second trigger line |
| LATCH_CHOICE_SOFTWARE_3 | The third trigger line |
| LATCH_CHOICE_FOOTSWITCH_1 | The fourth trigger line |
| LATCH_CHOICE_FOOTSWITCH_2 | The fifth trigger line |
| LATCH_CHOICE_ALL | Used to clear all triggers with the setLatch method |
| LATCH_CHOICE_NONE | None |

## ROTARY_FORMAT

The ROTARY_FORMAT enumeration is used to set the type of formatting to apply to an EnDat, 1 Vpp or TTL rotary encoder. The format is applied when calling the getPositions method of the EnDat, 1 Vpp or TTL modules.

**Enumeration**

```
ROTARY_FORMAT
                {
                        ROTARY_FORMAT_360,
                        ROTARY_FORMAT_PLUS_MINUS_360,
                        ROTARY_FORMAT_PLUS_MINUS_180,
                        ROTARY_FORMAT_INFINITE_PLUS_MINUS,
                        ROTARY_FORMAT_UNKNOWN
                };
```

**Parameters**

| | |
|---|---|
| ROTARY_FORMAT_360 | The rotary position is always from 0 to 360 |
| ROTARY_FORMAT_PLUS_MINUS_360 | The rotary position is between 0 to 360 when rotating clockwise from the starting 0 position of the encoder. The rotary position is between 0 to -360 when rotating counterclockwise from the starting 0 position of the encoder. The starting 0 position, for relative encoders, is set when the modules are first powered on and when referencing is performed. The 0 position of an absolute encoder is always in the same position. |
| ROTARY_FORMAT_PLUS_MINUS_180 | The rotary position goes from 0 to 180 and then from -180 to 0 when rotating clockwise. The rotary position goes from 0 to -180 and then from 180 to 0 when rotating counterclockwise. |

| | |
|---|---|
| ROTARY_FORMAT_INFINITE_PLUS_MINUS | For 1 Vpp and TTL encoders: The rotary position is between 0 to the largest 64 bit double value when rotating clockwise from the starting 0 position of the encoder. The rotary position is between 0 to smallest 64 bit double value when rotating counterclockwise from the starting 0 position of the encoder. The starting 0 position is set when the modules are first powered on and when referencing is performed. For EnDat encoders: The rotary position is between 0 to a positive 64 bit double value based on the number of revolutions that the encoder can store when rotating clockwise from the 0 position of the encoder. The rotary position is between 0 to a negative 64 bit double value based on the number of revolutions that the encoder can store when rotating counterclockwise from the 0 position of the encoder. The 0 position of an absolute encoder is always in the same position. |
| ROTARY_FORMAT_UNKNOWN | Unknown |

## ADC_OPTIONS

The ADC_OPTIONS enumeration is used to select the analog to digital conversion value to read. The getAdcValues method of the MseModuleclass fills in the parameter adcVals with an array of shorts. This array can be indexed by this enumeration to access the desired ADC value.

**Enumeration**

```
ADC_OPTIONS
                {
                        ADC_CH0,
                        ADC_CH1,
                        ADC_CH2,
                        ADC_CH3,
                        ADC_TEMP,
                        ADC_NUM_CHANNELS
                };
```

**Parameters**

| | |
|---|---|
| ADC_CH0 | The voltage being read from the ADC on channel 0 in millivolts (reads the 3.3 V supply on the power supply and the 5 V supply on other modules) |
| ADC_CH1 | The voltage being read from the ADC on channel 1 in millivolts (reads the 24 V supply on the power supply and is not used on other modules) |
| ADC_CH2 | The voltage being read from the ADC on channel 2 in millivolts (reads the current draw on the power supply and not used on other modules) |
| ADC_CH3 | The voltage being read from the ADC on channel 3 in millivolts (reads the ground on the power supply and the 3.3 V supply on other modules) |
| ADC_TEMP | The temperature of the CPU in Celsius * 10. Divide by ten to calculate the degrees in Celsius. |
| ADC_NUM_CHANNELS | The number of ADC channels available |

## COUNT_REQUEST_OPTION

The COUNT_REQUEST_OPTION enumeration is used to select the type of count value to return.

**Enumeration**

```
COUNT_REQUEST_OPTION
                {
                        COUNT_REQUEST_LATEST,
                        COUNT_REQUEST_LATCHED,
                };
```

**Parameters**

| | |
|---|---|
| COUNT_REQUEST_LATEST | The latest count value should be returned |
| COUNT_REQUEST_LATCHED | The last latched count value should be returned |

## ENCODER_TYPES_ENUM

The ENCODER_TYPES_ENUM enumeration is used to store the type of encoder attached to a channel.

**Enumeration**

```
ENCODER_TYPES_ENUM
                {
                        ENCODER_TYPE_NONE,
                        ENCODER_TYPE_LINEAR,
                        ENCODER_TYPE_GAUGE,
                        ENCODER_TYPE_ROTARY
                };
```

**Parameters**

| | |
|---|---|
| ENCODER_TYPE_NONE | Enumeration for unknown or no encoder |
| ENCODER_TYPE_LINEAR | Enumeration for a linear encoder |
| ENCODER_TYPE_GAUGE | Enumeration for a gauge encoder |
| ENCODER_TYPE_ROTARY | Enumeration for a rotary encoder |

## VPP_VOLTAGE_FEEDBACK

The VPP_VOLTAGE_FEEDBACK enumeration is used for the voltage feedback for the A and B signals for a specific encoder. The getDiag method of the Mse1VppModule class fills in the parameter diagVals with an array of doubles. This array can be indexed by this enumeration to access the desired voltage value.

**Enumeration**

```
VPP_VOLTAGE_FEEDBACK
                {
                        VPP_VOLTAGE_SIGNAL_A_MV,
                        VPP_VOLTAGE_SIGNAL_B_MV,
                        VPP_VOLTAGE_NUM
                };
```

**Parameters**

| | |
|---|---|
| VPP_VOLTAGE_SIGNAL_A_MV | The last reading for the signal A voltage in millivolts |
| VPP_VOLTAGE_SIGNAL_B_MV | The last reading for the signal B voltage in millivolts |
| VPP_VOLTAGE_NUM | The number of values in the enumeration |

## INTEGRITY_ENUMS

The INTEGRITY_ENUMS enumeration is used for masking the integrity value to determine which warning or error occured in the module. The getIntegrity method of the MseModule class fills in the parameter integrity with an unsigned long. This value can be masked by this enumeration to determine which warnings or errors have occurred.

**Enumeration**

```
INTEGRITY_ENUMS
                {
                        INTEGRITY_CURRENT_WARNING          = 0x00000001,
                        INTEGRITY_CURRENT_ERROR            = 0x00000002,
                        INTEGRITY_24V_LOW_ERROR            = 0x00000004,
                        INTEGRITY_24V_HIGH_ERROR           = 0x00000008,
                        INTEGRITY_24V_LOW_WARNING          = 0x00000010,
                        INTEGRITY_24V_HIGH_WARNING         = 0x00000020,
                        INTEGRITY_5V_LOW_ERROR             = 0x00000040,
                        INTEGRITY_5V_HIGH_ERROR            = 0x00000080,
                        INTEGRITY_5V_LOW_WARNING           = 0x00000100,
                        INTEGRITY_5V_HIGH_WARNING          = 0x00000200,
                        INTEGRITY_TEMPERATURE_LOW_ERROR    = 0x00000400,
                        INTEGRITY_TEMPERATURE_HIGH_ERROR   = 0x00000800,
                        INTEGRITY_TEMPERATURE_LOW_WARNING  = 0x00001000,
                        INTEGRITY_TEMPERATURE_HIGH_WARNING = 0x00002000,
                        INTEGRITY_FRAM_ERROR               = 0x00004000,
                        INTEGRITY_FRAM_RECOVERED           = 0x00008000
                };
```

**Parameters**

| | |
|---|---|
| INTEGRITY_CURRENT_WARNING | Whether the current has exceeded the warning threshold (only used for the power supply) |
| INTEGRITY_CURRENT_ERROR | Whether the current has exceeded the error threshold (only used for the power supply) |
| INTEGRITY_24V_LOW_ERROR | Whether the 24V supply has exceeded the low error threshold (only used for the power supply) |
| INTEGRITY_24V_HIGH_ERROR | Whether the 24V supply has exceeded the high error threshold (only used for the power supply) |
| INTEGRITY_24V_LOW_WARNING | Whether the 24V supply has exceeded the low warning threshold (only used for the power supply) |
| INTEGRITY_24V_HIGH_WARNING | Whether the 24V supply has exceeded the high warning threshold (only used for the power supply) |
| INTEGRITY_5V_LOW_ERROR | Whether the 5V supply has exceeded the low error threshold (only used for non-power supply modules) |
| INTEGRITY_5V_HIGH_ERROR | Whether the 5V supply has exceeded the high error threshold (only used for non-power supply modules) |
| INTEGRITY_5V_LOW_WARNING | Whether the 5V supply has exceeded the low warning threshold (only used for non-power supply modules) |
| INTEGRITY_5V_HIGH_WARNING | Whether the 5V supply has exceeded the high warning threshold (only used for non-power supply modules) |
| INTEGRITY_TEMPERATURE_LOW_ERROR | Whether the temperature has exceeded the low error threshold (used for all modules) |
| INTEGRITY_TEMPERATURE_HIGH_ERROR | Whether the temperature has exceeded the high error threshold (used for all modules) |
| INTEGRITY_TEMPERATURE_LOW_ WARNING | Whether the temperature has exceeded the low warning threshold (used for all modules) |
| INTEGRITY_TEMPERATURE_HIGH_ WARNING | Whether the temperature has exceeded the high warning threshold (used for all modules) |
| INTEGRITY_FRAM_ERROR | Whether the non-volatile configuration data of the module has failed to be overwritten by the backup data after detection of memory corruption (used for all modules). The module will utilize a default IP address, netmask, and MAC address and will need to be sent back to HEIDENHAIN for reprogramming. |
| INTEGRITY_FRAM_RECOVERED | Whether the non-volatile configuration data of the module has been overwritten by the backup data because of memory corruption (used for all modules) |

## REFERENCE_MARK_ENUM

The REFERENCE_MARK_ENUM enumeration is used for the type of reference mark used by a 1Vpp or TTL encoder.

**Enumeration**

```
REFERENCE_MARK_ENUM
                {
                        REFERENCE_MARK_NONE,
                        REFERENCE_MARK_SINGLE,
                        REFERENCE_MARK_CODED_500,
                        REFERENCE_MARK_CODED_1000,
                        REFERENCE_MARK_CODED_2000,
                        REFERENCE_MARK_CODED_5000
                        REFERENCE_MARK_CODED_ANGULAR
                };
```

**Parameters**

| | |
|---|---|
| REFERENCE_MARK_NONE | No reference mark |
| REFERENCE_MARK_SINGLE | A single reference mark |
| REFERENCE_MARK_CODED_500 | Reference marks at a 500 signal period spacing |
| REFERENCE_MARK_CODED_1000 | Reference marks at a 1000 signal period spacing |
| REFERENCE_MARK_CODED_2000 | Reference marks at a 2000 signal period spacing |
| REFERENCE_MARK_CODED_5000 | Reference marks at a 5000 signal period spacing |
| REFERENCE_MARK_CODED_ANGULAR | Reference marks spaced based on the line count |

## REFERENCE_MARK_STATE

The REFERENCE_MARK_STATE enumeration is used to determine the state of the referencing used by the 1Vpp and TTL encoders.

**Enumeration**

```
REFERENCE_MARK_STATE
                {
                        REFERENCE_MARK_OFF,
                        REFERENCE_MARK_STARTED,
                        REFERENCE_MARK_FIND_FIRST,
                        REFERENCE_MARK_FIND_SECOND,
                        REFERENCE_MARK_FINISHED
                };
```

**Parameters**

| | |
|---|---|
| REFERENCE_MARK_OFF | Not referenced |
| REFERENCE_MARK_STARTED | Referencing has started |
| REFERENCE_MARK_FIND_FIRST | Referencing has found the first reference mark. Only needed for TTL since the G50 does this for the 1Vpp. |
| REFERENCE_MARK_FIND_SECOND | Referencing has found the second reference mark. Only needed for TTL since the G50 does this for the 1Vpp. |
| REFERENCE_MARK_FINISHED | Referencing has finished |

## COUNTER_STATUS

The COUNTER_STATUS enumeration are used to determine the counter status. The getChannelStatus method of the MseDeviceModule class fills in the parameter channelStatus with an unsigned char. This value can be masked by this enumeration to determine the error status. This method is only used to get the channel error status for a EnDat, 1Vpp, or TTL encoder. EnDat encoders should use the getErrors and getWarnings methods and read the counter status for an added check.

**Enumeration**

```
COUNTER_STATUS
                {
                        COUNTER_STATUS_EDGE_DISTANCE_ERROR              = 0x0001,
                        COUNTER_STATUS_AVG_ADDER_OVERFLOW               = 0x0002,
                        COUNTER_STATUS_TOO_MANY_AVERAGE_SAMPLES         = 0x0004,
                        COUNTER_STATUS_TOUCH_PROBE_OVERFLOW             = 0x0008,
                        COUNTER_STATUS_FILTER_SPIKE_DETECTED            = 0x0010,
                        COUNTER_STATUS_AMPLITUDE_MIN_ERROR              = 0x0020,
                        COUNTER_STATUS_AMPLITUDE_MIN_WARNING            = 0x0040,
                        COUNTER_STATUS_AMPLITUDE_MAX_ERROR              = 0x0080
                };
```

**Parameters**

| | |
|---|---|
| COUNTER_STATUS_EDGE_DISTANCE_ERROR | This error occurs when the dg00 and dg90 inputs change simultaneously within one system clock cycle resulting in position errors. This error can be reported on EnDat, 1Vpp, and TTL encoders. |
| COUNTER_STATUS_AVG_ADDER_OVERFLOW | Currently not used |
| COUNTER_STATUS_TOO_MANY_AVERAGE_SAMPLES | Currently not used |
| COUNTER_STATUS_TOUCH_PROBE_OVERFLOW | Currently not used |
| COUNTER_STATUS_FILTER_SPIKE_DETECTED | This error occurs when the filter for the dg00 and dg90 has suppressed input spikes resulting in position errors. This error can be reported on EnDat and 1Vpp encoders. |
| COUNTER_STATUS_AMPLITUDE_MIN_ERROR | The amplitude of the dg00 and dg90 signals are out of range resulting in position errors. This error can be reported on EnDat and 1Vpp encoders. |
| COUNTER_STATUS_AMPLITUDE_MIN_WARNING | The amplitude of the dg00 and dg90 signals are close to being out of range. This error can be reported on EnDat and 1Vpp encoders. |
| COUNTER_STATUS_AMPLITUDE_MAX_ERROR | The amplitude of the dg00 and dg90 signals are out of range resulting in position errors. This error can be reported on EnDat and 1Vpp encoders. |

## MSE_XML_RETURN

The MSE_XML_RETURN enumeration are used for the return values of the MseConfigReader and MseConfigWriter.

**Enumeration**

```
MSE_XML_RETURN
                {
                        MSE_XML_RETURN_OK          = 0,
                        MSE_XML_RETURN_INVALID_TAG,
                        MSE_XML_RETURN_INVALID_FILE,
                        MSE_XML_RETURN_DOM_CREATION_FAILED,
                        MSE_XML_RETURN_DOM_NOT_CREATED,
                        MSE_XML_RETURN_DOM_NULL,
                        MSE_XML_RETURN_DOM_ROOT_ELEMENT_NULL,
                        MSE_XML_RETURN_INVALID_MODULE_CONFIG_TAGNAME,
                        MSE_XML_RETURN_INVALID_MODULE_TAGNAME,
                        MSE_XML_RETURN_INVALID_CHANNEL_TAGNAME,
                        MSE_XML_RETURN_INVALID_MODULE,
                        MSE_XML_RETURN_INVALID_MODULE_LIST,
                        MSE_XML_RETURN_INVALID_CHANNEL,
                        MSE_XML_RETURN_INVALID_CHANNEL_LIST,
                        MSE_XML_RETURN_TAGNAME_NOT_FOUND,
                        MSE_XML_RETURN_DATA_NOT_CHANGED,
                        MSE_XML_RETURN_NULL_POINTER,
                        MSE_XML_RETURN_NUM
                };
```

**Parameters**

| | |
|---|---|
| MSE_XML_RETURN_OK | No error |
| MSE_XML_RETURN_INVALID_TAG | Invalid tag name |
| MSE_XML_RETURN_INVALID_FILE | The ModuleConfig file passed in is not valid |
| MSE_XML_RETURN_DOM_CREATION_FAILED | The DOM parser could not load the file into memory |
| MSE_XML_RETURN_DOM_NOT_CREATED | The DOM parser was never created |
| MSE_XML_RETURN_DOM_NULL | The DOM parser is NULL |
| MSE_XML_RETURN_DOM_ROOT_ELEMENT_NULL | The root element of the DOM parser is NULL |
| MSE_XML_RETURN_INVALID_MODULE_CONFIG_TAGNAME | The ModuleConfig tag name in the ModuleConfig file is invalid |
| MSE_XML_RETURN_INVALID_MODULE_TAGNAME | The tag name requested for the module is invalid |
| MSE_XML_RETURN_INVALID_CHANNEL_TAGNAME | The tag name requested for the channel is invalid |
| MSE_XML_RETURN_INVALID_MODULE | The module requested is invalid |
| MSE_XML_RETURN_INVALID_MODULE_LIST | The module list used for finding elements could not be created |
| MSE_XML_RETURN_INVALID_CHANNEL | The channel requested is invalid |
| MSE_XML_RETURN_INVALID_CHANNEL_LIST | The channel list used for finding elements could not be created |
| MSE_XML_RETURN_TAGNAME_NOT_FOUND | The tag name could not be found |
| MSE_XML_RETURN_NULL_POINTER | A NULL pointer was passed in as a parameter |
| MSE_XML_RETURN_NUM | The number of values in the enumeration |

## MSE_XML_ELEMENTS

The MSE_XML_ELEMENTS enumeration are used for accessing the XML data loaded into memory.

**Enumeration**

```
MSE_XML_ELEMENTS
                {
                        MSE_XML_ELEMENT_BASE_LABEL       = 0,
                        MSE_XML_ELEMENT_SERIAL_NUMBER,
                        MSE_XML_ELEMENT_MODEL,
                        MSE_XML_ELEMENT_LABEL,
                        MSE_XML_ELEMENT_MODEL_ID,
                        MSE_XML_ELEMENT_HARDWARE_ID,
                        MSE_XML_ELEMENT_BL_VERSION,
                        MSE_XML_ELEMENT_FW_VERSION,
                        MSE_XML_ELEMENT_USING_DHCP,
                        MSE_XML_ELEMENT_NETMASK,
                        MSE_XML_ELEMENT_NETMASK_STATIC,
                        MSE_XML_ELEMENT_MAC,
                        MSE_XML_ELEMENT_IP,
                        MSE_XML_ELEMENT_IP_STATIC,
                        MSE_XML_ELEMENT_PORT,
                        MSE_XML_ELEMENT_STATE,
                        MSE_XML_ELEMENT_PRIMARY_EXCITATION_VOLTAGE,
                        MSE_XML_ELEMENT_PRIMARY_EXCITATION_FREQUENCY,
                        MSE_XML_ELEMENT_LAST_MODULE_ENUM,
                        MSE_XML_ELEMENT_CHANNEL_LABEL = 100,
                        MSE_XML_ELEMENT_ERROR_MONITORING,
                        MSE_XML_ELEMENT_POPULATED,
                        MSE_XML_ELEMENT_DEVICE_TYPE,
                        MSE_XML_ELEMENT_ROTARY_FORMAT_TYPE,
                        MSE_XML_ELEMENT_UOM,
                        MSE_XML_ELEMENT_ERROR_COMPENSATION,
                        MSE_XML_ELEMENT_SCALE_FACTOR,
                        MSE_XML_ELEMENT_MASTERING_ENABLED,
                        MSE_XML_ELEMENT_MASTER_DESIRED,
                        MSE_XML_ELEMENT_MASTER_OFFSET,
                        MSE_XML_ELEMENT_MASTER_UOM,
                        MSE_XML_ELEMENT_DISPLAY_RESOLUTION,
                        MSE_XML_ELEMENT_RESOLUTION,
                        MSE_XML_ELEMENT_OFFSET,
                        MSE_XML_ELEMENT_DISTINGUISHABLE_REVOLUTIONS,
                        MSE_XML_ELEMENT_ENCODER_NAME,
                        MSE_XML_ELEMENT_ENCODER_ID,
                        MSE_XML_ELEMENT_ENCODER_SERIAL_NUMBER,
                        MSE_XML_ELEMENT_LINE_COUNT,
                        MSE_XML_ELEMENT_SIGNAL_PERIOD,
                        MSE_XML_ELEMENT_COUNTING_DIRECTION,
                        MSE_XML_ELEMENT_REFERENCE_MARK,
                        MSE_XML_ELEMENT_UNUSED_1,
                        MSE_XML_ELEMENT_INSTRUMENTATION_RANGE_MIN,
                        MSE_XML_ELEMENT_INSTRUMENTATION_RANGE_MAX,
                        MSE_XML_ELEMENT_ACTUAL_RANGE_MIN,
                        MSE_XML_ELEMENT_ACTUAL_RANGE_MAX,
                        MSE_XML_ELEMENT_CALIBRATION_TIMESTAMP,
                        MSE_XML_ELEMENT_RECALIBRATION_TIMER,
                        MSE_XML_ELEMENT_GAIN_CODE,
                        MSE_XML_ELEMENT_INTERPOLATION,
                        MSE_XML_ELEMENT_SIGNAL_TYPE,
                        MSE_XML_ELEMENT_LAST_CHANNEL_ENUM
                };
```

**Parameters**

| | |
|---|---|
| MSE_XML_ELEMENT_BASE_LABEL | The base label |
| MSE_XML_ELEMENT_SERIAL_NUMBER | Used for the Module serial numbers |
| MSE_XML_ELEMENT_MODEL | The model number of the module |
| MSE_XML_ELEMENT_LABEL | The customizable label of the module |
| MSE_XML_ELEMENT_MODEL_ID | The model ID of the module |
| MSE_XML_ELEMENT_HARDWARE_ID | The hardware ID of the module |
| MSE_XML_ELEMENT_BL_VERSION | The bootloader version of the module |
| MSE_XML_ELEMENT_FW_VERSION | The firmware version of the module |
| MSE_XML_ELEMENT_USING_DHCP | Whether the module is using DHCP |
| MSE_XML_ELEMENT_NETMASK | The netmask of the module |
| MSE_XML_ELEMENT_NETMASK_STATIC | The netmask of the module if DHCP cannot be obtained |
| MSE_XML_ELEMENT_MAC | The MAC address of the module |
| MSE_XML_ELEMENT_IP | The IP address of the module |
| MSE_XML_ELEMENT_IP_STATIC | The IP address of the module if DHCP cannot be obtained |
| MSE_XML_ELEMENT_PORT | The port used by the module |
| MSE_XML_ELEMENT_STATE | Whether the module is inactive (0), active (1), or bootloader (2) |
| MSE_XML_ELEMENT_PRIMARY_EXCITATION_VOLTAGE | The primary excitation voltage for an LVDT module |
| MSE_XML_ELEMENT_PRIMARY_EXCITATION_FREQUENCY | The primary excitation frequency for an LVDT module |
| MSE_XML_ELEMENT_LAST_MODULE_ENUM | The last module enumeration is for ease of use when indexing this enumerated list |
| MSE_XML_ELEMENT_CHANNEL_LABEL | The customizable label of the channel |
| MSE_XML_ELEMENT_ERROR_MONITORING | If error monitoring should be performed in the firmware for a specific channel. Currently on supported for EnDat and 1Vpp. |
| MSE_XML_ELEMENT_POPULATED | If the channel has an device connected. Currently only used for EnDat and 1Vpp. |
| MSE_XML_ELEMENT_DEVICE_TYPE | The type of device for a specific channel. The device types are none, Linear, Gauge, and Rotary for EnDat and 1Vpp. |
| MSE_XML_ELEMENT_ROTARY_FORMAT_TYPE | The type of format to show rotary positioning in for a specific channel |
| MSE_XML_ELEMENT_UOM | The unit of measurement to display position data in for a specific channel |
| MSE_XML_ELEMENT_ERROR_COMPENSATION | The multiplier to use for linear error correction for a specific channel |
| MSE_XML_ELEMENT_SCALE_FACTOR | The scale factor to use for a specific channel |
| MSE_XML_ELEMENT_MASTERING_ENABLED | Whether mastering is enabled in the MSEsetup for a specific channel |
| MSE_XML_ELEMENT_MASTER_DESIRED | The desired master position in the MSEsetup for a specific channel |
| MSE_XML_ELEMENT_MASTER_OFFSET | The computed master offset in the MSEsetup for a specific channel |
| MSE_XML_ELEMENT_MASTER_UOM | The unit of measurement used when creating the master offset in the MSEsetup for a specific channel |
| MSE_XML_ELEMENT_DISPLAY_RESOLUTION | The display resolution in the MSEsetup for a specific channel |
| MSE_XML_ELEMENT_RESOLUTION | The resolution for a specific channel. Used for analog and LVDT devices to scale the raw signal value of the device into the desired units. (currently not supported) |
| MSE_XML_ELEMENT_OFFSET | The offset to apply for a specific channel. Used for analog modules. (currently not supported) |
| MSE_XML_ELEMENT_DISTINGUISHABLE_REVOLUTIONS | The number of revolutions for a rotary encoder for a specific channel |
| MSE_XML_ELEMENT_ENCODER_NAME | The name of an EnDat encoder. |
| MSE_XML_ELEMENT_ENCODER_ID | The ID of an EnDat encoder. |
| MSE_XML_ELEMENT_ENCODER_SERIAL_NUMBER | The serial number of an EnDat encoder. |
| MSE_XML_ELEMENT_LINE_COUNT | The line count for a rotary encoder for a specific channel. Used for 1Vpp encoders. |

| | |
|---|---|
| MSE_XML_ELEMENT_SIGNAL_PERIOD | The signal period for a linear encoder for a specific channel. Used for 1Vpp encoders. |
| MSE_XML_ELEMENT_COUNTING_DIRECTION | The direction for the encoder for a specific channel |
| MSE_XML_ELEMENT_REFERENCE_MARK | The reference mark type for the encoder for a specific channel. Used for 1Vpp encoders. |
| MSE_XML_ELEMENT_UNUSED_1 | Unused |
| MSE_XML_ELEMENT_INSTRUMENTATION_RANGE_MIN | The minimum value that a device can utilize normalized to the UOM |
| MSE_XML_ELEMENT_INSTRUMENTATION_RANGE_MAX | The maximum value that a device can utilize normalized to the UOM |
| MSE_XML_ELEMENT_ACTUAL_RANGE_MIN | The minimum value that a device can utilize in raw form (mA or V for Analog module, V for LVDT module) |
| MSE_XML_ELEMENT_ACTUAL_RANGE_MAX | The maximum value that a device can utilize in raw form (mA or V for Analog module, V for LVDT module) |
| MSE_XML_ELEMENT_CALIBRATION_TIMESTAMP | The time that the calibration for an Analog or LVDT channel was performed |
| MSE_XML_ELEMENT_RECALIBRATION_TIMER | The number of hours before a recalibration is needed |
| MSE_XML_ELEMENT_GAIN_CODE | The gain code used for calibrating an LVDT sensor's output value |
| MSE_XML_ELEMENT_INTERPOLATION | The interpolation used for a TTL encoder |
| MSE_XML_ELEMENT_SIGNAL_TYPE | The type of signal that the encoder uses. This will be equal to the enumeration value of SIGNAL_TYPE and can be SIGNAL_TYPE_1VPP or SIGNAL_TYPE_11UAPP and is only used for the 1 Vpp module. |
| MSE_XML_ELEMENT_LAST_CHANNEL_ENUM | The number of values in the enumeration |

## PROGRAMMING_STATE_ENUMS

The PROGRAMMING_STATE_ENUMS enumeration is used for the state of the firmware and bootloader updates. The programming state can be queried while the program() method is running by calling the getProgrammingState() method from another thread.

**Enumeration**

```
PROGRAMMING_STATE_ENUMS
                {
                        PROGRAMMING_STATE_IDLE          = 0,
                        PROGRAMMING_STATE_INITIALIZING,
                        PROGRAMMING_STATE_DOWNLOADING,
                        PROGRAMMING_STATE_REBOOTING,
                        PROGRAMMING_STATE_FINISHED,
                        PROGRAMMING_STATE_FAILED,
                        PROGRAMMING_STATE_COUNT
                };
```

**Parameters**

| | |
|---|---|
| PROGRAMMING_STATE_IDLE | Programming has not been initiated |
| PROGRAMMING_STATE_INITIALIZING | Initializing the programming data |
| PROGRAMMING_STATE_DOWNLOADING | Downloading to the module |
| PROGRAMMING_STATE_REBOOTING | Rebooting the module |
| PROGRAMMING_STATE_FINISHED | Finished programming |
| PROGRAMMING_STATE_FAILED | Failed programming |
| PROGRAMMING_STATE_COUNT | The number of values in the enumeration |

## UdpCmdType

The UdpCmdType enumeration is used internally for communication to a module. A subset of the enumeration is used to determine which asynchronous message was received from a module.

**Enumeration**

```
UdpCmdType
                {
                        UDP_OPEN                = 0,
                        UDP_GET_COUNTS,
                        UDP_SET_OUTPUT,
                        UDP_RESET,
                        UDP_CONFIG_IP,
                        UDP_CONFIG_DHCP,
                        UDP_LOAD_FAIL,
                        UDP_GET_CONFIG,
                        UDP_GET_LEFT,
                        UDP_SET_RIGHT,
                        UDP_MOD_TYPE,
                        UDP_ENDAT_PARAMS,
                        UDP_ENDAT_INFO,
                        UDP_CONFIG_PORTS,
                        UDP_UNUSED_2,
                        UDP_CHANNEL_CONFIG,
                        UDP_CHANNEL_PRESENCE,
                        UDP_UNKNOWN_CMD,
                        UDP_CONNECT,
                        UDP_UNUSED_4,
                        UDP_RELOAD_CODE,
                        UDP_UNUSED_5,
                        UDP_LATCH,
                        UDP_ADC,
                        UDP_FRAM_DATA,
                        UDP_ASYNC,
                        UDP_INTEGRITY,
                        UDP_ANALOG_DIAGS,
                        UDP_INIT_BIN,
                        UDP_LOAD_BIN,
                        UDP_FINISH_BIN,
                        UDP_SET_MODE,
                        UDP_G50_DATA,
                        UDP_CHANNEL_STATUS,
                        UDP_RESTORE_FACTORY,
                        UDP_COUNT
                };
```

**Parameters**

| | |
|---|---|
| UDP_OPEN | Internal use only |
| UDP_GET_COUNTS | Internal use only |
| UDP_SET_OUTPUT | Internal use only |
| UDP_RESET | Internal use only |
| UDP_CONFIG_IP | Internal use only |
| UDP_CONFIG_DHCP | Internal use only |
| UDP_LOAD_FAIL | Internal use only |
| UDP_GET_CONFIG | Internal use only |
| UDP_GET_LEFT | Internal use only |
| UDP_SET_RIGHT | Internal use only |
| UDP_MOD_TYPE | Internal use only |
| UDP_ENDAT_PARAMS | Internal use only |
| UDP_ENDAT_INFO | Internal use only |
| UDP_CONFIG_PORTS | Internal use only |
| UDP_UNUSED_2 | Internal use only |
| UDP_CHANNEL_CONFIG | Internal use only |
| UDP_CHANNEL_PRESENCE | Internal use only |
| UDP_UNKNOWN_CMD | Internal use only |
| UDP_CONNECT | Used by a client to receive asynchronous updates from a module informing of its networking settings |
| UDP_UNUSED_4 | Internal use only |
| UDP_RELOAD_CODE | Internal use only |
| UDP_UNUSED_5 | Internal use only |
| UDP_LATCH | Used by a client to receive asynchronous updates from a module informing of footswitch presses |
| UDP_ADC | Internal use only |
| UDP_FRAM_DATA | Internal use only |
| UDP_ASYNC | Internal use only |
| UDP_INTEGRITY | Used by a client to receive asynchronous updates from a module informing of module warnings and errors |
| UDP_ANALOG_DIAGS | Internal use only |
| UDP_INIT_BIN | Internal use only |
| UDP_LOAD_BIN | Internal use only |
| UDP_FINISH_BIN | Internal use only |
| UDP_SET_MODE | Internal use only |
| UDP_G50_DATA | Internal use only |
| UDP_CHANNEL_STATUS | Used by a client to receive asynchronous updates from a module informing of channel warnings, errors, or referencing completed |
| UDP_RESTORE_FACTORY | Internal use only |
| UDP_COUNT | The number of values in the enumeration |

## LVDT_UOM

The LVDT_UOM enumeration is used for the units of measurement that are allowed for an LVDT sensor.

**Enumeration**

```
LVDT_UOM
                {
                        LVDT_UOM_UNDEFINED = 0,
                        LVDT_UOM_INCHES,
                        LVDT_UOM_MM
                };
```

**Parameters**

| | |
|---|---|
| LVDT_UOM_UNDEFINED | The UOM is undefined |
| LVDT_UOM_INCHES | Inches |
| LVDT_UOM_MM | Millimeters |

## LVDT_UPDATE_CHOICES

The LVDT_UPDATE_CHOICES enumeration is used for choosing the desired voltages to read in the module. This is useful for diagnostic purposes to isolate specific voltages. This enumeration is used by the setDiagnosticsEnabled method.

**Enumeration**

```
LVDT_UPDATE_CHOICES
                {
                        LVDT_UPDATE_GROUP_1 = 0,
                        LVDT_UPDATE_GROUP_2,
                        LVDT_UPDATE_GROUP_3,
                        LVDT_UPDATE_GROUP_4,
                        LVDT_UPDATE_EXCITATION_VOLTAGE,
                        LVDT_UPDATE_CHOICE_ALL
                };
```

**Parameters**

| | |
|---|---|
| LVDT_UPDATE_GROUP_1 | The output voltages for sensors connected to channel 1 and 2 |
| LVDT_UPDATE_GROUP_2 | The output voltages for sensors connected to channel 3 and 4 |
| LVDT_UPDATE_GROUP_3 | The output voltages for sensors connected to channel 5 and 6 |
| LVDT_UPDATE_GROUP_4 | The output voltages for sensors connected to channel 7 and 8 |
| LVDT_UPDATE_EXCITATION_VOLTAGE | The excitation voltage for the primary winding |
| LVDT_UPDATE_CHOICE_ALL | The number of values in the enumeration |

## ANALOG_DIAG_VOLTAGES_ENUM

The ANALOG_DIAG_VOLTAGES_ENUM enumeration is used to index into the voltages read from the getDiagVoltages method.

**Enumeration**

```
ANALOG_DIAG_VOLTAGES_ENUM
                {
                        ANALOG_DIAG_VOLTAGE = 0,
                        ANALOG_DIAG_CURRENT,
                        ANALOG_DIAG_5V_1,
                        ANALOG_DIAG_GROUND,
                        ANALOG_DIAG_5V_2,
                        ANALOG_DIAG_VREF,
                        NUM_ANALOG_DIAG_VOLTAGES
                };
```

**Parameters**

| | |
|---|---|
| ANALOG_DIAG_VOLTAGE | The voltages reading from a channel |
| ANALOG_DIAG_CURRENT | The current reading from a channel |
| ANALOG_DIAG_5V_1 | The 5 volt reading from a channel |
| ANALOG_DIAG_GROUND | The ground reading from a channel |
| ANALOG_DIAG_5V_2 | The second 5 volt reading from a channel |
| ANALOG_DIAG_VREF | The reference voltage reading from a channel |
| NUM_ANALOG_DIAG_VOLTAGES | The number of reading returned for each channel |

## TTL_INTERPOLATION

The TTL_INTERPOLATION enumeration is used to select the type of interpolation to use for a TTL encoder when the setSignalPeriod or setLineCount methods are called.

**Enumeration**

```
TTL_INTERPOLATION
                {
                        TTL_INTERPOLATION_X1 = 1,
                        TTL_INTERPOLATION_X2 = 2,
                        TTL_INTERPOLATION_X5 = 5,
                        TTL_INTERPOLATION_X10 = 10,
                        TTL_INTERPOLATION_X20 = 20,
                        TTL_INTERPOLATION_X25 = 25,
                        TTL_INTERPOLATION_X50 = 50,
                        TTL_INTERPOLATION_X100 = 100,
                        TTL_INTERPOLATION_X200 = 200
                };
```

**Parameters**

| | |
|---|---|
| TTL_INTERPOLATION_X1 | No interpolation is needed |
| TTL_INTERPOLATION_X2 | Uses a 2x multiplier |
| TTL_INTERPOLATION_X5 | Uses a 5x multiplier |
| TTL_INTERPOLATION_X10 | Uses a 10x multiplier |
| TTL_INTERPOLATION_X20 | Uses a 20x multiplier |
| TTL_INTERPOLATION_X25 | Uses  a 25x multiplier |
| TTL_INTERPOLATION_X50 | Uses a 50x multiplier |
| TTL_INTERPOLATION_X100 | Uses a 100x multiplier |
| TTL_INTERPOLATION_X200 | Uses a 200x multiplier |

## SIGNAL_TYPE

The SIGNAL_TYPE enumeration is used to show the type of signal used by an encoder. See the getSignalType, setSignalType, and detectSignalType methods of the 1 Vpp module.

**Enumeration**

```
SIGNAL_TYPE
                {
                        SIGNAL_TYPE_1VPP = 0,
                        SIGNAL_TYPE_11UAPP,
                        SIGNAL_TYPE_TTL,
                        SIGNAL_TYPE_UNKNOWN = 100
                };
```

**Parameters**

| | |
|---|---|
| SIGNAL_TYPE_1VPP | The encoder has a 1 Vpp signal |
| SIGNAL_TYPE_11UAPP | The encoder has a 11 µApp signal |
| SIGNAL_TYPE_TTL | The encoder has a TTL signal. Currently not used. |
| SIGNAL_TYPE_UNKNOWN | The encoder has an unknown signal. |

# 2.6 Classes and structures

## ModuleData

The ModuleData class holds all of the significant information regarding a specific module. This class can be accessed by the getModuleData method of the MseModule class.

**Class**

```
class ModuleData
                {
                        public:
                        MODULE_ID               type;
                        unsigned long           hwId;
                        unsigned char           hwRev;
                        unsigned short          numChannels;
                        bool                    isFirst;
                        bool                    isInputConnected;
                        char                    ipAddress[SIZE_IP_ADDRESS];
                        unsigned short          port;
                        char                    macAddress[SIZE_MAC_ADDRESS];
                        char                    bootloaderVersion[SIZE_BUILD_INFO];
                        char                    firmwareVersion[SIZE_BUILD_INFO];
                        bool                    isUsingDhcp;
                        char                    netmask[SIZE_IP_ADDRESS];
                        char                    ipAddressStatic[SIZE_IP_ADDRESS];
                        char                    netmaskStatic[SIZE_IP_ADDRESS];
                        char                    serialNumber[SIZE_SERIAL_NUMBER];
                        char                    moduleIndex;
                };
```

**Parameters**

| | |
|---|---|
| type | The type of module |
| hwId | The ID of the PCBA for the module |
| hwRev | The revision of the PCBA for the module |
| numChannels | The number of channels in the module |
| isFirst | Whether the module is the first one in the chain |
| isInputConnected | Whether there is input connected (used for ordering after a broadcast) |
| ipAddress | The IP address returned from the module |
| port | The port used by the module |
| macAddress | The MAC address used by the module |
| bootloaderVersion | The bootloader version |
| firmwareVersion | The firmware version |
| isUsingDhcp | Whether or not the module is using DHCP |
| netmask | The netmask of the module that received the UDP_OPEN command |
| ipAddressStatic | The static IP address of the module that received the UDP_OPEN command |
| netmaskStatic | The static netmask of the module that received the UDP_OPEN command |
| serialNumber | The serial number of the module that received the UDP_OPEN command |
| moduleIndex | The module index character of the module that received the UDP_OPEN command |

## DeviceData

The DeviceData structure is used to hold the encoder information returned from an EnDat module. This class can be accessed with the getDeviceData method of the MseEndatModule class.

### Structure

```
struct DeviceData
                {
                        char                    name[DEVICE_NAME_SIZE + 1];
                        char                    id[DEVICE_ID_SIZE + 1];/
                        char                    serialNum[SERIAL_NUMBER_SIZE + 1];
                        bool                    isReversed;
                        bool                    isRotary;
                        unsigned long           resolution;
                        unsigned long           measurementLength;
                        unsigned long           signalPeriod;
                        unsigned short          distinguishableRevolutions;
                        unsigned char           positionBits;
                };
```

### Parameters

| | |
|---|---|
| name | The name returned from the encoder (enough space is allocated to include the terminating character) |
| id | The id returned from the encoder (enough space is allocated to include the terminating character) |
| serialNum | The serial number returned from the encoder (enough space is allocated to include the terminating character) |
| isReversed | Whether positive numerical count data refers to motion in the negative or positive direction. A value of true refers to negative direction as being positive count increments |
| isRotary | Whether the encoder is rotary or linear |
| resolution | The resolution for the encoder (in counts per nanometer for non-rotary and steps per revolution for rotary) |
| measurementLength | The measurement length of the encoder |
| signalPeriod | The signal period of the encoder |
| distinguishableRevolutions | The number of distinguishable revolutions for a multi-turn rotary encoder. Single turn rotary encoders will be 1. |
| positionBits | The number of bits used for calculating the position. Used internally by the MSElibrary. |

## LeftData

The LeftData structure holds all the information returned from the getLeft() command.

**Structure**

```
struct LeftData
                {
                        char                    ipAddress[SIZE_IP_ADDRESS];
                        bool                    isConnectInSet;
                        bool                    isFirstModule;
                        bool                    isLastModule;
                        bool                    isMiddleModule;
                };
```

**Parameters**

| | |
|---|---|
| ipAddress | The IP address of the module |
| isConnectInSet | Whether the module has GPIO input pins set |
| isFirstModule | Whether the module is the first in the line |
| isLastModule | Whether the module is the last in the line |
| isMiddleModule | Whether the module is the middle in the line |

## MSE1000ConnectResponse

The MSE1000ConnectResponse structure holds the MSE Connect response information. This structure is filled in when the response is received for a UDP_OPEN command

**Structure**

```
struct MSE1000ConnectResponse
                {
                        char                    ipAddress[SIZE_IP_ADDRESS];
                        unsigned short          port;
                        bool                    isFirstModule;
                        bool                    isUsingDhcp;
                        char                    macAddress[SIZE_MAC_ADDRESS];
                        char                    netmask[SIZE_IP_ADDRESS];
                        char                    ipAddressStatic[SIZE_IP_ADDRESS];
                        char                    netmaskStatic[SIZE_IP_ADDRESS];
                        char                    serialNumber[SIZE_SERIAL_NUMBER];
                };
```

**Parameters**

| | |
|---|---|
| ipAddress | The IP address of the module that received the UDP_OPEN command |
| port | The UDP port of the module that received the UDP_OPEN command |
| isFirstModule | Whether or not the module is the first one in the MSE module chain |
| isUsingDhcp | Whether or not the module is using DHCP |
| macAddress | The MAC address of the module that received the UDP_OPEN command |
| netmask | The netmask of the module that received the UDP_OPEN command |
| ipAddressStatic | The static IP address of the module that received the UDP_OPEN command |
| netmaskStatic | The static netmask of the module that received the UDP_OPEN command |
| serialNumber | The serial number of the module that received the UDP_OPEN command |

## EncoderInfo

The EncoderInfo structure holds the encoder information for a specific device.

**Structure**

```
struct EncoderInfo
                {
                        ENCODER_TYPES_ENUM      encoderType;
                        UOM                     uom;
                        unsigned long           resolution;
                        bool                    countingDirectionPositive;
                        double                  errorCompensation;
                };
```

**Parameters**

| | |
|---|---|
| encoderType | The type of encoder attached to the channel |
| uom | The unit of measurement for the device |
| resolution | Not used (use the getResolution method instead) |
| countingDirectionPositive | The direction the counts are traversing |
| errorCompensation | The multiplier used to scale the counts returned from the device for error compensation |

# 2.7 Return values

Most methods will return a MseResults data type. The MseResults contains the following methods for getting the return code and additional information from the MseResults data type. Refer to **4.11 MSE_RESPONSE_CODE** for response codes.

The following methods are used only for C++ calls. The C wrappers will return the MSE_RESPONSE_CODE only.

## getCode

The getCode method returns the response code.

**Method**

```
MSE_RESPONSE_CODE getCode();
```

## getMethod

The getMethod method returns the method that failed or the first method called.

**Method**

```
char* getMethod();
```

## getLine

The getLine method returns the line that failed.

**Method**

```
unsigned long getLine();
```

## showRespCode

The showRespCode method is used to return a string representation of the MSE_RESPONSE_CODE enumeration.

**Method**

```
char* showRespCode
                (
                        MSE_RESPONSE_CODE       code
                );
```

**Parameters**

| | |
|---|---|
| code | The MSE_RESPONSE_CODE to stringify |

**Example:**

```
MseResults retVal;
retVal = module->getCounts(counts, module->getNumChannels(), COUNT_REQUEST_LATEST);
if(RESPONSE_OK != retVal.getCode())
{
    std::stringstream ss;
    ss << "Error: " << MseResults:: showRespCode(retVal.getCode())
    cout << ss;
}
```

# 2.8 Constants

## NUM_MSE1000_IO_INPUTS

The NUM_MSE1000_IO_INPUTS constant is the number of inputs on the I/O module.

**Constant**

```
static const unsigned int NUM_MSE1000_IO_INPUTS = 4;
```

## NUM_MSE1000_IO_OUTPUTS

The NUM_MSE1000_IO_OUTPUTS constant is the number of outputs on the I/O module.

**Constant**

```
static const unsigned int NUM_MSE1000_IO_OUTPUTS = 4;
```

## DEVICE_NAME_SIZE

The DEVICE_NAME_SIZE constant is the size of the device name char array returned in the DeviceData structure not including a terminating character.

**Constant**

```
const int DEVICE_NAME_SIZE = 9;
```

## DEVICE_ID_SIZE

The DEVICE_ID_SIZE constant is the size of the device ID char array returned in the DeviceData structure (not counting a terminating character.

**Constant**

```
const int DEVICE_ID_SIZE = 10;
```

## SERIAL_NUMBER_SIZE

The SERIAL_NUMBER_SIZE constant is the size of the encoder serial number char array returned in the DeviceData structure not including a terminating character.

**Constant**

```
const int SERIAL_NUMBER_SIZE = 16;
```

## SIZE_IP_ADDRESS

The SIZE_IP_ADDRESS constant is the size of the IP address string including decimal notation and terminator.

**Constant**

```
const short SIZE_IP_ADDRESS = 18;
```

## SIZE_MAC_ADDRESS

The SIZE_MAC_ADDRESS constant is the size of the MAC address string including colons and terminator.

**Constant**

```
const short SIZE_MAC_ADDRESS = 19;
```

## SIZE_BUILD_INFO

The SIZE_BUILD_INFO constant is the size of the Maximum build info string including terminator.

**Constant**

```
const short SIZE_BUILD_INFO = 32;
```

## SIZE_SERIAL_NUMBER

The SIZE_SERIAL_NUMBER constant is the size of the module serial number (ASCII characters) + 1 byte for the terminator and 2 bytes for the spaces.

**Constant**

```
const short SIZE_SERIAL_NUMBER = 11;
```

## MAX_NUM_MODULES

The MAX_NUM_MODULES constant is the maximum number of modules that can be connected to a MSE.

**Constant**

```
const int MAX_NUM_MODULES = 64;
```

## MAX_CHANNELS_PER_MODULE

The MAX_CHANNELS_PER_MODULE constant is the maximum number of channels that can be connected to each module.

**Constant**

```
const short MAX_CHANNELS_PER_MODULE = 8;
```

## MSE1000_PORT

The MSE1000_PORT constant is the port used by the MSE module for UDP communication.

**Constant**

```
const int MSE1000_PORT = 27015;
```

## MSE1000_CLIENT_DEFAULT_PORT

The MSE1000_CLIENT_DEFAULT_PORT constant is the port used by the client PC for UDP communication. The client PC can use a different port if there is another application installed that is using the same port.

**Constant**

```
const int PC_PORT = 27016;
```

## MSE1000_ASYNC_PORT

The MSE1000_ASYNC_PORT  const is the port used by the MSE to send asynchronous messages.

**Constant**

```
const int MSE1000_ASYNC_PORT = 27300;
```

## NUM_INTEGRITY_RANGES

The number of integrity range values that are returned when requesting the integrity value.

**Constant**

```
const short NUM_INTEGRITY_RANGES = 14;
```

## NUM_LATCH_TYPES

The number of latch types available. The latch types are located in the LATCH_CHOICE enumeration and consist of the 3 software latches and the two footswitches.

**Constant**

```
const unsigned short NUM_LATCH_TYPES = 5;
```

## COUNTS_PER_LINE

The number of counts per each line of an analog rotary encoder

**Constant**

```
const int COUNTS_PER_LINE = 4;
```

## INTERPOLATION_VALUE

There are 12 bits used for interpolation of the analog encoders, which equates to a value of 1024

**Constant**

```
const int INTERPOLATION_VALUE = 1024;
```

## NUM_LVDT_CHANNELS

The NUM_LVDT_CHANNELS constant is the maximum number of channels available for an LVDT module.

**Constant**

```
const int NUM_LVDT_CHANNELS = 8;
```

## LVDT_EXCITATION_VOLTAGE_MIN_VPP

The LVDT_EXCITATION_VOLTAGE_MIN_VPP constant is the minimum voltage allowed for the setExcitationVoltage method.

**Constant**

```
const double LVDT_EXCITATION_VOLTAGE_MIN_VPP  = 1.5;
```

## LVDT_EXCITATION_VOLTAGE_MAX_VPP

The LVDT_EXCITATION_VOLTAGE_MAX_VPP constant is the maximum voltage allowed for the setExcitationVoltage method.

**Constant**

```
const double LVDT_EXCITATION_VOLTAGE_MAX_VPP  = 5.5;
```

## LVDT_EXCITATION_FREQUENCY_MIN_KHZ

The LVDT_EXCITATION_FREQUENCY_MIN_KHZ constant is the minimum frequency allowed for the setExcitationFrequency method.

**Constant**

```
const double LVDT_EXCITATION_FREQUENCY_MIN_KHZ  = 3.0;
```

## LVDT_EXCITATION_FREQUENCY_MAX_KHZ

The LVDT_EXCITATION_FREQUENCY_MAX_KHZ constant is the maximum frequency allowed for the setExcitationFrequency method.

**Constant**

```
const double LVDT_EXCITATION_FREQUENCY_MAX_KHZ  = 50.0;
```

## NUM_MSE1000_ANALOG_CHANNELS

The NUM_MSE1000_ANALOG_CHANNELS constant is the maximum number of channels available for an analog module.

**Constant**

```
const int NUM_MSE1000_ANALOG_CHANNELS= 2;
```

## NUM_MSE1000_ANALOG_VALUES_PER_CHANNEL

The NUM_MSE1000_ANALOG_VALUES_PER_CHANNEL constant is the number of data values returned for each channel of the analog module.

**Constant**

```
const int NUM_MSE1000_ANALOG_VALUES_PER_CHANNEL = 2;
```

## MAX_NUM_ANALOG_AVG_SAMPLES

The MAX_NUM_ANALOG_AVG_SAMPLES constant is the maximum number of samples that can be used when computing the average voltage and current in the analog module.

**Constant**

```
const int MAX_NUM_ANALOG_AVG_SAMPLES = 100;
```

# 2.9 Interface methods

The interface methods are available for C++ only. Users of the C wrappers must create their own module chain by creating instances of the modules and initializing them.

## MseInterface

**Constructor**

```
MseInterface();
```

## addModule

The addModule method will create an instance of a new module of the type requested. The module IP must be passed in because each module in the MSE has a different IP address. The new module will be added to the end of the moduleChain_.

**Method**

```
MseResults addModule
                (
                        const MODULE_ID         moduleType,
                        const char*             moduleIp,
                        bool                    useAsync
                );
```

**Parameters**

| | |
|---|---|
| moduleType | The type of module to create |
| moduleIp | The IP address of the module to connect to |
| useAsync | True if the MSE should send asynchronous messages to the MSE1000_ASYNC_PORT |

**Return value**

The return value delivers a status for the method call.

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

## removeConnections

The removeConnections method empties the UDP client list used internally by the MSE library.

**Method**

```
void removeConnections();
```

## createChain

The createChain method will perform a broadcast and wait for all of the responses from all of the modules. It will then create an instance of a MseModule for each response and add it to the moduleChain_ array. The modules will then be re-ordered based on their location in the chain. The modules can then be retrieved with the getModule(), getEndatModule(), getIoModule(), get1VppModule(), or getPneumaticModule() methods. This method may take up to two minutes to complete based on the number of modules in the chain and whether DHCP is enabled or not.

**Method**

```
MseResults createChain
                (
                        const char*             clientIp,
                        unsigned short          clientPort,
                        bool                    useAsync,
                        const char*             broadcastNetmask
                );
```

**Parameters**

| | |
|---|---|
| clientIp | The IP address for the MSE to respond to for broadcast requests. |
| clientPort | The port for the MSE to respond to for broadcast requests. |
| useAsync | True if the MSE should send asynchronous messages to the MSE1000_ASYNC_PORT |
| broadcastNetmask | The netmask to use to create the broadcast address. |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether createChain was successful. |

## getChainCreationState

The getChainCreationState method is used to get the state of the chain creation initiated by the createChain method. The state represents whether the chain creation is currently idle, broadcasting, ordering the chain, finished, or if it had an error. The error can be determined by the response code of the createChain method.

**Method**

```
MSE_CHAIN_CREATION_STATE getChainCreationState();
```

**Return value**

The return value delivers a MSE_CHAIN_CREATION_STATE enumeration representing the state of the chain creation.

## getNumModules

The getNumModules method is used to get the number of modules in the chain.

**Method**

```
unsigned short getNumModules();
```

**Return value**

The return value delivers an unsigned short representing the number of modules in the chain.

## getModule

The getModule method will return the requested module as a base MseModule. It is up to the caller to downcast the module based on the type if needed. This method allows flexibility in that it can be called for any module and the logic can be performed by the client code.

```
MseModule* getModule
                (
                        const unsigned short    moduleNumber
                );
```

**Return value**

The return value delivers a pointer to the MseModule. A NULL pointer will be returned if the module is not in the chain.

## getDeviceModule

The getDeviceModule method will return the requested module as a base MseDeviceModule. This method should be used if the complexity in downcasting from getModule() is unnecessary. If the module requested is not of type MseDeviceModule, a NULL pointer will be returned.

**Method**

```
MseDeviceModule* getDeviceModule
                 (
                        const unsigned short   moduleNumber
                 );
```

**Return value**

The return value delivers a pointer to a MseDeviceModule. A NULL pointer will be returned if the module is not in the chain.

## getEndatModule

The getEndatModule method will return the requested module as a MseEndatModule. This method should be used if the complexity in downcasting from getModule() is unnecessary. If the module requested is not of type MseEndatModule, a NULL pointer will be returned.

**Method**

```
MseEndatModule* getEndatModule
                (
                       const unsigned short   moduleNumber
                );
```

**Return value**

The return value delivers a pointer to a MseEndatModule. A NULL pointer will be returned if the module is not in the chain or if the module requested is not a MseEndatModule.

## getIoModule

The getIoModule method will return the requested module as a MseIoModule. This method should be used if the complexity in downcasting from getModule() is unnecessary. If the module requested is not of type MseIoModule, a NULL pointer will be returned.

**Method**

```
MseIoModule* getIoModule
             (
                    const unsigned short   moduleNumber
             );
```

**Return value**

The return value delivers a pointer to a MseIoModule. A NULL pointer will be returned if the module is not in the chain or if the module requested is not a MseIoModule.

## get1VppModule

The get1VppModule method will return the requested module as a Mse1VppModule. This method should be used if the complexity in downcasting from getModule() is unnecessary. If the module requested is not of type Mse1VppModule, a NULL pointer will be returned.

**Method**

```
Mse1VppModule* get1VppModule
               (
                      const unsigned short   moduleNumber
               );
```

**Return value**

The return value delivers a pointer to a Mse1VppModule. A NULL pointer will be returned if the module is not in the chain or if the module requested is not a Mse1VppModule.

## getPneumaticModule

The getPneumaticModule method will return the requested module as a MsePneumaticModule. This method should be used if the complexity in downcasting from getModule() is unnecessary. If the module requested is not of type MsePneumaticModule, a NULL pointer will be returned.

**Method**

```
MsePneumaticModule* getPneumaticModule
                (
                        const unsigned short    moduleNumber
                );
```

**Return value**

The return value delivers a pointer to a MsePneumaticModule. A NULL pointer will be returned if the module is not in the chain or if the module requested is not a MsePneumaticModule.

## getAnalogModule

The getAnalogModule method will return the requested module as a MseAnalogModule. This method should be used if the complexity in downcasting from getModule() is unnecessary. If the module requested is not of type MseAnalogModule, a NULL pointer will be returned.

**Method**

```
MseAnalogModule* getAnalogModule
                (
                        const unsigned short    moduleNumber
                );
```

**Return value**

The return value delivers a pointer to a MseAnalogModule. A NULL pointer will be returned if the module is not in the chain or if the module requested is not a MseAnalogModule.

## getLvdtModule

The getLvdtModule method will return the requested module as a MseLvdtModule. This method should be used if the complexity in downcasting from getModule() is unnecessary. If the module requested is not of type MseLvdtModule, a NULL pointer will be returned.

**Method**

```
MseLvdtModule* getLvdtModule
                (
                        const unsigned short    moduleNumber
                );
```

**Return value**

The return value delivers a pointer to a MseLvdtModule. A NULL pointer will be returned if the module is not in the chain or if the module requested is not a MseLvdtModule.

## getTtlModule

The getTtlModule method will return the requested module as a MseTtlModule. This method should be used if the complexity in downcasting from getModule() is unnecessary. If the module requested is not of type MseTtlModule, a NULL pointer will be returned.

**Method**

```
MseTtlModule* getTtlModule
                (
                        const unsigned short moduleNumber
                );
```

**Return value**

The return value delivers a pointer to a MseTtlModule. A NULL pointer will be returned if the module is not in the chain or if the module requested is not a MseTtlModule.

# 2.10 General methods and functions

The general methods and functions are provided for common functionality across all module types. The C++ methods and the C functions are separated into two sections for easier lookup.

## C++ methods

### MseModule

The MseModule constructor instantiates and initializes a ModuleData structure and instantiates a MseProgramming object for programming the modules.

**Constructor**

```
MseModule
                (
                        void
                );
```

### initializeModule

The initializeModule method will configure the UDP messaging and fill in the moduleData_ structure with all the information known from the module and it's devices. The moduleData_ is the private object representing the ModuleData class.

**Method**

```
virtual MseResults initializeModule
                (
                        const char*             mseIpAddress
                        bool                    useAsync
                );
```

**Parameters**

| | |
|---|---|
| mseIpAddress | The MSE Ip address |
| useAsync | True if the MSE should send asynchronous messages to the MSE1000_ASYNC_PORT |

**Return value**

The return value delivers a response code representing whether the initialization information was retrieved correctly.

### initializeFirmware

The initializeFirmware method will open a connection for use in communicating to a module that is running out of the bootloader. It differs from initializeModule in that it does not try to initialize module data because the information cannot be obtained unless the firmware is loaded.

**Method**

```
virtual MseResults initializeFirmware
                (
                        const char*             mseIpAddress
                );
```

**Parameters**

| | |
|---|---|
| mseIpAddress | The MSE Ip address |

**Return value**

The return value delivers a response code representing whether the initialization of the firmware succeeded.

### getModuleType

The getModuleType method returns the module type information. This information is requested from the MSE and contains the module type and number of axes on the module.

**Method**

```
MseResults getModuleType
                (
                        MODULE_ID*              moduleType,
                        unsigned long*          hwId,
                        unsigned char*          hwRev,
                        unsigned short*         numAxes
                );
```

**Parameters**

| | |
|---|---|
| moduleType | The type of module |
| hwId | The hardware ID of the PCBA |
| hwRev | The revision of the PCBA |
| numAxes | The number of axes |

**Return value**

The return value delivers a response code representing whether the getModuleType command was sent.

### getConfig

The getConfig method gets the configuration of the MSE. The configuration information consists of the IP address, input connection status, bootloader version, and firmware version. The bootloader and firmware versions are also stored in the moduleData_ structure.

**Method**

```
MseResults getConfig
                (
                        char*                   ipAddress,
                        bool*                   isInputConnected,
                        char*                   blVersion,
                        char*                   fwVersion
                );
```

**Parameters**

| | |
|---|---|
| ipAddress | The IP address of the module |
| isInputConnected | Whether the input is connected |
| blVersion | The bootloader version of the module |
| fwVersion | The firmware version of the module |

**Return value**

The return value delivers a response code representing whether the config was read correctly.

**getNumChannels**

The getNumChannels method returns the number of channels in the module.

**Method**

```
unsigned short getNumChannels();
```

**Return value**

The return value delivers an unsigned char representing the number of channels.

**getModuleData**

The getModuleData method returns the ModuleData information. The ModuleData information is filled in when the initializeModule method is called.

**Method**

```
ModuleData getModuleData();
```

**Return value**

| | |
|---|---|
| ModuleData | A structure containing the module data information. |

**getLeft**

The getLeft method is used to get the module location settings. The MSE may have multiple modules connected together and this command can help determine the location of current one.

**Method**

```
MseResults getLeft
                (
                      LeftData*              leftData
                );
```

**Parameters**

| | |
|---|---|
| leftData | The LeftData structure that is filled in with the values returned from the MSE. |

**Return value**

The return value delivers a response code representing whether the getLeft command was sent.

**getCounts**

The getCounts method returns the counts of the measurement devices. If the option is set to COUNT_REQUEST_LATCHED, the module will clear the latch after the position is read to allow for faster subsequent latching. This method should only be used for 1Vpp and EnDat modules.

**Method**

```
MseResults getCounts
                (
                        unsigned long*          counts,
                        unsigned short          numChannels,
                        COUNT_REQUEST_OPTION    option
                );
```

**Parameters**

| | |
|---|---|
| counts | The counts returned from the devices |
| numChannels | The number of channels to read into the counts parameter |
| option | Whether to retrieve live or latched counts |

**Return value**

The return value delivers a response code representing whether the getCounts was retrieved correctly.

**setRotaryFormat**

The setRotaryFormat method is used to set the rotary format that will be applied to the position calculated from the counts in the derived class's getPositions method. This method is used by the EnDat, 1Vpp and TTL modules.

**Method**

```
void setRotaryFormat
                (
                        const unsigned short&   channel,
                        const ROTARY_FORMAT&    format
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel of the encoder to apply the rotary format to |
| format | The ROTARY_FORMAT to apply |

**getRotaryFormat**

The getRotaryFormat method is used to return the rotary format that will be applied to the position calculated from the counts in the derived class's getPositions method. This method is used by the EnDat, 1Vpp and TTL modules.

**Method**

```
ROTARY_FORMAT getRotaryFormat
                (
                        const unsigned short&   channel
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel of the encoder that the rotary format will be applied to |

**Return value**

| | |
|---|---|
| ROTARY_FORMAT | The rotary format that will be applied to the position |

**setDeviceOffset**

The setDeviceOffset method is used to set an offset that will be applied to the position calculated from the counts in the derived class's getPositions method. The offset is useful for applying a master position for an encoder. The offset is applied before the rotary formatting and is in the user units set for the channel. This method is used by the EnDat, 1Vpp, TTL, Analog, and LVDT modules.

**Method**

```
void setDeviceOffset
                (
                        const unsigned short&   channel,
                        const double&           offset
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel of the device to apply the offset to |
| offset | The offset to apply |

**getDeviceOffset**

The getDeviceOffset method is used to return the offset that will be applied to the position calculated from the counts in the derived class's getPositions method. This method is used by the EnDat, 1Vpp, TTL, Analog, and LVDT modules.

**Method**

```
double getDeviceOffset
                (
                        const unsigned short&   channel
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel of the encoder that the offset will be applied to |

**Return value**

| | |
|---|---|
| double | The offset that will be applied to the position |

**setRight**

The setRight method is used to set the input of the next module for use in ordering the module chain and allowing for modules to wait until the communication line is ready during DHCP requests.

**Method**

```
MseResults setRight
                (
                        const bool              setConnectOut
                );
```

**Parameters**

| | |
|---|---|
| setConnectOut | A value of true sets the output pin high, false sets it low. Setting the pin high allows the next module to communicate over the network during DHCP discovery and is useful when determining the ordering of the modules. |

**Return value**

The return value delivers a response code representing whether the setRight command was sent.

**resetMse1000**

The resetMse1000 method sends a reset request to the MSE.

**Method**

```
MseResults resetMse1000();
```

**Return value**

The return value delivers a response code representing whether the reset command was sent.

**program**

The program method programs the module with the selected file and then waits for the reboot to finish. The modules must not be in DHCP mode when programming because the IP address must be constant for the entire programming process.

Programming the MSEfirmware with a version > 1.0.2 requires that the MSEbootloader be at least version 1.0.2. The MSEbootloader and MSEfirmware cannot be programmed to a version prior to version 1.0.3 once they are version 1.0.3 or greater. The versioning incompatibility is due to improvements in configuration data robustness.

**Method**

```
MseResults program
                (
                        const char*             filename,
                        bool                    isBootloader
                );
```

**Parameters**

| | |
|---|---|
| filename | The file to program into the firmware |
| bool isBootloader | True if the file to program is the bootloader, otherwise false |

**Return value**

The return value delivers a response code representing whether the programming completed.

**getProgrammingState**

The getProgrammingState method returns the programming state. This method exists as a convenience for users of this library.

**Method**

```
PROGRAMMING_STATE_ENUMS getProgrammingState();
```

**Return value**

The return value delivers a PROGRAMMING_STATE_ENUMS containing the programming state.

**getProgrammingPercentComplete**

The getProgrammingPercentComplete method returns the percent complete of the programming.The percent complete is updated during the PROGRAMMING_STATE_DOWNLOADING state.

**Method**

```
double getProgrammingPercentComplete();
```

**Return value**

The return value delivers a double containing the percent complete.

**showModuleType**

The showModuleType method is used to return a string representation of the type based on the MODULE_ID enumeration.

**Method**

```
static char* showModuleType
                (
                        MODULE_ID               type
                );
```

**Parameters**

| | |
|---|---|
| type | The MODULE_ID to stringify |

**Return value**

| | |
|---|---|
| string | The string type representation of the MODULE_ID |

**showModuleId**

The showModuleId method is used to return a string representation of the ID based on the MODULE_ID enumeration

**Method**

```
static char* showModuleId
                (
                        MODULE_ID               type
                );
```

**Parameters**

| | |
|---|---|
| type | The MODULE_ID to stringify |

**Return value**

| | |
|---|---|
| string | The string ID representation of the MODULE_ID |

**setIp**

The setIp method sets the IP address of the module. This method also validates the strings passed in for errors.

**Method**

```
MseResults setIp
                (
                        const char*             address,
                        const char*             netmask
                );
```

**Parameters**

| | |
|---|---|
| address | The IP address to set the module to |
| netmask | The netmask to set the module to |

**Return value**

The return value delivers a response code representing whether the IP was set correctly.

**setAsyncPort**

The setAsyncPort method sets the UDP asynchronous port that the module will send broadcast, error, latching, and referencing commands to.

**Method**

```
MseResults setAsyncPort
                (
                        const unsigned short*   asynchronousPort
                );
```

**Parameters**

| | |
|---|---|
| asynchronousPort | The port for the asynchronous communication. The UDP port must be between 1024 and 49151 (registered ports). |

**Return value**

The return value delivers a response code representing whether the command was successful.

**getAsyncPort**

The getAsyncPort method gets the UDP asynchronous port that the module will send broadcast, error, latching, and referencing commands to.

**Method**

```
MseResults getAsyncPort
                (
                        unsigned short*         asynchronousPort
                );
```

**Parameters**

| | |
|---|---|
| asynchronousPort | A pointer to an unsigned short that will be filled in with the port for the asynchronous communication |

**Return value**

The return value delivers a response code representing whether the command was successful.

**setDhcp**

The setDhcp method sets whether or not to use DHCP.

**Method**

```
MseResults setDhcp
                (
                        unsigned char           choice
                );
```

**Parameters**

| | |
|---|---|
| choice | A value of 0 will disable DHCP, 1 will enable it |

**Return value**

The return value delivers a response code representing whether the setDhcp was set correctly.

**broadcastOpenConnection**

The broadcastOpenConnection method sends a broadcast message to open a connection to the MSE 1000 module. The modules will all send back responses containing their IP address and other data in the form of a MSE1000ConnectResponse. The total number of responses is also returned. The setBroadcastingNetmask method can be used to set the type of broadcast to perform. The modules will not be ordered.

**Method**

```
MseResults broadcastOpenConnection
                (
                        const char*             clientIpAddress,
                        const unsigned short*   port,
                        MSE1000ConnectResponse* connResponses,
                        unsigned short*         numResponses
                );
```

**Parameters**

| | |
|---|---|
| clientIpAddress | The IP address of the sender. This is needed in order to bind a socket for the modules to send responses to. |
| port | The UDP port of the sender needed for the bind |
| connResponses | The responses to the broadcast. This must be an array of MSE1000ConnectResponses that is large enough to hold MAX_NUM_MODULES of responses. |
| numResponses | The number of modules that responded to the broadcast |

**setBroadcastingNetmask**

The setBroadcastingNetmask method sets the netmask used during broadcasting. A netmask of "255.255.255.255" should be used for a limited broadcast. A netmask of "255.255.255.0", "255.255.0.0", or "255.0.0.0" should be used for a directed broadcast. A limited broadcast is limited to a single LAN and is received by all clients connected to that LAN. A directed broadcast will be sent to all clients on a specific subnet.

**Method**

```
void setBroadcastingNetmask
                (
                        const char*             netmask
                );
```

**Parameters**

| | |
|---|---|
| netmask | A char* in the form 255.255.255.0 that will be used for determining the broadcasting address. A value of 255.255.255.255 will be used as the default. |

**restoreFactoryDefaults**

The restoreFactoryDefaults method sends a broadcast to all modules that will reset the static IP address to 172.31.46.2 for power supplies and 172.31.46.1 for all other modules. The modules will be set to DHCP addressing and if a DHCP server is not present, each module will change back to static after a 1 minute timeout. The asynchronous port will be set to MSE1000_ASYNC_PORT.

**Method**

```
void restoreFactoryDefaults
                (
                );
```

**setUdpTimeout**

The setUdpTimeout method sets the UDP timeout that is used when waiting for a response from a module. The setUdpTimeout method can be set from 50 ms to 10000 ms. The default is 800ms in order to handle the validation and backup of the FRAM and FLASH memory during programming and setting of the IP address. Very large values are only useful for debugging purposes. Values below the default may not allow enough time for the microcontroller to respond.

**Method**

```
void setUdpTimeout
                (
                        long                    timeoutMs
                );
```

**Parameters**

| | |
|---|---|
| timeoutMs | The timeout to wait for a UDP response in milliseconds |

**getUdpTimeout**

The getUdpTimeout method gets the UDP timeout in milliseconds that is used when waiting for a response from a module.

**Method**

```
long getUdpTimeout
                (
                );
```

**Return value**

| | |
|---|---|
| long | The UDP timeout in milliseconds that is used when waiting for a response from a module |

**setUdpNumRetries**

The setUdpNumRetries method sets the number of retries to use if a timeout occurs. The default is 0 and it can be set to as high as 10. The number of retries should be set to 0 before performing critical command such as programming since definite results are needed to proceed.

**Method**

```
void setUdpNumRetries
                (
                        short                   numRetries
                );
```

**Parameters**

| | |
|---|---|
| numRetries | The number of retries |

**getUdpNumRetries**

The getUdpNumRetries method gets the number of retries to use if a timeout occurs.

**Method**

```
short getUdpNumRetries
                (
                );
```

**Return value**

| | |
|---|---|
| short | The number of retries to use if a timeout occurs |

**setNetworkDelay**

The setNetworkDelay method sets the delay in milliseconds to use before each UDP message is sent to the module. This is useful in case the module's network stack cannot handle the throughput. Large module chains may need to increase the value since there is latency in reception of the messages later in the chain.

**Method**

```
void setNetworkDelay
                (
                        short                   networkDelayMs
                );
```

**Parameters**

| | |
|---|---|
| networkDelayMs | The number of milliseconds to delay. The value can be from 1 to 1000. The default is 1. |

**getNetworkDelay**

The getNetworkDelay method sets the delay in milliseconds to use before each UDP message is sent to the module.

**Method**

```
short getNetworkDelay
                (
                );
```

**Return value**

| | |
|---|---|
| short | The network delay in milliseconds to use before each UDP message is sent to the module |

**setLatch**

The setLatch method is used to latch or unlatch channel data in the MSE.

**Method**

```
MseResults setLatch
                (
                        const LATCH_OPTIONS     latchOption,
                        const LATCH_CHOICE      latchChoice
                );
```

**Parameters**

| | |
|---|---|
| latchOption | The LATCH_OPTIONS to choose |
| latchChoice | The enumerated latch number to select for setting or resetting |

**getLatch**

The getLatch method is used to get the status of the latches in the MSE 1000. An active latch will inform the client that latched data is available or can be used as a signal. The latch is cleared when the data is read or the setLatch LATCH_COUNT_RESET, LATCH_CHOICE_ALL method is called.

**Method**

```
MseResults getLatch
                (
                        unsigned char*          latchState,
                        const unsigned short    size
                );
```

**Parameters**

| | |
|---|---|
| latchState | An array that will hold the status of the latch states. Will store a 1 if the corresponding latch is set, otherwise 0. |
| size | The size of the latchState array passed in. Must be large enough to store all 5 latches. |

**getAdcValues**

The getAdcValues method is used to get the ADC (Analog to digital conversion) values from the module.
The ADC values are used to get a digital representation of voltages and temperatures used in the module.

**Method**

```
MseResults getAdcValues
                (
                        short*                  adcVals,
                        const unsigned short    length
                );
```

**Parameters**

| | |
|---|---|
| adcVals | The address where the ADC values will be returned |
| length | The length of the adcVals array passed in (must be at least ADC_NUM_CHANNELS shorts to store the entire response |

**getIntegrity**

The getIntegrity method is used to get the system integrity values from the module. The values are returned masked in an unsigned long. The INTEGRITY_ENUMS enumeration can be used to see what integrity value is currently out of specification. The ranges array stores the warning and error ranges in the following order: Current warning, current error, 24V min error, 24V max error, 24V min warning, 24V max warning, 5V min error, 5V max error, 5V min warning, 5V max warning, temperature min error, temperature max error, temperature min warning, temperature max warning.

**Method**

```
MseResults getIntegrity
                (
                        unsigned long*          integrity,
                        double*                 ranges,
                        unsigned short          numRanges
                );
```

**Parameters**

| | |
|---|---|
| integrity | The address where the integrity masked values values will be stored |
| ranges | A pointer to an array of doubles to store the ranges for the integrity checks |
| numRanges | The size of the ranges array passed in (must hold at least NUM_INTEGRITY_RANGES doubles |

**setAsyncMode**

The setAsyncMode method is used to set the asynchronous mode of the module. Setting to asynchronous will allow for logging,
footswitch updates, triggering updates, and EnDat encoder warning and error updates. Asynchronous updates will be sent to the
MSE1000_ASYNC_PORT of the IP address that requested this method.

**Method**

```
MseResults setAsyncMode
                (
                        bool useAsync
                );
```

**Parameters**

| | |
|---|---|
| useAsync | True to enable asynchronous updates, false to disable |

**clearAllErrors**

The clearAllErrors method is used to clear the systemIntegrity as well as the encoder warnings and errors. If warnings or errors still persist, they will be immediately set again.

**Method**

```
MseResults clearAllErrors
                (
                );
```

**clearIntegrityErrors**

The clearIntegrityErrors method is used to clear the module system integrity warnings and errors. If warnings or errors still persist, they will be immediately set again.

**Method**

```
MseResults clearIntegrityErrors
                (
                );
```

**enableDiags**

The enableDiags method is used to set the diagnostics mode. The diagnostics mode affects the throughput of the data since diagnostics will be performed while the counts are being updated.

**Method**

```
MseResults enableDiags
                (
                        const DIAG_MODE_OPTIONS choice
                );
```

**Parameters**

| | | |
|---|---|---|
| choice | DIAG_MODE_FULL | Enables function reserves (for Endat), errors and warnings (for EnDat), control register status (EnDat, 1Vpp and TTL), and system integrity (all modules) |
| | DIAG_MODE_STATUS | Enables errors and warnings (for EnDat), control register status ( EnDat, 1Vpp and TTL), and system integrity (all modules) |
| | DIAG_MODE_MINIMAL | Enables system integrity (all modules) |
| | DIAG_MODE_NONE | Will not monitor anything |

**getLibraryVersion**

The getLibraryVersion method is used to return the version of the library as a string.

**Method**

```
static char* getLibraryVersion
                (
                );
```

## C Functions

The common C functions can be found in the MseModuleWrapper.h file.

### MseModuleCreate

Creates a MseModule object and returns a pointer to it.

**Function**

```
MseModulePtr MseModuleCreate
                (
                );
```

**Return value**

The return value delivers a pointer to the MseModule object that was created.

### MseModuleDelete

Deletes the MseModule object that was passed in.

**Function**

```
void MseModuleDelete
                (
                        MseModulePtr            object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |

### MseModuleInitialize

Initializes the MseModule object that was passed in.

**Function**

```
MSE_RESPONSE_CODE MseModuleInitialize
                (
                        MseModulePtr            object,
                        char*                   mseIpAddress,
                        bool                    useAsync
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| mseIpAddress | The IP address of the module to initialize |
| useAsync | Whether to enable asynchronous communication from the module |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetLibraryVersion**

Gets the version of the MSElibrary.

**Function**

```
void MseModuleGetLibraryVersion
                (
                        char*                   version,
                );
```

**Parameters**

| | |
|---|---|
| version | A pointer to the location where the MSElibrary version will be copied to |

**MseModuleGetModuleType**

Gets the module type.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetModuleType
                (
                        MseModulePtr            object,
                        MODULE_ID*              moduleType
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| moduleType | A pointer to the location where the module type will be copied to |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetModuleErrorState**

Gets the error state of the module. A value of True signifies that there is an error.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetModuleErrorState
                (
                        MseModulePtr            object,
                        bool*                   errorState
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| errorState | A pointer to the location where the error state will be copied to. A subsequent call to MseModuleGetModuleErrors can be made to get the actual errors. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetModuleErrors**

Gets the actual module errors.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetModuleErrors
                (
                      MseModulePtr          object,
                      long*                 errors,
                      double*               ranges,
                      short                 size
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| errors | A pointer to the location where the errors will be copied to. The errors is a single long that can be masked with the INTEGRITY_ENUMS to determine which error has occurred. |
| ranges | A pointer to the location where the ranges used to determine an error will be copied to. The ranges is an array that must be large enough to hold NUM_INTEGRITY_RANGES. |
| size | The size of the ranges array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetAdcValues**

Gets the voltage and temperature values for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetAdcValues
                (
                      MseModulePtr          object,
                      short*                adcValues,
                      short                 size
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| adcValues | A pointer to the location where the voltage and temperature values will be copied to. The adcValues is an array that must be large enough to hold ADC_NUM_CHANNELS. The array can be indexed using the ADC_OPTIONS enumeration. |
| size | The size of the adcValues array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleClearErrors**

Clears the module errors and warnings.

**Function**

```
MSE_RESPONSE_CODE MseModuleClearErrors
                  (
                        MseModulePtr            object
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleSetIpAddress**

Sets the static IP address and netmask for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleSetIpAddress
                  (
                        MseModulePtr            object,
                        char*                   ipAddress,
                        char*                   netmask
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| ipAddress | The IP address to set |
| netmask | The netmask to set |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetIpAddress**

Gets the currently used IP address for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetIpAddress
                  (
                        MseModulePtr            object,
                        char*                   ipAddress
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| ipAddress | A pointer to the location where the IP address will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetIpStaticAddress**

Gets the static IP address for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetIpStaticAddress
                  (
                        MseModulePtr            object,
                        char*                   ipAddress
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| ipAddress | A pointer to the location where the static IP address will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetNetmask**

Gets the currently used netmask for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetNetmask
                  (
                        MseModulePtr            object,
                        char*                   netmask
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| ipAddress | A pointer to the location where the netmask will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetNetmaskStatic**

Gets the static netmask for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetNetmaskStatic
                  (
                        MseModulePtr            object,
                        char*                   netmask
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| ipAddress | A pointer to the location where the static netmask will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetPort**

Gets the UDP port for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetPort
                (
                        MseModulePtr            object,
                        short*                  port
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| ipAddress | A pointer to the location where the UDP port will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleSetAsyncPort**

Sets the UDP asynchronous port that the module will send broadcast, error, latching, and referencing commands to.

**Method**

```
MseResults MseModuleSetAsyncPort
                (
                        MseModulePtr            object,
                        const unsigned short*   asynchronousPort
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| asynchronousPort | The port for the asynchronous communication. The UDP port must be between 1024 and 49151 (registered ports). |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetAsyncPort**

Gets the UDP asynchronous port that the module will send broadcast, error, latching, and referencing commands to.

**Method**

```
MseResults MseModuleGetAsyncPort
                (
                        MseModulePtr            object,
                        unsigned short*         asynchronousPort
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| asynchronousPort | A pointer to an unsigned short that will be filled in with the port for the asynchronous communication |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleSetUsingDhcp**

Sets the DHCP setting for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleSetUsingDhcp
                (
                        MseModulePtr            object,
                        bool                    isDhcp
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| isDhcp | True to enable DHCP |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetUsingDhcp**

Gets the DHCP setting for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetUsingDhcp
                (
                        MseModulePtr            object,
                        bool*                   isDhcp
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| isDhcp | A pointer to the location where the DHCP setting will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetMacAddress**

Gets the MAC address for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetMacAddress
                (
                        MseModulePtr            object,
                        char*                   macAddress
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| macAddress | A pointer to the location where the MAC address will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetBootloaderVersion**

Gets the bootloader version for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetBootloaderVersion
                  (
                        MseModulePtr            object,
                        char*                   version
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| version | A pointer to the location where the bootloader version will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetFirmwareVersion**

Gets the firmware version for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetFirmwareVersion
                  (
                        MseModulePtr            object,
                        char*                   version
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| version | A pointer to the location where the firmware version will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetSerialNumber**

Gets the serial number for the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetSerialNumber
                  (
                        MseModulePtr            object,
                        char*                   serialNumber
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| serialNumber | A pointer to the location where the serial number will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleReset**

Reboots the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleReset
                  (
                        MseModulePtr            object,
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleShowType**

Shows the textual representation of the module type.

**Function**

```
MSE_RESPONSE_CODE MseModuleShowType
                  (
                        MseModulePtr            object,
                        char*                   type
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| type | A pointer to the location where the type will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleShowId**

Shows the textual representation of the module ID.

**Function**

```
MSE_RESPONSE_CODE MseModuleShowId
                  (
                        MseModulePtr            object,
                        char*                   id
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| id | A pointer to the location where the ID will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleSetBroadcastingNetmask**

Set the netmask used for the broadcast. A netmask of "255.255.255.255" should be used for a limited broadcast. A netmask of "255.255.255.0", "255.255.0.0", or "255.0.0.0" should be used for a directed broadcast. A limited broadcast is limited to a single LAN and is received by all clients connected to that LAN. A directed broadcast will be sent to all clients on a specific subnet.

**Function**

```
MSE_RESPONSE_CODE MseModuleSetBroadcastingNetmask
                  (
                        MseModulePtr            object,
                        char*                   netmask
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| netmask | The netmask to be used for broadcasting. A value of 255.255.255.255 will be used as the default. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleSetUdpTimeout**

Set the UDP timeout used for communication to the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleSetUdpTimeout
                  (
                        MseModulePtr            object,
                        long                    timeoutMs
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| timeoutMs | The timeout to be used in milliseconds. Can be set from 50 to 10000. The default is 800ms in order to handle the validation and backup of the FRAM and FLASH memory during programming and setting of the IP address. Very large values are only useful for debugging purposes. Values below the default may not allow enough time for the microcontroller to respond. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetUdpTimeout**

Get the UDP timeout used for communication to the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetUdpTimeout
                  (
                        MseModulePtr            object,
                        long*                   timeoutMs
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| timeoutMs | A pointer to the location where the timeout to be used in milliseconds will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleSetUdpNumRetries**

Set the number of retries to use when communicating to the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleSetUdpNumRetries
                  (
                        MseModulePtr            object,
                        short                   numRetries
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| numRetries | The number of retries to use |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetUdpNumRetries**

Get the number of retries to use when communicating to the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetUdpNumRetries
                  (
                        MseModulePtr            object,
                        short*                  numRetries
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| numRetries | A pointer to the location where the number of retries to use will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleSetNetworkDelay**

Set the delay to use between commands to the module. Used to not overload the firmware in the module since there is only a small amount of memory available. The value can be from 1 ms to 1000 ms and defaults to 1 ms.

**Function**

```
MSE_RESPONSE_CODE MseModuleSetNetworkDelay
                  (
                        MseModulePtr            object,
                        short                   networkDelayMs
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| networkDelayMs | The network delay to use |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseModuleGetNetworkDelay

Get the delay to use between commands to the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetNetworkDelay
                  (
                        MseModulePtr            object,
                        short                   networkDelayMs
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| networkDelayMs | A pointer to the location where the network delay to use will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseModuleBroadcast

Sends out a broadcast to obtain the IP addresses, netmasks, and ports of all the modules. The moduleIpAddresses, moduleNetmasks, and modulePorts arrays must be large enough to hold MAX_NUM_MODULES. The modules will not be ordered.

**Function**

```
MSE_RESPONSE_CODE MseModuleBroadcast
                  (
                        MseModulePtr            object,
                        char*                   clientIp
                        short                   clientPort
                        short*                  numResponses
                        char*                   moduleIpAddresses
                        char*                   moduleNetmasks
                        short*                  modulePorts
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| clientIp | The IP address of the client |
| clientPort | The UDP port of the client |
| numResponses | A pointer to the location where the number of modules found is stored |
| moduleIpAddresses | A pointer to the location the the IP addresses of the modules are stored. The IP addresses will be delimited by spaces. |
| moduleNetmasks | A pointer to the location the the netmasks of the modules are stored. The netmasks will be delimited by spaces. |
| modulePorts | A pointer to the location where the module UDP ports are stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleProgram**

Programs the module with the selected file.

Programming the MSEfirmware with a version > 1.0.2 requires that the MSEbootloader be at least version 1.0.2. The MSEbootloader and MSEfirmware cannot be programmed to a version prior to version 1.0.3 once they are version 1.0.3 or greater. The versioning incompatibility is due to improvements in configuration data robustness.

**Function**

```
MSE_RESPONSE_CODE MseModuleProgram
                  (
                        MseModulePtr            object,
                        char*                   filename,
                        bool                    isBootloader
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| filename | The file to program into the module |
| isBootloader | True if the file being programmed is the MSEbootloader, false if it is the MSEfirmware |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetProgramState**

Gets the programming state.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetProgramState
                  (
                        MseModulePtr            object,
                        PROGRAMMING_STATE_ENUMS*   programState
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| programState | The state of the programming |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetProgramPercentComplete**

Gets the programming percent complete. The percent complete is updated during the PROGRAMMING_STATE_ DOWNLOADING state.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetProgramPercentComplete
                  (
                        MseModulePtr            object,
                        double*                 percentComplete
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseModule object that was created by the MseModuleCreate function |
| percentComplete | The percent complete of the programming |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetAsyncMsgType**

Gets the asynchronous message type received from the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetAsyncMsgType
                  (
                        char*                   msg,
                        UdpCmdType*             code
                  );
```

**Parameters**

| | |
|---|---|
| msg | The asynchronous message received from the module |
| code | The location where the message type will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetAsyncMsgIpAddress**

Gets the asynchronous IP address received from the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetAsyncMsgIpAddress
                  (
                        char*                   msg,
                        char*                   ipAddress
                  );
```

**Parameters**

| | |
|---|---|
| msg | The asynchronous message received from the module |
| ipAddress | The location where the ip address of the module will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetAsyncMsgPort**

Gets the asynchronous UDP port received from the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetAsyncMsgPort
                  (
                        char*                   msg,
                        short*                  port
                  );
```

**Parameters**

| | |
|---|---|
| msg | The asynchronous message received from the module |
| port | The location where the UDP port of the module will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetAsyncMsgDhcp**

Gets the asynchronous DHCP state received from the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetAsyncMsgDhcp
                  (
                        char*                   msg,
                        bool*                   isDhcp
                  );
```

**Parameters**

| | |
|---|---|
| msg | The asynchronous message received from the module |
| isDhcp | The location where the DHCP state of the module will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetAsyncMsgMacAddress**

Gets the asynchronous MAC address received from the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetAsyncMsgMacAddress
                  (
                        char*                   msg,
                        char*                   macAddress
                  );
```

**Parameters**

| | |
|---|---|
| msg | The asynchronous message received from the module |
| macAddress | The location where the MAC address of the module will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetAsyncMsgNetmask**

Gets the asynchronous netmask received from the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetAsyncMsgNetmask
                  (
                        char*                   msg,
                        char*                   netmask
                  );
```

**Parameters**

| | |
|---|---|
| msg | The asynchronous message received from the module |
| netmask | The location where the netmask of the module will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseModuleGetAsyncMsgSerialNumber

Gets the asynchronous serial number received from the module.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetAsyncMsgSerialNumber
                  (
                        char*                   msg,
                        char*                   serialNumber
                  );
```

**Parameters**

| | |
|---|---|
| msg | The asynchronous message received from the module |
| serialNumber | The location where the serial number of the module will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseModuleGetAsyncMsgChannelStatus

Informs the listener that a warning, error, or reference complete has occurred. The listener must then read the channel status or send a reference complete acknowledge in order to tell the module that the message has been received.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetAsyncMsgChannelStatus
                  (
                        char*                   msg,
                        short*                  type,
                        short*                  channel
                  );
```

**Parameters**

| | |
|---|---|
| msg | The asynchronous message received from the module |
| type | The type of channel status. 0 is currently not used, 1 is for warnings and errors, and 2 is for reference complete. |
| channel | The channel for the ‘reference complete’ type. This parameter is not used for warnings and errors. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleGetAsyncMsgLatch**

Informs the listener that a latch has occurred.

**Function**

```
MSE_RESPONSE_CODE MseModuleGetAsyncMsgLatch
                  (
                        char*                   msg,
                        char*                   latchVals
                  );
```

**Parameters**

| | |
|---|---|
| msg | The asynchronous message received from the module |
| latchVals | The value of each of the latches. A value of 0 is not triggered, a value of 1 is triggered. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseModuleShowRespCode**

Gets the string representation of the response code.

**Function**

```
MSE_RESPONSE_CODE MseModuleShowRespCode
                  (
                        char*                   response,
                        MSE_RESPONSE_CODE       code
                  );
```

**Parameters**

| | |
|---|---|
| response | The location where the text representation of the MSE_RESPONSE_CODE will be stored |
| code | The MSE_RESPONSE_CODE to get a string representation of |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

# 2.11 Device methods

Device methods are only available for C++ usage.

## MseDeviceModule

The MseDeviceModule method creates an array of EncoderInfo objects for use in storing encoder information for each channel.

**Constructor**

```
MseDeviceModule();
```

## getEncoderInfo

The getEncoderInfo method returns the  EncoderInfo object used to store the encoder information for a specific channel.

**Method**

```
bool getEncoderInfo
                (
                        EncoderInfo*            encoderInfo,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| encoderInfo, | A pointer to a EncoderInfo structure to hold the encoder information requested |
| channel | The channel to get the encoder data of indexed from 0 |

**Return value**

The return value delivers true if getEncoderInfo passed and false if the channel requested is an invalid index.

## setEncoderInfo

The setEncoderInfo method sets the encoderInfo_ object to the desired values.

**Method**

```
bool setEncoderInfo
                (
                        EncoderInfo*            encoderInfo,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| encoderInfo | A pointer to a encoderInfo structure that has the encoder information to set |
| channel | The channel to set the encoder data to indexed from 0 |

**Return value**

The return value delivers true if setEncoderInfo passed and false if the channel requested is an invalid index.

## getCountingDirection

Gets the counting direction for a specific channel. True for positive and false for negative. Positive is when the count direction matches the traverse direction.

**Method**

```
bool getCountingDirection
                (
                        bool*                   isPositive,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| isPositive | A pointer where the counting direction will be stored |
| channel | The channel to get the counting direction from indexed from 0 |

**Return value**
The return value delivers False if the channel is out of range or if the pointer is NULL.

## setErrorCompensation

Sets the linear error compensation for a specific channel to the desired multiplier. This value will be applied to the position when getPositions is called.

**Method**

```
bool setErrorCompensation
                (
                        double                  value,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| value | The multiplier to use for error compensation of the position value |
| channel | The channel to set indexed from 0 |

**Return value**
The return value delivers False if the channel is out of range.

## getErrorCompensation

Gets the linear error compensation for a specific channel.

**Method**

```
bool getErrorCompensation
                (
                        double*                 value,
                        const unsigned short    channel
                );
```

Parameters

| | |
|---|---|
| value | The multiplier used for error compensation of the position value |
| channel | The channel to get indexed from 0 |

**Return value**
The return value delivers False if the channel is out of range or if the pointer is NULL.

## getResolution

Gets the computed encoder resolution for a specific channel. This value is in mm/count for linear encoders and degrees/count for rotary.

**Method**

```
bool getResolution
                (
                        double*                 resolution,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| resolution | The resolution of the encoder |
| channel | The channel to get indexed from 0 |

**Return value**
The return value delivers False if the channel is out of range or if the pointer is NULL.

## getEncoderType

Gets the encoder type for a specific channel.

**Method**

```
bool getEncoderType
                (
                        ENCODER_TYPES_ENUM*     type,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| type | The type of the encoder |
| channel | The channel to get indexed from 0 |

**Return value**
The return value delivers False if the channel is out of range or if the pointer is NULL.

## getUom

Gets the units of measure for a specific channel.

**Method**

```
bool getUom
                (
                        UOM*                    uom,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| uom | The units of measure of the encoder |
| channel | The channel to get indexed from 0 |

**Return value**
The return value delivers False if the channel is out of range or if the pointer is NULL.

## enableErrorChecking

The enableErrorChecking method sets whether error checking will be done on the specified channel.

**Method**

```
MseResults enableErrorChecking
                (
                      const bool             choice,
                      const unsigned short   channel
                );
```

**Parameters**

| | |
|---|---|
| choice | True if error checking should be enabled |
| channel | The channel to enable or disable error checking on indexed from 0 |

**Return value**

The return value delivers a response code representing whether the error checking command was sent correctly.

## getChannelStatus

The getChannelStatus method gets the error status of an EnDat, 1Vpp or TTL encoder. The COUNTER_STATUS enumeration has the mask values to compare the status with to determine which error occurred.

**Method**

```
MseResults getChannelStatus
                (
                      const unsigned short   channel,
                      unsigned char*         channelStatus
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to get the status of indexed from 0 |
| channelStatus | Holds the masked status of the channel. The status can be obtained by masking this value with the COUNTER_STATUS enumeration. |

**Return value**

The return value delivers a response code representing whether the getChannelStatus command was sent correctly.

## clearErrorsAndWarnings

The clearErrorsAndWarnings method clears errors and warnings. The EnDat modules will clear the errors from the EnDat protocol. The 1Vpp module will clear the errors through the counter status register.

**Method**

```
MseResults clearErrorsAndWarnings
                (
                      unsigned short         channel
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to clear errors and warnings for indexed from 0 |

**Return value**

The return value delivers a response code representing whether the warnings and errors were cleared correctly.

## setLatchDebouncing

The setLatchDebouncing method sets the number of milliseconds to use for debouncing the hardware latch input. The input defaults to 10ms on bootup of the module and is based on having a footswitch attached. If another device is attached that has a faster or slower debounce time, modifying this value will speed up or slow down latch triggering.

### Method

```
MseResults setLatchDebouncing
                (
                      const unsigned char    choice,
                      const unsigned short   timeMs
                );
```

### Parameters

| | |
|---|---|
| choice | 0 for the first footswitch input, 1 for the second |
| timeMs | The number of milliseconds to use to debounce the requested input. Can be between 0 - 20ms. |

# 2.12 EnDat methods and functions

C++ methods and the C functions are separated into two sections for easier lookup.

## C++ methods

**Constructor**

```
MseEndatModule(void);
```

**initializeModule**

The initializeModule method will fill in the moduleData_ and deviceData_ structure with all the information known from the module and it's devices.

**Method**

```
virtual MseResults initializeModule
                (
                      const char*           mseIpAddress
                      bool                  useAsync
                );
```

**Parameters**

| | |
|---|---|
| mseIpAddress | The IP address of the module to initialize |
| useAsync | True if the MSE should send asynchronous messages to the MSE_ASYNC_PORT |

**Return value**

The return value delivers a response code representing whether the initialization information was retrieved correctly.

**getPositions**

The getPositions method is used to return the positions and the current revolutions for the attached encoders. Linear encoders just return the positions. The position of a linear encoder is returned in user units. The position of a rotary encoder is returned in degrees. The rotary format of a rotary encoder can be changed with the setRotaryFormat method (it defaults to ROTARY_FORMAT_360). The user units are configured separately along with the EncoderInfo information.

**Method**

MSELIB_EXPORT MseResults getPositions

```
                (
                      double*               pos,
                      long*                 currentRevolution,
                      const unsigned short& numChannels,
                      COUNT_REQUEST_OPTION  option
                )
```

**Parameters**

| | |
|---|---|
| pos | The position(s) scaled from counts to the correct unit of measurement |
| currentRevolution | The current revolution of a rotary encoder |
| numChannels | The number of channels to read and store into the array passed in with pos and currentRevolution |
| option | The type of position to return. If COUNT_REQUEST_LATCHED is requested, the latching in the module will be reset after the value is read. |

**getCounts**

Gets the counts of all the attached encoders. Rotary encoders will also return the current revolution.

**Method**

```
MSELIB_EXPORT MseResults getCounts
                (
                        unsigned long*          counts,
                        long*                   currentRevolution,
                        unsigned short          numChannels,
                        COUNT_REQUEST_OPTION    option
                )
```

**Parameters**

| | |
|---|---|
| counts | The counts returned from the encoders |
| currentRevolution | The current revolution of a rotary encoder |
| numChannels | The number of channels to read and store into the array passed in with counts and currentRevolution |
| option | The type of count to return. If COUNT_REQUEST_LATCHED is requested, the latching in the module for the desired latchChoice will be reset after the value is read. |

**Return value**

The return value delivers a response code representing whether the counts were retrieved correctly.

**getWarnings**

The getWarnings method returns the warnings as an array of ENDAT_ERROR_RESULT values. The warnings in the array are ordered as indexed in the ENDAT_WARNINGS enumeration.

**Method**

```
MseResults getWarnings
                (
                        unsigned short          channel,
                        ENDAT_ERROR_RESULT*     warnings,
                        unsigned char           size
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to read the warnings from |
| warnings | A pointer to an array of ENDAT_ERROR_RESULT values that the warnings returned from the devices will be saved to |
| size | The number of ENDAT_ERROR_RESULT values in the warnings array passed in |

**Return value**

The return value delivers a response code representing whether the warnings were retrieved correctly.

**getErrors**

The getErrors method returns the errors as an array of ENDAT_ERROR_RESULT values. The errors are ordered as indexed in the ENDAT_ERRORS enumeration.

**Method**

```
MseResults getErrors
                (
                      unsigned short          channel,
                      ENDAT_ERROR_RESULT*     errors,
                      unsigned char           size
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to read the errors from indexed from 0 |
| errors | A pointer to an array of ENDAT_ERROR_RESULT values that the errors returned from the devices will be saved to |
| size | The number of ENDAT_ERROR_RESULT values in the errors array passed in |

**Return value**

The return value delivers a response code representing whether the errors were retrieved correctly.

**getDiag**

The getDiag method returns the method reserves that are supported and their values for the requested channel. The ENDAT_DIAG enumeration can be used to index into the diagVals parameter to access the desired value.

**Method**

```
MseResults getDiag
                (
                      const unsigned char     channel,
                      unsigned char*          diagVals,
                      unsigned char           arrLength
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to read the diagnostic from indexed from 0 |
| diagVals | The method reserves supported along with their values from the requested channel |
| arrLength | The size of the diagVals array passed in (must be >= ENDAT_DIAG_COUNT) |

**Return value**

The return value delivers a response code representing whether the diags were retrieved correctly.

**getDeviceData**

The getDeviceData method returns the device data for a specified channel.

**Method**

```
bool getDeviceData
                (
                        DeviceData*             data,
                        const unsigned short    channelNumber
                );
```

**Parameters**

| | |
|---|---|
| data | The DeviceData for the requested channel |
| channelNumber | The channel to get the DeviceData of indexed from 0 |

**Return value**

True if the DeviceData was returned, otherwise false.

**getDistinguishableRevolutions**

Gets the distinguishable revolutions of a rotary encoder for a specified channel.

**Method**

```
bool getDistinguishableRevolutions
                (
                        short*                  numRevs,
                        const unsigned short    channelNum
                );
```

**Parameters**

| | |
|---|---|
| numRevs | The distinguishable revolutions for the requested channel |
| channelNum | The channel to get indexed from 0 |

**Return value**

False if the channel is out of range or the pointer is NULL.

**getEncoderName**

Gets the encoder name of a encoder for a specified channel.

**Method**

```
bool getEncoderName
                (
                        char*                   name,
                        const unsigned short    channelNum
                );
```

**Parameters**

| | |
|---|---|
| name | The encoder name for the requested channel |
| channelNum | The channel to get indexed from 0 |

**Return value**

False if the channel is out of range or the pointer is NULL.

**getEncoderId**

Gets the encoder ID of a encoder for a specified channel.

**Method**

```
bool getEncoderId
                (
                        char*                   id,
                        const unsigned short    channelNum
                );
```

**Parameters**

| | |
|---|---|
| id | The encoder ID for the requested channel |
| channelNum | The channel to get indexed from 0 |

**Return value**

False if the channel is out of range or the pointer is NULL.

**getSerialNumber**

Gets the serial number of a encoder for a specified channel.

**Method**

```
bool getSerialNumber
                (
                        char*                   serialNumber,
                        const unsigned short    channelNum
                );
```

**Parameters**

| | |
|---|---|
| serialNumber | The serial number for the encoder of the requested channel |
| channelNum | The channel to get indexed from 0 |

**Return value**

False if the channel is out of range or the pointer is NULL.

**setUom**

Sets the unit of measurement of a encoder for a specified channel. This value will be applied to the position when getPositions is called.

**Method**

```
bool setUom
                (
                        UOM                     uom,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| uom | The unit of measurement for the encoder of the requested channel |
| channel | The channel to get indexed from 0 |

**Return value**

False if the channel is out of range.

**getChannelPresence**

The getChannelPresence method returns the encoder connection status for a channel on the module.

**Method**

```
MseResults getChannelPresence
                (
                        unsigned char*          isConnected,
                        unsigned short          channel
                );
```

**Parameters**

| | |
|---|---|
| isConnected | True if the channel is populated |
| channel | The channel to request indexed from 0 |

**Return value**

The return value delivers a response code representing whether the channel presence were retrieved correctly.

**setEncoderInfo**

The setEncoderInfo method sets the encoder information values in the MseDeviceModule base class to the desired values for the specified channel. The resolution is overwritten because it is already known for EnDat modules.

**Method**

```
bool setEncoderInfo
                (
                        EncoderInfo*            encoderInfo,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| encoderInfo | A EncoderInfo structure holding the encoder information values for the desired channel of this module |
| channel | The channel to set the encoder information of indexed from 0 |

**Return value**

The return value delivers true if the encoder information is set or false if channel is greater than the number of channels in the module.

## C Functions

The EnDat C functions can be found in the MseEndatModuleWrapper.h file.

**MseEndatModuleCreate**

Creates a MseEndatModule object and returns a pointer to it.

**Function**

```
MseEndatModulePtr MseEndatModuleCreate
                  (
                  );
```

**Return value**

The return value delivers a pointer to the MseEndatModule object that was created.

**MseEndatModuleDelete**

Deletes the MseEndatModule object that was passed in.

**Function**

```
void MseEndatModuleDelete
                  (
                        MseEndatModulePtr       object
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |

**MseEndatModuleInitialize**

Initializes the MseEndatModule object that was passed in.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleInitialize
                  (
                        MseEndatModulePtr       object,
                        char*                   mseIpAddress,
                        bool                    useAsync
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| mseIpAddress | The IP address of the module to initialize |
| useAsync | Whether to enable asynchronous communication from the module |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetNumChannels**

Gets the number of channels on the module.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetNumChannels
                (
                        MseEndatModulePtr       object,
                        unsigned short*         numChannels
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| numChannels | A pointer to the location where the number of channels will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetChannelPresence**

Gets whether there is an encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetChannelPresence
                (
                        MseEndatModulePtr       object,
                        bool*                   isConnected,
                        short                   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| isConnected | A pointer to the location where the connection status is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetEncoderType**

Gets the type of encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetEncoderType
                (
                        MseEndatModulePtr       object,
                        ENCODER_TYPES_ENUM*     type,
                        short                   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| type | A pointer to the location where the encoder type is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleSetUom**

Sets the unit of measurement of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleSetUom
                  (
                        MseEndatModulePtr      object,
                        UOM                    uom,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| uom | The unit of measurement of the encoder connected to the channel |
| channel | The channel to set indexed from 0 |

**MseEndatModuleGetUom**

Gets the unit of measurement of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetUom
                  (
                        MseEndatModulePtr      object,
                        UOM*                   uom,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| uom | A pointer to the location where the encoder unit of measurement is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleSetErrorCompensation**

Sets the linear error compensation of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleSetErrorCompensation
                  (
                        MseEndatModulePtr      object,
                        double                 val,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| val | The error compensation to use for the channel |
| channel | The channel to set indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetErrorCompensation**

Gets the linear error compensation of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetErrorCompensation
                  (
                        MseEndatModulePtr      object,
                        double*                val,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| val | A pointer to the location where the error compensation is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetCountingDirection**

Gets the counting direction of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetCountingDirection
                  (
                        MseEndatModulePtr      object,
                        bool*                  isPositive,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| isPositive | A pointer to the location where the counting direction is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetDistinguishableRevolutions**

Gets the distinguishable revolutions of a rotary encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetDistinguishableRevolutions
                  (
                        MseEndatModulePtr      object,
                        short*                 numRevs,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| numRevs | A pointer to the location where the distinguishable revolutions will be stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetResolution**

Gets the resolution of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetResolution
                  (
                        MseEndatModulePtr      object,
                        double*                resolution,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| resolution | A pointer to the location where the encoder resolution will be stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetCounts**

Gets the encoder counts for all the channels.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetCounts
                  (
                        MseEndatModulePtr      object,
                        unsigned long*         counts,
                        long*                  currentRevolution,
                        short                  numChannels,
                        COUNT_REQUEST_OPTION   option
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| counts | A pointer to the location where the counts will be stored. This is an array that must be large enough to store MAX_CHANNELS_PER_MODULE. |
| currentRevolution | A pointer to the location where the current revolution of a rotary encoder will be stored. This is an array that must be large enough to store MAX_CHANNELS_PER_MODULE. |
| numChannels | The size of the counts and currentRevolution arrays passed in |
| option | Whether to get the latest or the latched counts |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetPositions**

Gets the encoder positions for all the channels.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetPositions
                  (
                        MseEndatModulePtr      object,
                        double*                pos,
                        long*                  currentRevolution,
                        short                  numChannels,
                        COUNT_REQUEST_OPTION   option
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| pos | A pointer to the location where the positions will be stored. This is an array that must be large enough to store MAX_CHANNELS_PER_MODULE. |
| currentRevolution | A pointer to the location where the current revolution of a rotary encoder will be stored. This is an array that must be large enough to store MAX_CHANNELS_PER_MODULE. |
| numChannels | The size of the counts and currentRevolution arrays passed in |
| option | Whether to get the latest or the latched positions |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleSetRotaryFormat**

The MseEndatModuleSetRotaryFormat method is used to set the rotary format that will be applied to the position calculated from the counts in the MseEndatModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE  MseEndatModuleSetRotaryFormat
                  (
                        MseEndatModulePtr      object,
                        unsigned short         channel,
                        ROTARY_FORMAT          format
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| channel | The channel of the encoder to apply the rotary format to |
| format | The ROTARY_FORMAT to apply |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetRotaryFormat**

The MseEndatModuleGetRotaryFormat method is used to return the rotary format that will be applied to the position calculated from the counts in the MseEndatModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE   MseEndatModuleGetRotaryFormat
                    (
                          MseEndatModulePtr      object,
                          unsigned short         channel
                          ROTARY_FORMAT*         format
                    );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| channel | The channel of the encoder that the rotary format will be applied to |
| format | A pointer to the location where the rotary format will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleSetDeviceOffset**

The MseEndatModuleSetDeviceOffset method is used to set the offset that will be applied to the position calculated from the counts in the MseEndatModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE  MseEndatModuleSetDeviceOffset
                   (
                         MseEndatModulePtr      object,
                         unsigned short         channel,
                         double                 offset
                   );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| channel | The channel of the encoder to apply the offset to |
| offset | The offset to apply |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetDeviceOffset**

The MseEndatModuleGetDeviceOffset method is used to return the offset that will be applied to the position calculated from the counts in the MseEndatModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE   MseEndatModuleGetDeviceOffset
                    (
                          MseEndatModulePtr      object,
                          unsigned short         channel
                          double*                offset
                    );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| channel | The channel of the encoder that the offset will be applied to |
| offset | A pointer to the location where the offset will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleSetLatch**

Sets or clears the desired latch for the module chain.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleSetLatch
                  (
                        MseEndatModulePtr       object,
                        LATCH_OPTIONS           option,
                        LATCH_CHOICE            latchChoice
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| option | Set or reset the module chain latch. Set is only used on a base module. Reset will clear the latch and must be called on the base module first followed by each additional module. |
| latchChoice | The type of latch to set. Clearing a latch will clear all latches in the base module. Non-base modules only know about being triggered or not and the base module is used to determine which trigger occurred. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetLatches**

Gets the latches that are active. The base module can differentiate between three software latches and two footswitch latches. All other modules only know if they have been latched or not.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetLatches
                  (
                        MseEndatModulePtr       object,
                        char*                   latchState,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| latchState | A pointer to the location where the latch state will be stored. This is an array that must be large enough to store NUM_LATCH_TYPES. The non-base modules will only utilize the first byte. |
| size | The size of the latchState array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetModuleErrorState**

Gets the error state of the module. A value of True signifies that there is an error.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetModuleErrorState
                  (
                        MseEndatModulePtr      object,
                        bool*                  errorState
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| errorState | A pointer to the location where the error state will be copied to. A subsequent call to MseEndatModuleGetModuleErrors can be made to get the actual errors. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetModuleErrors**

Gets the actual module errors.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetModuleErrors
                  (
                        MseEndatModulePtr      object,
                        long*                  errors,
                        double*                ranges,
                        short                  size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| errors | A pointer to the location where the errors will be copied to. The errors is a single long that can be masked with the INTEGRITY_ENUMS to determine which error has occurred. |
| ranges | A pointer to the location where the ranges used to determine an error will be copied to. The ranges is an array that must be large enough to hold NUM_INTEGRITY_RANGES. |
| size | The size of the ranges array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetChannelErrorState**

Gets the error state of a channel. An errorState of 1 signifies an error.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetChannelErrorState
                  (
                        MseEndatModulePtr      object,
                        bool*                  errorState,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| errorState | A pointer to the location where the error state will be copied to. A subsequent call to MseEndatModuleGetEndatErrors can be made to get the actual errors. |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetChannelStatus**

Gets the error status of a channel. The COUNTER_STATUS can be masked with status to determine the channel status.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetChannelStatus
                  (
                        MseEndatModulePtr       object,
                        char*                   status,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| status | A pointer to the location where the channel status will be copied to. |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetEndatErrors**

Gets the EnDat error of a channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetEndatErrors
                  (
                        MseEndatModulePtr       object,
                        ENDAT_ERROR_RESULT*     errors,
                        short                   size,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| errors | A pointer to the location where the errors will be stored. The errors is an array used to store the status of each type of error. The array must be large enough to hold NUM_ENDAT_ERRORS. |
| size | The size of the errors array passed in |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetChannelWarningState**

Gets the warning state of a channel. A warningState of 1 signifies a warning.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetChannelWarningState
                  (
                        MseEndatModulePtr       object,
                        bool*                   warningState,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| warningStat | A pointer to the location where the warning state will be copied to. A subsequent call to MseEndatModuleGetEndatWarning can be made to get the actual warnings. |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetEndatWarnings**

Gets the EnDat warnings of a channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetEndatWarnings
                (
                      MseEndatModulePtr      object,
                      ENDAT_ERROR_RESULT*    warnings,
                      short                  size,
                      short                  channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| warnings | A pointer to the location where the warnings will be stored. The warnings is an array used to store the status of each type of warning. The array must be large enough to hold NUM_ENDAT_WARNINGS. |
| size | The size of the warnings array passed in |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleClearErrors**

Clears the module and channel errors and warnings.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleClearErrors
                (
                      MseEndatModulePtr      object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetEncoderName**

Gets the name of the encoder attached to a channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetEncoderName
                (
                      MseEndatModulePtr      object,
                      char*                  encoderName,
                      short                  channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| encoderName | A pointer to the location where the encoder name will be stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetEncoderId**

Gets the ID of the encoder attached to a channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetEncoderId
                  (
                        MseEndatModulePtr      object,
                        char*                  encoderId,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| encoderId | A pointer to the location where the encoder ID will be stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetEncoderSerialNumber**

Gets the ID of the encoder attached to a channel.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetEncoderSerialNumber
                  (
                        MseEndatModulePtr      object,
                        char*                  serialNumber,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| serialNumber | A pointer to the location where the encoder serial number will be stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleSetLatchDebouncing**

Sets the latch debouncing used on the footswitch lines in the base module.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleSetLatchDebouncing
                  (
                        MseEndatModulePtr      object,
                        char                   choice,
                        short                  timeMs
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| choice | 0 for the first footswitch input and 1 for the second |
| timeMs | The number of milliseconds to debounce the input. Can be from 0 - 20 ms. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleEnableDiags**

Sets the diagnostic mode for the channels and module. See the Diagnostics Mode section of this document for more information.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleEnableDiags
                  (
                        MseEndatModulePtr       object,
                        DIAG_MODE_OPTIONS       choice
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| choice | The desired level of diagnostics |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetDiags**

Gets the EnDat function reserves for an encoder.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetDiags
                  (
                        MseEndatModulePtr       object,
                        char*                   diagVals,
                        short                   size,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| diagVals | A pointer to the location where the diagnostic values will be stored. Must be large enough to hold ENDAT_DIAG_COUNT. The ENDAT_DIAG enumeration can be used to index into the diagVals array. |
| size | The size of the diagVals array |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleGetAdcValues**

Gets the voltage and temperature values for the module.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleGetAdcValues
                  (
                        MseEndatModulePtr      object,
                        short*                 adcVals,
                        short                  sizel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| adcVals | A pointer to the location where the voltage and temperature values will be stored. Must be large enough to hold ADC_NUM_CHANNELS. The ADC_OPTIONS enumeration can be used to index into the adcVals array. |
| size | The size of the adcVals array |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseEndatModuleEnableErrorChecking**

Sets whether error checking will be done on the specified channel. The channel defaults to enabled on power up of the module and will be checked as long as the channel is populated and the error checking is enabled. The channel status can be checked with the MseEnDatModuleGetChannelStatus when error checking is enabled.

**Function**

```
MSE_RESPONSE_CODE MseEndatModuleEnableErrorChecking
                  (
                        MseEndatModulePtr      object,
                        const bool             choice,
                        const unsigned short   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseEndatModule object that was created by the MseEndatModuleCreate function |
| choice | True to enable error checking, false to disable |
| channel | The channel to enable or disable error checking on indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful

# 2.13 1Vpp methods and functions

C++ methods and the C functions are separated into two sections for easier lookup.

## C++ methods

**Constructor**

```
Mse1VppModule(void);
```

**initializeModule**

The initializeModule method is used to initialize a 1Vpp module. It calls the MseDeviceModule::initializeModule() and then calls the MseDeviceModule::setEncoderInfo() with default values.

**Method**

```
MseResults initializeModule
                (
                      const char*           mseIpAddress,
                      bool                  useAsync
                );
```

**Parameters**

| | |
|---|---|
| mseIpAddress | The IP address of the module to initialize |
| useAsync | True if the MSE should send asynchronous messages (for notification of footswitch pressed) |

**getDiag**

The getDiag method is used to return the diagnostic values of the requested channel. The diagVals is an array of doubles that holds the values enumerated in the VPP_VOLTAGE_FEEDBACK enumeration. The ideal diagnostic values for the A and B channels should be between -0.5 V and +0.5 V. The A and B values can be plotted in a graph with A as the X and B as the Y in order to show a Lissajou figure. The Lissajou figure should look like a circle with 1Vpp amplitude but the graph will need to have many samples that occur while the encoder is moving. The enableAnalogDiag method must first be called for the required channel before the diagnostics can be retrieved.

**Method**

```
MseResults getDiag
                (
                      const unsigned        char channel,
                      double*               diagVals,
                      unsigned char         arrLength
                )
```

**Parameters**

| | |
|---|---|
| channel | The channel to read the diagnostic from |
| diagVals | The diagnostic values returned from the module for the requested channel |
| arrLength | The size of the diagVals array passed in (must be >= VPP_VOLTAGE_NUM) |

**enableAnalogDiag**

The enableAnalogDiag method is used to set whether the analog diagnostics for the desired channel should be performed or not. This will start collecting the A and B signals for the desired channel and allow the values to be read with the getDiag command. Only 1 channel can be enabled at a time.

**Method**

```
MseResults enableAnalogDiag
                (
                        const unsigned char     channel,
                        const bool              enable
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to enable or disable the diagnostics of indexed from 0 |
| enable | True to enable, false to disable |

**getPositions**

The getPositions method is used to return the positions of the encoders in user units. The user units are configured separately with the EncoderInfo. If the option is set to COUNT_REQUEST_LATCHED, the module will clear the latch after the position is read to allow for faster subsequent latching. The rotary formats for each rotary encoder can be set first with the setRotaryFormat method. The default rotary format is ROTARY_FORMAT_360.

**Method**

```
MseResults getPositions
                (
                        double*                 pos,
                        unsigned short          numChannels,
                        COUNT_REQUEST_OPTION    option
                );
```

**Parameters**

| | |
|---|---|
| pos | A pointer to a buffer for storing the positions. The positions will be scaled from counts to the correct unit of measurement. The pointer must point to an array that is large enough to store MAX_CHANNELS_PER_MODULE. |
| numChannels | The number of channels to read and store into the array passed in with pos |
| option | The type of position to return |

**setUom**

The setUom method sets the unit of measurement to the desired value. This value will be used when computing the position when getPositions() is called.

**Method**

```
bool setUom
                (
                        UOM                     uom,
                        const unsigned short    channel
                );
```

Parameters

| | |
|---|---|
| uom | The unit of measurement to use for computing the position value |
| channel | The channel to set the UOM of indexed from 0 |

**Return value**

False if the channel is out of range

**setEncoderType**

The setEncoderType method sets the type of encoder to the desired value. This value will be used when computing the position when getPositions() is called.

**Method**

```
bool setEncoderType
                (
                        ENCODER_TYPES_ENUM      encoderType,
                        const unsigned short    channel
                );
```

Parameters

| | |
|---|---|
| encoderType | The type of encoder to use for computing the position value |
| channel | The channel to set the encoder type of indexed from 0 |

**Return value**

False if the channel is out of range.

**setLineCount**

The setLineCount method sets the line count used for a rotary encoder to the desired value. This value will be used when computing the position when getPositions() is called.

**Method**

```
bool setLineCount
                (
                        unsigned long           lineCount,
                        const unsigned          short channel
                );
```

**Parameters**

| | |
|---|---|
| lineCount | The line count of the rotary encoder to use for computing the position value |
| channel | The channel to set the line count of indexed from 0 |

**Return value**

False if the channel is out of range.

**getLineCount**

Gets the line count used for a rotary encoder.

**Method**

```
bool getLineCount
                (
                        unsigned long*          lineCount,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| lineCount | A pointer to the location where the line count of the rotary encoder will be stored |
| channel | The channel to get indexed from 0 |

**getSignalPeriod**

Gets the signal period used for a linear encoder.

**Method**

```
bool getSignalPeriod
                (
                        unsigned short*         signalPeriod,
                        const unsigned short    channel
                )
```

**Parameters**

| | |
|---|---|
| signalPeriod | A pointer to the location where the signal period of the linear encoder will be stored |
| channel | The channel to get indexed from 0 |

**setSignalPeriod**

The setSignalPeriod method sets the signal period used for a linear encoder to the desired value. This value will be used when computing the position when getPositions() is called.

**Method**

```
bool setLineCount
                (
                        unsigned short          signalPeriod,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| signalPeriod | The signal period of the linear encoder to use for computing the position value |
| channel | The channel to set the signal period of indexed from 0 |

**Return value**

False if the channel is out of range.

**setCountingDirection**

The setCountingDirection method sets the counting direction to the desired value. This value will be used when computing the position when getPositions() is called.

**Method**

```
bool setCountingDirection
                (
                       bool                    positive,
                       const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| positive | True if the encoder should count in the direction of the traversal |
| channel | The channel to set the counting direction of indexed from 0 |

**Return value**

False if the channel is out of range.

**initAbsolutePosition**

The initAbsolutePosition method will tell the module to start obtaining absolute positions utilizing reference marks. This method will cause all readings to be invalid until the reference mark is crossed.

**Method**

```
MseResults initAbsolutePosition
                (
                       const unsigned char        channel,
                       const REFERENCE_MARK_ENUM  refMarkType,
                       const unsigned short       value
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to start absolute referencing for indexed from 0 |
| refMarktype | The type of reference mark utilized by the encoder. A value of REFERENCE_MARK_NONE will not try an obtain an absolute position |
| value | The signal period for a linear encoder and line count for a rotary encoder |

**Return value**

The return value delivers a response code representing whether the initAbsolutePosition command was sent correctly.

**isReferencingComplete**

The isReferencingComplete method will check if referencing is complete for the specified channel.

**Method**

```
MseResults isReferencingComplete
                (
                       const unsigned char    channel,
                       bool*                  isComplete
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to check to determine if referencing is complete indexed from 0 |
| isComplete | True if referencing is complete, otherwise false |

**Return value**

The return value delivers a response code representing whether the isReferencingComplete command was sent correctly.

**acknowledgeAbsolutePosition**

The acknowledgeAbsolutePosition method will send an acknowledge to the module for the specified channel. The acknowledge tells the module that the asynchronous referencing complete has been received for a specific channel. The module will keep sending asynchronous messages every 5 seconds if the acknowledge is not received. This method only needs to be called if the module is in asynchronous mode.

**Method**

```
MseResults acknowledgeAbsolutePosition
                (
                        const unsigned char     channel
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to acknowledge reception of the referencing complete indexed from 0 |

**Return value**

The return value delivers a response code representing whether the command was successful.

**getReferencingState**

Gets the state of the referencing for the desired channel. This method should be called after isReferencingComplete is true or before acknowledgeAbsolutePosition is sent in order to check if referencing succeeded. Referencing succeeds if the refMarkState is REF_MARK_FINISHED.

**Method**

```
MseResults getReferencingState
                (
                        const unsigned          char channel,
                        REF_MARK_STATE*         refMarkState
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to get the referencing state indexed from 0 |
| refMarkState | The state of the referencing. See the REF_MARK_STATE enumeration for more information. |

**Return value**

The return value delivers a response code representing whether the command was successful.

**getSignalType**

Gets the signal type of the encoder. The signal type is detected when the module is first powered on. The signal type can also be set with setSignalType.

**Method**

```
MseResults getSignalType
                (
                        const unsigned short    channel,
                        SIGNAL_TYPE*            signalType
                )
```

**Parameters**

| | |
|---|---|
| channel | The channel to get indexed from 0 |
| signalType | The type of signal the encoder uses. This will be 1 Vpp or 11 µApp. |

**Return value**

The return value delivers a response code representing whether the command was successful.

**setSignalType**

Sets the signal type of the encoder. The signal type is detected and set when the module is first powered on. The signal can be set with this method in case of an error in the auto-detection.

**Method**

```
MseResults setSignalType
                (
                        const unsigned short    channel,
                        const SIGNAL_TYPE       signalType
                )
```

**Parameters**

| | |
|---|---|
| channel | The channel to set indexed from 0 |
| signalType | The type of signal the encoder uses. This can be 1 Vpp or 11 µApp. |

**Return value**

The return value delivers a response code representing whether the command was successful.

**detectSignalType**

Detects the signal type of the encoder. The signal type will be set to the detected value. The signal type is first detected and set when the module is first powered on. The signal type can be set explicitly with setSignalType.

**Method**

```
MseResults detectSignalType
                (
                        const unsigned          short channel,
                        SIGNAL_TYPE*            signalType
                )
```

**Parameters**

| | |
|---|---|
| channel | The channel to detect indexed from 0 |
| signalType | The type of signal detected. This will be 1 Vpp or 11 µApp. |

**Return value**

The return value delivers a response code representing whether the command was successful.

## C Functions

The 1Vpp C functions can be found in the Mse1VppModuleWrapper.h file.

**Mse1VppModuleCreate**

Creates a Mse1VppModule object and returns a pointer to it.

**Function**

```
Mse1VppModulePtr Mse1VppModuleCreate
                (
                );
```

**Return value**

The return value delivers a pointer to the Mse1VppModule object that was created.

**Mse1VppModuleDelete**

Deletes the Mse1VppModule object that was passed in.

**Function**

```
void Mse1VppModuleDelete
                (
                        Mse1VppModulePtr        object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |

**Mse1VppModuleInitialize**

Initializes the Mse1VppModule object that was passed in.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleInitialize
                (
                        Mse1VppModulePtr        object,
                        char*                   mseIpAddress,
                        bool                    useAsync
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| mseIpAddress | The IP address of the module to initialize |
| useAsync | Whether to enable asynchronous communication from the module |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetNumChannels**

Gets the number of channels on the module.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetNumChannels
                (
                        Mse1VppModulePtr        object,
                        unsigned short*         numChannels
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| numChannels | A pointer to the location where the number of channels will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleSetEncoderType**

Sets the type of encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleSetEncoderType
                (
                        Mse1VppModulePtr        object,
                        ENCODER_TYPES_ENUM      type,
                        short                   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| type | The type of encoder connected to the channel |
| channel | The channel to set indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetEncoderType**

Gets the type of encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetEncoderType
                  (
                        Mse1VppModulePtr        object,
                        ENCODER_TYPES_ENUM*     type,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| type | A pointer to the location where the encoder type is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleSetUom**

Sets the unit of measurement of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleSetUom
                  (
                        Mse1VppModulePtr        object,
                        UOM                     uom,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| uom | The unit of measurement of the encoder connected to the channel |
| channel | The channel to set indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetUom**

Gets the unit of measurement of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetUom
                  (
                        Mse1VppModulePtr        object,
                        UOM*                    uom,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| uom | A pointer to the location where the encoder unit of measurement is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleSetErrorCompensation**

Sets the linear error compensation of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleSetErrorCompensation
                  (
                        Mse1VppModulePtr        object,
                        double                  val,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| val | The error compensation to apply when requesting a position |
| channel | The channel to set indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetErrorCompensation**

Gets the linear error compensation of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetErrorCompensation
                  (
                        Mse1VppModulePtr        object,
                        double*                 val,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| val | A pointer to the location where the error compensation is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleSetCountingDirection**

Sets the counting direction of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleSetCountingDirection
                  (
                        Mse1VppModulePtr        object,
                        bool                    isPositive,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| val | True for positive and false for negative |
| channel | The channel to set indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetCountingDirection**

Gets the counting direction of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetCountingDirection
                (
                        Mse1VppModulePtr        object,
                        bool*                   isPositive,
                        short                   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| val | A pointer to the location where the counting direction is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetResolution**

Gets the resolution of the encoder connected to the selected channel. The resolution is computed internally based on the line count or signal period. The resolution is in mm/count for linear encoders and degrees/count for rotary encoders.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetResolution
                (
                        Mse1VppModulePtr        object,
                        double*                 resolution,
                        short                   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| resolution | A pointer to the location where the encoder resolution will be stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetCounts**

Gets the encoder counts for all the channels.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetCounts
                (
                        Mse1VppModulePtr        object,
                        unsigned long*          counts,
                        short                   numChannels,
                        COUNT_REQUEST_OPTION    option
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| counts | A pointer to the location where the counts will be stored. This is an array that must be large enough to store MAX_CHANNELS_PER_MODULE. |
| numChannels | The size of the counts array passed in |
| option | Whether to get the latest or the latched counts |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleGetPositions

Gets the encoder positions for all the channels. Refer to the 1Vpp getPositions C++ method on page 121 for more information.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetPositions
                  (
                        Mse1VppModulePtr        object,
                        double*                 pos,
                        short                   numChannels,
                        COUNT_REQUEST_OPTION    option
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| pos | A pointer to the location where the positions will be stored. This is an array that must be large enough to store MAX_CHANNELS_PER_MODULE. |
| numChannels | The size of the counts array passed in |
| option | Whether to get the latest or the latched positions |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleSetRotaryFormat

The Mse1VppModuleSetRotaryFormat method is used to set the rotary format that will be applied to the position calculated from the counts in the Mse1VppModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE  Mse1VppModuleSetRotaryFormat
                  (
                        Mse1VppModulePtr        object,
                        unsigned short          channel,
                        ROTARY_FORMAT           format
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | The channel of the encoder to apply the rotary format to |
| format | The ROTARY_FORMAT to apply |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleGetRotaryFormat

The Mse1VppModuleGetRotaryFormat method is used to return the rotary format that will be applied to the position calculated from the counts in the Mse1VppModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE   Mse1VppModuleGetRotaryFormat
                  (
                        Mse1VppModulePtr        object,
                        unsigned short          channel
                        ROTARY_FORMAT*          format
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | The channel of the encoder that the rotary format will be applied to |
| format | A pointer to the location where the rotary format will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleSetDeviceOffset

The Mse1VppModuleSetDeviceOffset method is used to set the offset that will be applied to the position calculated from the counts in the Mse1VppModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE  Mse1VppModuleSetDeviceOffset
                   (
                         Mse1VppModulePtr       object,
                         unsigned short         channel,
                         double                 offset
                   );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | The channel of the encoder to apply the offset to |
| offset | The offset to apply |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleGetDeviceOffset

The Mse1VppModuleGetDeviceOffset method is used to return the offset that will be applied to the position calculated from the counts in the Mse1VppModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE   Mse1VppModuleGetDeviceOffset
                    (
                      Mse1VppModulePtr       object,
                      unsigned short         channel
                      double*                offset
                    );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | he channel of the encoder that the offset will be applied to |
| offset | A pointer to the location where the offset will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleSetLatch

Sets or clears the desired latch for the module chain.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleSetLatch
                  (
                        Mse1VppModulePtr       object,
                        LATCH_OPTIONS          option,
                        LATCH_CHOICE           latchChoice
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| option | Set or reset the module chain latch. Set is only used on a base module. Reset will clear the latch and must be called on the base module first followed by each additional module. |
| latchChoice | The type of latch to set. Clearing a latch will clear all latches in the base module. Non-base modules only know about being triggered or not and the base module is used to determine which trigger occurred. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetLatches**

Gets the latches that are active. The base module can differentiate between three software latches and two footswitch latches. All other modules only know if they have been latched or not.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetLatches
                  (
                        Mse1VppModulePtr        object,
                        char*                   latchState,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| latchState | A pointer to the location where the latch state will be stored. This is an array that must be large enough to store NUM_LATCH_TYPES. The non-base modules will only utilize the first byte. |
| size | The size of the latchState array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetModuleErrorState**

Gets the error state of the module. A value of True signifies that there is an error.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetModuleErrorState
                  (
                        Mse1VppModulePtr        object,
                        bool*                   errorState
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| errorState | A pointer to the location where the error state will be copied to. A subsequent call to Mse1VppModuleGetModuleErrorscan be made to get the actual errors. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetModuleErrors**

Gets the actual module errors.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetModuleErrors
                  (
                        Mse1VppModulePtr        object,
                        long*                   errors,
                        double*                 ranges,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| errors | A pointer to the location where the errors will be copied to. The errors is a single long that can be masked with the INTEGRITY_ENUMS to determine which error has occurred. |
| ranges | A pointer to the location where the ranges used to determine an error will be copied to. The ranges is an array that must be large enough to hold NUM_INTEGRITY_RANGES. |
| size | The size of the ranges array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetChannelErrorState**

Gets the error state of a channel. An errorState of 1 signifies an error.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetChannelErrorState
                (
                      Mse1VppModulePtr       object,
                      bool*                  errorState,
                      short                  channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| errorState | A pointer to the location where the error state will be copied to. A subsequent call to Mse1VppModuleGetChannelStatuscan be made to get the actual errors. |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetChannelStatus**

Gets the error status of a channel. The COUNTER_STATUS can be masked with status to determine the channel status.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetChannelStatus
                (
                      Mse1VppModulePtr       object,
                      char*                  status,
                      short                  channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| status | A pointer to the location where the channel status will be copied to. |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleClearErrors**

Clears the module and channel errors and warnings.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleClearErrors
                (
                      Mse1VppModulePtr       object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleSetLatchDebouncing**

Sets the latch debouncing used on the footswitch lines in the base module.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleSetLatchDebouncing
                  (
                        Mse1VppModulePtr        object,
                        char                    choice,
                        short                   timeMs
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| choice | 0 for the first footswitch input and 1 for the second |
| timeMs | The number of milliseconds to debounce the input. Can be from 0 - 20 ms. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleEnableDiags**

Sets the diagnostic mode for the channels and module. See the Diagnostics Mode section of this document for more information.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleEnableDiags
                  (
                        Mse1VppModulePtr        object,
                        DIAG_MODE_OPTIONS       choice
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| choice | The desired level of diagnostics |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetAdcValues**

Gets the voltage and temperature values for the module.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetAdcValues
                  (
                        Mse1VppModulePtr        object,
                        short*                  adcVals,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| adcVals | A pointer to the location where the voltage and temperature values will be stored. Must be large enough to hold ADC_NUM_CHANNELS. The ADC_OPTIONS enumeration can be used to index into the adcVals array. |
| size | The size of the adcVals array |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleEnableAnalogDiag

Sets the diagnostic mode for the analog A and B channels of an encoder. The module can only monitor the diagnostics of 1 channel at a time.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleEnableAnalogDiag
                (
                        Mse1VppModulePtr        object,
                        bool                    enable,
                        short                   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| enable | True to enable monitoring of the diagnostics |
| channel | The channel to monitor indexed from 0 |

**Return value**
The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleGetAnalogDiag

Gets the A and B channel data of an encoder.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetAnalogDiag
                (
                        Mse1VppModulePtr        object,
                        double*                 diagVals,
                        short                   size,
                        short                   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| diagVals | A pointer to the location where the A and B voltage data values will be stored. Must be large enough to hold VPP_VOLTAGE_NUM |
| size | The size of the diagVals array |
| channel | The channel to get indexed from 0 |

**Return value**
The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleSetLineCount

Sets the line count of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleSetLineCount
                (
                        Mse1VppModulePtr        object,
                        long                    lineCount,
                        short                   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| lineCount | The line count of a rotary encoder |
| channel | The channel to set indexed from 0 |

**Return value**
The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetLineCount**

Gets the line count of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetLineCount
                  (
                        Mse1VppModulePtr        object,
                        long*                   lineCount,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| lineCount | A pointer to the location where the line count is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleSetSignalPeriod**

Sets the signal period of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleSetSignalPeriod
                  (
                        Mse1VppModulePtr        object,
                        short                   signalPeriod,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| signalPeriod | The signal period of a linear encoder |
| channel | The channel to set indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**Mse1VppModuleGetSignalPeriod**

Gets the signal period of the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetSignalPeriod
                  (
                        Mse1VppModulePtr        object,
                        short*                  signalPeriod,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| signalPeriod | A pointer to the location where the signal period is stored |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleStartReferencing

Starts the referencing for the encoder connected to the selected channel.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleStartReferencing
                (
                       Mse1VppModulePtr       object,
                       short                  channel,
                       REFERENCE_MARK_ENUM    refMarkType,
                       short                  value
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | The channel to start referencing on indexed from 0 |
| refMarkType | The type of referencing used by the encoder |
| value | The signal period or line count used for the referencing |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleGetReferencingComplete

Gets whether the referencing is complete for the specified encoder.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleGetReferencingComplete
                (
                       Mse1VppModulePtr       object,
                       short                  channel,
                       bool*                  isComplete
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | The channel to get indexed from 0 |
| isComplete | A pointer to the location where the status of the referencing is stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleAcknowledgeAbsolutePosition

Sends an acknowledge to the module informing it that the client received the asynchronous referencing message.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleAcknowledgeAbsolutePosition
                (
                       Mse1VppModulePtr       object,
                       short                  channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | The channel to acknowledge the referencing of indexed from 0 |

### Mse1VppModuleGetReferencingState

Gets the state of the referencing for the desired channel. This method should be called after isReferencingComplete is true or before acknowledgeAbsolutePosition is sent in order to check if referencing succeeded. Referencing succeeds if the refMarkState is REF_MARK_FINISHED.

**Method**

```
MseResults Mse1VppModuleGetReferencingState
                (
                        Mse1VppModulePtr        object,
                        const unsigned          char channel,
                        REF_MARK_STATE*         refMarkState
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | The channel to get the referencing state indexed from 0 |
| refMarkState | A pointer to the location where the state of the referencing will be stored. See the REF_MARK_STATE enumeration for more information. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppModuleEnableErrorChecking

Sets whether error checking will be done on the specified channel. The channel defaults to enabled on power up of the module and will be checked as long as the channel is populated and the error checking is enabled. The channel status can be checked with the Mse1VppModuleGetChannelStatus when error checking is enabled.

**Function**

```
MSE_RESPONSE_CODE Mse1VppModuleEnableErrorChecking
                (
                        Mse1VppModulePtr        object,
                        const bool              choice,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| choice | True to enable error checking, false to disable |
| channel | The channel to enable or disable error checking on indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppGetSignalType

Gets the signal type of the encoder. The signal type is detected when the module is first powered on. The signal type can also be set with setSignalType.

**Method**

```
MSE_RESPONSE_CODE Mse1VppGetSignalType
                (
                        Mse1VppModulePtr        object,
                        const unsigned short    channel,
                        SIGNAL_TYPE*            signalType
                )
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | The channel to get indexed from 0 |
| signalType | The type of signal the encoder uses. This will be 1 Vpp or 11 µApp. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppSetSignalType

Sets the signal type of the encoder. The signal type is detected and set when the module is first powered on. The signal can be set with this function in case of an error in the auto-detection.

**Method**

```
MSE_RESPONSE_CODE Mse1VppSetSignalType
                  (
                        Mse1VppModulePtr       object,
                        const unsigned short   channel,
                        const SIGNAL_TYPE      signalType
                  )
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | The channel to set indexed from 0 |
| signalType | The type of signal the encoder uses. This can be 1 Vpp or 11 µApp. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### Mse1VppDetectSignalType

Detects the signal type of the encoder. The signal type will be set to the detected value. The signal type is first detected and set when the module is first powered on. The signal type can be set explicitly with setSignalType.

**Method**

```
MSE_RESPONSE_CODE Mse1VppDetectSignalType
                  (
                        Mse1VppModulePtr       object,
                        const unsigned short   channel,
                        SIGNAL_TYPE*           signalType
                  )
```

**Parameters**

| | |
|---|---|
| object | A pointer to the Mse1VppModule object that was created by the Mse1VppModuleCreate function |
| channel | The channel to detect indexed from 0 |
| signalType | The type of signal detected. This will be 1 Vpp or 11 µApp. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

# 2.14 I/O methods and functions

C++ methods and the C functions are separated into two sections for easier lookup.

## C++ Methods

**Constructor**

```
MseIoModule(void);
```

**initializeModule**

The initializeModule method is used to initialize an I/O module. It calls the MseModule::initializeModule() and then calls setModuleInitialized (true) if the initialization passes. The number of channels is set to NUM_MSE_IO_INPUTS + NUM_MSE_IO_OUTPUTS.

**Method**

```
MseResults initializeModule
                (
                      const char*           mseIpAddress,
                      bool                  useAsync
                );
```

**Parameters**

| | |
|---|---|
| mseIpAddress | The IP address of the module to initialize |
| useAsync | True if the MSE should send asynchronous messages |

**setOutputs**

The setOutputs method is used to set the output of the I/O module to the desired values.

**Method**

```
MseResults setOutputs
                (
                      const unsigned char*   output
                );
```

**Parameters**

| | |
|---|---|
| output | A pointer to an unsigned char, each output in the I/O module will be set to the corresponding bit in the char. The char can only set output 1,2,3 and 4 in the module. |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the setOutputs command was sent |

**setOutput**

The setOutput method is used to set an individual output of the I/O module to the desired value.

**Method**

```
MseResults setOutput
                (
                      unsigned char          pin,
                      bool                   val
                );
```

**Parameters**

| | |
|---|---|
| pin | An unsigned char representing the pin to set to the desired value. Acceptable values are 1 to NUM_MSE_IO_OUTPUTS. |
| val | A boolean representing whether to set the pin high or low |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the setOutput command was sent |

**getOutputs**

The getOutputs method is used to get the outputs of the I/O module.

**Method**

```
MseResults getOutputs
                (
                      unsigned char*         outputs
                );
```

**Parameters**

| | |
|---|---|
| outputs | A character where the output settings of the I/O module will be stored. Bit 0 will hold output 1 and bit 3 will hold output 4. |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the getOutputs command was completed |

### getInputs

The getInputs method is used to get the inputs of the I/O module.

**Method**

```
MseResults getInputs
                (
                        unsigned char*          inputs
                );
```

**Parameters**

| | |
|---|---|
| inputs | A character where the input settings of the I/O module will be stored. Bit 0 will hold input 1 and bit 3 will hold input 4. |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the getInputs command was completed |

### getIO

The getIO method is used to get the inputs and outputs of the I/O module. If the option is set to COUNT_REQUEST_LATCHED, the module will clear the latch after the I/O is read to allow for faster subsequent latching.

**Method**

```
MseResults getIO
                (
                        unsigned char*          inputs,
                        unsigned char*          outputs,
                        COUNT_REQUEST_OPTION    option
                );
```

**Parameters**

| | |
|---|---|
| inputs | A character where the input settings of the I/O module will be stored. Bit 0 will hold input 1 and bit 3 will hold input 4. |
| outputs | A character where the output settings of the I/O module will be stored. Bit 0 will hold output 1 and bit 3 will hold output 4. |
| option | The type of position to return |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the getIO command was completed |

## C Functions

The I/O C functions can be found in the MseIoModuleWrapper.h file.

### MseIoModuleCreate

Creates a MseIoModule object and returns a pointer to it.

**Function**

```
MseIoModulePtr MseIoModuleCreate
               (
               );
```

**Return value**

The return value delivers a pointer to the MseIoModule object that was created.

### MseIoModuleDelete

Deletes the MseIoModule object that was passed in.

**Function**

```
void MseIoModuleDelete
               (
                     MseIoModulePtr          object
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |

### MseIoModuleInitialize

Initializes the MseIoModule object that was passed in.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleInitialize
               (
                     MseIoModulePtr          object,
                     char*                   mseIpAddress,
                     bool                    useAsync
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| mseIpAddress | The IP address of the module to initialize |
| useAsync | Whether to enable asynchronous communication from the module |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseIoModuleGetNumChannels**

Gets the number of channels on the module.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleGetNumChannels
                  (
                        MseIoModulePtr          object,
                        unsigned short*         numChannels
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| numChannels | A pointer to the location where the number of channels will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseIoModuleGetModuleErrorState**

Gets the error state of the module. A value of True signifies that there is an error.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleGetModuleErrorState
                  (
                        MseIoModulePtr          object,
                        bool*                   errorState
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| errorState | A pointer to the location where the error state will be copied to. A subsequent call to MseIoModuleGetModuleErrors can be made to get the actual errors. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseIoModuleGetModuleErrors**

Gets the actual module errors.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleGetModuleErrors
                  (
                        MseIoModulePtr          object,
                        long*                   errors,
                        double*                 ranges,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| errors | A pointer to the location where the errors will be copied to. The errors is a single long that can be masked with the INTEGRITY_ENUMS to determine which error has occurred. |
| ranges | A pointer to the location where the ranges used to determine an error will be copied to. The ranges is an array that must be large enough to hold NUM_INTEGRITY_RANGES. |
| size | The size of the ranges array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseIoModuleGetAdcValues**

Gets the voltage and temperature values for the module.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleGetAdcValues
                  (
                        MseIoModulePtr          object,
                        short*                  adcVals,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| adcVals | A pointer to the location where the voltage and temperature values will be stored. Must be large enough to hold ADC_NUM_CHANNELS. The ADC_OPTIONS enumeration can be used to index into the adcVals array. |
| size | The size of the adcVals array |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseIoModuleClearErrors**

Clears the module and channel errors and warnings.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleClearErrors
                  (
                        MseIoModulePtr          object
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseIoModuleSetOutputs**

Sets the outputs of the module.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleSetOutputs
                  (
                        MseIoModulePtr          object,
                        char                    output
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| output | The outputs to set masked into a single byte |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseIoModuleSetOutput**

Sets a single output of the module.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleSetOutput
                  (
                        MseIoModulePtr          object,
                        short                   pin,
                        short                   val
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| pin | The output to set. Can be 1 - 4. |
| val | The value to set the output to. Can be 0 or 1. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseIoModuleGetOutputs**

Gets the outputs of the module.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleGetOutputs
                  (
                        MseIoModulePtr          object,
                        char*                   outputs
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| outputs | A pointer to the location where the outputs will be stored. Bit 0 will hold output 1 and bit 3 will hold output 4. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseIoModuleGetInputs**

Gets the inputs of the module.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleGetInputs
                  (
                        MseIoModulePtr          object,
                        char*                   inputs
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| inputs | A pointer to the location where the inputs will be stored. Bit 0 will hold input 1 and bit 3 will hold input 4. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseIoModuleGetIO

Gets the inputs and outputs of the module.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleGetInputs
                (
                      MseIoModulePtr          object,
                      char*                   inputs,
                      char*                   outputs,
                      COUNT_REQUEST_OPTION    option
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| inputs | A pointer to the location where the inputs will be stored. Bit 0 will hold input 1 and bit 3 will hold input 4. |
| outputs | A pointer to the location where the outputs will be stored. Bit 0 will hold output 1 and bit 3 will hold output 4. |
| option | Whether to get the latest or latched inputs. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseIoModuleGetLatch

Gets whether the latch is active.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleGetLatch
                (
                      MseIoModulePtr          object,
                      bool*                   isLatched
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |
| isLatched | A pointer to the location where the latch state will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseIoModuleClearLatch

Clears the latch. The user must make sure that the base module latches are cleared first or else the latch will immediately trigger again.

**Function**

```
MSE_RESPONSE_CODE MseIoModuleClearLatch
                (
                MseIoModulePtr                object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseIoModule object that was created by the MseIoModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

# 2.15 Pneumatic methods and functions

C++ methods and the C functions are separated into two sections for easier lookup.

## C++ Methods

**Constructor**

```
MsePneumaticModule(void);
```

**initializeModule**

The initializeModule method is used to initialize a pneumatic module. It calls the MseModule::initializeModule() and then calls setModuleInitialized (true) if the initialization passes. The number of channels is set to 1.

**Method**

```
MseResults initializeModule
                (
                        const char*             mseIpAddress,
                        bool                    useAsync
                );
```

**Parameters**

| | |
|---|---|
| mseIpAddress | The IP address of the module to initialize |
| useAsync | True if the MSE should send asynchronous messages |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**getOutput**

The getOutput method is used to get the output of the pneumatic module. If the option is set to COUNT_REQUEST_LATCHED, the module will clear the latch after the output is read to allow for faster subsequent latching.

**Method**

```
MseResults getOutput
                (
                        unsigned char*          output,
                        COUNT_REQUEST_OPTION    option
                );
```

**Parameters**

| | |
|---|---|
| output | A character where the output setting of the pneumatic module will be stored. |
| option | The type of output to return. |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the getOutput command was completed |

**setOutput**

The setOutput method is used to set the output of the pneumatic module to the desired value.

**Method**

```
MseResults setOutput
                (
                        bool                    val
                );
```

**Parameters**

| | |
|---|---|
| val | A boolean representing whether to set the output high or low |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the setOutput command was sent |

## C Functions

The pneumatic C functions can be found in the MsePneumaticModuleWrapper.h file.

### MsePneumaticModuleCreate

Creates a MsePneumaticModule object and returns a pointer to it.

**Function**

```
MsePneumaticModulePtr MsePneumaticModuleCreate
                (
                );
```

**Return value**

The return value delivers a pointer to the MsePneumaticModule object that was created.

### MsePneumaticModuleDelete

Deletes the MsePneumaticModule object that was passed in.

**Function**

```
void MsePneumaticModuleDelete
                (
                        MsePneumaticModulePtr  object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |

### MsePneumaticModuleInitialize

Initializes the MsePneumaticModule object that was passed in.

**Function**

```
MSE_RESPONSE_CODE MsePneumaticModuleInitialize
                (
                        MsePneumaticModulePtr  object,
                        char*                  mseIpAddress,
                        bool                   useAsync
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |
| mseIpAddress | The IP address of the module to initialize |
| useAsync | Whether to enable asynchronous communication from the module |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MsePneumaticModuleGetNumChannels

Gets the number of channels on the module.

**Function**

```
MSE_RESPONSE_CODE MsePneumaticModuleGetNumChannels
                  (
                        MsePneumaticModulePtr  object,
                        unsigned short*        numChannels
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |
| numChannels | A pointer to the location where the number of channels will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MsePneumaticModuleGetModuleErrorState

Gets the error state of the module. A value of True signifies that there is an error.

**Function**

```
MSE_RESPONSE_CODE MsePneumaticModuleGetModuleErrorState
                  (
                        MsePneumaticModulePtr  object,
                        bool*                  errorState
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |
| errorState | A pointer to the location where the error state will be copied to. A subsequent call to MsePneumaticModuleGetModuleErrors can be made to get the actual errors. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MsePneumaticModuleGetModuleErrors**

Gets the actual module errors.

**Function**

```
MSE_RESPONSE_CODE MsePneumaticModuleGetModuleErrors
                  (
                        MsePneumaticModulePtr  object,
                        long*                  errors,
                        double*                ranges,
                        short                  size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |
| errors | A pointer to the location where the errors will be copied to. The errors is a single long that can be masked with the INTEGRITY_ENUMS to determine which error has occurred. |
| ranges | A pointer to the location where the ranges used to determine an error will be copied to. The ranges is an array that must be large enough to hold NUM_INTEGRITY_RANGES. |
| size | The size of the ranges array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MsePneumaticModuleGetAdcValues**

Gets the voltage and temperature values for the module.

**Function**

```
MSE_RESPONSE_CODE MsePneumaticModuleGetAdcValues
                  (
                        MsePneumaticModulePtr  object,
                        short*                 adcVals,
                        short                  size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |
| adcVals | A pointer to the location where the voltage and temperature values will be stored. Must be large enough to hold ADC_NUM_CHANNELS. The ADC_OPTIONS enumeration can be used to index into the adcVals array. |
| size | The size of the adcVals array |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MsePneumaticModuleClearErrors**

Clears the module and channel errors and warnings.

**Function**

```
MSE_RESPONSE_CODE MsePneumaticModuleClearErrors
                  (
                        MsePneumaticModulePtr   object
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MsePneumaticModuleSetOutput**

Sets the output of the module.

**Function**

```
MSE_RESPONSE_CODE MsePneumaticModuleSetOutput
                  (
                        MsePneumaticModulePtr   object,
                        short                   val
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |
| val | 1 to enable and 0 to disable |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MsePneumaticModuleGetOutput**

Gets the output of the module.

**Function**

```
MSE_RESPONSE_CODE MsePneumaticModuleGetOutput
                  (
                        MsePneumaticModulePtr   object,
                        char                    outputVal,
                        COUNT_REQUEST_OPTION    option
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |
| outputVal | A pointer to the location where the output will be stored |
| option | Whether to get the latest or latched output |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MsePneumaticModuleGetLatch

Gets whether the latch is active.

**Function**

```
MSE_RESPONSE_CODE MsePneumaticModuleGetLatch
                  (
                  MsePneumaticModulePtr         object,
                  bool*                         isLatched
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |
| isLatched | A pointer to the location where the latch state will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MsePneumaticModuleClearLatch

Clears the latch. The user must make sure that the base module latches are cleared first or else the latch will immediately trigger again.

**Function**

```
MSE_RESPONSE_CODE MsePneumaticModuleClearLatch
                  (
                        MsePneumaticModulePtr  object
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MsePneumaticModule object that was created by the MsePneumaticModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

# 2.16 LVDT methods and functions

C++ methods and the C functions are separated into two sections for easier lookup.

## C++ Methods

**Constructor**

```
MseLvdtModule(void);
```

**initializeModule**

The initializeModule method is used to initialize an LVDT module. It calls the MseModule::initializeModule() and then calls setModuleInitialized(true) if the initialization passes. The number of channels is set to 8.

**Method**

```
MseResults initializeModule
                (
                        const char*             mseIpAddress,
                        bool                    useAsync
                );
```

**Parameters**

| | |
|---|---|
| mseIpAddress | The IP address of the module to initialize |
| useAsync | True if the MSE should send asynchronous messages |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**getUom**

The getUom method is used to get the unit of measurement for a specified channel.

**Method**

```
bool getUom
                (
                        LVDT_UOM*               uom,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| uom | The location the units of measure for the specified channel will be stored |
| channel | The channel to get indexed from 0 |

**Return value**

| | |
|---|---|
| bool | True if the method succeeds, false if the channel is out of range or the pointer is NULL. |

**setUom**

The setUom method is used to set the unit of measurement for a specified channel.

**Method**

```
bool setUom
                (
                        LVDT_UOM                uom,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| uom | The units of measure for the specified channel |
| channel | The channel to set indexed from 0 |

**Return value**

| | |
|---|---|
| bool | True if the method succeeds, false if the channel is out of range. |

**getExcitationValues**

The getExcitationValues method is used to get the excitation voltage and frequency used for the primary windings of the LVDT sensors. The frequency is in kHz.

**Method**

```
MseResults getExcitationValues
                (
                        double*                 voltage,
                        double*                 frequency
                );
```

**Parameters**

| | |
|---|---|
| voltage | The location where the primary winding excitation voltage will be stored |
| frequency | The location where the primary winding excitation frequency will be stored |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**setExcitationVoltage**

The setExcitationVoltage method is used to set the excitation voltage used for the primary windings of the LVDT sensors.

**Method**

```
MseResults setExcitationVoltage
                (
                        const double*           voltage
                );
```

**Parameters**

| | |
|---|---|
| voltage | The desired primary winding excitation voltage. The voltage can be from LVDT_EXCITATION_VOLTAGE_MIN_VPP to LVDT_EXCITATION_VOLTAGE_MAX_VPP. |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**setExcitationFrequency**

The setExcitationFrequency method is used to set the excitation frequency used for the primary windings of the LVDT sensors.

**Method**

```
MseResults setExcitationFrequency
                (
                        const double*           frequency
                );
```

**Parameters**

| | |
|---|---|
| frequency | The desired primary winding excitation frequency in kHz. The frequency can be from LVDT_EXCITATION_FREQUENCY_MIN_KHZ to LVDT_EXCITATION_FREQUENCY_MAX_KHZ. |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**getVoltage**

The getVoltage method is used to get the LVDT output voltage for the desired channel.

**Method**

```
MseResults getVoltage
                (
                        unsigned short          channel,
                        double*                 channelVoltage,
                        long*                   counts
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to get the voltage of indexed from 0 |
| channelVoltage | The location where the LVDT sensor output voltage will be stored |
| counts | The location where the LVDT sensor output counts will be stored |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**getPositions**

The getPositions method is used to get the position of a specific LVDT sensor in user units. The setResolution and setUom methods must be called before calling this method.

**Method**

```
MseResults getPositions
                (
                        double*                 pos,
                        unsigned short          numChannels,
                        COUNT_REQUEST_OPTION    option
                );
```

**Parameters**

| | |
|---|---|
| pos | The location where the position will be stored |
| numChannels | The number of doubles in the pos array passed in |
| option | Whether to read live or latched positions |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

### setChannelPresence

The setChannelPresence method is used to set whether an LVDT sensor is attached to a specific channel.

**Method**

```
MseResults setChannelPresence
                (
                      unsigned char          isConnected,
                      unsigned char          channel
                );
```

**Parameters**

| | |
|---|---|
| isConnected | Set to 1 if an LVDT is connected to the channel |
| channel | The channel to set indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

### getChannelPresence

The getChannelPresence method is used to get whether an LVDT sensor is attached to a specific channel.

**Method**

```
MseResults getChannelPresence
                (
                      unsigned char*         isConnected,
                      unsigned char          channel
                );
```

**Parameters**

| | |
|---|---|
| isConnected | 1 signifies that an LVDT sensor is connected to the channel |
| channel | The channel to get indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

### getResolution

The getResolution method is used to get the resolution used when converting an LVDT output voltage to a position.

**Method**

```
MseResults getResolution
                (
                      unsigned short         channelNum,
                      double*                resolution
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel to get the resolution of indexed from 0 |
| resolution | The location where the resolution will be stored |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**setResolution**

The setResolution method is used to set the resolution used when converting an LVDT output voltage to a position. This value will be in mm/V or in/V depending on what was set with setUom.

**Method**

```
MseResults setResolution
                (
                        unsigned short          channelNum,
                        const double            resolution
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel to set the resolution of indexed from 0 |
| resolution | The resolution to use when converting an LVDT output voltage to a position |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**setDiagnosticsEnabled**

The setDiagnosticsEnabled method is used to set the voltages to monitor based on the LVDT_UPDATE_CHOICES enumeration passed in.

**Method**

```
MseResults setDiagnosticsEnabled
                (
                        const LVDT_UPDATE_CHOICES  choice
                );
```

**Parameters**

| | |
|---|---|
| choice | The desired voltages to monitor |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**getFpgaRevision**

The getFpgaRevision method is used to get the revision of the FPGA code used in the module. The revision is in the form 0xMMmm, where MM is the major number and mm is the minor number (e.g. 0x0100 is V1.00).

**Method**

```
MseResults getFpgaRevision
                (
                        unsigned short*         revision
                );
```

**Parameters**

| | |
|---|---|
| revision | A pointer to the location where the FPGA revision will be stored |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**getSensorGain**

The getSensorGain method is used to get the gain code used for a given sensor.

**Method**

```
MseResults getSensorGain
                (
                        const unsigned short    channelNum,
                        unsigned char*          gainCode
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel number to get the gain code of indexed from 0 |
| gainCode | A pointer to the location where the gain code for the desired channel will be stored |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**setSensorGain**

The setSensorGain method is used to set the gain code used for a given sensor.

**Method**

```
MseResults setSensorGain
                (
                        const unsigned short    channelNum,
                        const unsigned char     gainCode
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel number to get the gain code of indexed from 0 |
| gainCode | The gain code for the desired channel |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**teachSensorGain**

The teachSensorGain method is used to send a command to the module to adjust the gain until a value is found that allows for the greatest range.

**Method**

```
MseResults teachSensorGain
                (
                        const unsigned short    channelNum
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel number to teach the gain code for indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

#### getTeachSensorGainFinished

The getTeachSensorGainFinished method is used to get whether the teach has finished for a sensor's position gain. The teach is started when the teachSensorGain method is called.

**Method**

```
MseResults getTeachSensorGainFinished
                (
                      const unsigned short    channelNum,
                      unsigned short*         gainCode
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel number to get the teach completion status for indexed from 0 |
| gainCode | The resulting gain code from the teach. This will be 0 if the teach has not been completed. |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

## C Functions

The LVDT module C functions can be found in the MseLvdtModuleWrapper.h file.

#### MseLvdtModuleCreate

Creates a MseLvdtModule object and returns a pointer to it.

**Function**

```
MseLvdtModulePtr MseLvdtModuleCreate
                (
                );
```

**Return value**

The return value delivers a pointer to the MseLvdtModule object that was created.

#### MseLvdtModuleDelete

Deletes the MseLvdtModule object that was passed in.

**Function**

```
void MseLvdtModuleDelete
                (
                      MseLvdtModulePtr        object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |

**MseLvdtModuleInitialize**

Initializes the MseLvdtModule object that was passed in.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleInitialize
                  (
                        MseLvdtModulePtr       object,
                        char*                  mseIpAddress,
                        bool                   useAsync
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| mseIpAddress | The IP address of the module to initialize |
| useAsync | Whether to enable asynchronous communication from the module |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetNumChannels**

Gets the number of channels on the module.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleGetNumChannels
                  (
                        MseLvdtModulePtr       object,
                        unsigned short*        numChannels
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| numChannels | A pointer to the location where the number of channels will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleSetUom**

Sets the unit of measurement to use for the specified channel when requesting position.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleSetUom
                  (
                        MseLvdtModulePtr       object,
                        LVDT_UOM               uom,
                        short                  channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| uom | The unit of measurement to use when requesting position for the specified channel |
| channel | The channel to set the unit of measurement of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetUom**

Gets the unit of measurement used for the specified channel when requesting position.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleGetUom
                  (
                        MseLvdtModulePtr        object,
                        LVDT_UOM*               uom,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| uom | A pointer to the location where the unit of measurement will be stored |
| channel | The channel to get the unit of measurement of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleSetResolution**

Sets the resolution to use for the specified channel when requesting position.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleSetResolution
                  (
                        MseLvdtModulePtr        object,
                        const double            resolution,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| resolution | The resolution to use when requesting position for the specified channel |
| channel | The channel to set the resolution of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetResolution**

Gets the resolution used for the specified channel when requesting position.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleGetResolution
                  (
                        MseLvdtModulePtr        object,
                        double*                 resolution,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| resolution | A pointer to the location where the resolution will be stored |
| channel | The channel to get the resolution of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetLatch**

Gets whether the latch is active.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleGetLatch
                  (
                        MseLvdtModulePtr        object,
                        bool*                   isLatched
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| isLatched | A pointer to the location where the latch state will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleClearLatch**

Clears the latch. The user must make sure that the base module latch is cleared first or the latch will immediately trigger again.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleClearLatch
                        (
                        MseLvdtModulePtr        object
                        );
```

Parameters

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetModuleErrorState**

Gets the error state of the module. A value of True signifies that there is an error.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleGetModuleErrorState
                  (
                        MseLvdtModulePtr        object,
                        bool*                   errorState
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| errorState | A pointer to the location where the error state will be stored. A subsequent call to MseLvdtModuleGetModuleErrors can be made to get the actual errors. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetModuleErrors**

Gets the errors specific to the module.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleGetModuleErrors
                  (
                        MseLvdtModulePtr        object,
                        long*                   errors,
                        double*                 ranges,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| errors | A pointer to the location where the errors state will stored. The errors is a single long that can be masked with the INTEGRITY_ENUMS to determine which error has occurred. |
| ranges | A pointer to the location where the ranges used to determine an error will be stored. The ranges is an array that must be large enough to hold NUM_INTEGRITY_RANGES. |
| size | The size of the ranges array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleEnableDiags**

Sets the diagnostic mode for the channels and module.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleEnableDiags
                  (
                        MseLvdtModulePtr        object,
                        DIAG_MODE_OPTIONS       choice
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| choice | The desired level of diagnostics |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetAdcValues**

Gets the voltage and temperature values for the module.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleGetAdcValues
                  (
                        MseLvdtModulePtr        object,
                        short*                  adcVals,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| adcVals | A pointer to the location where the voltage and temperature values will be stored. Must be large enough to hold ADC_NUM_CHANNELS. The ADC_OPTIONS enumeration can be used to index into the adcVals array. |
| size | The size of the adcVals array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleClearErrors**

Clears the module errors and warnings.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleClearErrors
                  (
                        MseLvdtModulePtr       object
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetPositions**

Gets the positions of all of the LVDT sensors in the module.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleGetPositions
                  (
                        MseLvdtModulePtr       object,
                        double*                pos,
                        short                  numChannels,
                        COUNT_REQUEST_OPTION   option
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| pos | A pointer to the location where the LVDT positions will be copied to. Must be large enough to hold NUM_LVDT_CHANNELS. |
| numChannels | The size of the pos array |
| option | Whether to get the latest or the latched positions |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleSetDeviceOffset**

The MseLvdtModuleSetDeviceOffset method is used to set the offset that will be applied to the position calculated from the counts in the MseLvdtModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE  MseLvdtModuleSetDeviceOffset
                  (
                        MseLvdtModulePtr       object,
                        unsigned short         channel,
                        double                 offset
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| channel | The channel of the encoder to apply the offset to |
| offset | The offset to apply |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetDeviceOffset**

The MseLvdtModuleGetDeviceOffset method is used to return the offset that will be applied to the position calculated from the counts in the MseLvdtModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE   MseLvdtModuleGetDeviceOffset
                    (
                          MseLvdtModulePtr       object,
                          unsigned short         channel
                          double*                offset
                    );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| channel | The channel of the encoder that the offset will be applied to |
| offset | A pointer to the location where the offset will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetExcitationValues**

Gets the primary windings excitation voltage and frequency. The frequency is in kHz.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleGetExcitationValues
                  (
                        MseLvdtModulePtr       object,
                        double*                voltage,
                        double*                frequency
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| voltage | A pointer to the location where the primary winding excitation voltage will be stored |
| frequency | A pointer to the location where the primary winding excitation frequency will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleSetExcitationVoltage**

Sets the primary windings excitation voltage. The voltage is used for all sensors connected to the module. The data sheet for the sensor should be used to determine the correct voltage.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleSetExcitationVoltage
                (
                      MseLvdtModulePtr       object,
                      const double           voltage
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| voltage | The desired primary winding excitation voltage. The voltage can be from LVDT_EXCITATION_VOLTAGE_MIN_VPP to LVDT_EXCITATION_VOLTAGE_MAX_VPP. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleSetExcitationFrequency**

Sets the primary windings excitation frequency. The frequency is used for all sensors connected to the module. The data sheet for the sensor should be used to determine the correct frequency.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleSetExcitationFrequency
                (
                      MseLvdtModulePtr       object,
                      const double           frequency
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| frequency | The desired primary winding excitation frequency in kHz. The frequency can be from LVDT_EXCITATION_FREQUENCY_MIN_KHZ to LVDT_EXCITATION_FREQUENCY_MAX_KHZ. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetVoltage**

Gets the LVDT output voltage for the desired channel.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleGetVoltage
                (
                      MseLvdtModulePtr       object,
                      unsigned short         channel,
                      double*                channelVoltage,
                      long*                  counts
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| channel | The channel to get the voltage of indexed from 0 |
| channelVoltage | The location where the LVDT sensor output voltage will be stored |
| counts | The location where the LVDT sensor output counts will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleSetChannelPresence**

Sets whether the specified channel is populated.

**Function**

```
MSE_RESPONSE_CODE MseLvdtModuleSetChannelPresence
                  (
                        MseLvdtModulePtr       object,
                        unsigned char          isConnected,
                        unsigned char          channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| isConnected | A value of 1 if an LVDT is connected to the channel |
| channel | The channel to set indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtModuleGetChannelPresence**

The MseLvdtModuleGetChannelPresence method is used to get whether an LVDT sensor is attached to a specific channel.

**Method**

```
MSE_RESPONSE_CODE MseLvdtModuleGetChannelPresence
                  (
                        MseLvdtModulePtr       object,
                        unsigned char*         isConnected,
                        unsigned char          channel
                  );
```

**Parameters**

| | |
|---|---|
| isConnected | 1 signifies that an LVDT sensor is connected to the channel |
| channel | The channel to get indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtSetDiagnosticsEnabled**

The MseLvdtSetDiagnosticsEnabled method is used to set the voltages to monitor based on the LVDT_UPDATE_CHOICES enumeration passed in.

**Function**

```
MSE_RESPONSE_CODE MseLvdtSetDiagnosticsEnabled
                  (
                        MseLvdtModulePtr           object
                        const LVDT_UPDATE_CHOICES  choice
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| choice | The desired voltages to monitor |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseLvdtGetSensorGain

The MseLvdtGetSensorGain method is used to get the gain code used for a given sensor.

**Function**

```
MSE_RESPONSE_CODE MseLvdtGetSensorGain
                (
                        MseLvdtModulePtr        object,
                        const unsigned short    channelNum,
                        unsigned char*          gainCode
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| channelNum | The channel number to get the gain code of indexed from 0 |
| gainCode | A pointer to the location where the gain code for the desired channel will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseLvdtSetSensorGain

The MseLvdtSetSensorGain method is used to set the gain code used for a given sensor.

**Function**

```
MSE_RESPONSE_CODE MseLvdtSetSensorGain
                (
                        MseLvdtModulePtr        object,
                        const unsigned short    channelNum,
                        const unsigned char     gainCode
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| channelNum | The channel number to get the gain code of indexed from 0 |
| gainCode | The gain code for the desired channel |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseLvdtTeachSensorGain

The MseLvdtTeachSensorGain method is used to send a command to the module to adjust the gain until a value is found that allows for the greatest range.

**Function**

```
MSE_RESPONSE_CODE MseLvdtTeachSensorGain
                (
                        MseLvdtModulePtr        object,
                        const unsigned short    channelNum
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| channelNum | The channel number to teach the gain code of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtGetTeachSensorGainFinished**

The MseLvdtGetTeachSensorGainFinished method is used to get whether the teach has finished for the MseLvdtTeachSensorGain function.

**Function**

```
MSE_RESPONSE_CODE MseLvdtGetTeachSensorGainFinished
                  (
                        MseLvdtModulePtr       object,
                        const unsigned short   channelNum,
                        unsigned short*        gainCode
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| channelNum | The channel number to get the teach completion status of indexed from 0 |
| gainCode | A pointer to the location where the resulting gain code from the teach will be stored. This will be 0 if the teach has not been completed. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseLvdtGetFpgaRevision**

The MseLvdtGetFpgaRevision method is used to get the revision of the FPGA code used in the module. The revision is in the form 0xMMmm, where MM is the major number and mm is the minor number (e.g. 0x0100 is V1.00).

**Function**

```
MSE_RESPONSE_CODE MseLvdtGetFpgaRevision
                  (
                        MseLvdtModulePtr       object,
                        unsigned short*        revision
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseLvdtModule object that was created by the MseLvdtModuleCreate function |
| revision | A pointer to the location where the FPGA revision will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.
add:

# 2.17 Analog methods and functions

C++ methods and the C functions are separated into two sections for easier lookup.

## C++ Methods

**Constructor**

```
MseAnalogModule(void);
```

**initializeModule**

The initializeModule method is used to initialize an analog module. It calls the MseModule::initializeModule() and then calls setModuleInitialized(true) if the initialization passes. The number of channels is set to NUM_MSE1000_ANALOG_CHANNELS.

**Method**

```
MseResults initializeModule
                (
                      const char*           mseIpAddress,
                      bool                  useAsync
                );
```

**Parameters**

| | |
|---|---|
| mseIpAddress | The IP address of the module to initialize |
| useAsync | True if the MSE should send asynchronous messages |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**getVoltage**

The getVoltage method is used to get the analog voltage for all channels. The voltage is a value between -10 and 10 V.

**Method**

```
MseResults getVoltage
                (
                      double*               values,
                      unsigned short        numValues,
                      COUNT_REQUEST_OPTION  option
                );
```

**Parameters**

| | |
|---|---|
| values | A pointer to the location where the analog voltage values will be stored. This must be large enough to hold NUM_MSE1000_ANALOG_VALUES_PER_CHANNEL values. |
| numValues | The number of doubles passed in for the values array |
| option | Whether to read live or latched positions |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**getCurrent**

The getCurrent method is used to get the analog current for all channels. The current is a value between 4 and 20 mA.

**Method**

```
MseResults getCurrent
                (
                      double*                values,
                      unsigned short         numValues,
                      COUNT_REQUEST_OPTION   option
                );
```

**Parameters**

| | |
|---|---|
| values | A pointer to the location where the analog current values will be stored. This must be large enough to hold NUM_MSE1000_ANALOG_VALUES_PER_CHANNEL values. |
| numValues | The number of doubles passed in for the values array |
| option | Whether to read live or latched positions |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**getValues**

The getValues method is used to get the analog voltage and current for all channels. The voltage is a value between -10 and 10 V. The current is a value between 4 and 20 mA.

**Method**

```
MseResults getValues
                (
                      double*                values,
                      unsigned short         numValues,
                      COUNT_REQUEST_OPTION   option
                );
```

**Parameters**

| | |
|---|---|
| values | A pointer to the location where the analog voltage and current values will be stored. This must be large enough to hold (NUM_MSE1000_ANALOG_CHANNELS * NUM_MSE1000_ANALOG_VALUES_PER_CHANNEL) values. The values returned are in the following order: values[0] = voltage channel 1, values[1] = current channel 1, values[2] = voltage channel 2, values[3] = current channel 2. |
| numValues | The number of doubles passed in for the values array |
| option | Whether to read live or latched positions |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

### getScaledValues

The getScaledValues method is used to get the analog voltage and current for all channels. The values for each channel are scaled with the resolution and the offset is subtracted. The voltage is a value between -10 and 10 V. The current is a value between 4 and 20 mA.

#### Method

```
MseResults getScaledValues
                (
                        double*                 values,
                        unsigned short          numValues,
                        COUNT_REQUEST_OPTION    option
                );
```

#### Parameters

| | |
|---|---|
| values | A pointer to the location where the analog voltage and current values will be stored. This must be large enough to hold (NUM_MSE1000_ANALOG_CHANNELS * NUM_MSE1000_ANALOG_VALUES_PER_CHANNEL) values. The values returned are in the following order: values[0] = voltage channel 1, values[1] = current channel 1, values[2] = voltage channel 2, values[3] = current channel 2. The resolution is set with the setResolution method. The offset is set with the setOffset method. |
| numValues | The number of doubles passed in for the values array |
| option | Whether to read live or latched positions |

#### Return value

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

### getDiagVoltages

The getDiagVoltages method is used to get the supply and output voltages of the analog module ADC.

#### Method

```
MseResults getDiagVoltages
                (
                        double*                 values,
                        unsigned short          numValues
                );
```

#### Parameters

| | |
|---|---|
| values | A pointer to the location where the supply and output voltages will be stored. This array must be large enough to hold (NUM_ANALOG_DIAG_VOLTAGES * NUM_MSE1000_ANALOG_CHANNELS). |
| numValues | The number of doubles passed in for the values array |

#### Return value

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

### setNumSamples

The setNumSamples method is used to set the number of samples to use for the averaging function in the analog module. Defaults to MAX_NUM_ANALOG_AVG_SAMPLES.

#### Method

```
MseResults setNumSamples
                (
                        const unsigned char     channelNum,
                        const unsigned char     numSamples
                );
```

#### Parameters

| | |
|---|---|
| channelNum | The channel number to set the number of samples of indexed from 0 |
| numSamples | The number of samples to use when determining the running average. Can be from 0 to MAX_NUM_ANALOG_AVG_SAMPLES. |

#### Return value

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**setResolution**

Sets the resolution to use when converting from the device's signal value in mA or V to a value in user units. Defaults to 1.

**Method**

```
MseResults setResolution
                (
                        const unsigned short    channelNum,
                        const double            resolution
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel number to set the resolution of indexed from 0 |
| resolution | The resolution to use |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**getResolution**

Gets the resolution used when converting from the device's signal value in mA or V to a value in user units.

**Method**

```
MseResults getResolution
                (
                        const unsigned short    channelNum,
                        const double*           resolution
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel number to get the resolution of indexed from 0 |
| resolution | The resolution used |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**setOffset**

Sets the offset to use after converting from the device's signal value in mA or V to a value in user units. Defaults to 0.

**Method**

```
MseResults setOffset
                (
                        const unsigned short    channelNum,
                        const double            offset
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel number to set the offset of indexed from 0 |
| offset | The offset to use |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

### getOffset

Gets the offset to use after converting from the device's signal value in mA or V to a value in user units.

**Method**

```
MseResults getOffset
                (
                        const unsigned short    channelNum,
                        const double*           offset
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel number to get the offset of indexed from 0 |
| offset | The offset used |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

### computeResolutionAndOffset

Computes and saves the resolution and offset to use for converting from the device's signal value in mA or V to a value in user units. The computed resolution and offset will be used when the user calls the getScaledValues method.

**Method**

```
MseResults computeResolutionandOffset
                (
                        const unsigned short    channelNum,
                        double*                 resolution,
                        double*                 offset,
                        const double            instrumentationMax,
                        const double            instrumentationMin,
                        const double            signalMax,
                        const double            signalMin
                );
```

**Parameters**

| | |
|---|---|
| channelNum | The channel number to compute the reslution and offset for indexed from 0 |
| resolution | A pointer to the location where the computed resolution will be saved |
| offset | A pointer to the location where the computed offset will be saved |
| instrumentationMax | The calibration max value of the device in user units |
| instrumentationMin | The calibration min value of the device in user units |
| signalMax | The calibration max value of the device in raw voltage or mA |
| signalMin | The calibration min value of the device in raw voltage or mA |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

## C Functions

The analog module C functions can be found in the MseAnalogModuleWrapper.h file.

### MseAnalogModuleCreate

Creates a MseAnalogModule object and returns a pointer to it.

**Function**

```
MseAnalogModulePtr MseAnalogModuleCreate
                        (
                        );
```

**Return value**

The return value delivers a pointer to the MseAnalogModule object that was created.

### MseAnalogModuleDelete

Deletes the MseAnalogModule object that was passed in.

**Function**

```
void MseAnalogModuleDelete
                (
                        MseAnalogModulePtr      object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |

### MseAnalogModuleInitialize

Initializes the MseAnalogModule object that was passed in.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleInitialize
                (
                        MseAnalogModulePtr      object,
                        char*                   mseIpAddress,
                        bool                    useAsync
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| mseIpAddress | The IP address of the module to initialize |
| useAsync | Whether to enable asynchronous communication from the module |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleGetNumChannels**

Gets the number of channels on the module.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetNumChannels
                (
                      MseAnalogModulePtr     object,
                      unsigned short*        numChannels
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| numChannels | A pointer to the location where the number of channels will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleGetModuleErrorState**

Gets the error state of the module. A value of True signifies that there is an error.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetModuleErrorState
                (
                      MseAnalogModulePtr     object,
                      bool*                  errorState
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| errorState | A pointer to the location where the error state will be stored. A subsequent call to MseAnalogModuleGetModuleErrors can be made to get the actual errors. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleGetModuleErrors**

Gets the errors specific to the module.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetModuleErrors
                (
                      MseAnalogModulePtr     object,
                      long*                  errors,
                      double*                ranges,
                      short                  size
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| errors | A pointer to the location where the errors state will stored. The errors is a single long that can be masked with the INTEGRITY_ENUMS to determine which error has occurred. |
| ranges | A pointer to the location where the ranges used to determine an error will be stored. The ranges is an array that must be large enough to hold NUM_INTEGRITY_RANGES. |
| size | The size of the ranges array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleGetAdcValues**

Gets the voltage and temperature values for the module.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetAdcValues
                  (
                        MseAnalogModulePtr      object,
                        short*                  adcVals,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| adcVals | A pointer to the location where the voltage and temperature values will be stored. Must be large enough to hold ADC_NUM_CHANNELS. The ADC_OPTIONS enumeration can be used to index into the adcVals array. |
| size | The size of the adcVals array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleClearErrors**

Clears the module errors and warnings.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleClearErrors
                  (
                        MseAnalogModulePtr      object
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleGetLatch**

Gets whether the latch is active.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetLatch
                  (
                        MseAnalogModulePtr      object,
                        bool*                   isLatched,
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| isLatched | A pointer to the location where the latch state will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseAnalogModuleClearLatch

Clears the latch. The user must make sure that the base module latch is cleared first or the latch will immediately trigger again.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleClearLatch
                  (
                        MseAnalogModulePtr     object
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseAnalogModuleGetVoltage

Gets the analog voltage for all channels. The voltage is a value between -10 and 10V.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetVoltage
                  (
                        MseAnalogModulePtr     object,
                        double*                values,
                        unsigned short         numValues,
                        COUNT_REQUEST_OPTION   option
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| values | A pointer to the location where the voltage values will be stored |
| numValues | The size of the values array. This must be large enough to hold NUM_MSE1000_ANALOG_CHANNELS. |
| option | Whether to get the latest or the latched positions |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseAnalogModuleGetCurrent

Gets the analog current for all channels. The current is a value between 4 and 20mA.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetCurrent
                  (
                        MseAnalogModulePtr     object,
                        double*                values,
                        unsigned short         numValues,
                        COUNT_REQUEST_OPTION   option
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| values | A pointer to the location where the current values will be stored |
| numValues | The size of the values array. This must be large enough to hold NUM_MSE1000_ANALOG_CHANNELS. |
| option | Whether to get the latest or the latched positions |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleGetValues**

Gets the analog voltage and current for all channels. The voltage is a value between -10 and 10V. The current is a value between 4 and 20mA.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetValues
                  (
                        MseAnalogModulePtr     object,
                        double*                values,
                        unsigned short         numValues,
                        COUNT_REQUEST_OPTION   option
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| values | A pointer to the location where the analog voltage and current values will be stored. This must be large enough to hold (NUM_MSE1000_ANALOG_CHANNELS * NUM_MSE1000_ANALOG_VALUES_PER_CHANNEL) values. The values returned are in the following order: values[0] = voltage channel 1, values[1] = current channel 1, values[2] = voltage channel 2, values[3] = current channel 2. |
| numValues | The size of the values array. This must be large enough to hold NUM_MSE1000_ANALOG_CHANNELS. |
| option | Whether to get the latest or the latched positions |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleGetScaledValues**

Gets the analog voltage and current for all channels. The values for each channel are scaled with the resolution and the offset is subtracted. The voltage is a value between -10 and 10V. The current is a value between 4 and 20mA.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetScaledValues
                  (
                        MseAnalogModulePtr     object,
                        double*                values,
                        unsigned short         numValues,
                        COUNT_REQUEST_OPTION   option
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| values | A pointer to the location where the analog voltage and current values will be stored. This must be large enough to hold (NUM_MSE1000_ANALOG_CHANNELS * NUM_MSE1000_ANALOG_VALUES_PER_CHANNEL) values. The values returned are in the following order: values[0] = voltage channel 1, values[1] = current channel 1, values[2] = voltage channel 2, values[3] = current channel 2. |
| numValues | The size of the values array. This must be large enough to hold NUM_MSE1000_ANALOG_CHANNELS. |
| option | Whether to get the latest or the latched positions |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleSetDeviceOffset**

The MseAnalogModuleSetDeviceOffset method is used to set the offset that will be applied to the position calculated from the counts in the MseAnalogModuleGetScaledValues function.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleSetDeviceOffset
                  (
                        MseAnalogModulePtr     object,
                        unsigned               short channel,
                        double                 offset
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| channel | The channel of the encoder to apply the offset to |
| offset | The offset to apply |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleGetDeviceOffset**

The MseAnalogModuleGetDeviceOffset method is used to return the offset that will be applied to the position calculated from the counts in the MseAnalogModuleGetScaledValues function.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetDeviceOffset
                  (
                        MseAnalogModulePtr     object,
                        unsigned short         channel
                        double*                offset
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| channel | The channel of the encoder that the offset will be applied to |
| offset | A pointer to the location where the offset will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleGetDiagVoltages**

Gets the supply and output voltages of the analog module ADC.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetDiagVoltages
                  (
                        MseAnalogModulePtr     object,
                        double*                values,
                        unsigned short         numValues
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| values | A pointer to the location where the supply and output voltages will be stored. This array must be large enough to hold (NUM_ANALOG_DIAG_VOLTAGES * NUM_MSE1000_ANALOG_CHANNELS). |
| numValues | The number of doubles passed in for the values array |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleSetNumSamples**

Sets the number of samples to use for the averaging function in the analog module. Defaults to MAX_NUM_ANALOG_AVG_SAMPLES.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleSetNumSamples
                  (
                        MseAnalogModulePtr      object,
                        const unsigned char     channelNum,
                        const unsigned char     numSamples
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| channelNum | The channel number to set the number of samples of indexed from 0 |
| numSamples | The number of samples to use when determining the running average. Can be from 0 to MAX_NUM_ANALOG_AVG_SAMPLES. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleSetResolution**

Sets the resolution to use when converting from the device's signal value in mA or V to a value in user units. Defaults to 1.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleSetResolution
                  (
                        MseAnalogModulePtr      object,
                        const unsigned short    channelNum,
                        const double            resolution
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| channelNum | The channel number to set the resolution of indexed from 0 |
| resolution | The resolution to use |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseAnalogModuleGetResolution**

Gets the resolution used when converting from the device's signal value in mA or V to a value in user units.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetResolution
                  (
                        MseAnalogModulePtr      object,
                        const unsigned short    channelNum,
                        const double*           resolution
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| channelNum | The channel number to get the resolution of indexed from 0 |
| resolution | A pointer to the location where the resolution will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseAnalogModuleSetOffset

Gets the resolution used when converting from the device's signal value in mA or V to a value in user units.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleSetOffset
                  (
                        MseAnalogModulePtr      object,
                        const unsigned short    channelNum,
                        const double            offset
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| channelNum | The channel number to set the offset of indexed from 0 |
| offset | The offset to use |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseAnalogModuleGetOffset

Gets the offset to use after converting from the device's signal value in mA or V to a value in user units.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetOffset
                  (
                        MseAnalogModulePtr      object,
                        const unsigned short    channelNum,
                        const double*           offset
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| channelNum | The channel number to get the offset of indexed from 0 |
| offset | A pointer to the location where the offset will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseAnalogModuleComputeResolutionAndOffset

Computes and saves the resolution and offset to use for converting from the device's signal value in mA or V to a value in user units. The computed resolution and offset will be used when the user calls the getScaledValues method.

**Function**

```
MSE_RESPONSE_CODE MseAnalogModuleGetOffset
                  (
                        MseAnalogModulePtr      object,
                        const unsigned short    channelNum,
                        double*                 resolution,
                        double*                 offset,
                        const double            instrumentationMax,
                        const double            instrumentationMin,
                        const double            signalMax,
                        const double            signalMin
);
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseAnalogModule object that was created by the MseAnalogModuleCreate function |
| channelNum | The channel number to compute the resolution and offset for indexed from 0 |
| resolution | A pointer to the location where the computed resolution will be saved |
| offset | A pointer to the location where the computed offset will be saved |
| instrumentationMax | The calibration max value of the device in user units |
| instrumentationMin | The calibration min value of the device in user units |
| signalMax | The calibration max value of the device in raw voltage or mA |
| signalMin | The calibration min value of the device in raw voltage or mA |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

# 2.18 TTL methods and functions

C++ methods and the C functions are separated into two sections for easier lookup.

## C++ Methods

**Constructor**

```
MseTtlModule(void);
```

**initializeModule**

The initializeModule method is used to initialize a TTL module. It calls the MseModule::initializeModule() and then calls setModuleInitialized(true) if the initialization passes. The number of channels is set based on the type of TTL module.

**Method**

```
MseResults initializeModule
                (
                      const char*           mseIpAddress,
                      bool                  useAsync
                );
```

**Parameters**

| | |
|---|---|
| mseIpAddress | The IP address of the module to initialize |
| useAsync | True if the MSE should send asynchronous messages |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**getPositions**

The getPositions method is used to get the position of a specific TTL encoder in user units. The setEncoderType, setUom, and setLineCount or setSignalPeriod methods must be called before calling this method. The rotary format of a rotary encoder can be changed with the setRotaryFormat method (it defaults to ROTARY_FORMAT_360).

**Method**

```
MseResults getPositions
                (
                      double*               pos,
                      unsigned short        numChannels,
                      COUNT_REQUEST_OPTION  option
                );
```

**Parameters**

| | |
|---|---|
| pos | A pointer to the location where the position will be stored |
| numChannels | The number of doubles in the pos array passed in |
| option | Whether to read live or latched positions |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded. |

**setEncoderType**

Set the type of encoder used on the specified channel.

**Method**

```
MseResults setEncoderType
                (
                      ENCODER_TYPE_ENUM     encoderType,
                      const unsigned short  channel
                );
```

**Parameters**

| | |
|---|---|
| encoderType | The type of encoder to use for calculating the position value |
| channel | The channel to set the encoder type of indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**setUom**

Set the unit of measurement on the specified channel. This value will be applied to the position when getPositions is called.

**Method**

```
MseResults setUom
                (
                        UOM                     uom,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| uom | The unit of measurement to use for computing the position value |
| channel | The channel to set the uom for indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**setLineCount**

Set the line count of the encoder for the specified channel.

**Method**

```
MseResults setLineCount
                (
                        unsigned long           lineCount,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| lineCount | The line count of the encoder to use for computing the position value |
| channel | The channel to set the line count for indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**getLineCount**

Get the line count of the encoder for the specified channel.

**Method**

```
MseResults getLineCount
                (
                        unsigned long*          lineCount,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| lineCount | A pointer to the location where the line count of the encoder used for computing the position value will be stored |
| channel | The channel to get the line count of indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**setSignalPeriod**

Set the signal period of the encoder for the specified channel.

**Method**

```
MseResults setSignalPeriod
                (
                        unsigned long           signalPeriod,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| signalPeriod | The signal period of the encoder to use for computing the position value |
| channel | The channel to set the signal period for indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**getSignalPeriod**

Get the signal period of the encoder for the specified channel.

**Method**

```
MseResults getSignalPeriod
                (
                        unsigned long*          signalPeriod,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| signalPeriod | A pointer to the location where the signal period of the encoder used for computing the position value will be stored |
| channel | The channel to get the signal period of indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**setCountingDirection**

Set the counting direction of the encoder for the specified channel.

**Method**

```
MseResults setCountingDirection
                (
                        const unsigned char     direction,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| direction | The counting direction of the encoder. A value of 0 is used for normal and 1 for inverted. |
| channel | The channel to set the counting direction for indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**setChannelPresence**

Set the connection status of the encoder for the specified channel.

**Method**

```
MseResults setChannelPresence
                (
                        unsigned char           isConnected,
                        unsigned char           channel
                );
```

**Parameters**

| | |
|---|---|
| isConnected | A value of 1 if the channel is populated, otherwise 0 |
| channel | The channel to set the presence for indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**getChannelPresence**

Get the connection status of the encoder for the specified channel.

**Method**

```
MseResults getChannelPresence
                (
                        unsigned char*          isConnected,
                        unsigned char           channel
                );
```

**Parameters**

| | |
|---|---|
| isConnected | A pointer to the location where the channel presence will be stored |
| channel | The channel to get the presence of indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**isReferencingComplete**

Gets whether the referencing has been completed for an encoder on the specified channel.

**Method**

```
MseResults isReferencingComplete
                (
                        const unsigned char     channel,
                        bool*                               isComplete
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to get the referencing state of indexed from 0 |
| isComplete | A pointer to the location where the referencing state value will be stored. A value of True is returned if referencing is complete. |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**initReferencing**

Initializes the parameters used for determining absolute position of a specified encoder.

**Method**

```
MseResults initReferencing
                (
                      const unsigned char        channel,
                      const REFERENCE_MARK_ENUM  refMarkType,
                      const unsigned short       value
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to initialize the referencing of indexed from 0 |
| refMarkType | The type of referencing used by the encoder |
| value | This is the signal period of a linear encoder and the line count for a rotary encoder |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**acknowledgeReferencing**

Used to send an acknowledge to the module informing it that the asynchronous reference complete message was received. If asynchronous communication is used and this is not sent, the module will keep sending reference complete messages.

**Method**

```
MseResults acknowledgeReferencing
                (
                      const unsigned char    channel
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to acknowledge the referencing of indexed from 0 |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

**getReferencingState**

Gets the state of the referencing for the desired channel. This method should be called after isReferencingComplete is true or before acknowledgeReferencing is sent in order to check if referencing succeeded. Referencing succeeds if the refMarkState is REF_MARK_FINISHED.

**Method**

```
MseResults getReferencingState
                (
                      const unsigned char channel,
                      REF_MARK_STATE* refMarkState
                );
```

**Parameters**

| | |
|---|---|
| channel | The channel to get the referencing state indexed from 0 |
| refMarkState | The state of the referencing. See the REF_MARK_STATE enumeration for more information. |

**Return value**

The return value delivers a response code representing whether the command was successful.

#### getFpgaRevision

Get the revision of the FPGA code used in the module.

**Method**

```
MseResults getFpgaRevision
                (
                        unsigned short*         revision
                );
```

**Parameters**

| | |
|---|---|
| revision | A pointer to the location where the FPGA revision will be stored. The revision is in the form 0xMMmm, where MM is the major version and mm is the minor version (e.g. 0x0100 is V1.00). |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the method succeeded |

## C Functions

The TTL module C functions can be found in the MseTtlModuleWrapper.h file.

#### MseTtlModuleCreate

Creates a MseTtlModule object and returns a pointer to it.

**Function**

```
MseTtlModulePtr MseTtlModuleCreate
                (
                );
```

**Return value**

The return value delivers a pointer to the MseTtlModule object that was created.

#### MseTtlModuleDelete

Deletes the MseTtlModule object that was passed in.

**Function**

```
void MseTtlModuleDelete
                (
                        MseTtlModulePtr         object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |

#### MseTtlModuleInitialize

Initializes the MseTtlModule object that was passed in.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleInitialize
                (
                        MseTtlModulePtr         object,
                        char*                   mseIpAddress,
                        bool                    useAsync
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| mseIpAddress | The IP address of the module to initialize |
| useAsync | Whether to enable asynchronous communication from the module |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetNumChannels**

Gets the number of channels on the module.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetNumChannels
                (
                      MseTtlModulePtr        object,
                      unsigned short*        numChannels
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| numChannels | A pointer to the location where the number of channels will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleSetEncoderType**

Set the type of encoder used on the specified channel.

**Function**

```
MSE_RESPONSE_CODE setEncoderType
                (
                      MseTtlModulePtr        object,
                      ENCODER_TYPE_ENUM      encoderType,
                      const unsigned short   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| encoderType | The type of encoder to use for calculating the position value |
| channel | The channel to set the encoder type of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetEncoderType**

Get the type of encoder used on the specified channel.

**Function**

```
MSE_RESPONSE_CODE getEncoderType
                (
                      MseTtlModulePtr        object,
                      ENCODER_TYPE_ENUM*     encoderType,
                      const unsigned short   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| encoderType | A pointer to the location where the type of encoder to use for calculating the position value will be stored |
| channel | The channel to get the encoder type of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleSetUom**

Sets the unit of measurement to use for the specified channel when requesting position.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleSetUom
                  (
                        MseTtlModulePtr         object,
                        UOM                     uom,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| uom | The unit of measurement to use when requesting position for the specified channel |
| channel | The channel to set the unit of measurement of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetUom**

Gets the unit of measurement used for the specified channel when requesting position.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetUom
                  (
                        MseTtlModulePtr         object,
                        UOM*                       uom,
                        short                      channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| uom | A pointer to the location where the unit of measurement will be stored |
| channel | The channel to get the unit of measurement of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleSetErrorCompensation**

Set the error compensation used on the specified channel.

**Function**

```
MSE_RESPONSE_CODE setErrorCompensation
                  (
                        MseTtlModulePtr            object,
                        double                           val,
                        short                            channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| val | The error compensation value to apply when calculating the position |
| channel | The channel to set the error compensation value of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetErrorCompensation**

Get the error compensation used on the specified channel.

**Function**

```
MSE_RESPONSE_CODE getErrorCompensation
                (
                      MseTtlModulePtr        object,
                      double*                val,
                      short                  channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| val | A pointer to the location where the error compensation value to apply when calculating the position will be stored |
| channel | The channel to get the error compensation value of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleSetCountingDirection**

Set the counting direction of the encoder for the specified channel.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleSetCountingDirection
                (
                      MseTtlModulePtr        object,
                      const unsigned char    direction,
                      const unsigned short   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| direction | The counting direction of the encoder. A value of 0 is used for normal and 1 for inverted. |
| channel | The channel to set the counting direction for indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetCountingDirection**

Get the counting direction of the encoder for the specified channel.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetCountingDirection
                (
                      MseTtlModulePtr        object,
                      const unsigned char*   direction,
                      const unsigned short   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| direction | A pointer to the location where the counting direction of the encoder will be stored |
| channel | The channel to get the counting direction for indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleSetChannelPresence**

Set the connection status of the encoder for the specified channel.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleSetChannelPresence
                  (
                        MseTtlModulePtr         object,
                        unsigned char           isConnected,
                        unsigned char           channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| isConnected | A value of 1 if the channel is populated, otherwise 0 |
| channel | The channel to set the presence for indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetChannelPresence**

Get the connection status of the encoder for the specified channel.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetChannelPresence
                  (
                        MseTtlModulePtr         object,
                        unsigned char*          isConnected,
                        unsigned char           channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| isConnected | A pointer to the location where the channel presence will be stored |
| channel | The channel to get the presence of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetResolution**

Get the resolution of the encoder for the specified channel. The resolution is calculated when the MseTtlModuleSetLineCount or MseTtlModuleGetLineCount is called.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetResolution
                  (
                        MseTtlModulePtr         object,
                        double*                 resolution,
                        short                   channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| resolution | A pointer to the location where the resolution of the encoder will be stored |
| channel | The channel to get the resolution for indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseTtlModuleSetLineCount

Set the line count and interpolation value of the encoder for the specified channel.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleSetLineCount
                (
                        MseTtlModulePtr         object,
                        long                    lineCount,
                        TTL_INTERPOLATION       interpolation,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| lineCount | The line count of the encoder. This value is used for computing the position value. |
| interpolation | The interpolation value of the encoder. This value is used for computing the position value. |
| channel | The channel to set the line count for indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseTtlModuleGetLineCount

Get the line count and interpolation value of the encoder for the specified channel.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetLineCount
                (
                        MseTtlModulePtr         object,
                        long*                   lineCount,
                        TTL_INTERPOLATION*      interpolation,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| lineCount | A pointer to the location where the line count of the encoder will be stored. This value is used for computing the position value. |
| interpolation | A pointer to the location where the interpolation value of the encoder will be stored. This value is used for computing the position value. |
| channel | The channel to get the line count of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseTtlModuleSetSignalPeriod

Set the signal period and interpolation value of the encoder for the specified channel.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleSetSignalPeriod
                (
                        MseTtlModulePtr         object,
                        double                  signalPeriod,
                        TTL_INTERPOLATION       interpolation,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| signalPeriod | The signal period of the encoder. This value is used for computing the position value. |
| interpolation | The interpolation value of the encoder. This value is used for computing the position value. |
| channel | The channel to set the signal period for indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetSignalPeriod**

Get the signal period and interpolation value of the encoder for the specified channel.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetSignalPeriod
                (
                        MseTtlModulePtr         object,
                        unsigned long*          signalPeriod,
                        TTL_INTERPOLATION*      interpolation,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| signalPeriod | A pointer to the location where the signal period of the encoder will be stored. This value is used for computing the position value. |
| interpolation | A pointer to the location where the interpolation value of the encoder will be stored. This value is used for computing the position value. |
| channel | The channel to get the signal period of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetCounts**

Get the encoder counts for all channels.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetCounts
                (
                        MseTtlModulePtr         object,
                        unsigned long*          counts,
                        short                   numChannels,
                        COUNT_REQUEST_OPTION    option
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| counts | A pointer to the location where the encoder counts will be stored. This array must be large enough to store MAX_CHANNELS_PER_MODULE. |
| numChannels | The size of the counts array passed in |
| option | Whether to get the latest counts or the latched counts |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetPositions**

The getPositions method is used to get the position of a specific TTL encoder in user units. The MseTtlModuleSetEncoderType, MseTtlModuleSetUom, and MseTtlModuleSetLineCount or MseTtlModuleSetSignalPeriod methods must be called before calling this method.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetPositions
                (
                        MseTtlModulePtr         object,
                        double*                 pos,
                        unsigned short          numChannels,
                        COUNT_REQUEST_OPTION    option
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| pos | The location where the position will be stored |
| numChannels | The number of doubles in the pos array passed in |
| option | Whether to read live or latched positions |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseTtlModuleSetRotaryFormat

The MseTtlModuleSetRotaryFormat method is used to set the rotary format that will be applied to the position calculated from the counts in the MseTtlModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleSetRotaryFormat
                  (
                        MseTtlModulePtr         object,
                        unsigned short          channel,
                        ROTARY_FORMAT           format
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| channel | The channel of the encoder to apply the rotary format to |
| format | The ROTARY_FORMAT to apply |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseTtlModuleGetRotaryFormat

The MseTtlModuleGetRotaryFormat method is used to return the rotary format that will be applied to the position calculated from the counts in the MseTtlModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetRotaryFormat
                  (
                        MseTtlModulePtr         object,
                        unsigned short          channel
                        ROTARY_FORMAT*          format
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| channel | The channel of the encoder that the rotary format will be applied to |
| format | A pointer to the location where the rotary format will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

### MseTtlModuleSetDeviceOffset

The MseTtlModuleSetDeviceOffset method is used to set the offset that will be applied to the position calculated from the counts in the MseTtlModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleSetDeviceOffset
                  (
                        MseTtlModulePtr         object,
                        unsigned short          channel,
                        double                  offset
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| channel | The channel of the encoder to apply the offset to |
| offset | The offset to apply |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetDeviceOffset**

The MseTtlModuleGetDeviceOffset method is used to return the offset that will be applied to the position calculated from the counts in the MseTtlModuleGetPositions function.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetDeviceOffset
                  (
                        MseTtlModulePtr         object,
                        unsigned short          channel
                        double*                 offset
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| channel | The channel of the encoder that the offset will be applied to |
| offset | A pointer to the location where the offset will be stored |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleSetLatch**

Set or clear the desired latch for the entire module chain.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleSetLatch
                  (
                        MseTtlModulePtr         object,
                        LATCH_OPTIONS           option,
                        LATCH_CHOICE            latchChoice
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| option | Set or reset the module chain latch. Set is only used on a base module. The reset functions as a clearing of the latch and must be called on the base module first. |
| latchChoice | The type of latch to set or clear |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetLatches**

Gets the latches that are active.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetLatches
                  (
                        MseTtlModulePtr         object,
                        char*                   latchState,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| latchState | A pointer to the location where the latch state(s) will be stored. This is an array that is must be large enough to store NUM_LATCH_TYPES. The non-base modules only utilize the first latch state in the array. |
| size | The size of the latchState array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetModuleErrorState**

Gets the error state of the module. A value of True signifies that there is an error.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetModuleErrorState
                (
                      MseTtlModulePtr        object,
                      bool*                  errorState
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| errorState | A pointer to the location where the error state will be stored. A subsequent call to MseTtlModuleGetModuleErrors can be made to get the actual errors. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetModuleErrors**

Gets the errors specific to the module.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetModuleErrors
                (
                      MseTtlModulePtr        object,
                      long*                  errors,
                      double*                ranges,
                      short                  size
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| errors | A pointer to the location where the errors state will stored. The errors is a single long that can be masked with the INTEGRITY_ENUMS to determine which error has occurred. |
| ranges | A pointer to the location where the ranges used to determine an error will be stored. The ranges is an array that must be large enough to hold NUM_INTEGRITY_RANGES. |
| size | The size of the ranges array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleEnableDiags**

Sets the diagnostic mode for the channels and module.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleEnableDiags
                (
                      MseTtlModulePtr        object,
                      DIAG_MODE_OPTIONS      choice
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| choice | The desired level of diagnostics |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetAdcValues**

Gets the voltage and temperature values for the module.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetAdcValues
                  (
                        MseTtlModulePtr         object,
                        short*                  adcVals,
                        short                   size
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| adcVals | A pointer to the location where the voltage and temperature values will be stored. Must be large enough to hold ADC_NUM_CHANNELS. The ADC_OPTIONS enumeration can be used to index into the adcVals array. |
| size | The size of the adcVals array passed in |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleClearErrors**

Clears the module and channel errors and warnings.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleClearErrors
                  (
                        MseTtlModulePtr         object
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleIsReferencingComplete**

Gets whether the referencing has been completed for an encoder on the specified channel.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleIsReferencingComplete
                  (
                        MseTtlModulePtr         object,
                        const unsigned char     channel,
                        bool*                   isComplete
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| channel | The channel to get the referencing state of indexed from 0 |
| isComplete | A pointer to the location where the referencing state value will be stored. A value of True is returned if referencing is complete. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleStartReferencing**

Initializes the parameters used for determining absolute position of a specified encoder.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleStartReferencing
                  (
                        MseTtlModulePtr           object,
                        const unsigned short      channel,
                        const REFERENCE_MARK_ENUM refMarkType,
                        const unsigned short      value
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| channel | The channel to initialize the referencing of indexed from 0 |
| refMarkType | The type of referencing used by the encoder |
| value | This is the signal period of a linear encoder and the line count for a rotary encoder |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleAcknowledgeReferencing**

Used to send an acknowledge to the module informing it that the asynchronous reference complete message was received. If asynchronous communication is used and this is not sent, the module will keep sending reference complete messages.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleAcknowledgeReferencing
                  (
                        MseTtlModulePtr        object,
                        const unsigned char    channel
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| channel | The channel to acknowledge the referencing of indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetReferencingState**

Gets the state of the referencing for the desired channel. This method should be called after isReferencingComplete is true or before acknowledgeAbsolutePosition is sent in order to check if referencing succeeded. Referencing succeeds if the refMarkState is REF_MARK_FINISHED.

**Method**

```
MseResults MseTtlModuleGetReferencingState
                  (
                        MseTtlModulePtr        object,
                        const unsigned char    channel,
                        REF_MARK_STATE*        refMarkState
                  );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| channel | The channel to get the referencing state indexed from 0 |
| refMarkState | A pointer to the location where the state of the referencing will be stored. See the REF_MARK_STATE enumeration for more information. |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetFpgaRevision**

Get the revision of the FPGA code used in the module.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetFpgaRevision
                (
                        MseTtlModulePtr           object,
                        unsigned short*           revision
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| revision | A pointer to the location where the FPGA revision will be stored. The revision is in the form 0xMMmm, where MM is the major version and mm is the minor version (e.g. 0x0100 is V1.00). |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleGetChannelErrorState**

Gets the error state of a channel. An errorState of 1 signifies a COUNTER_STATUS_EDGE_DISTANCE_ERROR error. Errors can be cleared with the MseTtlModuleClearErrors function

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleGetChannelErrorState
                (
                        MseTtlModulePtr         object,
                        bool*                   errorState,
                        short                   channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| errorState | A pointer to the location where the error state will be copied to |
| channel | The channel to get |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

**MseTtlModuleEnableErrorChecking**

Sets whether error checking will be done on the specified channel. The channel defaults to enabled on power up of the module and will be checked as long as the channel is populated and the error checking is enabled. The channel status can be checked with the MseTtlModuleGetChannelErrorState when error checking is enabled.

**Function**

```
MSE_RESPONSE_CODE MseTtlModuleEnableErrorChecking
                (
                        MseTtlModulePtr         object,
                        const bool              choice,
                        const unsigned short    channel
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseTtlModule object that was created by the MseTtlModuleCreate function |
| choice | True to enable error checking, false to disable |
| channel | The channel to enable or disable error checking on indexed from 0 |

**Return value**

The return value delivers a MSE_RESPONSE_CODE representing whether the function call was successful.

# 2.19 Asynchronous methods

The MSE modules utilize Ethernet for communication. The client software that utilizes this library can poll constantly for errors, warnings, latching triggers, etc... or it can create a thread and wait on a socket connected to the MSE_ASYNC_PORT. The MSE modules will always send UDP_CONNECT messages once a second at startup until a connection is obtained. The other asynchronous messages are only sent out if the client subscribes using the useAsync parameter during initialization.

## getAsyncMsgType

The getAsyncMsgType method is static and is used to get the type of asynchronous message that was received from the MSE . A subsequent decode request needs to be sent to get the data from the message.

**Method**

```
UdpCmdType getAsyncMsgType
                (
                      char*                 msg
                );
```

**Parameters**

| | |
|---|---|
| msg | The initial message received from the asynchronous port |

**Return value**

| | |
|---|---|
| UdpCmdType | The type of message received |

## decodeConnectMsg

The decodeConnectMsg method is static and is used to decode a UDP_CONNECT asynchronous message from the MSE . The UdpCmdType is validated and the message is then decoded and returned in a MSEConnectResponse structure.

**Method**

```
MseResults decodeConnectMsg
                (
                      char*                 msg,
                      MSEConnectResponse*   resp
                );
```

**Parameters**

| | |
|---|---|
| msg | A pointer to the UDP packet that was sent from the module |
| resp | A pointer to a MSEConnectResponse structure to store the decoded message to |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the decodeConnectMsg command was completed |

## decodeLatchMsg

The decodeLatchMsg method is static and is used to decode a UDP_LATCH asynchronous message from the MSE . The UdpCmdType is validated and the message is then decoded. The latch states are stored in the array passed in.

**Method**

```
MseResults decodeLatchMsg
                (
                      char*                 msg,
                      unsigned char*        latchVals
                );
```

**Parameters**

| | |
|---|---|
| msg | A pointer to the UDP packet that was sent from the module |
| latchVals | value of 0 if not latched or 1 if latched |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the decodeLatchMsg command was completed |

## decodeChannelStatusMsg

The decodeChannelStatusMsg method is static and is used to decode a UDP_CHANNEL_STATUS asynchronous message from the MSE . The UdpCmdType is validated and the message is then decoded. The UDP_CHANNEL_STATUS informs the listener if warning, error, or reference completion of a 1Vpp channel has occured. The listener must read the channel status with a getErrors() or getWarnings() method or call the acknowledgeAbsolutePosition() method to acknowledge the reference complete.

**Method**

```
MseResults decodeChannelStatusMsg
                (
                      char*                 msg,
                      unsigned short*       type,
                      unsigned short*       axis
                );
```

**Parameters**

| | |
|---|---|
| msg | A pointer to the UDP packet that was sent from the module |
| type | The type of channel status. 1 is for warnings and errors, 2 is for reference complete |
| axis | The channel for reference complete acknowledgement indexed from 0. This parameter is not used for warnings and errors. |

**Return value**

| | |
|---|---|
| MseResults | A response code representing whether the decodeFootswitchMsg command was completed |

# 2.20 ModuleConfig Base/Reader/Writer

C++ methods and the C functions are separated into two sections for easier lookup.

## C++ Methods

The MSE  module chain can be determined with the createChain() method. The MSEsetup application calls the createChain() method and stores all of the module and channel information in a file called ModuleConfig.xml. The MSEsetup application stores much more information that is used to configure the chain such as the module labels, channel units of measurement, etc... This file can be read and updated via the MseConfigReader and MseConfigWriter classes.

The MseConfigBase class contains methods that are common to the reader and the writer. The MseConfigReader is derived from the MseConfigBase and has additional methods specific to reading the ModuleConfig data. The MseConfigWriter is derived from the MseConfigReader in order to allow for read and write functionality. The MseConfigWriter was originally derived directly from the MseConfigBase but caused unnecessary complexity and overhead from needing two instantiated classes for reading and writing.

**MseConfigBase**

**loadXml**

The loadXml method loads the ModuleConfig file passed in into memory using the DOM XML standard. This method must be called before any of the accessor methods can be used.

**Method**

```
MSE_XML_RETURN loadXml
               (
                      const std::string& filename;
               );
```

**Parameters**

| | |
|---|---|
| filename | The filename of the ModuleConfig XML file to be loaded into memory |

**Return value**

| | |
|---|---|
| MSE_XML_RETURN | A response code representing whether the loadXml command was successful |

**reloadXml**

The reloadXml method reloads the ModuleConfig file that was previously passed in into memory. This method is useful for keeping the DOM data that is in memory synchronized with changes in the XML file.

**Method**

```
MSE_XML_RETURN reloadXml
               (
               );
```

**Return value**

| | |
|---|---|
| MSE_XML_RETURN | A response code representing whether the reloadXml command was successful |

**decodeErrorType**

The decodeErrorType method returns a string representation of the MSE_XML_RETURN enumeration. This method is static and can be called without having to instantiate a MseConfigBase object.

**Method**

```
static std::string decodeErrorType
               (
                      const MSE_XML_RETURN& type;
               );
```

**Parameters**

| | |
|---|---|
| type | The MSE_XML_RETURN enumeration to stringify |

**Return value**

| | |
|---|---|
| std::string | The string representation of the enumeration |

**decodeElementType**

The decodeElementType method returns a string representation of the MSE_XML_ELEMENTS enumeration. This method is static and can be called without having to instantiate a MseConfigBase object.

**Method**

```
static std::string decodeElementType
                (
                        const MSE_XML_ELEMENTS& type;
                );
```

**Parameters**

| | |
|---|---|
| type | The MSE_XML_ELEMENTS enumeration to stringify |

**Return value**

| | |
|---|---|
| std::string | The string representation of the enumeration |

**getFilename**

The getFilename method returns the filename as a string. If the filename has not been set, an empty string is returned.

**Method**

```
std::string getFilename
                (
                );
```

**Return value**

| | |
|---|---|
| std::string | The filename or an empty string |

**removeSpecificModuleNode**

The removeSpecificModuleNode deletes the specified node and all of its children.

**Method**

```
void removeSpecificModuleNode
(
                const unsigned short&          moduleNum
);
```

**Parameters**

| | |
|---|---|
| moduleNum | The module to remove indexed from 1 |

**MseConfigReader**

The loadXml method must be called after the MseConfigReader class is instantiated before any of the accessor methods can be used.

**Constructor**

```
MseConfigReader(void);
```

**getElement**

The getElement method searches the DOM data that is loaded in memory for all instances of the tagname requested. The element data for each match is added to a string with a newline separating each.

**Method**

```
MSE_XML_RETURN getElement
                (
                        const MSE_XML_ELEMENT& tagname,
                        std::string& value
                );
```

**Parameters**

| | |
|---|---|
| tagname | The XML tag to look for |
| value | All of the matching element data is stored in this parameter |

**Return value**

| | |
|---|---|
| MSE_XML_RETURN | A response code representing whether the getElement command was successful |

**getElement**

The getElement method searches the DOM data that is loaded in memory for a specific element based on the tagname requested. The tagname is searched only in the module requested.

**Method**

```
MSE_XML_RETURN getElement
                (
                        const MSE_XML_ELEMENT& tagname,
                        std::string& value,
                        const unsigned short& moduleNum
                );
```

**Parameters**

| | |
|---|---|
| tagname | The XML tag to look for |
| value | The matching element data is stored in this parameter |
| moduleNum | The module to search for the tagname indexed from 1 |

**Return value**

MSE_XML_RETURN A response code representing whether the getElement command was successful

**getElement**

The getElement method searches the DOM data that is loaded in memory for a specific element based on the tagname requested. The tagname is searched only in the specific module and channel requested.

**Method**

```
MSE_XML_RETURN getElement
                (
                        const MSE_XML_ELEMENT& tagname,
                        std::string& value,
                        const unsigned short& moduleNum,
                        const unsigned short& channelNum
                );
```

**Parameters**

| | |
|---|---|
| tagname | The XML tag to look for |
| value | The matching element data is stored in this parameter |
| moduleNum | The module to search for the tagname indexed from 1 |
| channelNum | The channel to search for the tagname indexed from 1 |

**Return value**

MSE_XML_RETURN A response code representing whether the getElement command was successful

**getAllElements**

The getAllElements method returns the entire XML file as a string and retains the XML formatting.

**Method**

```
MSE_XML_RETURN getAllElements
                (
                        std::string& value
                );
```

**Parameters**

| | |
|---|---|
| value | All of the element data is stored in this parameter |

**Return value**

MSE_XML_RETURN A response code representing whether the getAllElements command was successful

**validateElements**

The validateElements method checks if all the module and channel elements exist in the file. If they do not, the file has been invalidated.

**Method**

```
MSE_XML_RETURN validateElements
                (
                        MSE_XML_ELEMENTS&       elementReturn,
                        unsigned short&         moduleNumReturn,
                        unsigned short&         channelNumReturn
                );
```

**Parameters**

| | |
|---|---|
| elementReturn | A reference to an enumeration that is filled in with the name of the element that failed validation. This is only used if the return code is MXE_XML_RETURN_TAGNAME_NOT_FOUND. |
| moduleNumReturn | A reference to an unsigned short that is filled in with the module number of the element that failed validation. This is only used if the return code is MXE_XML_RETURN_TAGNAME_NOT_FOUND. |
| channelNumReturn | A reference to an unsigned short that is filled in with the channel number of the element that failed validation. This is only used if the return code is MXE_XML_RETURN_TAGNAME_NOT_FOUND. |

**Return value**

| | |
|---|---|
| MSE_XML_RETURN | A response code representing whether the validateElements command was successful |

**getSpecificModule**

The getSpecificModule method returns all of the element tag names and corresponding data for a specific module.

**Method**

```
std::string getSpecificModule
                (
                        const unsigned short& moduleNum
                );
```

**Parameters**

| | |
|---|---|
| moduleNum | The number of the module to request element data of indexed from 1 |

**Return value**

| | |
|---|---|
| std::String | A string containing the module element data in csv format separated by new lines. Returns an empty string if there is an error. |

**getSpecificChannel**

The getSpecificChannel method returns all of the element tag names and corresponding data for a specific channel.

**Method**

```
std::string getSpecificChannel
                (
                        const unsigned short& moduleNum,
                        const unsigned short& channelNum
                );
```

**Parameters**

| | |
|---|---|
| moduleNum | The number of the module to request element data of indexed from 1 |
| channelNum | The number of the channel to request element data of indexed from 1 |

**Return value**

| | |
|---|---|
| std::String | A string containing the channel element data in csv format separated by newlines. Returns an empty string if there is an error. |

**getNumModules**

The getNumModules method returns the number of modules in the XML file.

**Method**

```
MSE_XML_RETURN getNumModules
                (
                        unsigned short& numModules
                );
```

**Parameters**

| | |
|---|---|
| numModules | The number of the modules in the XML file |

**Return value**

| | |
|---|---|
| MSE_XML_RETURN | A response code representing whether the getNumModules command was successful |

**getNumChannels**

The getNumChannels method returns the number of channels for a specific module in the XML file.

**Method**

```
MSE_XML_RETURN getNumChannels
                (
                        const unsigned short& moduleNum,
                        unsigned short& numChannels
                );
```

**Parameters**

| | |
|---|---|
| moduleNum | The module number to request the number of channels indexed from 1 |
| numChannels | The number of the channels in the XML file for the specified module |

**Return value**

| | |
|---|---|
| MSE_XML_RETURN | A response code representing whether the getNumChannels command was successful |

**MseConfigWriter**

The loadXml method must be called after the MseConfigWriter class is instantiated before any of the accessor methods can be used.

**Constructor**

```
MseConfigWriter(void);
```

**setElement**

The setElement method sets the element data for a specific module tagname. This method just sets the data in memory. A subsequent writeFile() must be performed to permanently save the DOM data to the file.

**Method**

```
MSE_XML_RETURN setElement
                (
                        const MSE_XML_ELEMENT& tagname,
                        const std::string& value,
                        const unsigned short& moduleNum
                );
```

**Parameters**

| | |
|---|---|
| tagname | The XML tag to look for |
| value | The value to set the element data to for the tagname |
| moduleNum | The module to use for finding the tagname indexed from 1 |

**Return value**

| | |
|---|---|
| MSE_XML_RETURN | A response code representing whether the setElement command was successful |

**setElement**

The setElement method sets the element data for a specific channel tagname. This method just sets the data in memory. A subsequent writeFile() must be performed to permanently save the DOM data to the file.

**Method**

```
MSE_XML_RETURN setElement
                (
                        const MSE_XML_ELEMENT& tagname,
                        const std::string& value,
                        const unsigned short& moduleNum,
                        const unsigned short& channelNum
                );
```

**Parameters**

| | |
|---|---|
| tagname | The XML tag to look for |
| value | The value to set the element data to for the tagname |
| moduleNum | The module to use for finding the tagname indexed from 1 |
| channelNum | The channel to use for finding the tagname indexed from 1 |

**Return value**

| | |
|---|---|
| MSE_XML_RETURN | A response code representing whether the setElement command was successful |

**writeFile**

The writeFile method writes the DOM data to the file loaded from the loadXml method.

**Method**

```
MSE_XML_RETURN writeFile
                (
                );
```

**Return value**

| | |
|---|---|
| MSE_XML_RETURN | A response code representing whether the writeFile command was successful |

**writeFile**

The writeFile method writes the DOM data to the desired file.

**Method**

```
MSE_XML_RETURN writeFile
                (
                        const std::string& filename
                );
```

**Parameters**

| | |
|---|---|
| filename | The filename to write the DOM data to |

**Return value**

| | |
|---|---|
| MSE_XML_RETURN | A response code representing whether the writeFile command was successful |

## C Functions

The Configuration file C functions can be found in the MseConfigFileWrapper.h file

### MseConfigFileCreate

Creates a MseConfigWriter object and returns a pointer to it.

**Function**

```
MseConfigFilePtr MseConfigFileCreate
                (
                );
```

**Return value**

The return value delivers a pointer to the MseConfigWriter object that was created.

### MseConfigFileDelete

Deletes the MseConfigWriter object that was passed in.

**Function**

```
void MseConfigFileDelete
                (
                        MseConfigFilePtr        object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |

### MseConfigFileLoadXml

Load the module config XML file into memory.

**Function**

```
MSE_XML_RETURN MseConfigFileLoadXml
                (
                        MseConfigFilePtr        object,
                        char*                   filename,
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| filename | The path and filename of the module config XML file |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

### MseConfigFileReloadXml

Reload the module config XML file into memory.

**Function**

```
MSE_XML_RETURN MseConfigFileLoadXml
                (
                        MseConfigFilePtr        object
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileGetFilename**

Get the filename that is loaded into memory.

**Function**

```
MSE_XML_RETURN MseConfigFileGetFilename
               (
                      MseConfigFilePtr        object,
                      char*                   filename,
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| filename | A pointer to the location where the filename will be stored |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileDecodeErrorType**

Decodes a MSE_XML_RETURN type as a string.

**Function**

```
MSE_XML_RETURN MseConfigFileDecodeErrorType
               (
                      MseConfigFilePtr        object,
                      char*                   decodedErrorType,
                      MSE_XML_RETURN          type
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| decodedErrorType | A pointer to the location where the decoded error type will be stored |
| type | The MSE_XML_RETURN enumeration to decode |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileDecodeElementType**

Decodes a MSE_XML_ELEMENTS type as a string.

**Function**

```
MSE_XML_RETURN MseConfigFileDecodeElementType
               (
                      MseConfigFilePtr        object,
                      char*                   decodedElementType,
                      MSE_XML_ELEMENTS        type
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| decodedElementType | A pointer to the location where the decoded element type will be stored |
| type | The MSE_XML_ELEMENTS enumeration to decode |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileGetElement**

Get the data for all instances of the desired element.

**Function**

```
MSE_XML_RETURN MseConfigFileGetElement
                (
                        MseConfigFilePtr        object,
                        char*                   data,
                        MSE_XML_ELEMENTS        tagname
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| data | A pointer to the location where the data will be stored. Each instance is separated by a newline. |
| tagname | The element to find |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileGetModuleElement**

Get the data for the desired element of a module.

**Function**

```
MSE_XML_RETURN MseConfigFileGetModuleElement
                (
                        MseConfigFilePtr        object,
                        char*                   data,
                        short                   module,
                        MSE_XML_ELEMENTS        tagname
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| data | A pointer to the location where the data will be stored |
| module | The module to look for the element indexed from 1 |
| tagname | The element to find |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileGetChannelElement**

Get the data for the desired element of a channel within a module.

**Function**

```
MSE_XML_RETURN MseConfigFileGetChannelElement
                (
                        MseConfigFilePtr        object,
                        char*                   data,
                        short                   module,
                        short                   channel,
                        MSE_XML_ELEMENTS        tagname
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| data | A pointer to the location where the data will be stored |
| module | The module to look for the element indexed from 1 |
| channel | The channel to look for the element indexed from 1 |
| tagname | The element to find |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileGetAllElements**

Get the entire XML file.

**Function**

```
MSE_XML_RETURN MseConfigFileGetAllElements
                (
                        MseConfigFilePtr        object,
                        char*                   data
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| data | A pointer to the location where the data will be stored |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileValidateElements**

The MseConfigFileValidateElements method checks if all the module and channel elements exist in the file. If they do not, the file has been invalidated.

**Method**

```
MSE_XML_RETURN MseConfigFileValidateElements
                (
                        MseConfigFilePtr        object,
                        MSE_XML_ELEMENTS*       elementReturn,
                        unsigned short*         moduleNumReturn,
                        unsigned short*         channelNumReturn
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| elementReturn | A pointer to the location where the name of the element that failed validation will be stored. This is only used if the return code is MXE_XML_RETURN_TAGNAME_NOT_FOUND. |
| moduleNumReturn | A pointer to the location where the module number of the element that failed validation will be stored. This is only used if the return code is MXE_XML_RETURN_TAGNAME_NOT_FOUND. |
| channelNumReturn | A pointer to the location where the channel number of the element that failed validation will be stored. This is only used if the return code is MXE_XML_RETURN_TAGNAME_NOT_FOUND. |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileGetAllElements**

Get the entire XML file.

**Function**

```
MSE_XML_RETURN MseConfigFileGetAllElements
                (
                        MseConfigFilePtr        object,
                        char*                   data
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| data | A pointer to the location where the data will be stored |

**MseConfigFileGetSpecificModule**

Get all of the elements and data for the desired module.

**Function**

```
MSE_XML_RETURN MseConfigFileGetSpecificModule
               (
                      MseConfigFilePtr        object,
                      char*                   data,
                      short                   module
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| data | A pointer to the location where the data will be stored. The data for each element is returned as the element name, followed by a comma, followed by the data, followed by a newline. |
| module | The module to look for elements indexed from 1 |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileGetSpecificChannel**

Get all of the elements and data for the desired channel of a module.

**Function**

```
MSE_XML_RETURN MseConfigFileGetSpecificModule
               (
                      MseConfigFilePtr        object,
                      char*                   data,
                      short                   module,
                      short                   channel
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| data | A pointer to the location where the data will be stored. The data for each element is returned as the element name, followed by a comma, followed by the data, followed by a newline. |
| module | The module to look for elements indexed from 1 |
| channel | The channel to look for elements indexed from 1 |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileGetNumModules**

Get the number of modules in the XML file.

**Function**

```
MSE_XML_RETURN MseConfigFileGetNumModules
               (
                      MseConfigFilePtr        object,
                      short*                  numModules
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| numModules | A pointer to the location where the number of modules will be stored |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileGetNumChannels**

Get the number of channels in the XML file.

**Function**

```
MSE_XML_RETURN MseConfigFileGetNumChannels
                (
                        MseConfigFilePtr        object,
                        short                   module,
                        short*                  numChannels
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| module | The module to look for the number of channels indexed from 1 |
| numChannels | A pointer to the location where the number of channels will be stored |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileSetModuleElement**

Set the value for a module element.

**Function**

```
MSE_XML_RETURN MseConfigFileSetModuleElement
                (
                        MseConfigFilePtr        object,
                        char*                   data,
                        short                   module,
                        MSE_XML_ELEMENTS        tagname
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| data | The value to set the element to |
| module | The module to set the element of indexed from 1 |
| tagname | The element to set the value of |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileSetChannelElement**

Set the value for a channel element.

**Function**

```
MSE_XML_RETURN MseConfigFileSetModuleElement
                (
                        MseConfigFilePtr        object,
                        char*                   data,
                        short                   module,
                        short                   channel,
                        MSE_XML_ELEMENTS        tagname
                );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| data | The value to set the element to |
| module | The module to set the element of indexed from 1 |
| channel | The channel to set the element of indexed from 1 |
| tagname | The element to set the value of |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileRemoveModule**

Removes the specified module from the XML file.

**Function**

```
MSE_XML_RETURN MseConfigFileRemoveModule
               (
                     MseConfigFilePtr        object,
                     const short             moduleNum
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| moduleNum | The module to remove from the XML file indexed from 1 |

**MseConfigFileWriteFile**

Write the data in memory to the file.

**Function**

```
MSE_XML_RETURN MseConfigFileWriteFile
               (
                     MseConfigFilePtr        object
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

**MseConfigFileWriteNewFile**

Write the data in memory to a new file.

**Function**

```
MSE_XML_RETURN MseConfigFileWriteNewFile
               (
                     MseConfigFilePtr        object,
                     char*                   filename
               );
```

**Parameters**

| | |
|---|---|
| object | A pointer to the MseConfigWriter object that was created by the MseConfigFileCreate function |
| filename | The path and filename of the new file to write the XML data to |

**Return value**

The return value delivers a MSE_XML_RETURN representing whether the function call was successful.

# 3

# System integrity

## 3.1 About system Integrity

System integrity refers to the monitoring of the ethernet, programming status, voltages, current, and temperature in the module.

There is a 4 byte value called systemIntegrity that is used to store the masked warnings and errors that are active. The systemIntegrity variable is only used for the voltages, current, and temperature monitoring. A value of 0 means that there are no values out of range.

The system integrity has warning and error ranges for the voltages, current, and temperature monitoring. If the integrity exceeds a warning or error range, a bit is set in the system integrity. The client code can request the systemIntegrity value and check if any of the bits are set.

The power and status LEDs on the module are set based on system integrity errors. The warning limit is only used by clients and does not affect the LEDs.

The getIntegrity() method is used to check the systemIntegrity.

The clearIntegrityErrors() method is used to clear integrity errors.

## 3.2 Obtaining IP Address

The status LED will flash from green to off at a 5 Hz interval when an IP address is being obtained by DHCP or static addressing and then applied to the FNET stack.

The LED will change to a 2Hz interval once the IP address is obtained.

## 3.3 Waiting for Client

The status LED will flash from green to off at a 2 Hz interval when an IP address is obtained and the module is waiting for a connection to a client.

The LED will change to solid green once the connection to a client is obtained.

## 3.4 Duplicate IP

The status LED will flash from green to red at a 2 Hz interval when an IP address is already used.

One of the modules with the identical IP address must be disconnected and the IP address of the module that remains connected must be set to a unique value.

## 3.5 Programming Error

The LED will alternate the power and status LEDs 10 times with a 250ms interval if the MSEfirmware has a checksum error after completion.

## 3.6 Ethernet Chip

The LEDs will both flash red 30 times with a 250ms interval if the ethernet chip has malfunctioned.

## 3.7 Current

The current is only monitored on the power supply modules. The current shows how much current is being drawn by subsequent modules. If the amount of current being drawn is over the error limit, the power LED will stay red until the condition and systemIntegrity value is cleared.

The current sets a warning if > 2.0 amps for the 100-240V power supply.

The current sets a warning if > 2.9 amps for the 24V power supply.

The current sets an error if > 2.1 amps for the 100-240V power supply.

The current sets an error if > 3.0 amps for the 24V power supply.

## 3.8 24V

The power LED will toggle between red and green at a rate of once a second until the error is cleared. The status LED is unaffected.

The 24V sets an error if not between 20 and 28 V.

The 24V sets a warning if not between 21.5 and 26.5V.

## 3.9 5V

The power LED will toggle between red and green at a rate of once every 2 seconds until the error is cleared. The status LED is unaffected.

The 5V sets an error if not between 4.8 and 5.5 V.

The 5V sets a warning if not between 4.9 and 5.3V.

## 3.10 3.3V

The 3.3V is just used for informational purposes and does not affect the LEDs. If the 3.3V is bad, the CPU will stop functioning.

## 3.11 CPU temperature

The power LED will toggle between red and green at a rate of once every 3 seconds until the error is cleared. The status LED is unaffected.

The temperature sets an error if not between -40 and 110 Celsius.

The temperature sets a warning if not between -30 and 100 Celsius.

## 3.12 Non-Volatile Memory Backup Failure

The power LED will toggle between red and green at a rate of once every 10 seconds until the error is cleared. The status LED is unaffected.

This error signifies that the non-volatile configuration data in FRAM memory could not be read and the backup stored in FLASH memory could not be copied into FRAM. If this error occurs, the module memory has become corrupted. Contact HEIDENHAIN Support for instructions.

The configuration data contains the module ID, hardware ID, IP address, netmask, MAC address, firmware checksum, programming state, bootloader versioning information, and DHCP choice.

# 4

# Diagnostic modes

# 4.1 About Diagnostic Modes

Diagnostics are performed within each module in order check for warnings and errors regarding voltages, temperature, and encoders.

The diagnostics are checked every 200 ms.

There are 4 diagnostic modes. They are full, status, minimal, and off.

Changing the diagnostic modes have a large benefit for EnDat modules since they can cause a lot of latency when running at 'Full'.

The diagnostic mode is changed with the enableDiags() method.

# 4.2 Full

Full diagnostics will perform function reserve checking for EnDat modules.

The 1Vpp and TTL modules will perform the same diagnostics as 'Status'.

The other modules will perform the same diagnostics as 'Minimal'.

The function reserves take 11ms per axis to be performed. The UDP commands cannot be serviced faster than once every 11ms while in this mode. It will take 44ms for a 4x EnDat module to have all four axes updated and 88 ms for an 8x EnDat module to update all 8 axes.

The read of the channels are broken up so that one channel is read each time through the main loop. This allows for UDP messages to be sent at any time between reads.

# 4.3 Status

The EnDat modules will check for warnings and errors. It takes between 1-2 ms to obtain the error information for a single channel. This means that it will take 4-8 ms for a 4x module and 8-16 ms for an 8x module. If a V2.1 EnDat encoder is being used, this delay cannot be removed. If a V2.2 EnDat encoder is being used, changing the diagnostic mode to minimal will skip checking the warnings and errors and the delay will be 250us per axis.

The errors and warnings for the EnDat module will be read each time the positions are updated (not at the normal 200ms timing of the diagnostic timer). This is because the error and warning information is combined with the read counts command when using the EnDat V2.1 protocol and helps in determining if the count is valid.

The 1Vpp modules will check the counter register to verify amplitude, edge distance errors, and filter spikes. The TTL modules will check the counter register to verify edge distance errors.

The 1Vpp and TTL error checking does not affect the timing since it is performed much faster than the time it takes to request a UDP command.

The read of the channels for both the EnDat and 1Vpp modules are broken up so that one channel is read each time through the main loop. This allows for UDP messages to be sent at any time between reads.

The other modules will perform the same diagnostics as 'Minimal'.

# 4.4 Minimal

Minimal diagnostics will perform checking of the system integrity. The system integrity is described in the 'System Integrity' section.

The system integrity checking does not affect the timing since it is performed much faster than the time it takes to request a UDP command.

# 4.5 None

None of the diagnostics will be performed in this mode.

# 5

# Trigger line

# 5.1 About the Trigger Line

A single trigger line is utilized that is electrically connected to all modules. This line is activated by the base module when one of 5 latch requests are received. The base module keeps track of the latch requests until the trigger line is cleared. The trigger line is used for latching data within a small timeframe or for signaling purposes.

The first 3 latch requests are used for software latches. Software latches are received via UDP from an external application. The 4th latch request is used for footswitch 1. The 5th latch request is used for footswitch 2. The footswitch latch requests can be activated by an external footswitch or other device that is attached to the footswitch connector on the base module. The footswitch latch requests can also be activated by a software request if needed.

Once the output line is active, all of the modules will be able to read the line and then latch the data accordingly. The EnDat, 1Vpp, TTL, and LVDT modules will latch the latest count for each axis and store it in buffers. The I/O and pneumatic modules will store the current I/O states. The analog module will store the latest voltage and current.

There is only 1 buffer for storing latched data. The latch must be cleared before the buffer will overwrite the data. The base module must be cleared before all other modules or the latch will immediately trigger again.

The client software must send a read or a 'clear latch' command to clear the latch.

# 5.2 Software Latency

Latency from a software latch is based on the time it takes for the UDP packet to be sent plus the time it takes for the module to store the data.

Most software commands will take less time than it takes for UDP packet transmission which will not add any more overhead other than the UDP transit time.

The EnDat modules level of diagnostics should be changed depending on the throughput desired. The 'Full' diagnostic mode will affect the latch timing dramatically and the 'Status' diagnostic mode will affect the latch timing slightly. The levels are described in the 'Diagnostic Modes' section.

All other modules do not have additional latency.

## Full Diagnostics

Full diagnostics should not be used if accuracy of the EnDat positions is desired faster than once every 100ms. See the 'Diagnostic Modes' section for more information.

## Status Diagnostics

Status diagnostics should not be used if accuracy of the EnDat positions is desired faster than once every 8-16ms. See the 'Diagnostic Modes' section for more information.

## Minimal Diagnostics

Minimal diagnostics should be used if accuracy of the EnDat positions is desired at the maximum rate. The maximum rate is 250us per axis which is 1ms for a 4x module and 2 ms for a 8x module.

## 5.3 Debouncing Latency

The 2 footswitch lines assume that a footswitch is attached to the hardware input lines. The default debouncing time for each line on an EnDat or 1Vpp base module is 10ms. This will add 10ms to the amount of time it takes for the input to be detected. This time does not affect the ability to handle UDP requests since it utilizes a timer instead of holding up the CPU. The debouncing for the TTL module is negligible.

The debouncing time for each footswitch line can be changed to a value between 0 – 20ms. A value of zero will disable debouncing.

Disabling debouncing is useful if a different device is attached to the footswitch input that does not have need for debouncing.

The debouncing latency only occurs when the hardware lines are polled to check for change in state. There is no debouncing if the software simulates a footswitch by setting the 4th or 5th trigger output.

Debouncing can be modified on an EnDat or 1Vpp base module with the setLatchDebouncing() method.

## 5.4 Setting a Trigger

The footswitch can be used to set the trigger and the base module will store that latch 4 or 5 occured.

The setLatch() method is used to cause a trigger to be set. Any of the latch requests can cause a latch trigger with this command.

## 5.5 Determining Which Latches are Set

The getLatch() method is used to determine which latches are set. The base module will respond with all of the latches that are active. The other modules will just respond with whether or not the latch is currently active.

## 5.6 Reading the Latched Data

The getCounts() of the MseModule , getPositions() of the MseEndatModule, Mse1VppModule, MseTtlModule, and MseLvdtModule classes, getValues() of the MseAnalogModule class, getIO of the MseIoModule class, and getOutput of the MsePneumaticModule are used to read the latched data after a trigger is set. Reading the latched data will clear the latch. The base module must be read first or have its latch cleared before reading from other modules.

## 5.7 Clearing a Trigger Manually

The setLatch() method is used to reset the desired trigger.

# 6

# Module descriptions

## 6.1 Power supply modules

The power supply modules are used to supply power to each module connected to its right. The current drawn from modules to the right of the power supply is taken from the power supply. Power supplies do not draw current from modules to their left; this allows a new power supply to be placed in the module chain in order to supply power for the next group of modules.

## 6.2 EnDat modules

The EnDat modules can connect up to 4 or up to 8 channels with HEIDENHAIN EnDat encoders. EnDat encoders have non-volatile memory that allow them to store absolute position without the need for referencing as well as encoder information such as resolution, signal period, and more. EnDat encoders are considered gauge, linear, or rotary. Gauge and linear are treated the same in the library and firmware and are differentiated simply to help the user differentiate between the two.

## 6.3 1Vpp modules

The 1Vpp modules can connect up to 4 or up to 8 channels with HEIDENHAIN 1Vpp encoders. HEIDENHAIN 1Vpp encoders do not have non-volatile memory that allow them to store absolute position and therefore need to be manually referenced on each power up of the module if the encoder offers reference marks and the user wants to utilize absolute positioning. The 1Vpp modules can perform referencing for linear and rotary encoders. The encoder information such as device type, signal period, and line count must be configured each time an object is instantiated by the MSElibrary. 1Vpp encoders are considered gauge, linear, or rotary.
HEIDENHAIN 1Vpp modules use the encoders signal period in conjunction with the quadrature signal and internal electronics to compute the resolution of a linear encoder. The line count in conjunction with the quadrature signal and internal electronics is used to compute the resolution of rotary encoders.

## 6.4 TTL modules

The TTL modules can connect up to 4 or up to 8 channels with HEIDENHAIN TTL encoders. HEIDENHAIN TTL encoders do not have non-volatile memory that allow them to store absolute position and therefore need to be manually referenced on each power up of the module if the encoder offers reference marks and the user wants to utilize absolute positioning. The TTL modules can perform referencing for linear encoders only. The encoder information such as device type, signal period, and line count must be configured each time an object is instantiated by the MSElibrary. The interpolation of the TTL encoders must be configured for the TTL encoders. TTL encoders are considered gauge, linear, or rotary.
HEIDENHAIN TTL modules use the encoders signal period in conjunction with the quadrature signal and interpolation value to compute the resolution of a linear encoder. The line count in conjunction with the quadrature signal and interpolation value is used to compute the resolution of rotary encoders.

## 6.5 LVDT modules

The LVDT modules can connect up to 8 channels with Solatron/Tesa compatible, Mahr compatible, or Marposs compatible LVDT sensors depending on the module. The LVDT modules each utilize an excitation frequency and excitation voltage to source the LVDT sensors that are connected. The excitation frequency and voltage are stored in non-volatile memory in the module and therefore only need to be configured each time different sensors are added since the optimal frequency and voltage is dependent on the sensor itself. The gain of each sensor must be configured at least once and is stored in non-volatile memory in the module. The resolution of the sensor is not saved in non-volatile memory and must be configured each time the LVDT module is instantiated. The resolution must be calibrated at least once and should be calibrated as often as required by the user. The LVDT modules have added latency due to the subsequent electronics. It takes 40 ms to read each group of channels. It takes an additional 40 ms to read the excitation voltage. It takes a total of 200 ms before all of the data can be read with new values. The channels are grouped 1 & 2, 3 & 4, 5 & 6, 7 & 8.

## 6.6 Analog module

The Analog modules can connect up to 2 channels with 4-20 mA or +/- 10V analog sensors. The raw current or voltage value of the attached sensor can be retrieved, or the library can be configured to apply a resolution and offset to the value. The resolution and offset are not non-volatile and need to be configured each time the module is instantiated. The raw value utilizes a running average of the last 100 value and can be modified if this is too much.

## 6.7 I/O modules

The I/O modules can connect up to 4 inputs and 4 outputs. There is no need for software configuration.

## 6.8 Pneumatic module

The pneumatic module has a single output that is used to enable or disable a solenoid. Enabling the solenoid will allow air to pass through the module. There is no need for configuration.

# 7

# Operating principles

# 7.1 Overview

The MSE 1000 consists of Endat, 1Vpp, TTL, LVDT, Analog, I/O, Pneumatic, and Power Supply modules. Some of the operating principles are common to all modules; others are specific to the type of module.

Examples of the operating principles can be obtained in the example code sections later in the document or in the examples code supplied with the installation of the MSElibrary.

# 7.2 Initialization

The modules communicate over Ethernet using the UDP protocol. Each module has its own IP address and needs to be initialized after it has been instantiated.

Initialization of the modules does the following:

- Creates a UDP socket for communicating with the module
- Sends a UDP_OPEN command to the module at the specified IP address and receives a MSE1000ConnectResponse response
- Sets the module in asynchronous mode if requested
- Fills in the ModuleData information
- Sets the module communication as initialized. If this has not been completed, calls into the module will fail with a return code of RESPONSE_COMM_NOT_INITIALIZED.

The LVDT module has additional configuration of the excitation voltage and excitation frequency used for all of the sensors. The excitation voltage and frequency is stored in non-volatile memory in the module and needs to be configured on initial use whenever the types of sensors are changed. The setExcitationFrequency and setExcitationVoltage C++ methods, and the MseLvdtModuleSetExcitationFrequency and MseLvdtModuleSetExcitationVoltage C functions are used for setting the excitation frequency and voltage.

## C++ Initialization

The MseInterface class allows for ease in initializing by offering the createChain and addModule methods. These methods are only available for C++ developers and perform the instantiation of the classes as well as the initialization.

Instantiating an object in C++ refers to creating an instance of the desired class in order to start initializing and/or accessing its methods.

The example "Creating a Chain via Broadcasting" on page 240 shows how to initialize using createChain.

The example "Creating a Chain Manually" on page 242 shows how to initialize using addModule.

All instantiated modules can use the initializeModule C++ method in order to communicate to a module instead of creating a chain.

## Non-C++ Initialization

Non-C++ developers must create their own module objects by instantiating the desired classes and using the initialization methods for each module.

The C calls will wrap the instantiation of the object in the create calls which make the pointer to the object accessible through the return parameter. Refer to "Mse1VppModuleCreate" on page 122. Non-C++ can utilize the C calls to work with all of the functionality in the library.

The C calls for simply instantiating and then initializing are:

| Module | Instantiation | Initialization |
|---|---|---|
| 1Vpp | Mse1VppModuleCreate | Mse1VppModuleInitialize |
| Analog | MseAnalogModuleCreate | MseAnalogModuleInitialize |
| EnDat | MseEndatModuleCreate | MseEndatModuleInitialize |
| I/O | MseIoModuleCreate | MseIoModuleInitialize |
| LVDT | MseLvdtModuleCreate | MseLvdtModuleInitialize |
| Pneumatic | MsePneumaticModuleCreate | MsePneumaticModuleInitialize |
| TTL | MseTtlModuleCreate | MseTtlModuleInitialize |

The example "Creating a Chain via Broadcasting" on page 240 shows how to instantiate and initialize using C functions without a chain.

# 7.3 Configuring the Channels

Most of the modules have the ability to attach devices to one or more channels. The power supply modules do not have any channels. The I/O and Pneumatic modules do not need to be configured through software.

## 1Vpp

The 1Vpp module must set the error compensation, UOM, encoder type, signal period or line count, and counting direction.

Refer to "1Vpp methods and functions" starting on page 117 for the methods and functions listed below.

C++ methods:

- setErrorCompensation
- setUom
- setEncoderType
- setSignalPeriod
- setLineCount
- setCountingDirection
- initAbsolutePosition
- isReferencingComplete
- getReferencingState

C functions:

- Mse1VppModuleSetErrorCompensation
- Mse1VppModuleSetUom
- Mse1VppModuleSetEncoderType
- Mse1VppModuleSetSignalPeriod
- Mse1VppModuleSetLineCount
- Mse1VppModuleSetCountingDirection
- Mse1VppModuleStartReferencing
- Mse1VppModuleGetReferencingComplete
- Mse1VppModuleGetReferencingState

Refer to "Setting the Encoder Information" on page 244 for a channel configuration example.

Refer to "Referencing" on page 239 for information on referencing.

Refer to "Referencing  1Vpp Linear Encoder" on page 248 for a referencing example.

The signal period and reference mark type for many of the HEIDENHAIN 1Vpp encoders is shown in the following table:

| Encoder | Signal period | Reference marks |
|---|---|---|
| ST 128x | 20 | Single |
| ST 308x | 20 | Single |
| LS 388C | 20 | 1000 |
| LS 688C | 20 | 1000 |
| LS 187<br>LS 187C | 20 | Single<br>Coded/1000 |
| LS 487<br>LS 487C | 20 | Single<br>Coded/1000 |
| LB 382C | 40 | Coded/2000 |
| LF 183<br>LF 183C | 4 | Single<br>Coded/5000 |
| LF 483<br>LF 483C | 4 | Single<br>Coded/5000 |

## EnDat

The EnDat module only allows for setting the error compensation and UOM. EnDat encoders have non-volatile memory that allow for detection of all other values.

Refer to "EnDat methods and functions" starting on page 97 for the methods and functions listed below.

C++ methods:
- setErrorCompensation
- setUom

C functions:
- MseEndatModuleSetErrorCompensation
- MseEndatModuleSetUom

Refer to "Setting the Encoder Information" on page 244 for a 1Vpp channel configuration example. The EnDat configuration is performed in the same manner except that it only utilizes the error compensation and UOM.

## TTL

The TTL module must set the error compensation, UOM, encoder type, signal period or line count, interpolation, and counting direction.

Refer to "TTL methods and functions" starting on page 180 for the methods and functions listed below.

C++ methods:
- setChannelPresence
- setErrorCompensation
- setUom
- setEncoderType
- setSignalPeriod
- setLineCount
- setCountingDirection

C functions:
- MseTtlModuleSetChannelPresence
- MseTtlModuleSetErrorCompensation
- MseTtlModuleSetUom
- MseTtlModuleSetEncoderType
- MseTtlModuleSetSignalPeriod
- MseTtlModuleSetLineCount
- MseTtlModuleSetCountingDirection

The signal period and reference mark type for many of the HEIDENHAIN TTL encoders is shown in the following table:

| Encoder | Resolution | Signal period | Interpol. factor | Reference marks |
|---|---|---|---|---|
| LS 177/477 | 1 µm | 20 µm | 5-fold | single |
| | 0.5 µm | 20 µm | 10-fold | single |
| | 0.25 µm | 20 µm | 20-fold | single |
| LS 177C/477C | 1 µm | 20 µm | 5-fold | coded/1000 |
| | 0.5 µm | 20 µm | 10-fold | coded/1000 |
| | 0.25 µm | 20 µm | 20-fold | coded/1000 |
| LS 328C/628C | 5 µm | 20 µm | n/a | coded/1000 |
| LS 378C | 1 µm | 20 µm | 5-fold | coded/1000 |
| | 0.5 µm | 20 µm | 10-fold | coded/1000 |
| | 0.25 µm | 20 µm | 20-fold | coded/1000 |

## LVDT

The LVDT module must set the channel presence, UOM, sensor gain, and resolution.

Refer to “LVDT methods and functions” starting on page 151 for the methods and functions listed below.

C++ methods:
- setChannelPresence
- setUom
- setSensorGain
- setResolution

C functions:
- MseLvdtModuleSetChannelPresence
- MseLvdtModuleSetUom
- MseLvdtModuleSetSensorGain
- MseLvdtModuleSetResolution

The LVDT sensors have the ability to teach the sensor gain. This is useful for getting a gain with 80% usage of the total voltage range of the electronics. Too much gain will cause the sensor to become unreliable. Too little gain will cause lower resolution. Calling the teachSensorGain method will start the teach. Polling the getTeachSensorGainFinished can be used to determine when the gain teach has completed.

Refer to “LVDT methods and functions” starting on page 151 for the methods and functions listed below.

C++ methods:
- teachSensorGain
- getTeachSensorGainFinished

C functions:
- MseLvdtModuleTeachSensorGain
- MseLvdtModuleTeachSensorGainFinished

## Analog

The Analog module must set the resolution and offset.

Refer to “Analog methods and functions” starting on page 167 for the methods and functions listed below.

C++ methods:
- setResolution
- setOffset
- computeResolutionAndOffset

C functions:
- MseAnalogModuleSetResolution
- MseAnalogModuleSetOffset
- MseAnalogModuleComputeResolutionAndOffset

# 7.4 Channel Operations

The 1Vpp, EnDat, TTL, LVDT, and Analog modules can read information about the devices attached to the channel. The I/O modules can read channel inputs and set outputs. The Pneumatic module can read and set its output used for controlling the solenoid valve.

## 1Vpp

The 1Vpp latest or latched position of all channels can be retrieved as counts or in user units. The counts are a representation of the number of interpolated crossings of the signal periods on the encoder that have been passed. The position in user units is the counts multiplied by the resolution and the error compensation value.

Refer to "1Vpp methods and functions" starting on page 117 for the methods and functions listed below.

C++ methods:

- getCounts
- getPositions
- getResolution

C functions:

- Mse1VppModuleGetCounts
- Mse1VppModuleGetPositions
- Mse1VppModuleGetResolution

Refer to "Setting the Encoder Information" on page 244 for reading the counts and positions from a 1Vpp module.

## EnDat

The Endat latest or latched position of all channels can be retrieved as counts or in user units. The counts are a representation of the number of interpolated crossings of the signal periods on the encoder that have been passed. The position in user units is the counts multiplied by the resolution and the error compensation value.

The EnDat rotary encoders return the current revolution with the getPostions method. The total number of distinguishable revolutions available to the encoder can be retrieved separately.

Refer to "EnDat methods and functions" starting on page 97 for the methods and functions listed below.

C++ methods:

- getCounts
- getPositions
- getResolution
- getDistinguishableRevolutions

C functions:

- MseEndatModuleGetCounts
- MseEndatModuleGetPositions
- MseEndatModuleGetResolution
- MseEndatModuleGetDistinguishableRevolutions

Refer to "Latching" on page 246 for reading the positions from an EnDat module.

## TTL

The TTL latest or latched position of all channels can be retrieved as counts or in user units. The counts are a representation of the number of interpolated crossings of the signal periods on the encoder that have been passed. The position in user units is the counts multiplied by the resolution and the error compensation value.

Refer to "TTL methods and functions" starting on page 180 for the methods and functions listed below.

C++ methods:

- getCounts
- getPositions
- getResolution.

C functions:

- MseTtlModuleGetCounts
- MseTtlModuleGetPositions
- MseTtlModuleGetResolution

## LVDT

The LVDT latest or latched position of all channels can be retrieved as voltage or in user units. The voltage is a representation of the position of the sensor in relation to its NULL, or center, point. The position in user units is the voltage multiplied by the resolution value.

Refer to "LVDT methods and functions" starting on page 151 for the methods and functions listed below.

C++ methods:
- getVoltage
- getPositions
- getResolution

C functions:
- MseLvdtModuleGetVoltage
- MseLvdtModuleGetPositions
- MseLvdtModuleGetResolution

## Analog

The Analog latest or latched position of all channels can be retrieved as voltage, current or in user units. The voltage is a representation of the position of the sensor in relation to its NULL, or center, point. The position in user units is the voltage multiplied by the resolution value.

Refer to "Analog methods and functions" starting on page 167 for the methods and functions listed below.

C++ methods.
- getVoltage
- getCurrent
- getValues
- getScaledValues
- getOffset
- getResolution

C functions:
- MseAnalogModuleGetVoltage
- MseAnalogModuleGetCurrent
- MseAnalogModuleGetValues
- MseAnalogModuleGetScaledValues
- MseAnalogModuleGetOffset
- MseAnalogModuleGetResolution

## I/O

The I/O latest or latched input and output channel values can be retrieved. The input and output value that are retrieved are each single characters that can be masked to determine which bit is set. Individual latest bit values can be retrieved as well. The outputs can be set individually or from the set bits of a single character.

Refer to "I/O methods and functions" starting on page 137 for the methods and functions listed below.

C++ methods:
- getIO
- getInputs
- getOutputs
- setOutput
- setOutputs

C functions
- MseIoModuleGetIO
- MseIoModuleGetInputs
- MseIoModuleGetOutputs
- MseIoModuleSetOutput
- MseIoModuleSetOutputs

## Pneumatic

The Pneumatic latest or latched output channel value can be retrieved. The output value that is retrieved is a single character that can be used to determine if the output is set. The output can be set as well.

Refer to "Pneumatic methods and functions" starting on page 145 for the methods and functions listed below.

C++ methods:
- getOutput
- setOutput

C functions:
- MsePneumaticModuleGetOutput
- MsePneumaticModuleSetOutput

## 7.5 Latching

Latching is used to accept a command in the base module that will cause the hardware trigger line to be set for all modules. The setting of the trigger line will allow all of the modules to store data in a very close timeframe which can be used by a client for tolerance or other functionality. The modules each store a single value for each channel no matter how many latch lines are set. The modules will be able to store a new value once the latches are all cleared in the base module followed by the remaining modules. Power supplies do not latch any data and do not need to perform any of the following functionality.

Latching consists of the following process:

- The base module waits for a command in order to activate the trigger line that is described in "Trigger line" on page 219.
- The command for activating the trigger is one of three software latch commands that are sent via the MSElibrary or one of the two footswitch latch requests that are inputs on the base module serial port.
- The command used for activating the software latch is setLatch in C++. The LATCH_OPTIONS enumeration value of LATCH_COUNT_SET must be called. The setLatch command with a value of LATCH_COUNT_SET can only be used for activating a latch on the base module.
- The commands used for activating the software latch are MseEndatModuleSetLatch, Mse1VppModuleSetLatch, and MseTtlModuleSetLatch in C.
- Once the trigger line is set, all of the modules will store that most recent count, position, voltage, current, or I/O value into memory.
- The latched position can be read using the COUNT_REQUEST_OPTION enumeration value of COUNT_REQUEST_LATCHED when getting the counts, position, voltage, current, or I/O values shown in "Channel Operations" on page 236.
- The latch can be cleared on each module by reading the latched position or by calling the setLatch method in C++. The LATCH_OPTIONS enumeration value of LATCH_COUNT_RESET must be called. The clearing of the latch must be done on the base module first or else the modules will immediately latch their values again since the trigger line is still active.
- The commands used for manually clearing the software latch are MseEndatModuleSetLatch, Mse1VppModuleSetLatch, MseTtlModuleSetLatch, MseLvdtModuleClearLatch, MseAnalogModuleClearLatch, MseIoModuleClearLatch, and MsePneumaticModuleClearLatch in C.

The footswitch is asynchronous to the client and needs to be polled to determine if it has been set. The asynchronous communication described page 243 can be used instead of polling to determine if the footswitch has been pressed.

Polling for whether any of the latches are set is done through the getLatch method in C++. The base module will indicate which latch is set. Non-base modules will just indicate whether the trigger line caused a latch to occur.

Polling for whether any of the latches are set is done through the MseEndatModuleGetLatches, Mse1VppModuleGetLatches, MseTtlModuleGetLatches, MseAnalogModuleGetLatch, MseLvdtModuleGetLatch, MseIoModuleGetLatch, and MsePneumaticModuleGetLatch functions in C.

## 7.6 Referencing

Some of the 1Vpp and TTL encoders utilize reference marks to obtain an absolute position on the scale. The encoder must be moved across at least one mark for encoders that have a single reference mark and across at least two for encoders that have coded referencing. The spacing between reference marks is dependent on the encoder and based on the signal period or line count of the encoder as well as the type of reference mark. The referencing process is performed in the module and is started, monitored, verified, and stopped through the MSElibrary. Referencing must be done each time the module is powered on.

The type of referencing for an encoder, interpolation (for TTL encoders), signal period, and line count can be obtained from the encoder manual or from the 1Vpp and TTL tables listed in "Configuring the Channels" on page 233.

Referencing is the following process:

- Configure the encoder and set the referencing type using the functions described in "Configuring the Channels" on page 233.
- The command used to start referencing in the module is initAbsolutePosition for a 1Vpp encoder or initReferencing for a TTL encoder in C++.
- The command used to start referencing in the module is Mse1VppModuleStartReferencing for a 1Vpp encoder or MseTtlModuleStartReferencing for a TTL encoder in C.
- The encoder can now be moved so that the reference mark(s) are crossed.
- The command used to poll the module to determine when referencing is complete is isReferencingComplete for both 1Vpp and TTL encoders in C++.
- The commands used to poll the module to determine when referencing is complete are Mse1VppModuleGetReferencingComplete for 1Vpp and MseTtlModuleGetReferencingComplete for TTL encoders in C.
- The command used to determine if referencing was successful is getReferencingState for both 1Vpp and TTL encoders in C++.
- The commands used to determine if referencing was successful are Mse1VppModuleGetReferencingState for 1Vpp and MseTtlModuleGetReferencingState for TTL encoders in C.

When referencing is complete and was verified as successful, the count and position requests will now be absolute.

The referencing complete message is available through the asynchronous communication described later in the document and can be used instead of polling to determine if the referencing is complete.

# 7.7 Module Errors and Warnings

The modules have errors and warnings described in “System integrity” on page 213.

A subset of the warnings and errors consisting of the INTEGRITY_ENUMS enumeration can be obtained through library calls. The errors and warnings obtained through the library call can be cleared. If the error or warning is still resident, it will be set again immediately.

The command used to get the integrity errors is getIntegrity in C++.

The commands used to get whether there is an integrity error or to get the integrity errors are Mse1VppModuleGetModuleErrorState, Mse1VppModuleGetModuleErrors, MseAnalogModuleGetModuleErrorState, MseAnalogModuleGetModuleErrors, MseEndatModuleGetModuleErrorState, MseEndatModuleGetModuleErrors, MseIoModuleGetModuleErrorState, MseIoModuleGetModuleErrors, MseLvdtModuleGetModuleErrorState, MseLvdtModuleGetModuleErrors, MsePneumaticModuleGetModuleErrorState, MsePneumaticModuleGetModuleErrors, MseTtlModuleGetModuleErrorState, and MseTtlModuleGetModuleErrors in C.

The getIntegrity method has a field that contains the ranges of each integrity error. This is used in order to retrieve the tolerance values that need to be reached before each integrity error is triggered. The NUM_INTEGRITY_RANGES constant is the number of integrity ranges returned. The INTEGRITY_FRAM_ERROR and INTEGRITY_FRAM_RECOVERED enumerations do not utilize a tolerance and so do not have a range entry.

The command used to get the actual values of the power supply current, power supply 24 V supply, non-power supply 5 V supply, 3.3 V supply, and CPU temperature is getAdcValues in C++.

The command used to get the actual values of the power supply current, power supply 24 V supply, non-power supply 5 V supply, 3.3 V supply, and CPU temperature are Mse1VppModuleGetAdcValues, MseAnalogModuleGetAdcValues, MseEndatModuleGetAdcValues, MseIoModuleGetAdcValues, MseLvdtModuleGetAdcValues, MsePneumaticModuleGetAdcValues, and MseTtlModuleGetAdcValues in C.

The module errors can be cleared with the clearIntegrityErrors method in C++.

The module errors and channel errors together can be cleared with the clearAllErrors method in C++.

The module errors and channel errors together can be cleared with the Mse1VppModuleClearErrors, MseAnalogModuleClearErrors, MseEndatModuleClearErrors, MseIoModuleClearErrors, MseLvdtModuleClearErrors, MsePneumaticModuleClearErrors, and MseTtlModuleClearErrors in C.

Module errors are cleared automatically when the MSElibrary initializes a module.

# 7.8 Channel Errors and Warnings

The EnDat and 1Vpp encoders both utilize the same microcontroller for reading counts and storing counter errors and warnings.

The EnDat encoder has the ability to report additional warnings and error specific to it and to keep track of its operating efficiency with Function Reserves.

The TTL encoder only monitors for a single error.

Errors and warnings are cleared automatically when the MSElibrary initializes a module.

## EnDat

The counter errors are used to determine if the microcontroller that is reading the counts is getting an error. The counter errors are described with the COUNTER_STATUS enumeration. Refer to "Enumerations" starting on page 29.

The counter errors can be obtained with the getChannelStatus C++ method.

The counter errors can be obtained with the MseEndatModuleGetChannelStatus C function.

The EnDat errors and warnings report additional errors and warnings that are not available through the counter status. The ENDAT_ERRORS and ENDAT_WARNINGS enumerations describe these additional errors and warnings. Refer to "Enumerations" starting on page 29.

The additional errors and warnings for the EnDat encoders can be read with getErrors and getWarnings C++ method.

The additional errors and warnings for the EnDat encoders can be read with MseEndatModuleGetChannelErrorState, MseEndatModuleGetEndatErrors, MseEndatModuleGetChannelWarningState, and MseEndatModuleGetEndatWarnings C functions.

The counter error and additional EnDat errors and warnings can be cleared with the clearErrorsAndWarnings C++ method.

The module errors, counter errors, and additional errors and warnings can be cleared together with the clearAllErrors method in C++.

The module errors and channel errors together can be cleared with the MseEndatModuleClearErrors function in C.

## 1Vpp

The counter errors are used to determine if the microcontroller that is reading the counts is getting an error. The counter errors are described with the COUNTER_STATUS enumeration. Refer to "Enumerations" starting on page 29.

The counter errors can be obtained with the getChannelStatus C++ method.

The counter errors can be obtained with the Mse1VppModuleGetChannelStatus C function.

The counter error can be cleared with the clearErrorsAndWarnings C++ method.

The module errors and counter errors can be cleared together with the clearAllErrors method in C++.

The module errors and counter errors together can be cleared with the Mse1VppModuleClearErrors function in C.

## TTL

The TTL module reports only whether there is a COUNTER_STATUS_EDGE_DISTANCE_ERROR. Refer to "Enumerations" starting on page 29.

The counter error can be obtained with the getChannelStatus C++ method.

The counter errors can be obtained with the MseTtlModuleGetChannelErrorState C function.

The counter error can be cleared with the clearErrorsAndWarnings C++ method.

The module errors and counter errors can be cleared together with the clearAllErrors method in C++.

The module errors and counter errors together can be cleared with the MseTtlModuleClearErrors function in C.

# 7.9 Diagnostics

The common diagnostics are described in "Diagnostic modes" on page 217.

The diagnostics default to DIAG_MODE_FULL when the modules power up. The DIAG_MODE_OPTIONS enumeration offers additional choices. Refer to "Enumerations" starting on page 29.

The diagnostics mode can be changed with the enableDiags C++ method.

The diagnostics mode can be changed with the Mse1VppModuleEnableDiags, MseAnalogModuleEnableDiags, MseEndatModuleEnableDiags, MseIoModuleEnableDiags, MseLvdtModuleEnableDiags, MsePneumaticModuleEnableDiags and MseTtlModuleEnableDiags C methods.

The EnDat, 1Vpp and LVDT modules each have additional diagnostics that can be monitored.

## EnDat

The EnDat module reports EnDat function reserves. The function reserve report how well the absolute tracking, incremental tracking, and position value calculation are being performed. The type of function reserve available is dependent on the encoder. If a function reserve is not available, it will be reported. If the encoder is normally running below 25% of a supported function reserve, it may be in need of servicing. The function reserves can be disabled using the enableDiags method.

The function reserves can be obtained with the getDiag C++ method.

The function reserves can be obtained with the MseEndatModuleGetDiags C function.

## 1Vpp

The 1Vpp module can return the A and B encoder amplitude values for the user to check that the amplitude is close to 1 Vpp, that they are within 90 degrees phase of each other, and for plotting a Lissajou figure of the signals.

The 1Vpp analog diagnostic is enabled with the enableAnalogDiag C++ method.

The 1Vpp analog diagnostic is enabled with the Mse1VppModuleEnableAnalogDiag C function.

The 1Vpp analog diagnostic values are read with the getDiag C++ method.

The 1Vpp analog diagnostic values are read with the Mse1VppModuleGetAnalogDiag C function.

## LVDT

The LVDT diagnostics allow for a single channel to be monitored rather than all 8. This is useful if a lot of samples need to be gathered of an individual sensor since it will be much faster.

The LVDT diagnostic is enabled with the setDiagnosticsEnabled C++ method.

The LVDT diagnostic is enabled with the MseLvdtModuleSetDiagnosticsEnabled C function.

# 7.10 Asynchronous Communication



Asynchronous communication allows for the client to wait on a socket for messages from the modules.

Asynchronous communication works for:

- Obtaining the IP addresses, netmasks, ports, MAC addresses, DHCP setting, and serial number for module that have been powered on but have not been connected yet.
- Receiving footswitch press notifications
- Receiving module and channel error notifications
- Receiving reference complete notifications

Asynchronous communication is turned on during the initialization of a module based on a parameter passed in by the client. Asynchronous communication can also be enabled or disabled with the setAsyncMode C++ method. There are no C functions for enabling asynchronous communication; the modules must be initialized with the required setting.

The client must bind on a UDP socket and wait on the asynchronous port in order to get asynchronous messages. Once the message is received, it can be decoded and/or acted upon.

The module will continue to send the asynchronous message until it is acknowledged.

Refer to “Asynchronous methods” on page 197 for more information.

The commands to decode the asynchronous message are:

- The getAsyncMsgType C++ method is used to determine the type of message received
- The MseModuleGetAsyncMsgType C function is used to determine the type of message received
- The decodeConnectMsg C++ method is used to get the information from a UDP_CONNECT message.
- The MseModuleGetAsyncMsgIpAddress, MseModuleGetAsyncMsgPort, MseModuleGetAsyncMsgDhcp, MseModuleGetAsyncMsgMacAddress, MseModuleGetAsyncMsgNetmask, and MseModuleGetAsyncMsgSerialNumber C functions are used to get the information from a UDP_CONNECT message.
- The decodeLatchMsg C++ method is used to get the information from a UDP_LATCH message.
- The MseModuleGetAsyncMsgLatch C function is used to get the information from a UDP_LATCH message.
- The decodeChannelStatusMsg C++ method is used to get the information from a UDP_CHANNEL_STATUS message.
- The MseModuleGetAsyncMsgChannelStatus C function is used to get the information from a UDP_CHANNEL_STATUS message.
- The UDP_INTEGRITY message does not need to be decoded. The actual errors should be read after this is received to determine what error occurred.

The UDP_CONNECT message will stop being sent when an initialize command is sent to the module.

The UDP_LATCH message will stop being sent when the module’s latch is cleared as described in “Latching” on page 238.

The UDP_CHANNEL_STATUS message with a channel status of 1 (warning or error) will stop being sent when the EnDat, 1Vpp, or TTL error is read as described in “Channel Errors and Warnings” on page 241.

The UDP_CHANNEL_STATUS message with a channel status of 2 (referencing complete) will stop being sent when the 1Vpp or TTL referencing is acknowledged. The LVDT diagnostic is enabled with the setDiagnosticsEnabled C++ method. The acknowledge is sent with the acknowledgeAbsolutePosition C++ method for 1Vpp and acknowledgeReferencing C++ method for TTL. The acknowledge is sent with the Mse1VppModuleAcknowledgeAbsolutePosition C function for 1Vpp and MseTtlModuleAcknowledgeReferenicng C function for TTL.

The UDP_INTEGRITY message will stop being sent when the module errors are read as described in “Module Errors and Warnings” on page 240.

The asynchronous port defaults to 27300. The MSE1000_ASYNC_PORT constant can be used access the default asynchronous port value. The asynchronous port can be changed for each module with the setAsyncPort C++ method. The asynchronous port can be changed for each module with the MseModuleSetAsyncPort C function. Changing the asynchronous port will set the value in the module non-volatile memory. All modules can be restored to factory defaults which will set the asynchronous port back to 27300.

# 8

# C++ examples

# 8.1 Overview

The C++ examples are located in the directory described in section 2.2 Installation Instruction.

Open the MSElibraryCppExamples.sln solution from within Visual Studio 2010 to access the MSElibraryCppExamples project. The MSElibraryCppExamples project's main file is MseExamples.cpp.

The C++ example is a command line program that allows for the following command line calls:

Broadcasting, CreateChain, SetIp, Program, Latching, SetLatch, GetLatches, IO, Pneumatic, EnDat, 1Vpp, Analog, LVDT, TTL, Referencing, Discovery, Subscribe, and ReadConfig.

The MseExamples.cpp file contains the main() function. The developer can use this file to access all of the examples. For example, if the developer wants to see how to perform a broadcast:

- Find the "Broadcasting" text in the argv string compare section of the main() function.
- Open the MseNetworking.cpp file since that is the object that is constructed in the example.
- Go to the createChain method in the MseNetworking.cpp file since that method is called next. Notice that the createChain method is called with the desired parameters, the return of the method is checked for errors, and the error code of the return can be decoded to get a textual representation.
- Go to the testChain method in the MseNetworking.cpp file since that method is called next. The module type, module data, counts, number of channels, and input and output values of I/O modules are all read.

The Broadcasting example will display all of the IP addresses for the modules in the chain. These addresses will be useful for utilizing the other examples.

# 8.2 Initializing the module chain

The initialization of the MSE is performed dynamically via broadcasting or manually by passing the required parameters.

Initialization is achieved by:

- Instantiating the MseInterface class.
- Calling the createChain() method for broadcasting or addModule() method for each module in the chain.

Initialization will create the UDP connection needed for communication to the module as well as gather all the module specific information and device information for EnDat modules.

The information returned from the broadcasting can be saved and used by client business logic to store all the needed information so that future broadcasts are not needed.

There is no need to deallocate memory for objects created by the library. The destructors of the classes will delete the dynamically created objects so that they are deallocated when the MseInterface goes out of scope.

## Creating a Chain via Broadcasting

The MSE chain is created via broadcasting with the createChain() method.

The createChain() method will do the following:

- Remove all connections that are currently in the chain.
- Send a broadcast message to the MSE requesting the IP address and port.
  - Each module in the MSE chain will respond to a broadcast message by sending a response with its IP address and port.
  - The information needed to communicate with each module is available once the responses are received but the order of the chain is not currently known.
- Read up to 64 responses from the MSE and stop waiting for responses after a timeout.
- Initialize each device that was found from the broadcast and add them to the MSE chain.
  - Initialization consists of setting up the UDP communication, requesting the module information from the module, and requesting the device information for each channel if the module is an EnDat module.
  - The asynchronous communication is not needed unless a separate thread is going to be used to watch for foot switch latches, 1Vpp reference complete, or errors.
- Organize the chain.
  - Utilizes the modules input and output connections, via the setRight() and getLeft() functions, to determine the order of the chain.
  - Reorganizes the MSE chain to represent the real physical locations of the modules.

**Example**
To initialize and create a chain of modules via broadcasting:

- Include the MseInterface.h header and instantiate the MseInterface class.

```
#include "MseInterface.h"
#include <iostream> // for sending results to the console
MseInterface mse;
```

- Create the MSE chain by calling createChain() with the IP address, base port to use for the client PC (this is what the MSE devices will use for responses), asynchronous messages set to false, and the netmask for use by the broadcasting.

```
MseResults retVal = mse.createChain("172.31.46.3",27016,false, "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;
```

## Creating a Chain Manually

The MSE chain is created manually with the addModule() method. This is the preferred method once all of the module IP addresses are known because it allows for the chain to be created faster, in the correct order from the start, and also allows for asynchronous communication from the modules.

The addModule() function will do the following:

- Return an error code of RESPONSE_MODULE_MISMATCH if the module requested does not match the module type in the firmware.
- Create a new module of the type requested.
- Initialize the module.
- Add the module to the MSE chain.

**Example**
To create a chain of modules manually:

- Include the MseInterface.h header and instantiate the MseInterface class.

```
#include "MseInterface.h"
#include <iostream> // for sending results to the console
#include <sstream> // for streaming object data
MseInterface mse;
```

- Create the MSE chain by calling addModule() for each module in the chain.

```
MseResults retVal = mse.addModule(MODULE_ID_ENDAT_BASE, "172.31.46.4",false);
if(RESPONSE_OK != retVal.getCode())
{
    std::stringstream ss;
    ss << "Error: " << MseResults:: showRespCode(retVal.getCode())
    cout << ss;
    std::cout << "handle error" << std::endl;
}
retVal = mse.addModule(MODULE_ID_IO_IP40, "172.31.46.5",false);
retVal = mse.addModule(MODULE_ID_1VPP_4X, "172.31.46.6",false);
retVal = mse.addModule(MODULE_ID_ENDAT_4X, "172.31.46.7",false);
retVal = mse.addModule(MODULE_ID_ENDAT_8X, "172.31.46.8",false);
```

# 8.3 Getting counts

This example shows how to get the counts of the measurement devices. The getCounts will return the requested number of channels worth of counts (unless the numChannels is > the number of channels available in that module).

**Example**
To initialize and read count data:

- Include the MseInterface.h header and instantiate the MseInterface class.

```
#include "MseInterface.h"
#include <iostream> // for sending results to the console
MseInterface mse;
```

- Create the MSE chain by calling createChain() with the IP address, base port to use for the client PC (this is what the MSE devices will use for responses), asynchronous messages set to false, and the netmask for use by the broadcasting.

```
MseResults retVal = mse.createChain("172.31.46.3",27016,false, "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;
```

- Get a reference to the desired module, request the counts, iterate through the channels and display the count value.

```
MseResults retVal;
// Allocate enough memory for the maximum number of channels
unsigned long counts[MAX_CHANNELS_PER_MODULE];

// Get the reference to the first module (indexed from 0)
MseModule* module = mse.getModule(0);
if(0 == module)
std::cout << "handle error" << std::endl;

// Request counts
retVal = module->getCounts(counts, module->getNumChannels(), COUNT_REQUEST_LATEST);
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;

// Display the resulting counts
for(unsigned int i = 0; i < module->getNumChannels()); ++i)
{
    cout << "Channel[" << i << "] = " << counts[i] << "\n";
}
```

# 8.4 Setting the Encoder Information

The encoder information is used for EnDat and 1Vpp modules. The encoder information is set after the module chain is created. The EnDat devices will default to millimeters for linear encoders and degrees for rotary encoders.

The 1Vpp encoders have additional information that needs to be set in order to get a position. 1Vpp rotary encoders require the line count to be set and 1Vpp linear encoders require the signal period.

**Example**
To set the encoder info:

- Include the headers and instantiate the MseInterface class.

```
#include "MseInterface.h"
MseInterface mse;
```

- Create the MSE chain by calling createChain() with the IP address and base port to use for the client PC (this is what the MSE devices will use for responses).

```
MseResults retVal = mse.createChain("172.31.46.3",27016,false, "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;
```

- Get a pointer to the 1Vpp module that needs to be configured and set the encoder information.

```
Mse1VppModule* module = mse.get1VppModule(0);
if(0 == module)
std::cout << "handle error" << std::endl;

module->setUom(UOM_INCHES,0);
module->setErrorCompensation(1.0,0);
module->setEncoderType(ENCODER_TYPE_GAUGE,0);
module->setSignalPeriod(20,0);
module->setCountingDirection(true,0);

module->setUom(UOM_DEGREES,1);
module->setErrorCompensation(1.0,1);
module->setEncoderType(ENCODER_TYPE_ROTARY,1);
module->setLineCount(4096,1);
module->setCountingDirection(true,1);

module->setUom(UOM_MM,2);
module->setErrorCompensation(1.0,2);
module->setEncoderType(ENCODER_TYPE_LINEAR,2);
module->setSignalPeriod(20,2);
module->setCountingDirection(false,2);

module->setUom(UOM_DEGREES,3);
module->setErrorCompensation(1.0,3);
module->setEncoderType(ENCODER_TYPE_ROTARY,3);
module->setLineCount(18000,3);
module->setCountingDirection(true,3);
```

- Read the counts. The counts will be raw values.

```
// Allocate enough memory for the maximum number of channels
unsigned long counts[MAX_CHANNELS_PER_MODULE];

retVal = module->getCounts(counts, module->getNumChannels(), COUNT_REQUEST_LATEST);
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;

// Display the resulting counts
for(unsigned int i = 0; i < module->getNumChannels()); ++i)
{
    cout << "Channel[" << i << "] = " << counts[i] << "\n";
}
```

- Read the position. The position will be based on the uom, line count, signal period, counting direction, and error compensation passed in.

```
double pos[MAX_CHANNELS_PER_MODULE];
retVal = module->getPositions(pos, module->getNumChannels(),COUNT_REQUEST_LATEST);
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;

for(unsigned int i = 0; i < module->getNumChannels(); ++i)
{
    cout << "Channel[" << i << "] = " << pos[i] << "\n";
}
```

# 8.5 Latching

Latching is used to capture position and I/O data for all modules for a specific moment in time. Latching occurs by telling the base module to start the latch via the MSElibrary or from a footswitch attached to the serial port of the base module. Latching is done after the module chain is created.

The MSElibrary utilizes the setLatch(LATCH_COUNT_RESET, LATCH_CHOICE_ALL) method for clearing a latch and the setLatch(LATCH_COUNT_SET, LATCH_CHOICE_SOFTWARE_1) method for causing the latch to occur. The getPositions() method with a option parameter of COUNT_REQUEST_LATCHED is used to get the latched data from a module. The stored latched position in a module will not be updated again unless the latch is cleared.

**Example**
To set latching:

- Include the headers and instantiate the MseInterface class.

```
#include "MseInterface.h"
MseInterface mse;
```

- Create the MSE chain by calling createChain() with the IP address and base port to use for the client PC. The MSE devices will use this for responses.

```
MseResults retVal = mse.createChain("172.31.46.3",27016,false, "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;
```

- Loop through the chain and clear the latches on all modules.

```
for(unsigned int moduleIndex = 0; moduleIndex < mse.getNumModules(); ++moduleIndex)
{
    MseModule* module = mse.getModule(moduleIndex);
    if(module)
    {
        retVal = module->setLatch(LATCH_COUNT_RESET, LATCH_CHOICE_ALL);
        if(RESPONSE_OK != retVal.getCode())
        {
            std::cout << "Could not clear the latch in the module";
            return false;
        }
    }
}
```

- Set the latch on the base module.

```
MseModule* baseModule = mse.getModule(1);
if(baseModule)
{
    retVal = baseModule->setLatch(LATCH_COUNT_SET, LATCH_CHOICE_SOFTWARE_1);
    if(RESPONSE_OK != retVal.getCode())
    {
        std::cout << "Could not set the latch in the base module";
        return false;
    }
}
```

- Loop through the chain and get the latched data from each 1Vpp and EnDat module

```
MODULE_ID moduleType;
unsigned long hwId = 0;
unsigned char hwRev = 0;
unsigned short numAxes;
double pos[MAX_CHANNELS_PER_MODULE];
long currentRevolution[MAX_CHANNELS_PER_MODULE];

for(unsigned int moduleIndex = 0; moduleIndex < mse.getNumModules();  ++moduleIndex)
{
    if(0 == mse.getModule(moduleIndex))
    {
        std::cout << "Module returned NULL" << std::endl;
        continue;
    }
```

```
    retVal = mse.getModule(moduleIndex)->getModuleType(&moduleType, &hwId, &hwRev,
    &numAxes);
    if(RESPONSE_OK != retVal.getCode())
    {
        std::cout << "Could not get the module type " << std::endl;
        continue;
    }
    switch(moduleType)
    {
        case MODULE_ID_ENDAT_BASE:
        case MODULE_ID_ENDAT_8X:
        case MODULE_ID_ENDAT_4X:
        {
            MseEndatModule* module = mse.getEndatModule(moduleIndex);
            if(0 == module)
            {
                std::cout << "Module " << moduleIndex << " is NULL " << std::endl;
                continue;
            }

            retVal = module->getPositions(pos,currentRevolution,module-
>getNumChannels(),
                COUNT_REQUEST_LATCHED);
            if(RESPONSE_OK != retVal.getCode())
            {
                std::cout << "Could not get positions from EnDat module" << std::endl;
                continue;
            }

            for(unsigned int i = 0; i < module->getNumChannels(); ++i)
            {
                std::cout << "Channel[" << i << "] = " << std::setiosflags
                (std::ios::fixed)
                    << std::setprecision(4) << pos[i] << std::endl;
            }
        }
        break;

        case MODULE_ID_1VPP_BASE:
        case MODULE_ID_1VPP_8X:
        case MODULE_ID_1VPP_4X:
        {
            Mse1VppModule* module = mse.get1VppModule(moduleIndex);
            if(0 == module)
            {
                std::cout << "Module " << moduleIndex << " is NULL " << std::endl;
                continue;
            }

            retVal = module->getPositions(pos,module->getNumChannels(),
                COUNT_REQUEST_LATCHED);
            if(RESPONSE_OK != retVal.getCode())
            {
                std::cout << "Could not get positions from 1Vpp module << std::endl;
                continue;
            }

            for(unsigned int i = 0; i < module->getNumChannels(); ++i)
            {
                std::cout << "Channel[" << i << "] = " << std::setiosflags
                (std::ios::fixed)
                    << std::setprecision(4) << pos[i] << std::endl;
            }
        }
        break;

        default:
        break;
    }
}
```

# 8.6 Referencing 1Vpp Linear Encoder

The referencing procedure is used for 1Vpp linear and rotary encoders. This example is for a HEIDENHAIN LS 388C linear encoder with a signal period of 20 micrometers and 1000 signal period spacing. Referencing the encoder is the process used to obtain an absolute position on the encoder's scale. The user must initialize the module, set the encoder data, start the referencing, move the encoder across the reference marks, wait for the referencing to complete, and then verify that the referencing was successful. Polling the referencing complete can be replaced with monitoring the asynchronous thread for a UDP_CHANNEL_STATUS message followed by decoding the asynchronous message with the decodeChannelStatusMsg method and then sending an acknowledgeAbsolutePosition method to the module.

**Example**
To reference the encoder:

- Include the headers and instantiate the MseInterface class.

```
#include "MseInterface.h"
MseInterface mse;
Create the MSE chain by calling createChain() with the IP address and base port to use
for the client PC (this is what the MSE devices will use for responses).

MseResults retVal = mse.createChain("172.31.46.3",27016,false, "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
    std::cout << "handle error" << std::endl;
```

- Get a pointer to the 1Vpp module and set the encoder data.

```
Mse1VppModule* module = mse.get1VppModule(0);
if(0 == module)
    std::cout << "handle error" << std::endl;

module->setUom(UOM_MM,0);
module->setErrorCompensation(1.0,0);
module->setEncoderType(ENCODER_TYPE_LINEAR,0);
module->setSignalPeriod(20,0);
module->setCountingDirection(true,0);
```

- Tell the module to obtain the reference position.

```
module_->initAbsolutePosition(0,REFERENCE_MARK_CODED_1000,20);
```

- Poll the module until the reference position has been obtained (the user must move the encoder read head until it crosses at least 2 reference marks).

```
bool isReferenced = false;

while(1)
{
    retVal = module_->isReferencingComplete(0,&isReferenced);
    if(RESPONSE_OK != retVal.getCode())
    {
        std::cout << "Could not check isReferenceComplete: " <<
MseResults::showRespCode(retVal.getCode()) << std::endl;
        return false;
    }

    if(isReferenced)
        break;
}
```

- Verify that the referencing has been successful.

```
REF_MARK_STATE refState = REF_MARK_OFF;

retVal = module_->getReferencingState(0,&refState);
if(RESPONSE_OK != retVal.getCode())
{
    std::cout << "Could not get the referencing state: " <<
MseResults::showRespCode(retVal.getCode()) << std::endl;
    return false;
}

if(refState == REF_MARK_FINISHED)
    std::cout << "The encoder referencing passed" << std::endl;
else
    std::cout << "The encoder referencing failed" << std::endl;
```

# 8.7 Programming Firmware

The firmware is programmed using the program() method in the MseModule class. The percent complete of the programming can be obtained with the getProgrammingPercentComplete() method. The program method blocks until done, so the getProgrammingPercentComplete() needs to run in another thread by the client. The percent complete is returned as a double. The programming can be done by using a module in the MSE chain or by IP address in case there is an initialization problem with a module in the chain.

**Example**
To program firmware:

- Include the headers and instantiate the MseInterface class.

```
#include "MseInterface.h"
MseInterface mse;
```

- Create the MSE chain by calling createChain() with the IP address and base port to use for the client PC (this is what the MSE devices will use for responses).

```
MseResults retVal = mse.createChain("172.31.46.3",27016,false, "255.255.255.0");
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;
```

- Get a reference to the desired module to program.

```
MseModule* module = mse.getModule(0);
if(0 == module)
std::cout << "handle error" << std::endl;
```

- Program the module with the new firmware.

```
MseResults retVal;
retVal = module->program("C:\\Program Files\\MSEsetup\\Firmware\\MSEfirmware.dat");
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;
```

To program firmware with IP address:

- Include the headers.

```
#include "MseInterface.h"
```

- Create a new module for programming (because the chain status is unknown) and remove it from the UDP server when done (in the destructor of the MseModule).

```
MseModule* module = new MseModule();
if(0 == module)
std::cout << "handle error" << std::endl;
```

- Initialize the module with the initializeFirmware function of the MseModule class.

```
MseResults retVal;
retVal = module->initializeFirmware("172.31.46.1");
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;
```

- Program the module with the new firmware.

```
retVal = module->program("C:\\Program Files\\MSEsetup\\Firmware\\MSEfirmware.dat");
if(RESPONSE_OK != retVal.getCode())
std::cout << "handle error" << std::endl;
```

# 8.8 MseConfigReader

The MseConfigReader is used to read configuration data that was created by the MSEsetup application. This data can be very useful when utilizing the MSElibrary as it allows a developer to leverage this data instead of having to create their own persistant storage.

The MSEsetup application must successfully perform a broadcast before the following example can be utilized.

The examples in this section utilize C++.

**Example**
To read from the ModuleConfig.xml file:

- Include the header and instantiate the MseConfigReader class.

```
#include "MseConfigReader.h"
#include "mseDeviceModule.h"
MseConfigReader configReader;
```

- Call loadXml with the filename of the ModuleConfig.xml file:

```
MSE_XML_RETURN retVal = MSE_XML_RETURN_OK;
retVal = configReader.loadXml("C:\\ProgramData\\HEIDENHAIN\\MSEsetup\\config\\
ModuleConfig.xml");
if(retVal != MSE_XML_RETURN_OK)
{
     std::cout << "Error: " << MseConfigbase::decodeErrorType(retVal) << std::endl;
     return;
}
```

- Call getElement with the desired tag name, module number, and channel number(getElement is an overloaded function that can be called with or without the module number or channel number based on the desired tag to retrieve). The following example retrieves the 1Vpp line count for module 2, channel 2.

```
MSE_XML_RETURN retVal = MSE_XML_RETURN_OK;
std::String tempStr;
int moduleNum = 2;
int channelNum = 2;

retVal = configReader.getElement(MSE_XML_ELEMENT_LINE_COUNT, tempStr, moduleNum,
channelNum);
if(retVal != MSE_XML_RETURN_OK)
{
     std::cout << "Error: " << MseConfigbase::decodeErrorType(retVal) << std::endl;
     return;
}
else
{
     std::cout << MseConfigBase::decodeElementType(MSE_XML_ELEMENT_LINE_COUNT)
     << " = " << tempStr << std::endl;
}
```

# 9

# C examples

# 9.1 Overview

The C examples are located in the directory described in section 2.2 Installation Instruction.

Open the MSElibraryCExamples.sln solution from within Visual Studio 2010 to access the MSElibraryCExamples project. The MSElibraryCExamples project's main file is main.cpp. The AsyncMessageHandler.cpp file is used for examples of asynchronous communication.

The main function uses a hardcoded module IP address and hardcoded client IP address. Modify the line in the main function that contains strcpy(ipAddress,"172.31.46.103") so that the IP address is equal to the IP address of the module to test. Modify the line in the main function that contains strcpy(clientIpAddress,"172.31.46.253") so that the IP address is equal to the IP address of the workstation.

Running this example will test the broadcasting, show all the IP addresses of the modules in the chain, initialize the module selected with the ipAddress variable, display information about the module selected, run test code based on the type of module, show the module labels in the ModuleConfig.xml file, and wait on an asynchronous socket for messages from the modules. The ModuleConfig.xml only exists if the MSEsetup application is run beforehand. The MSEsetup application is supplied by HEIDENHAIN as a graphical application to configure the module, store the configuration into a ModuleConfig.xml file, and perform data capturing of the modules.

# 9.2 Initialize, Configure, and Get Positions from a 1Vpp Module

The following example will connect to a 1Vpp module, configure the encoder information for the first channel, and get the encoder position. This example assumes a gauge with a signal period of 20um.

**Example**

- Include the headers and instantiate a Mse1VppModule.

```
#include "MseModuleWrapper.h"
#include "Mse1VppModuleWrapper.h"
#include <iostream>
#include <iomanip>
#include <sstream>

using namespace std;

char ipAddress[16];
MSE_RESPONSE_CODE respCode;
char respStr[256];
unsigned long counts[MAX_CHANNELS_PER_MODULE];
double pos[MAX_CHANNELS_PER_MODULE];
double resolution = 0.0;
short channelNum = 0;
ENCODER_TYPES_ENUM encoderType = ENCODER_TYPE_NONE;
UOM uom = UOM_UNDEFINED;
short signalPeriod = 0;

// The IP addres of the module to connect with
strcpy(ipAddress,"172.31.46.17");

// Get a pointer to a Mse1VppModule in order to initialize, configure, and get data
MseModulePtr module = Mse1VppModuleCreate();
if(!module )
    return 0;

// Initialize the module
respCode = Mse1VppModuleInitialize(module ,&ipAddress[0],false);
if(respCode != RESPONSE_OK)
{
    MseModuleShowRespCode(respStr,respCode);
    cout << "Mse1VppModuleInitialize failed: " << respStr << endl;
    Mse1VppModuleDelete(module);
    return;
}

encoderType = ENCODER_TYPE_LINEAR;
respCode = Mse1VppModuleSetEncoderType(module, encoderType, channelNum);
if(respCode != RESPONSE_OK)
{
    Mse1VppModuleDelete(module);
    return;
}
```

```
uom = UOM_MM;
respCode = Mse1VppModuleSetUom(module, uom, channelNum);
if(respCode != RESPONSE_OK)
{
    Mse1VppModuleDelete(module);
    return;
}

signalPeriod = 20;
respCode = Mse1VppModuleSetSignalPeriod(module, signalPeriod, channelNum);
if(respCode != RESPONSE_OK)
{
    Mse1VppModuleDelete(module);
    return;
}

respCode = Mse1VppModuleGetResolution(module, &resolution, channelNum);
if(respCode != RESPONSE_OK)
{
    Mse1VppModuleDelete(module);
    return;
}
cout << "The Resolution for channel " << channelNum << " is " << std::setiosflags
(std::ios::fixed) << std::setprecision(8) << resolution << endl;

respCode = Mse1VppModuleGetCounts(module, &counts[0], MAX_CHANNELS_PER_MODULE,
COUNT_REQUEST_LATEST);
if(respCode != RESPONSE_OK)
{
    Mse1VppModuleDelete(module);
    return;
}
cout << "The Counts for channel " << channelNum << " are " << counts[0] << endl;

respCode = Mse1VppModuleGetPositions(module, &pos[0], MAX_CHANNELS_PER_MODULE,
COUNT_REQUEST_LATEST);
if(respCode != RESPONSE_OK)
{
    Mse1VppModuleDelete(module);
    return;
}
cout << "The Position for channel " << channelNum << " is " << pos[0] << endl;

// Delete the module when not using it anymore and free up the memory
Mse1VppModuleDelete(module);
```

# 10

# Visual Basic examples

## 10.1 Overview

The Visual Basic examples are located in the directory described in section 2.2 Installation Instruction.

Open the MSETestbed.sln solution from within Visual Studio 2010 to access the MSETestbed project. The MSETestbed project's main file is MainForm.vb.

The MSElibrary.dll, QtCore4.dll, and QtXml4.dll should be deleted and re-added to the project if they cannot be found or are incorrect versions.

The following files contain most of the function declarations that are needed for calling into the MSElibrary dll: AnalogModule.vb, CommonModule.vb, ConfigFileModule.vb, EndatModule.vb, IoModule.vb, LvdtModule.vb, OneVppModule.vb, PneumaticModule.vb, and TtlModule.vb. Function declarations that are not provided can be added by the developer based on the already included declarations and the information provided in this manual.

The Visual Basic example relies on an already existing ModuleConfig.xml file to have been created by the MSEsetup application. The MSEsetup application is supplied by HEIDENHAIN as a graphical application to configure the module, store the configuration into a ModuleConfig.xml file, and perform data capturing of the modules. The example will create a module chain once the 'Init' button is pressed and the ModuleConfig.xml file is chosen. The module chain is visible in the Module drop down box. The desired test can then be selected from the 'Tests' dropdown box followed by clicking on 'Open Test'.

## 10.2 Module Throughput Test

The Module Throughput test is used to determine how many channels per second can be captured, the number of packets sent, and the number of dropped packets for an individual module. The results are shown dynamically and can be stored to a file.

The ModuleThroughputForm.vb file has the code used for the test.

The UDP delay, timeout, and number of retries can all be set to limit the number of dropped packets if necessary.

The diagnostic level can be changed in order to show how it affects the EnDat modules throughput.

## 10.3 Chain Throughput Test

The Chain Throughput test is used to determine how many channels per second can be captured, the number of packets sent, and the number of dropped packets for an entire chain. The results are shown dynamically and can be stored to a file.

The ChainThroughputForm.vb file has the code used for the test.

The UDP delay can be set to limit the number of dropped packets if necessary.

## 10.4 Latching Test

The Latching test can be used to show the latch state of all modules.

The LatchingForm.vb file has the code used for the test.

All 5 of the latches can be set through software. The physical footswitch can be tested by clicking on the 'Get latch(es)' button.

The 'Clear Latches' button can be used to clear the latches without reading the positions.

The 'Latched Values' button can be used to read all of the latched values into the screen.

The 'Live Values' button can be used to read all of the latest values into the screen. This is useful for testing latching to make sure that the latched value differs from the live value when a footswitch occurs and the value is read even after the position has changed.

The 'Latch and Read' button will cause a latch to occur and then time how long it takes to read all of the latched values from the modules.

## 10.5 Voltage Diagnostics

The voltage diagnostics test is used to read the sensor gain code, read the sensor voltage, set the sensor gain code, get the excitation voltage, get the excitation frequency, set the excitation voltage, and set the excitation frequency.

The LvdtDiagnosticForm.vb file has the code used for the test.

The 'Set Choice' button allows the user to isolate the desired voltage reading to the selected choice. This utilizes the MseLvdtModuleSetDiagnosticsEnabled C function. The selection of 'All' in the drop down will not show any reading when 'Get Voltage' is clicked but will instead set the module back to its normal polling routine of reading all populated sensors plus the excitation voltage.

The 'Start' button will allow the voltage value to be read continuously.

# 11

# Delphi examples

## 11.1 Overview

The Delphi examples are located in the users directory listed in "Installation instructions" on page 24.

- Open the Mse.dproj project from within Delphi XE3. The MSE project's main file is Main.pas.

The MSElibrary.dll, QtCore4.dll, and QtXml4.dll should be available to the project if they cannot be found or are incorrect versions.

The following files contain some examples of the function declarations that are needed for calling into the MSElibrary dll:

- Mse1VppModule.pas
- MseEndatModule.pas
- MseModule.pas
- MseConfigFile.pas

Function declarations that are not provided can be added by the developer based on the already included declarations and the information provided in these operating instructions.

The Delphi examples are in the files:

- OneVppExamples.pas
- EndatExamples.pas
- ConfigFileExamples.pas

# 12

: LabVIEW

## 12.1 Introduction

The MSElibrary software package contains pre-made LabVIEW VI wrappers to access all of the functionality within the MSElibrary. These wrappers were created with LabVIEW 2012 v120f3 (32-bit) and MSElibrary 2.0.0. An experienced Labview developer can choose to edit or create the VI's. To do this refer to the Labview documentation on integrating third party software into Labview. The included VI's are then used in a sample application to demonstrate using MSElibrary within Labview.

## 12.2 Installation

The MSElibrary installer installs both pre-configured wrapper VI's and an example application, both are based on MSElibrary v2.0.0. The wrapper VI's are located in the HEIDENHAIN\MSElibrary\LabVIEW\Wrappers folder, under which there will be individual folders grouped by library. Each individual library folder will contain the .lvlib file and a VI folder. The example application is located in the HEIDENHAIN\MSElibrary\Examples\LabVIEW folder. This folder contains the LabVIEW project file (.lvproj) and a sub-folder containing the necessary VI's. Refer to "Installation instructions" on page 24 for the location of the \HEIDENHAIN folder on different operating systems.

# 12.3 LabVIEW VI's and corresponding MSElibrary functions

## MSElibrary1VppWrapperVI.lvlib

| LabVIEW VI's | MSElibrary Function |
|---|---|
| Mse1Vpp Module Acknowledge Absolute Position.vi | Mse1VppModuleAcknowledgeAbsolutePosition |
| Mse1Vpp Module Clear Errors.vi | Mse1VppModuleClearErrors |
| Mse1Vpp Module Create.vi | Mse1VppModuleCreate |
| Mse1Vpp Module Delete.vi | Mse1VppModuleDelete |
| Mse1Vpp Module Enable Analog Diag.vi | Mse1VppModuleEnableAnalogDiag |
| Mse1Vpp Module Enable Diags.vi | Mse1VppModuleEnableDiags |
| Mse1Vpp Module Enable Error Checking.vi | Mse1VppModuleEnableErrorChecking |
| Mse1Vpp Module Get Adc Values.vi | Mse1VppModuleGetAdcValues |
| Mse1Vpp Module Get Analog Diag.vi | Mse1VppModuleGetAnalogDiag |
| Mse1Vpp Module Get Channel Error State.vi | Mse1VppModuleGetChannelErrorState |
| Mse1Vpp Module Get Channel Status.vi | Mse1VppModuleGetChannelStatus |
| Mse1Vpp Module Get Counting Direction.vi | Mse1VppModuleGetCountingDirection |
| Mse1Vpp Module Get Counts.vi | Mse1VppModuleGetCounts |
| Mse1Vpp Module Get Encoder Type.vi | Mse1VppModuleGetEncoderType |
| Mse1Vpp Module Get Error Compensation.vi | Mse1VppModuleGetErrorCompensation |
| Mse1Vpp Module Get Latches.vi | Mse1VppModuleGetLatches |
| Mse1Vpp Module Get Line Count.vi | Mse1VppModuleGetLineCount |
| Mse1Vpp Module Get Module Error State.vi | Mse1VppModuleGetModuleErrorState |
| Mse1Vpp Module Get Module Errors.vi | Mse1VppModuleGetModuleErrors |
| Mse1Vpp Module Get Num Channels.vi | Mse1VppModuleGetNumChannels |
| Mse1Vpp Module Get Positions.vi | Mse1VppModuleGetPositions |
| Mse1Vpp Module Get Referencing Complete.vi | Mse1VppModuleGetReferencingComplete |
| Mse1Vpp Module Get Referencing State.vi | Mse1VppModuleGetReferencingState |
| Mse1Vpp Module Get Resolution.vi | Mse1VppModuleGetResolution |
| Mse1Vpp Module Get Signal Period.vi | Mse1VppModuleGetSignalPeriod |
| Mse1Vpp Module Get Uom.vi | Mse1VppModuleGetUom |
| Mse1Vpp Module Initialize.vi | Mse1VppModuleInitialize |
| Mse1Vpp Module Set Counting Direction.vi | Mse1VppModuleSetCountingDirection |
| Mse1Vpp Module Set Encoder Type.vi | Mse1VppModuleSetEncoderType |
| Mse1Vpp Module Set Error Compensation.vi | Mse1VppModuleSetErrorCompensation |
| Mse1Vpp Module Set Latch Debouncing.vi | Mse1VppModuleSetLatchDebouncing |
| Mse1Vpp Module Set Latch.vi | Mse1VppModuleSetLatch |
| Mse1Vpp Module Set Line Count.vi | Mse1VppModuleSetLineCount |
| Mse1Vpp Module Set Signal Period.vi | Mse1VppModuleSetSignalPeriod |
| Mse1Vpp Module Set Uom.vi | Mse1VppModuleSetUom |
| Mse1Vpp Module Start Referencing.vi | Mse1VppModuleStartReferencing |

## MSElibraryAnalogWrapperVI.lvlib

| LabVIEW VI's | MSElibrary Function |
|---|---|
| Mse Analog Module Clear Errors.vi | MseAnalogModuleClearErrors |
| Mse Analog Module Clear Latch.vi | MseAnalogModuleClearLatch |
| Mse Analog Module Compute Resolution And Offset.vi | MseAnalogModuleComputeResolutionAndOffset |
| Mse Analog Module Create.vi | MseAnalogModuleCreate |
| Mse Analog Module Delete.vi | MseAnalogModuleDelete |
| Mse Analog Module Get Adc Values.vi | MseAnalogModuleGetAdcValues |
| Mse Analog Module Get Current.vi | MseAnalogModuleGetCurrent |
| Mse Analog Module Get Diag Voltages.vi | MseAnalogModuleGetDiagVoltages |
| Mse Analog Module Get Latch.vi | MseAnalogModuleGetLatch |
| Mse Analog Module Get Module Error State.vi | MseAnalogModuleGetModuleErrorState |
| Mse Analog Module Get Module Errors.vi | MseAnalogModuleGetModuleErrors |
| Mse Analog Module Get Num Channels.vi | MseAnalogModuleGetNumChannels |
| Mse Analog Module Get Offset.vi | MseAnalogModuleGetOffset |
| Mse Analog Module Get Resolution.vi | MseAnalogModuleGetResolution |
| Mse Analog Module Get Scaled Values.vi | MseAnalogModuleGetScaledValues |
| Mse Analog Module Get Values.vi | MseAnalogModuleGetValues |
| Mse Analog Module Get Voltage.vi | MseAnalogModuleGetVoltage |
| Mse Analog Module Initialize.vi | MseAnalogModuleInitialize |
| Mse Analog Module Set Num Samples.vi | MseAnalogModuleSetNumSamples |
| Mse Analog Module Set Offset.vi | MseAnalogModuleSetOffset |
| Mse Analog Module Set Resolution.vi | MseAnalogModuleSetResolution |

## MSElibraryConfigFileWrapperVIs.lvlib

| LabVIEW VI's | MSElibrary Function |
|---|---|
| Mse Config File Create.vi | MseConfigFileCreate |
| Mse Config File Decode Element Type.vi | MseConfigFileDecodeElementType |
| Mse Config File Decode Error Type.vi | MseConfigFileDecodeErrorType |
| Mse Config File Delete.vi | MseConfigFileDelete |
| Mse Config File Get All Elements.vi | MseConfigFileGetAllElements |
| Mse Config File Get Channel Element.vi | MseConfigFileGetChannelElement |
| Mse Config File Get Element.vi | MseConfigFileGetElement |
| Mse Config File Get Filename.vi | MseConfigFileGetFilename |
| Mse Config File Get Module Element.vi | MseConfigFileGetModuleElement |
| Mse Config File Get Num Channels.vi | MseConfigFileGetNumChannels |
| Mse Config File Get Num Modules.vi | MseConfigFileGetNumModules |
| Mse Config File Get Specific Channel.vi | MseConfigFileGetSpecificChannel |
| Mse Config File Get Specific Module.vi | MseConfigFileGetSpecificModule |
| Mse Config File Load Xml.vi | MseConfigFileLoadXml |
| Mse Config File Reload Xml.vi | MseConfigFileReloadXml |
| Mse Config File Remove Module.vi | MseConfigFileRemoveModule |
| Mse Config File Set Channel Element.vi | MseConfigFileSetChannelElement |
| Mse Config File Set Module Element.vi | MseConfigFileSetModuleElement |
| Mse Config File Validate Elements.vi | MseConfigFileValidateElements |
| Mse Config File Write File.vi | MseConfigFileWriteFile |
| Mse Config File Write New File.vi | MseConfigFileWriteNewFile |

## MSElibraryEndatWrapperVIs.lvlib

| LabVIEW VI's | MSElibrary Function |
|---|---|
| Mse Endat Module Clear Errors.vi | MseEndatModuleClearErrors |
| Mse Endat Module Create.vi | MseEndatModuleCreate |
| Mse Endat Module Delete.vi | MseEndatModuleDelete |
| Mse Endat Module Enable Diags.vi | MseEndatModuleEnableDiags |
| Mse Endat Module Enable Error Checking.vi | MseEndatModuleEnableErrorChecking |
| Mse Endat Module Get Adc Values.vi | MseEndatModuleGetAdcValues |
| Mse Endat Module Get Channel Error State.vi | MseEndatModuleGetChannelErrorState |
| Mse Endat Module Get Channel Presence.vi | MseEndatModuleGetChannelPresence |
| Mse Endat Module Get Channel Status.vi | MseEndatModuleGetChannelStatus |
| Mse Endat Module Get Channel Warning State.vi | MseEndatModuleGetChannelWarningState |
| Mse Endat Module Get Counting Direction.vi | MseEndatModuleGetCountingDirection |
| Mse Endat Module Get Counts.vi | MseEndatModuleGetCounts |
| Mse Endat Module Get Diags.vi | MseEndatModuleGetDiags |
| Mse Endat Module Get Distinguishable Revolutions.vi | MseEndatModuleGetDistinguishableRevolutions |
| Mse Endat Module Get Encoder Id.vi | MseEndatModuleGetEncoderId |
| Mse Endat Module Get Encoder Name.vi | MseEndatModuleGetEncoderName |
| Mse Endat Module Get Encoder Serial Number.vi | MseEndatModuleGetEncoderSerialNumber |
| Mse Endat Module Get Encoder Type.vi | MseEndatModuleGetEncoderType |
| Mse Endat Module Get Endat Errors.vi | MseEndatModuleGetEndatErrors |
| Mse Endat Module Get Endat Warnings.vi | MseEndatModuleGetEndatWarnings |
| Mse Endat Module Get Error Compensation.vi | MseEndatModuleGetErrorCompensation |
| Mse Endat Module Get Latches.vi | MseEndatModuleGetLatches |
| Mse Endat Module Get Module Error State.vi | MseEndatModuleGetModuleErrorState |
| Mse Endat Module Get Module Errors.vi | MseEndatModuleGetModuleErrors |
| Mse Endat Module Get Num Channels.vi | MseEndatModuleGetNumChannels |
| Mse Endat Module Get Positions.vi | MseEndatModuleGetPositions |
| Mse Endat Module Get Resolution.vi | MseEndatModuleGetResolution |
| Mse Endat Module Get Uom.vi | MseEndatModuleGetUom |
| Mse Endat Module Initialize.vi | MseEndatModuleInitialize |
| Mse Endat Module Set Error Compensation.vi | MseEndatModuleSetErrorCompensation |
| Mse Endat Module Set Latch Debouncing.vi | MseEndatModuleSetLatchDebouncing |
| Mse Endat Module Set Latch.vi | MseEndatModuleSetLatch |

## MSElibraryPneumaticWrapperVIs.lvlib

| LabVIEW VI's | MSElibrary Function |
|---|---|
| Mse Pneumatic Module Clear Errors.vi | MsePneumaticModuleClearErrors |
| Mse Pneumatic Module Clear Latch.vi | MsePneumaticModuleClearLatch |
| Mse Pneumatic Module Create.vi | MsePneumaticModuleCreate |
| Mse Pneumatic Module Delete.vi | MsePneumaticModuleDelete |
| Mse Pneumatic Module Get Adc Values.vi | MsePneumaticModuleGetAdcValues |
| Mse Pneumatic Module Get Latch.vi | MsePneumaticModuleGetLatch |
| Mse Pneumatic Module Get Module Error State.vi | MsePneumaticModuleGetModuleErrorState |
| Mse Pneumatic Module Get Module Errors.vi | MsePneumaticModuleGetModuleErrors |
| Mse Pneumatic Module Get Num Channels.vi | MsePneumaticModuleGetNumChannels |
| Mse Pneumatic Module Get Output.vi | MsePneumaticModuleGetOutput |
| Mse Pneumatic Module Initialize.vi | MsePneumaticModuleInitialize |
| Mse Pneumatic Module Set Output.vi | MsePneumaticModuleSetOutput |

## MSElibraryIoWrapperVIs.lvlib

| LabVIEW VI's | MSElibrary Function |
|---|---|
| Mse Io Module Clear Errors.vi | MseIoModuleClearErrors |
| Mse Io Module Clear Latch.vi | MseIoModuleClearLatch |
| Mse Io Module Create.vi | MseIoModuleCreate |
| Mse Io Module Delete.vi | MseIoModuleDelete |
| Mse Io Module Get Adc Values.vi | MseIoModuleGetAdcValues |
| Mse Io Module Get Inputs.vi | MseIoModuleGetInputs |
| Mse Io Module Get IO.vi | MseIoModuleGetIO |
| Mse Io Module Get Latch.vi | MseIoModuleGetLatch |
| Mse Io Module Get Module Error State.vi | MseIoModuleGetModuleErrorState |
| Mse Io Module Get Module Errors.vi | MseIoModuleGetModuleErrors |
| Mse Io Module Get Num Channels.vi | MseIoModuleGetNumChannels |
| Mse Io Module Get Outputs.vi | MseIoModuleGetOutputs |
| Mse Io Module Initialize.vi | MseIoModuleInitialize |
| Mse Io Module Set Output.vi | MseIoModuleSetOutput |
| Mse Io Module Set Outputs.vi | MseIoModuleSetOutputs |

## MSElibraryLvdtWrapperVIs.lvlib

| LabVIEW VI's | MSElibrary Function |
|---|---|
| Mse Lvdt Get Fpga Revision.vi | MseLvdtModuleGetFpgaRevision |
| Mse Lvdt Module Clear Errors.vi | MseLvdtModuleClearErrors |
| Mse Lvdt Module Clear Latch.vi | MseLvdtModuleClearLatch |
| Mse Lvdt Module Create.vi | MseLvdtModuleCreate |
| Mse Lvdt Module Delete.vi | MseLvdtModuleDelete |
| Mse Lvdt Module Enable Diags.vi | MseLvdtModuleEnableDiags |
| Mse Lvdt Module Get Adc Values.vi | MseLvdtModuleGetAdcValues |
| Mse Lvdt Module Get Channel Presence.vi | MseLvdtModuleGetChannelPresence |
| Mse Lvdt Module Get Excitation Values.vi | MseLvdtModuleGetExcitationValues |
| Mse Lvdt Module Get Latch.vi | MseLvdtModuleGetLatch |
| Mse Lvdt Module Get Module Error State.vi | MseLvdtModuleGetModuleErrorState |
| Mse Lvdt Module Get Module Errors.vi | MseLvdtModuleGetModuleErrors |
| Mse Lvdt Module Get Num Channels.vi | MseLvdtModuleGetNumChannels |
| Mse Lvdt Module Get Positions.vi | MseLvdtModuleGetPositions |
| Mse Lvdt Module Get Resolution.vi | MseLvdtModuleGetResolution |
| Mse Lvdt Module Get Teach Sensor Gain Finished.vi | MseLvdtModuleGetTeachSensorGainFinished |
| Mse Lvdt Module Get Sensor Gain.vi | MseLvdtModuleGetSensorGain |
| Mse Lvdt Module Get Uom.vi | MseLvdtModuleGetUom |
| Mse Lvdt Module Get Voltage.vi | MseLvdtModuleGetVoltage |
| Mse Lvdt Module Initialize.vi | MseLvdtModuleInitialize |
| Mse Lvdt Module Set Channel Presence.vi | MseLvdtModuleSetChannelPresence |
| Mse Lvdt Module Set Diagnostics Enabled.vi | MseLvdtModuleSetDiagnosticsEnabled |
| Mse Lvdt Module Set Excitation Frequency.vi | MseLvdtModuleSetExcitationFrequency |
| Mse Lvdt Module Set Excitation Voltage.vi | MseLvdtModuleSetExcitationVoltage |
| Mse Lvdt Module Set Resolution.vi | MseLvdtModuleSetResolution |
| Mse Lvdt Module Set Sensor Gain.vi | MseLvdtModuleSetSensorGain |
| Mse Lvdt Module Set Uom.vi | MseLvdtModuleSetUom |
| Mse Lvdt Module Teach Sensor Gain.vi | MseLvdtModuleTeachSensorGain |

## MSElibraryModuleWrapperVIs.lvlib

| LabVIEW VI's | MSElibrary Function |
|---|---|
| Mse Module Broadcast.vi | MseModuleBroadcast |
| Mse Module Clear Errors.vi | MseModuleClearErrors |
| Mse Module Create.vi | MseModuleCreate |
| Mse Module Delete.vi | MseModuleDelete |
| Mse Module Get Adc Values.vi | MseModuleGetAdcValues |
| Mse Module Get Async Msg Channel Status.vi | MseModuleGetAsyncMsgChannelStatus |
| Mse Module Get Async Msg Dhcp.vi | MseModuleGetAsyncMsgDhcp |
| Mse Module Get Async Msg Ip Address.vi | MseModuleGetAsyncMsgIpAddress |
| Mse Module Get Async Msg Latch.vi | MseModuleGetAsyncMsgLatch |
| Mse Module Get Async Msg Mac Address.vi | MseModuleGetAsyncMsgMacAddress |
| Mse Module Get Async Msg Netmask.vi | MseModuleGetAsyncMsgNetmask |
| Mse Module Get Async Msg Port.vi | MseModuleGetAsyncMsgPort |
| Mse Module Get Async Msg Serial Number.vi | MseModuleGetAsyncMsgSerialNumber |
| Mse Module Get Async Msg Type.vi | MseModuleGetAsyncMsgType |
| Mse Module Get Async Port.vi | MseModuleGetAsycPort |
| Mse Module Get Bootloader Version.vi | MseModuleGetBootloaderVersion |
| Mse Module Get Firmware Version.vi | MseModuleGetFirmwareVersion |
| Mse Module Get Ip Address.vi | MseModuleGetIpAddress |
| Mse Module Get Ip Static Address.vi | MseModuleGetIpStaticAddress |
| Mse Module Get Library Version.vi | MseModuleGetLibraryVersion |
| Mse Module Get Mac Address.vi | MseModuleGetMacAddress |
| Mse Module Get Module Error State.vi | MseModuleGetModuleErrorState |
| Mse Module Get Module Errors.vi | MseModuleGetModuleErrors |
| Mse Module Get Module Type.vi | MseModuleGetModuleType |
| Mse Module Get Netmask Static.vi | MseModuleGetNetmaskStatic |
| Mse Module Get Netmask.vi | MseModuleGetNetmask |
| Mse Module Get Network Delay.vi | MseModuleGetNetworkDelay |
| Mse Module Get Port.vi | MseModuleGetPort |
| Mse Module Get Program Percent Complete.vi | MseModuleGetProgramPercentComplete |
| Mse Module Get Program State.vi | MseModuleGetProgramState |
| Mse Module Get Serial Number.vi | MseModuleGetSerialNumber |
| Mse Module Get Udp Num Retries.vi | MseModuleGetUdpNumRetries |
| Mse Module Get Udp Timeout.vi | MseModuleGetUdpTimeout |
| Mse Module Get Using Dhcp.vi | MseModuleGetUsingDhcp |
| Mse Module Initialize.vi | MseModuleInitialize |
| Mse Module Program.vi | MseModuleProgram |
| Mse Module Reset.vi | MseModuleReset |
| Mse Module Set Async Port.vi | MseModuleSetAsyncPort |
| Mse Module Set Broadcasting Netmask.vi | MseModuleSetBroadcastingNetmask |
| Mse Module Set Ip Address.vi | MseModuleSetIpAddress |
| Mse Module Set Network Delay.vi | MseModuleSetNetworkDelay |
| Mse Module Set Udp Num Retries.vi | MseModuleSetUdpNumRetries |
| Mse Module Set Udp Timeout.vi | MseModuleSetUdpTimeout |
| Mse Module Set Using Dhcp.vi | MseModuleSetUsingDhcp |
| Mse Module Show Id.vi | MseModuleShowId |
| Mse Module Show Resp Code.vi | MseModuleShowRespCode |
| Mse Module Show Type.vi | MseModuleShowType |

## MSElibraryTtlWrapperVIs.lvlib

| LabVIEW VI's | MSElibrary Function |
|---|---|
| Mse Ttl Module Acknowledge Referencing.vi | MseTtlModuleAcknowledgeReferencing |
| Mse Ttl Module Clear Errors.vi | MseTtlModuleClearErrors |
| Mse Ttl Module Create.vi | MseTtlModuleCreate |
| Mse Ttl Module Delete.vi | MseTtlModuleDelete |
| Mse Ttl Module Enable Diags.vi | MseTtlModuleEnableDiags |
| Mse Ttl Module Enable Error Checking.vi | MseTtlModuleEnableErrorChecking |
| Mse Ttl Module Get Adc Values.vi | MseTtlModuleGetAdcValues |
| Mse Ttl Module Get Channel Error State.vi | MseTtlModuleGetChannelErrorState |
| Mse Ttl Module Get Channel Presence.vi | MseTtlModuleGetChannelPresence |
| Mse Ttl Module Get Counting Direction.vi | MseTtlModuleGetCountingDirection |
| Mse Ttl Module Get Counts.vi | MseTtlModuleGetCounts |
| Mse Ttl Module Get Encoder Type.vi | MseTtlModuleGetEncoderType |
| Mse Ttl Module Get Error Compensation.vi | MseTtlModuleGetErrorCompensation |
| Mse Ttl Get Fpga Revision.vi | MseTtlModuleGetFpgaRevision |
| Mse Ttl Module Get Latches.vi | MseTtlModuleGetLatches |
| Mse Ttl Module Get Line Count.vi | MseTtlModuleGetLineCount |
| Mse Ttl Module Get Signal Period.vi | MseTtlModuleGetSignalPeriod |
| Mse Ttl Module Get Module Error State.vi | MseTtlModuleGetModuleErrorState |
| Mse Ttl Module Get Module Errors.vi | MseTtlModuleGetModuleErrors |
| Mse Ttl Module Get Num Channels.vi | MseTtlModuleGetNumChannels |
| Mse Ttl Module Get Positions.vi | MseTtlModuleGetPositions |
| Mse Ttl Module Get Referencing Complete.vi | MseTtlModuleGetReferencingComplete |
| Mse Ttl Module Get Referencing State.vi | MseTtlModuleGetReferencingState |
| Mse Ttl Module Get Resolution.vi | MseTtlModuleGetResolution |
| Mse Ttl Module Get Uom.vi | MseTtlModuleGetUom |
| Mse Ttl Module Initialize.vi | MseTtlModuleInitialize |
| Mse Ttl Module Set Channel Presence.vi | MseTtlModuleSetChannelPresence |
| Mse Ttl Module Set Counting Direction.vi | MseTtlModuleSetCountingDirection |
| Mse Ttl Module Set Encoder Type.vi | MseTtlModuleSetEncoderType |
| Mse Ttl Module Set Error Compensation.vi | MseTtlModuleSetErrorCompensation |
| Mse Ttl Module Set Latch.vi | MseTtlModuleSetLatch |
| Mse Ttl Module Set Line Count.vi | MseTtlModuleSetLineCount |
| Mse Ttl Module Set Signal Period.vi | MseTtlModuleSetSignalPeriod |
| Mse Ttl Module Set Uom.vi | MseTtlModuleSetUom |
| Mse Ttl Module Start Referencing.vi | MseTtlModuleStartReferencing |

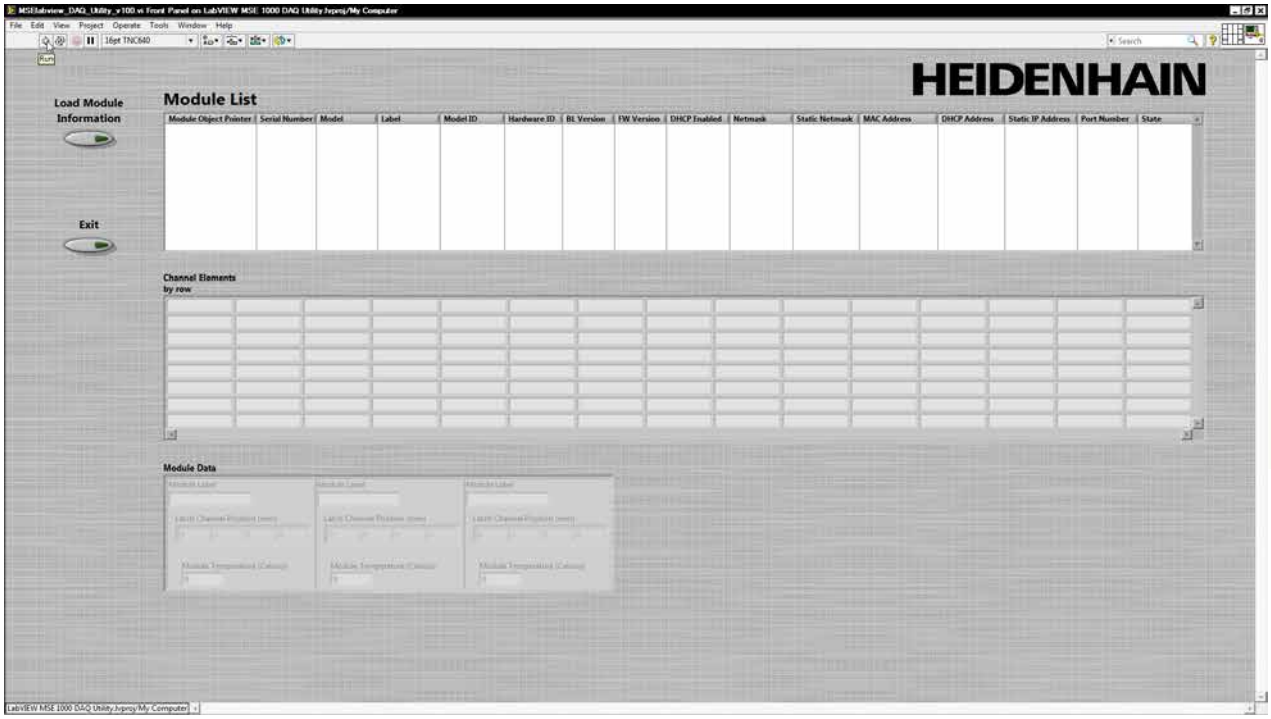
# 12.4 MSElabview DAQ utility explanation and operating instructions

The MSElabview DAQ (Data AcQuisition) Utility is a VI that uses sub-VI wrappers to access the MSElibrary.dll. The DAQ utility must be run from within the LabVIEW IDE and the PC it is running on must have an Ethernet connection (direct or via a networking device) to the base module of the MSE1000 system. The utility requires MSE1000 system's initial configuration to be completed using the MSEsetup application, the resulting ModuleConfig.xml file is then accessed from the DAQ utility.

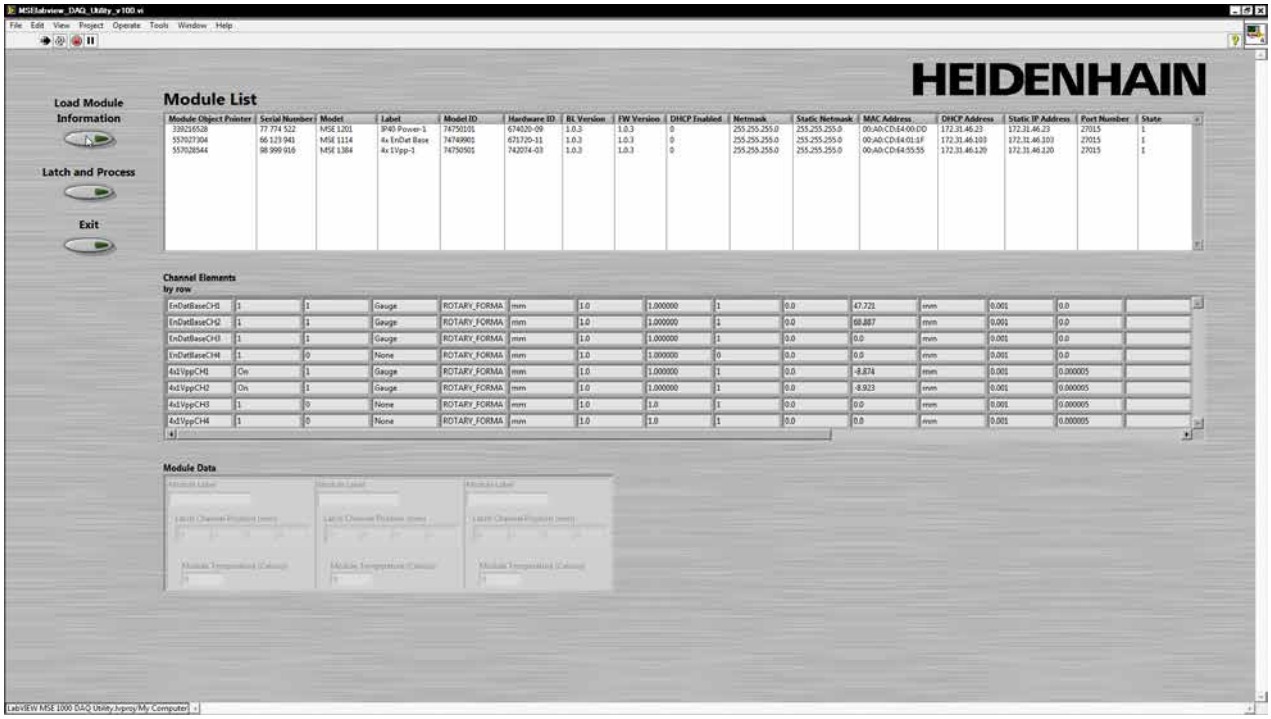
The necessary files are:

- MSElabview_DAQ_Utility_v100.vi
- Load Module MCL.vi
- LabVIEW MSE 1000 DAQ Utility.lvproj (for LabVIEW project)
- MSElibrary.dll
- QtCore4.dll
- QtXml4.dll
- .xml file created using MSEsetup

▶ Run MSElabview_DAQ_utility_v100.vi



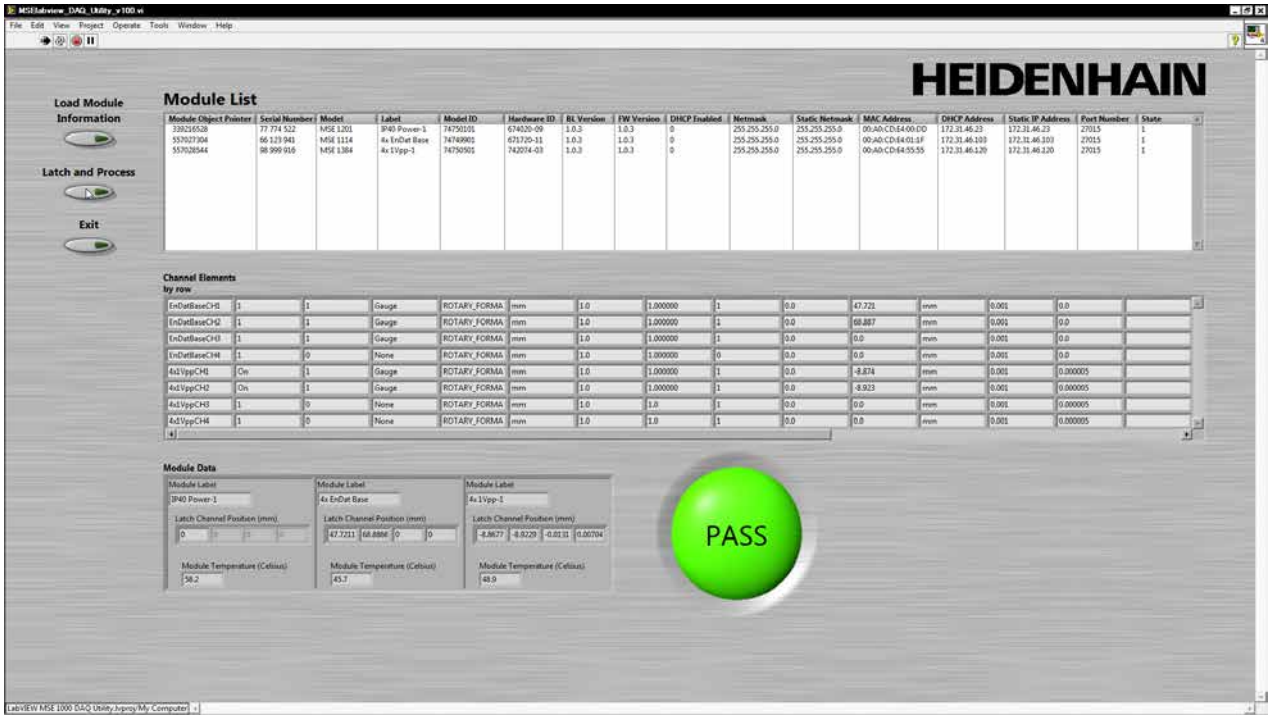

▶ Click the *Load Module Information* button to load the ModuleConfig.xml file into memory and display it to the screen



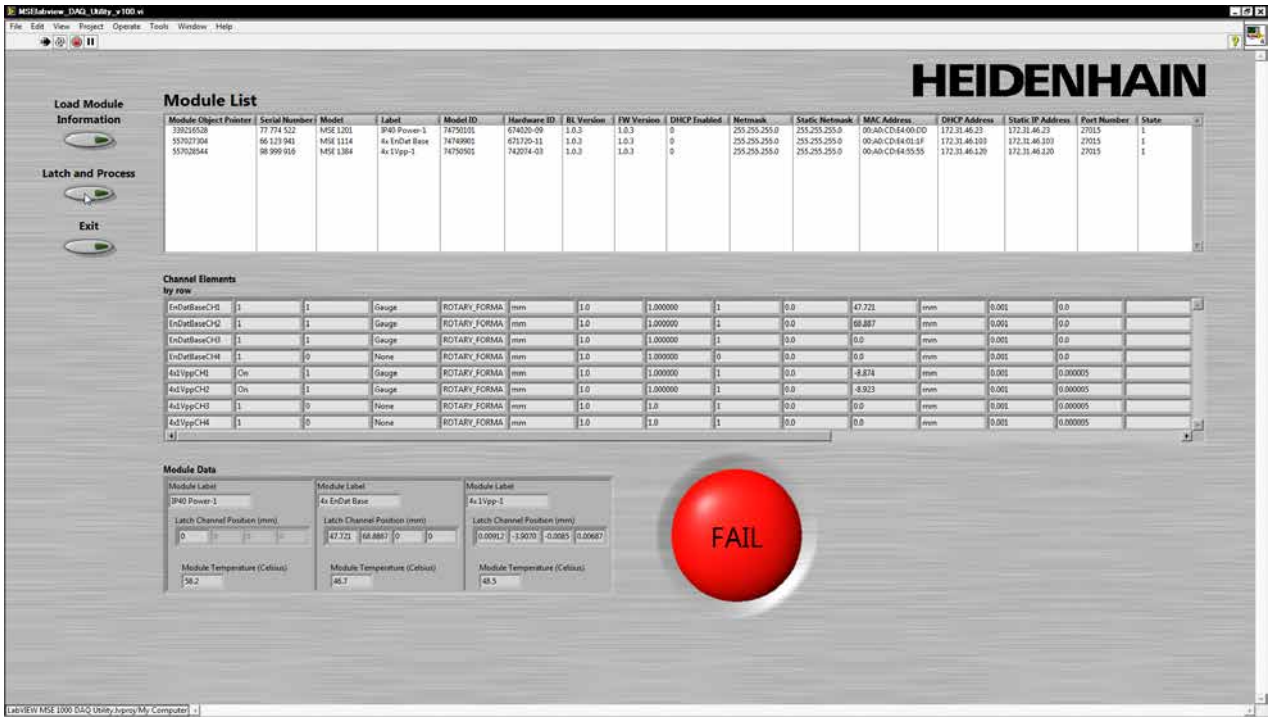
- Click the *Latch and Process* button to latch live data and display it to the screen

  Each press of this button will re-latch the live data. This can represent latching data of a part from a manufacturing run and compare it to a "gold master" part for a PASS/FAIL comparison.

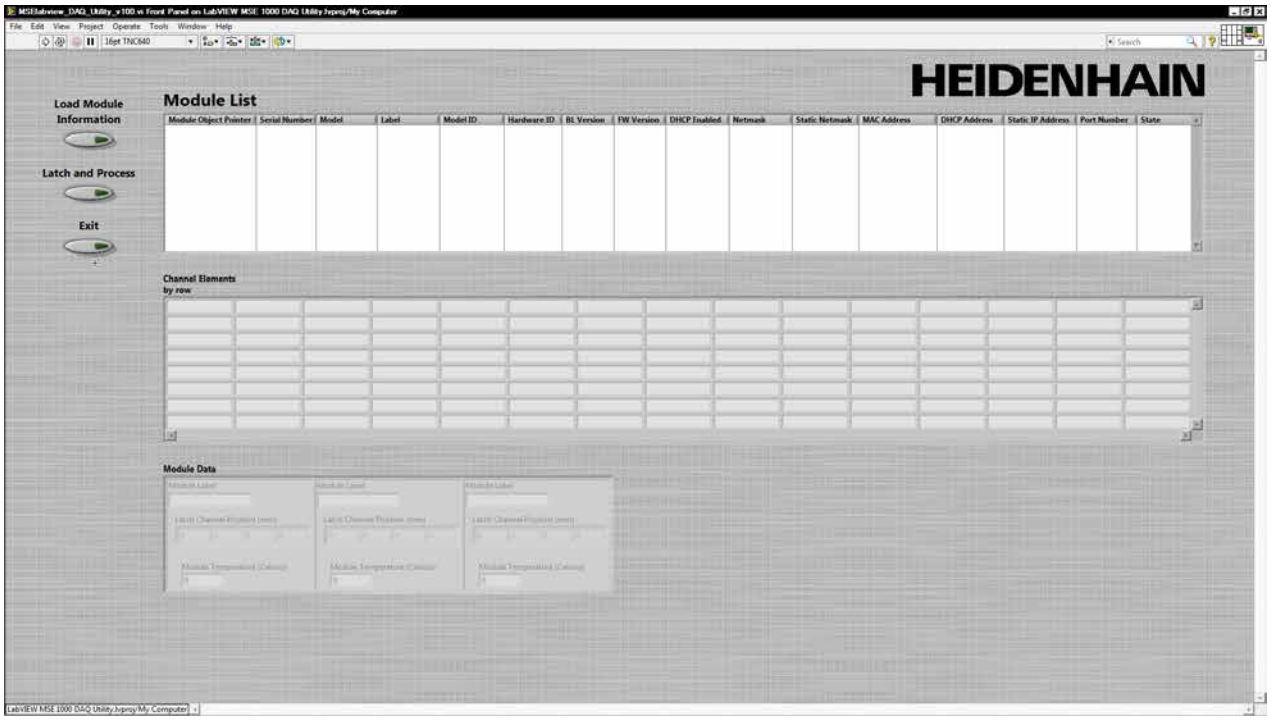
  A first pass shows a good part...




a second pass reveals a part that does not meet PASS criteria.



- Once done processing click the *Exit* button



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