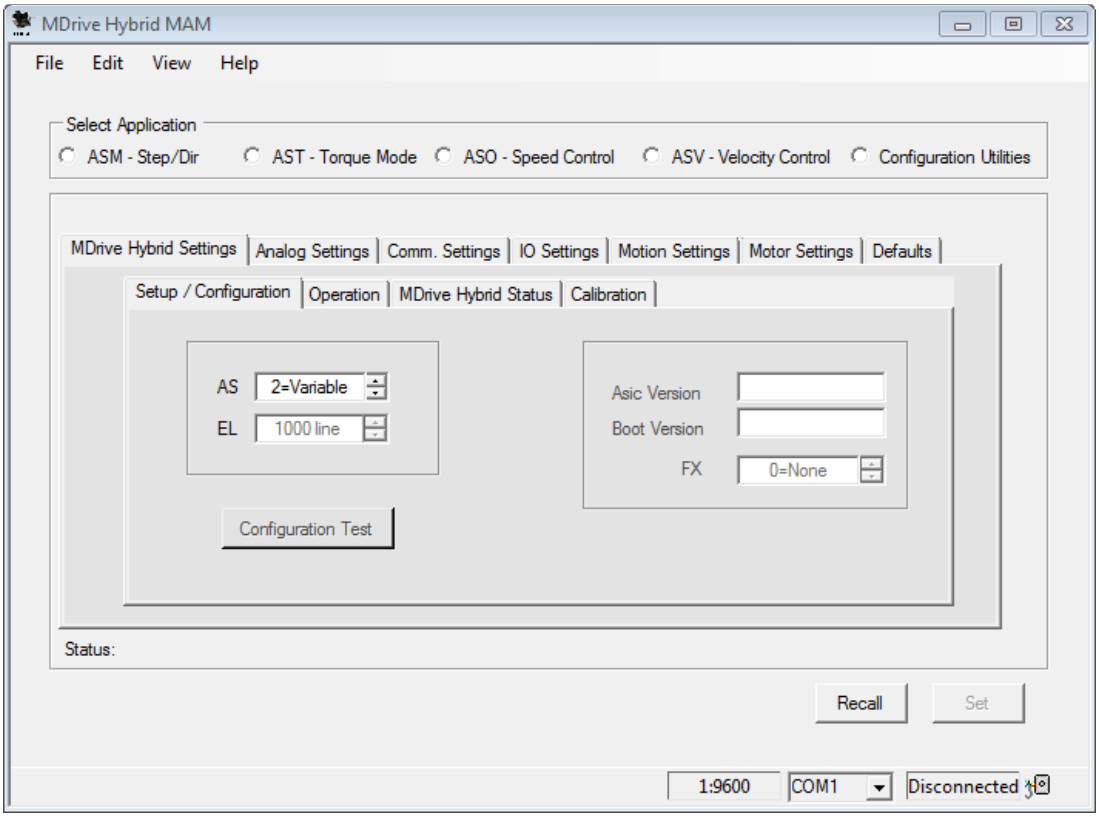
Hybrid Configurator Utility

Commissioning software

Product manual

V1.00, 06.2012



Schneider Electric

MDriveHybrid Configurator Utility Manual		
Date	**Revision**	**Changes**
10/21/2011	V1.00, 10.2011	Initial Release as a standalone document.
06/27/2012	V1.00, 06.2012	Modified to support change to calibration sequence operation and release of Hybrid Configurator Utility V1.0.07

Hybrid Configurator Utility Manual Revision V1.00, 06.2012

Important information

This manual is part of the product.

Carefully read this manual and observe all instructions.

Keep this manual for future reference.

Hand this manual and all other pertinent product documentation over to all users of the product.

Carefully read and observe all safety instructions and the chapter “Before you begin - safety information”.

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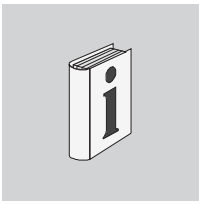
Writing conventions and symbols



Work steps

If work steps must be performed consecutively, this sequence of steps is represented as follows:

- ■ Special prerequisites for the following work steps
- ▶ Step 1
- ◁ Specific response to this work step
- ▶ Step 2

If a response to a work step is indicated, this allows you to verify that the work step has been performed correctly.

Unless otherwise stated, the individual steps must be performed in the specified sequence.

Bulleted lists

The items in bulleted lists are sorted alphanumerically or by priority. Bulleted lists are structured as follows:

- Item 1 of bulleted list
- Item 2 of bulleted list
  - Subitem for 2
  - Subitem for 2
- Item 3 of bulleted list

Making work easier

Information on making work easier is highlighted by this symbol:

Sections highlighted this way provide supplementary information on making work easier.

Parameters

Parameters are shown as follows

```
RC      Motor Run Current
```

Menu paths "⇨"

Action steps within the menu are described with complete menu path and the"⇨" symbol

e.g. "⇨ File ⇨ Save As..."

Units of measure

Measurements are given US units, metric values are given in SI units in parenthesis.

Examples"

1.00 in (25.4 mm)
100 oz-in (70 N-cm)

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1 Introduction

1

1.1 General features

The Hybrid Configurator Utility is a software application for Windows® based PCs that facilitates the commissioning and diagnostics of MDrive Hybrid Step • Torque • Speed products.

The Hybrid Configurator Utility is used to establish a connection to the device via the RS-422/485 bus.

Functions of the software

The functions of the software include:

- Establish a connection to the device
- Select and load the desired application (mode):
  - Step/direction mode (ASM)
  - Torque mode (AST)
  - Speed control mode (ASO)
  - Velocity mode (ASV)
- Set the device parameters by functional grouping:
  - Hybrid settings
  - Analog input settings
  - Communication bus settings
  - I/O settings
  - Motion settings
- Display device status and version information
- Archive and duplicate device parameters
- Display error information

Supported devices

The software supports all models of the MDrive Hybrid Step • Torque • Speed.

See the device hardware manual for wiring and connection information.

The software and all associated product documents are available on the Internet at:

http://motion.schnieder-electric.com

You must be familiar with the Windows operating system to work with the commissioning software.

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1.2 Calibration

The purpose of calibration is to bring the rotor and stator into alignment which allows operation of the Hybrid Motion logic. The Hard Stop Tolerant (HST) calibration technique seeks to ensure proper alignment when the rotor is mechanically prohibited from movement by a hard stop or excessive stick/slip.

HST tests for freedom of movement by attempting a 6 full step (10.8 deg) move in the CW direction followed by a 3 full step (5.4 deg) move in the CCW direction. The sequence proceeds as follows.

- Pause for CT allowing system to settle.
- Perform 6 full step CW move.
- Wait for CT.
- Perform 3 full step CCW move.
- Pause for CT allowing rotor to settle
- Set Calibration complete flag.

When motion is blocked the following occurs.

- If the 1st move can not complete it is abandoned.
- If the 2nd move can not complete it is abandoned then the sequence will be restarted one time.
- If neither move can be completed after 2 times through the sequence an error 109 will be generated, the calibration complete flag will set, and the bridges will be disabled (a locked rotor response).

Calibration time and distance required when the motor is free to move in both directions.

- The time required typically is 3.12 seconds when CT is 250 mS. This value of CT gives the best compromise between time and proper calibration.
- Motor position will be advanced 3 full steps CW from initial position after calibration is complete. Motor position can be confirmed using the encoder counter C2. The step counter C1 does not count calibration steps

Calibration time and distance when motor is blocked.

- The time will vary significantly based on where in the motion and which motion is blocked. When the motor can not move at all in either direction the failure will typically indicate in 10 seconds.
- The motor position will also vary significantly based on which motion is effected and where within the motion.
- The motor position can be determined using the encoder counter C2. The step counter C1 does not count calibration steps.

The following indicate when calibration is complete.

- On power up, calibration is complete when the sign on message is sent.
- The flag register AF can be polled for the Calibration Complete flag.
- The trip on flag capability (TA to define, TE to enable) can be used also.
- The flags are useful after a manually initiated calibration.

Attempting motion during calibration results in the following,

- The product will ignore incoming steps for the duration of calibration.

For mechanical systems with a large amount of prevailing torque a secondary calibration step is available, Torque Compensation (CA=0,1).

- The process measures and compensates for the prevailing torque.
- This typically adds 50 mS to the total calibration time and 1 encoder edge of movement.

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2 Before you begin - safety information

2

The information provided in this manual supplements the product manual. Carefully read the product manual before using the product.

2.1 Qualification of personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used.

All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

2.2 Intended use

The functions described in this manual are only intended for use with the basic product; you must read and understand the appropriate product manual.

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data.

Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented.

Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (for example, machine design).

Operate the product only with the specified cables and accessories. Use only genuine accessories and spare parts.

Any use other than the use explicitly permitted is prohibited and can result in hazards.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

The product must NEVER be operated in explosive atmospheres (hazardous locations, Ex areas).

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2.3 Hazard categories

Safety instructions to the user are highlighted by safety alert symbols in the manual. In addition, labels with symbols and/or instructions are attached to the product that alert you to potential hazards.

Depending on the seriousness of the hazard, the safety instructions are divided into 4 hazard categories.

⚠ DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

CAUTION

CAUTION used without the safety alert symbol, is used to address practices not related to personal injury (e.g. **can result** in equipment damage).

2.4 Basic information

⚠ DANGER

UNINTENDED CONSEQUENCES OF EQUIPMENT OPERATION

When the system is started, the drives are usually out of the operator's view and cannot be visually monitored.

- Only start the system if there are no persons in the hazardous area.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop, overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical functions.
- System control paths may include communication links. Consideration must be given to the implication of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines. 1)
- Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death or serious injury.

1) For USA: Additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems".

⚠CAUTION

MOVEMENT ON POWER APPLICATION

Hybrid Motion Technology's functionality requires that the rotor and stator of the motor be in precise alignment. To accomplish this, the product will perform an initial calibration move upon power up consisting of a 6 motor full step (10.8°) move in the clockwise direction, followed by a 3 motor full step (5.4°) move inthe counter-clockwise direction.

- Only power the system if there are no persons in the hazardous area.

Failure to follow these instructions can result in injury or equipment damage.

2.5 Standards and terminology

Technical terms, terminology and the corresponding descriptions in this manual are intended to use the terms or definitions of the pertinent standards.

In the area of drive systems, this includes, but is not limited to, terms such as "safety function", "safe state", "fault", "fault reset", "failure", "error", "error message", "warning", "warning message", etc.

Among others, these standards include:

- IEC 61800 series: "Adjustable speed electrical power drive systems"
- IEC 61158 series: "Industrial communication networks - Fieldbus specifications"
- IEC 61784 series: "Industrial communication networks - Profiles"
- IEC 61508 series: "Functional safety of electrical/electronic/ programmable electronic safety-related systems"

3 Installation

3

Source commissioning software

The latest version of the commissioning software is available for download from the internet:

http://motion.schnieder-electric.com

Use of this software is required to define the functionality of the device.

3.1 PC requirements

System requirements

The minimum hardware requirements for installation and operation of the software are:

- IBM-compatible PC
- Windows XP Service pack 2 or more recent
- Free USB port
- Internet connection (for internet installation and updates)

Required accessories

- MD-CC402-001 USB to RS485 converter or equivalent

3.2 Installation procedure

There are two methods by which the software may be installed, web based installation or administrator installation. The web based installation is the preferred method as the program will on subsequent uses automatically check for program and application updates.

If the program is to be used on a computer that is not connected to the internet, the administrator install should be used.

To install the software:

- Install your USB to RS422/485 converter according to manufacturer instructions. If using the MD-CC402-001 proceed to Section 3.3 of this document for installation instructions.
- Download the appropriate installation from: http://motion.schnieder-electric.com/downloads/software_interfaces.html to a location on your computer's hard drive.
- Double click the the setup.exe file, at the security warning dialog, click "Run".

Figure 3.1: Security warning dialog

- Click the button labeled "Install".

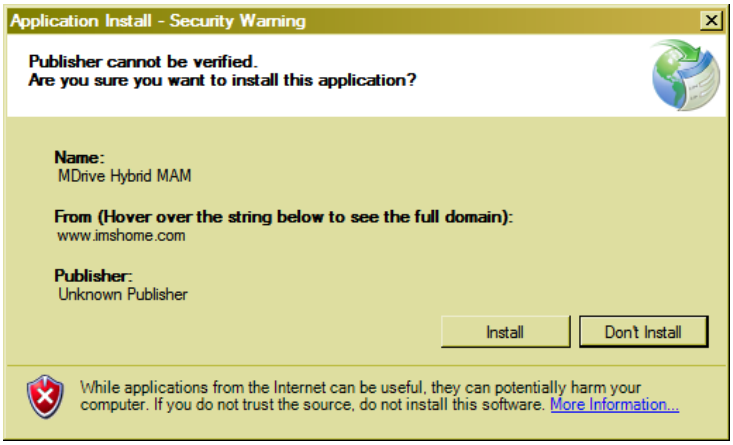

Figure 3.2: Install dialog

◁ The program will then install on your system, upon completion the program will launch.

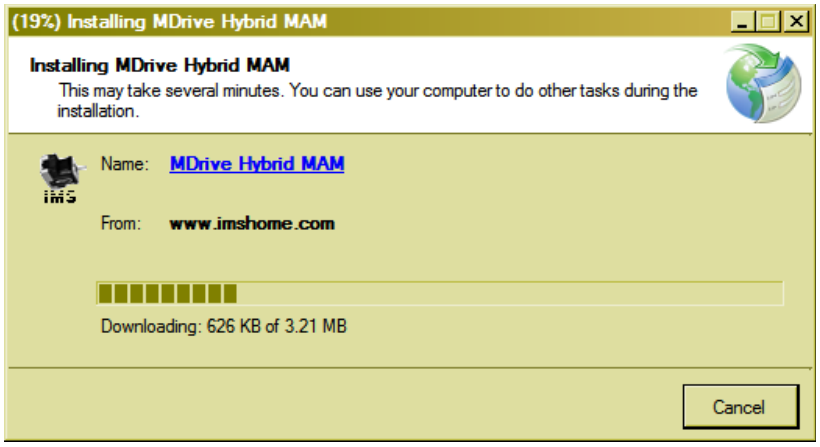

Figure 3.3: Installation progress

3.3 Installing the MD-CC402-001 USB to RS422/485 converter

System requirements

The minimum hardware requirements for installation and operation of the software are:

- IBM-compatible PC
- Windows XP (32-bit) Service pack 2 or more recent
- Free USB port

NOTE: The MD-CC402-001 has an issue operating under 64-bit Windows systems. A workaround shown to allow these units to operate properly in the 64-bit environments.

The workaround instructions and downloads ar located on the internet at http://motion.schnieder-electric.com/downloads/cable_drivers.html#3. This must be performed prior to installing the communication converter drivers.

3.3.1 Prior to plugging the cable into your system USB port

▶ Download the drivers for the RS-422/485 Communications Interface from the internet at:
http://motion.schnieder-electric.com/downloads/cable_drivers.html
to a location on your hard drive.

▶ Extract the zip file to a folder on your PCs hard drive.

▶ **IMPORTANT!** Double click the file “PreInstaller.exe” to run.

▶ Click the button labeled “Install”.

◁ A dialog indicating “Installation successful should appear. At this time you may plug the cable into your PCs USB port to complete the installation process.

3.3.2 Installing the drivers

The driver installation process will install two sets of drivers onto your PC.

1) Drivers for the communications converter.
2) Drivers for a virtual communication port.

Therefore the Hardware Update wizard will run twice during the installation process.

The full installation procedure will be a two-part process: Installing the Cable/VCP drivers and Determining the Virtual COM Port used.

▶ Plug the MD-CC402-001 into the USB port of your PC.

◁ The Hardware Update wizard will open.

▶ Select “No, not this time” on the radio buttons in answer to the query “Can Windows Connect to Windows Update to search for software?” Click “Next”

Figure 3.5: Hardware Update Wizard

▶ Select “Install from a list or specific location (Advanced)” on the radio buttons in answer to the query “What do you want the wizard to do?” Click “Next”

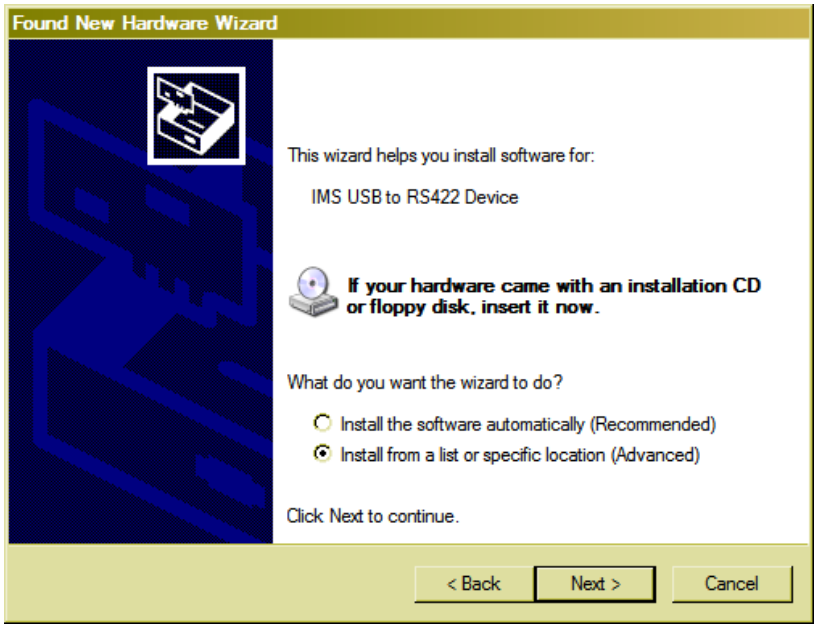

Figure 3.6: Select installation method

▶ Select “Search for the best driver in these locations.”

(a) Check “Include this location in the search.”
(b) Browse to the hard drive location of your extracted drivers.
(c) Click Next

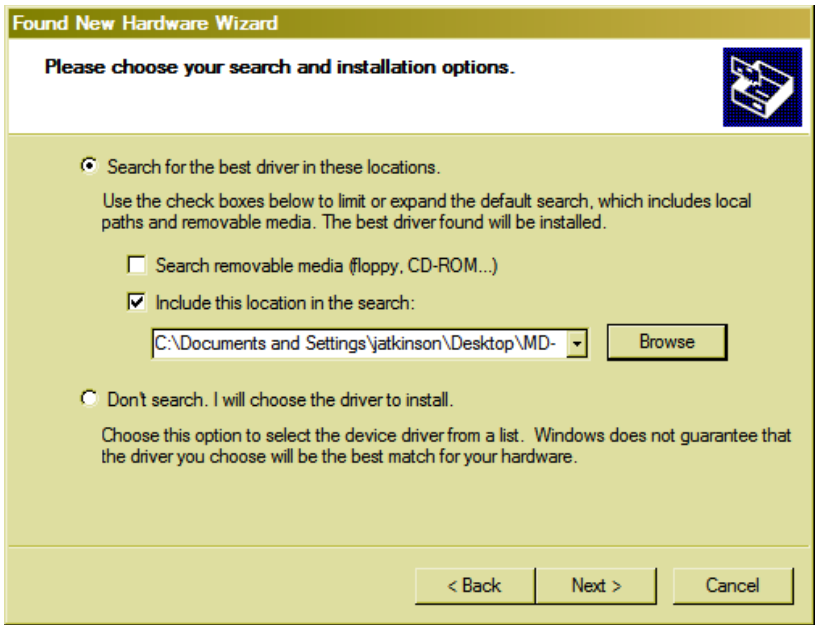

Figure 3.7: Locate drivers

◁ The drivers will begin to copy.

▶ When the copy process completes, click the “Finish” button to complete the installation.

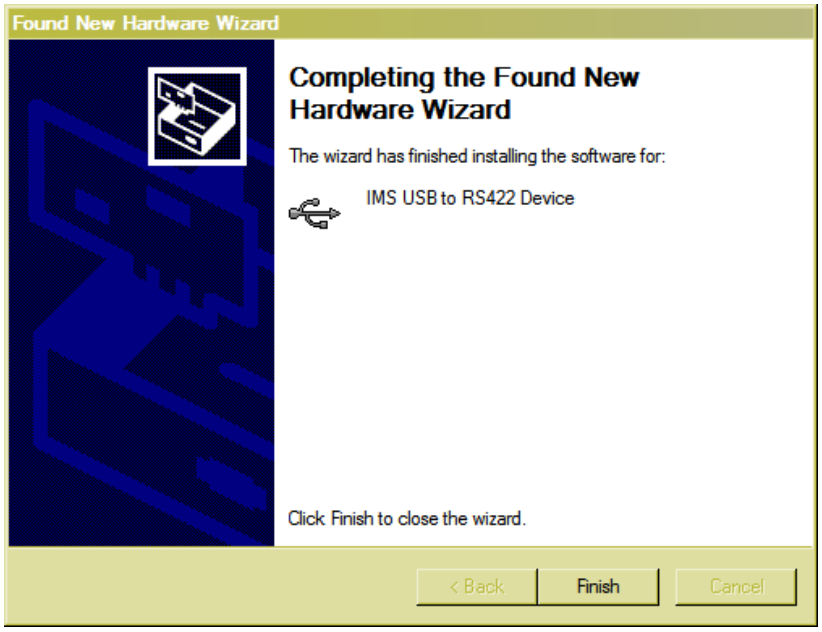

Figure 3.8: Finish installation

▶ After a few seconds, the Found New Hardware wizard will reopen. This is to install the Virtual COM Port (VCP) drivers. Repeat the steps as in the procedure above to complete the installation.

Verify installation

◁ When the installation process is complete, it can be verified by browsing to your PCs Device Manager in the system properties.

◁ Under the heading “Ports (COM & LPT)” the IMS USB to RS422 Converter Cable (COMx) will be visible.

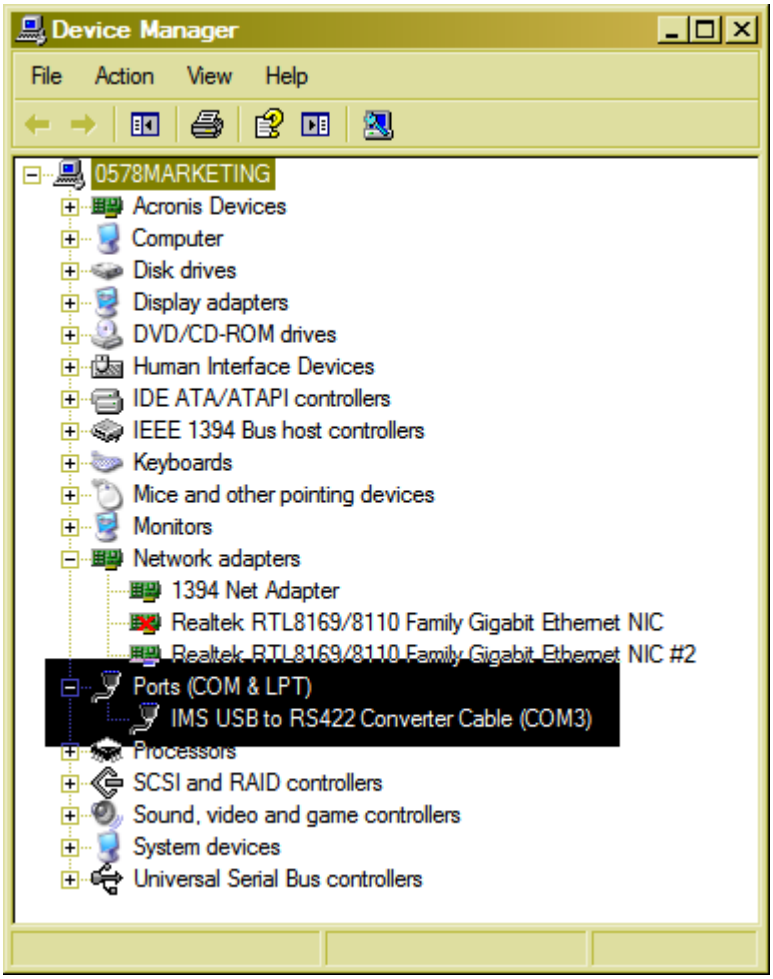

Figure 3.9: PC device manager

◁ The cable is now ready for use.

3.4 Screen overview

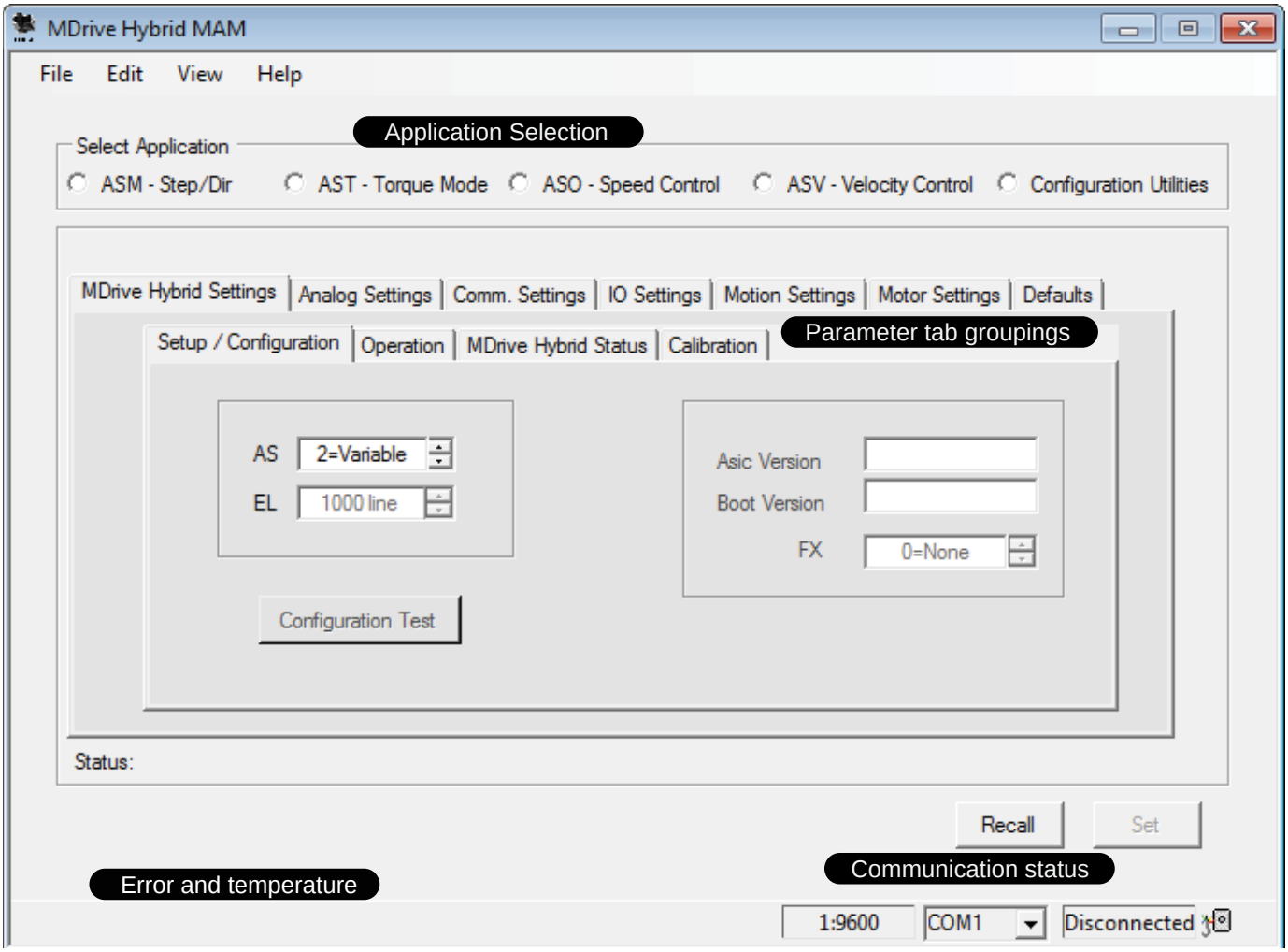

Figure 3.10: Hybrid Configurator Utility opening screen

4 Commissioning

4

⚠WARNING

LOSS OF CONTROL

The product is unable to detect an interruption of the network link if

- Verify that connection monitoring is on.
- The shorter the time for monitoring, the faster the detection of the interruption.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠WARNING

UNINTENDED OPERATION

The product is unable to detect an interruption of the network link if

- Do not write values to reserved parameters.
- Do not write values to parameters unless you fully understand the function.
- Run initial tests without coupled loads.
- Verify that the system is free and ready for the movement before changing parameters.
- Verify the use of the word sequence with fieldbus communication.
- Do not establish a fieldbus connection unless you have fully understood the communication principles.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠CAUTION

MOVEMENT ON POWER APPLICATION

Hybrid Motion Technology's functionality requires that the rotor and stator of the motor be in precise alignment. To accomplish this, the product will perform an initial calibration move upon power up consisting of a 6 motor full step (10.8°) move in the clockwise direction, followed by a 3 motor full step (5.4°) move inthe counter-clockwise direction.

• Only power the system if there are no persons in the hazardous area.

Failure to follow these instructions can result in injury or equipment damage.

4.1 Preparing for commissioning

CAUTION

MULTI-MODE OPERATION

This device will operate differently in each mode of operation. It is critical that all documentation be read completely. A clear understanding of how the device is to be employed be present before attempting to install or commission the device.

Failure to follow these instructions can result in equipment damage.

The following is required before commissioning:

- ▶ The device may be commissioned in system or out of system.
- ▶ Only supply voltage VDC and RS422/485 communication connections are required for commissioning.
- ▶ Ensure that this section and Section 5: Parameters and Operation are read in their entirety as some parameters are application specific or have defaults that vary by application loaded.
- ▶ This section assumes that the MDrive Hybrid Configuration Utility is installed and a communication converter is installed, connected and working. See Section 5: Installation for instructions.

4.1.1 Establish a connection to the device

- ▶ Apply power to the MDrive Hybrid.
- ▶ Open the MDrive Hybrid Configuration Utility.
- ◁ The software will scan the ports for the connected port,
- ▶ From the dropdown selector at the lower right of the software screen, select the COM port.

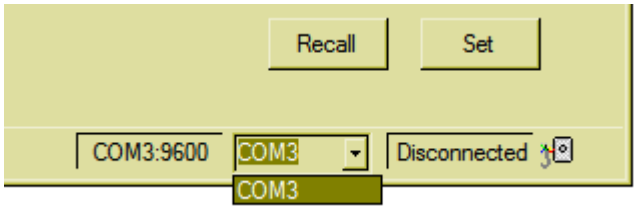

Figure 4.1: COM port selection

- ▶ Click the field labeled “Disconnected”.
- ◁ The field should change to “Connected” indicating an active communication state.

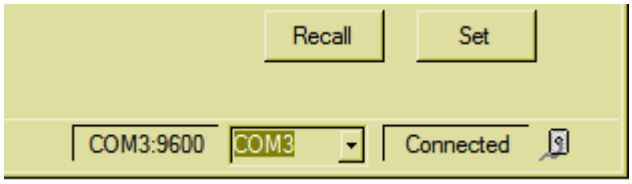

Figure 4.2: Connected indication

4.1.2 Communication parameters

Communication parameters such as BAUD rate, party mode state and Device name, etc should not be set at this time, but following the application load during device parameterization. See Section 5: Parameters

During application loading the BAUD rate automatically sets to 19200 bps.

4.2 MDrive Hybrid applications

The MDrive Hybrid Step • Torque • Speed device requires an application to be loaded to define the functionality of the device.

The device WILL NOT function without an application being loaded. The factory default application is a set of Configuration Utilities which allow for the specified application firmware to be loaded onto the device.

The available applications are explained below.

Step/direction (ASM) In step/direction mode the device will move the stepper motor as specified by a reference value. The setpoint signal is generated by a position or stepper controller and input to the device as a pulse signal. Shaft direction is controlled by a logic state on the direction input.

Torque mode (AST) In torque mode the device will maintain constant torque on the shaft at a value determined by a reference voltage fed to the analog input. The step pulses are generated via an internal velocity generator.

Speed control mode (ASO) In speed control mode the device will move the stepper motor at a velocity determined by a reference voltage fed to the analog input. The step pulses are generated via an internal velocity generator.

Velocity mode (ASV) In velocity mode the device will move the stepper motor at a constant velocity determined by an integer value input via the RS422/485 interface. The step pulses are generated via an internal velocity generator.

Detailed operational details of the applications are located in the device's hardware manual.

4.3 Loading the desired application

By default the MDrive Hybrid Step • Torque • Speed units ship in “Configuration Utilities” mode. In order for the device to function an application must be loaded.

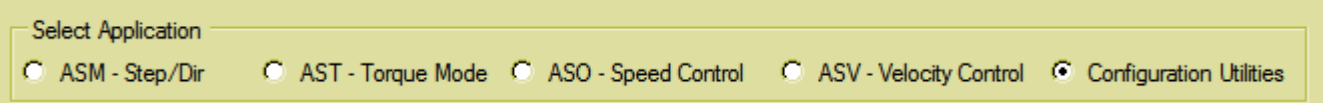

Figure 4.3: Application selection area

- ▶ Click the radio button for the desired application.
- ▶ On the “Application Not Installed” dialog, click “Yes”

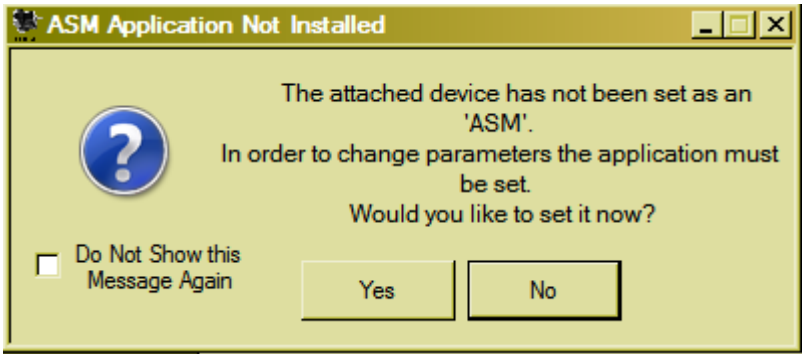

Figure 4.3: Application not installed dialog

- ◁ The application will load, loading progress will be displayed in a progress bar on the GUI screen.
- ◁ When complete, a dialog requesting a power cycle of the device will open.
- ▶ Cycle power to the device.
- ◁ The device will initialize in the loaded application and will now be ready for parameterization/use.
- ◁ The device will perform a calibration move to align the rotor to the stator of the motor.

5 Parameters

5

⚠WARNING

LOSS OF CONTROL

The product is unable to detect an interruption of the network link if

- Verify that connection monitoring is on.
- The shorter the time for monitoring, the faster the detection of the interruption.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠WARNING

UNINTENDED OPERATION

The product is unable to detect an interruption of the network link if

- Do not write values to reserved parameters.
- Do not write values to parameters unless you fully understand the function.
- Run initial tests without coupled loads.
- Verify that the system is free and ready for the movement before changing parameters.
- Verify the use of the word sequence with fieldbus communication.
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⚠CAUTION

MOVEMENT ON POWER APPLICATION

Hybrid Motion Technology's functionality requires that the rotor and stator of the motor be in precise alignment. To accomplish this, the product will perform an initial calibration move upon power up consisting of a 6 motor full step (10.8°) move in the clockwise direction, followed by a 3 motor full step (5.4°) move inthe counter-clockwise direction.

• Only power the system if there are no persons in the hazardous area.

Failure to follow these instructions can result in injury or equipment damage.

5.1 Parameters overview

CAUTION

MULTI-MODE OPERATION

This device will operate differently in each mode of operation. It is critical that all documentation be read completely. A clear understanding of how the device is to be employed be present before attempting to install or commission the device.

Failure to follow these instructions can result in equipment damage.

Parameterization methods

This Section covers parameterization using the Hybrid Configurator Utility.

The parameters may be set/changed using an ANSI Terminal emulator program and two character mnemonic commands representing the parameter followed by a value.

Application specific parameters

Some parameters are application specific. When using the software unavailable parameters will be disabled or invisible on the software screens.

Acronyms used in this section

Acronym	Meaning
ASM	Step/direction mode
AST	Torque mode
ASO	Speed control mode
ASV	Velocity mode
HMT	Hybrid Motion Technology

Organization of this Section

The parameter details of this section are organized by application. Parameter descriptions that are common to multiple applications are repeated as the defaults may change between applications.

All screen captures sow the factory defaults and available parameters for that specific mode.

Use the Subsection appropriate to the used application for setup details.

5.2 Communication parameters

The communication parameters set using the come settings tap are common to all applications, thus are listed once.

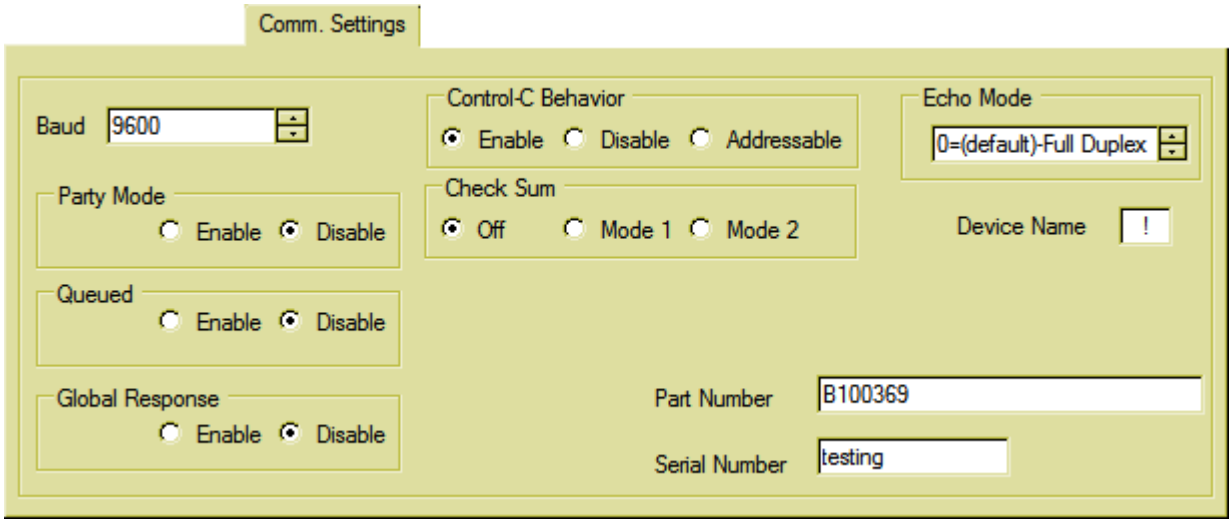

Figure 5.1: Communication settings tab

Name	ASCII	Description / Value	Range	Default
BAUD rate	BD	Sets the communication BAUD rate 4800 9600 19200 38400 115200	—	9600
Party mode	PY	Enable/disable party mode operation **0 = disable** **1 = enable**	0/1	0
Queued	QD	Allows multiple queued devices to respond to the caret “^” address character. 0 = disabled 1 = enabled	0/1	0
Global response	DG	The DG flag enables or disables device response to global commands made while in party mode. 0 = disabled 1 = enabled 2 = addressable	0 ... 2	0
CTRL+C behavior	CE	configure the device to respond or not respond to a CTRL+C software reset, or if the device will respond to an addressable reset in party mode. 0 = disabled 1 = enabled 2 = addressable	0 ... 2	0

Name	ASCII	Description Value	Range	Default
Checksum	CK	Puts the device into Check Sum Mode. When enabled, all communications with the device require a Check Sum to follow the commands. 0 = disabled 1 = ack/nak cksum+error 2 = ack/nak cksum only	0 ... 2	0
Echo mode	EM	The Echo Mode Flag will set the full/ half duplex configuration of the RS- 485 channel. 0 = full duplex 1 = half duplex 2 = list/print only 3 = Queue immediate 4 = computer friendly	0 ... 4	0
Device name	DN	Set the device name for party mode operation. Valid names A-Z, a-z, 0-9	—	!

5.2.1 Procedure: changing the BAUD rate

- ▶ In the Baud selector on the Comm. Settings tab, select the desired BAUD rate: 4800. 9600, 19200, 38400 or 115200.
- ▶ Click “Set”.
- ◁ A dialog will open instructing a power cycle of the device.
- ▶ Power cycle the device, click OK on the dialog.
- ▶ Browse to the “Defaults” tab.
- ▶ Click the button “Find my com settings”
- ◁ The software will cycle through a detection sequence and set itself to the set BAUD rate.

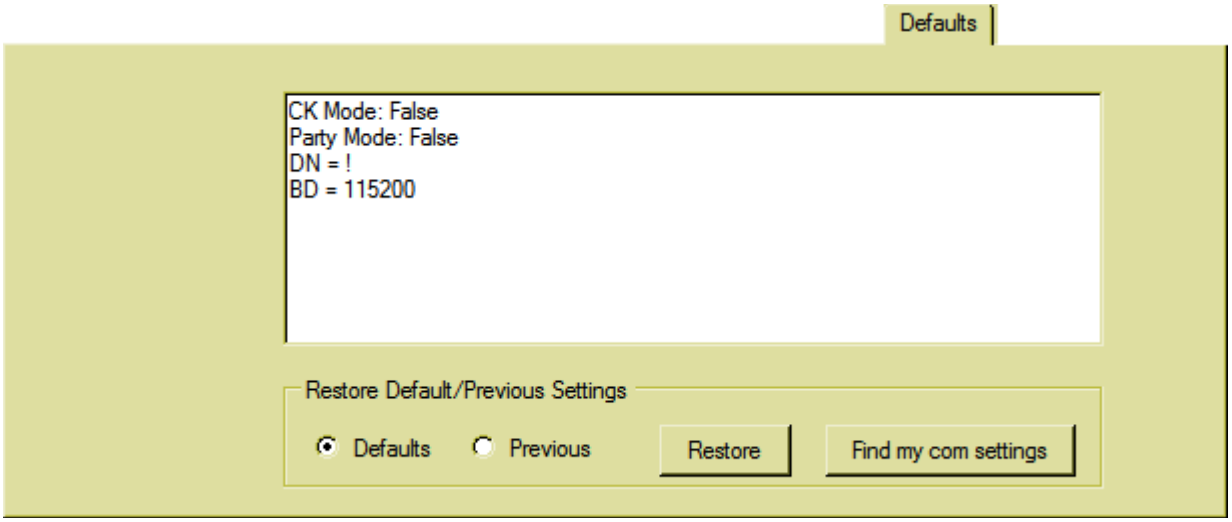

Figure 5.2: Comm settings displayed

5.3 Step/direction mode (ASM)

5.3.1 MDrive Hybrid Settings tab - step/direction mode

The MDrive Hybrid Settings tab and subtabs contain the parameters to setup and monitor the status of the Hybrid Motion Technology block of the device.

Setup / Configuration

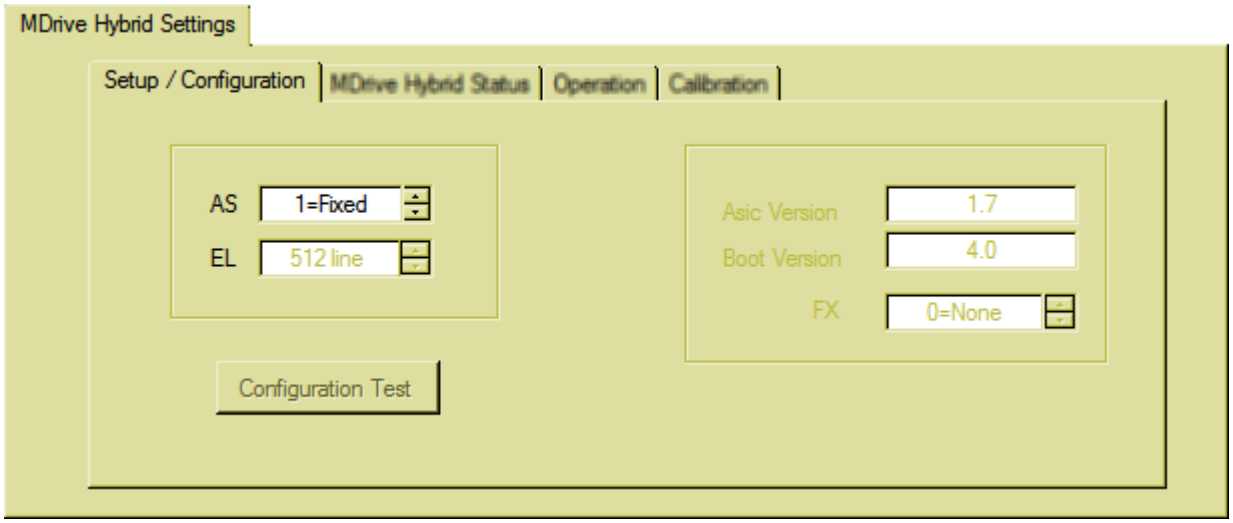

Figure 5.3: HMT setup and configuration

Name	ASCII	Description / Value	Range	Default
Hybrid mode	AS	Hybrid mode defines the enable/disable state of the HMT and the current mode.	0 ... 2	2

Value	Meaning
0	HMT disabled, anti-stall and encoder functions unavailable
1	HMT enabled, current control at fixed run (RC) and hold (HC) current settings as set on Motion Settings Tab.
2	HMT enabled, current control varies as needed to perform move

MDrive Hybrid Status

Read-only tab displays the status of the HMT block. Active conditions will display as checked, and as a BCD integer in the text field on the upper right.

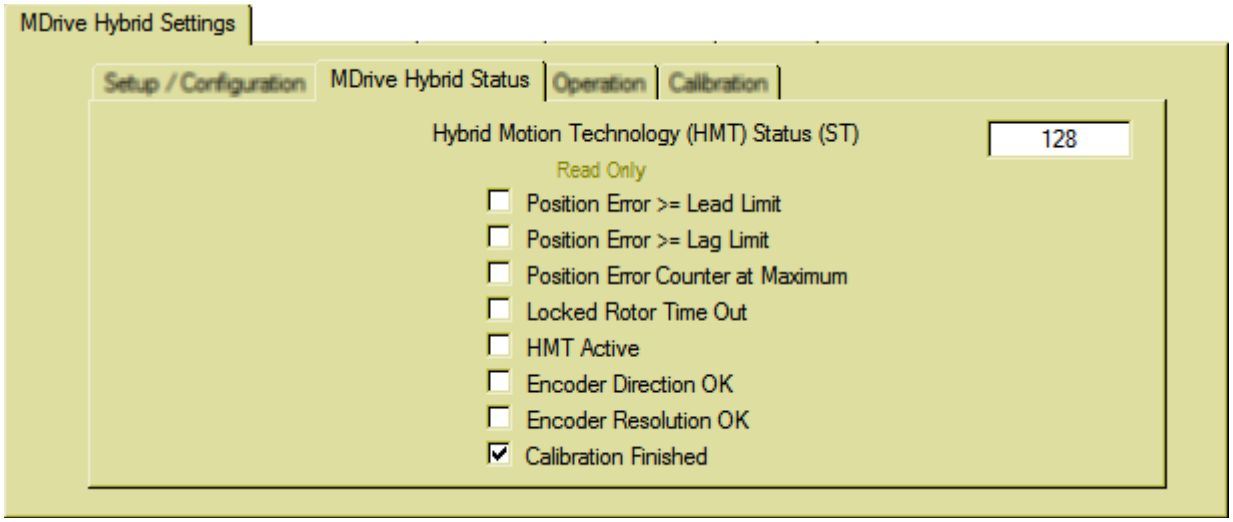

Figure 5.4: MDrive Hybrid Status tab

Operation

Parameters on this sub-tab define the operational characteristics of the HMT block of the device.

NOTE: If the Hybrid mode is disabled (AS=0), these parameters will be settable, but will have no impact on the operation of the device UNTIL HMT is enabled (AS=1/AS=2).

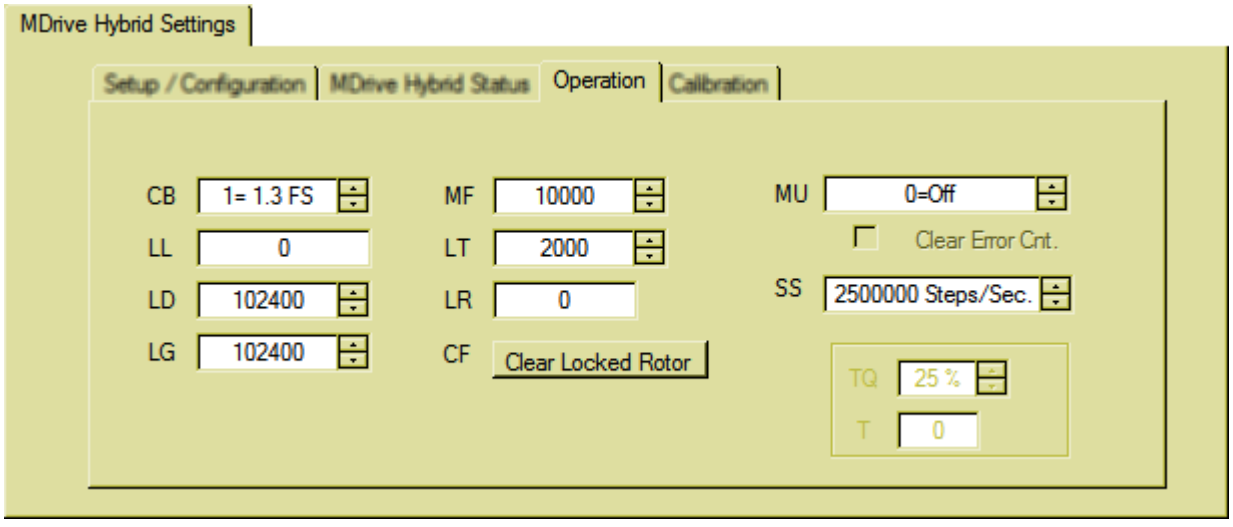

Figure 5.5: Operation tab

<table>
<tr><th>Name</th><th>ASCII</th><th>Description / Value</th><th>Range</th><th>Default</th></tr>
<tr><td>Control bounds</td><td>CB</td><td>Control bounds defines the limits in which HMT will maintain the rotor-stator relationship in full motor steps to eliminate a stall.
<table><tr><th>Value</th><th>Meaning</th><th></th></tr><tr><td>0</td><td>1.1 — highest torque</td><td></td></tr><tr><td>1</td><td>1.3 — high torque, medium speed</td><td rowspan="2">Best overall performance</td></tr><tr><td>2</td><td>1.5 — high speed, medium torque</td></tr><tr><td>3</td><td>1.7 — highest speed</td><td></td></tr></table></td><td>0 ... 3</td><td>1</td></tr>
<tr><td>Lead/lag counter</td><td>LL</td><td>Read-only field displays the position lead/lag step count. To clear, select a value for MU, check “Clear Error Cnt.” Click set, then click Recall. The count will be zero. Calibrating will also reset the count.</td><td></td><td></td></tr>
<tr><td>Lead limit</td><td>LD</td><td>Sets the position lead limit in counts at which position a locked rotor condition will assert.</td><td>0 ... 2147483647</td><td>102400</td></tr>
<tr><td>Lag limit</td><td>LG</td><td>Sets the position lag limit in counts at which position a locked rotor condition will assert.</td><td>0 ... 2147483647</td><td>102400</td></tr>
<tr><td>Position make up Speed</td><td>MF</td><td>Make up frequency sets the velocity during position make up when make up mode MU=1.</td><td>306 ... 5000000</td><td>10000</td></tr>
<tr><td>Locked rotor Timeout</td><td>LT</td><td>Locked rotor time-out in milliseconds. This is the time from the locked rotor flag activates to the disabling of the output bridge.</td><td>2 ... 65535</td><td>2000</td></tr>
<tr><td>Locked rotor</td><td>LR</td><td>Read-only field indicating the free/locked state of the rotor.
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Rotor is not locked</td></tr><tr><td>1</td><td>Rotor is locked</td></tr></table></td><td></td><td></td></tr>
<tr><td>Clear locked rotor</td><td>CF</td><td>Clicking this button will clear the locked rotor error (LR).</td><td></td><td></td></tr>
<tr><td>Make-up mode</td><td>MU</td><td>Make up selection for position make up.
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Position make-up disabled</td></tr><tr><td>1</td><td>Use make-up speed (MF) as make-up speed</td></tr><tr><td>2</td><td>Use system speed (SS) as make-up speed</td></tr></table></td><td>0 ... 2</td><td>0</td></tr>
<tr><td></td><td></td><td>Clear error count. If checked, LL count will be cleared on an MU change and set.
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>Unchecked</td><td>Do not clear lead/lag counter (LL)</td></tr><tr><td>Checked</td><td>Clear lead/lag counter (LL)</td></tr></table></td><td>0/1</td><td>0</td></tr>
<tr><td>System speed</td><td>SS</td><td>System speed Sets maximum response frequency for fixed or variable current modes. To switch the units to step width time in nSec, double click inside the field.</td><td>0 ... 5000000</td><td>2500000</td></tr>
</table>

Calibration

Calibration is the process where the HMT aligns the rotor and the stator. This occurs automatically on power-up, and can be initiated manually provided the motor is not in motion.

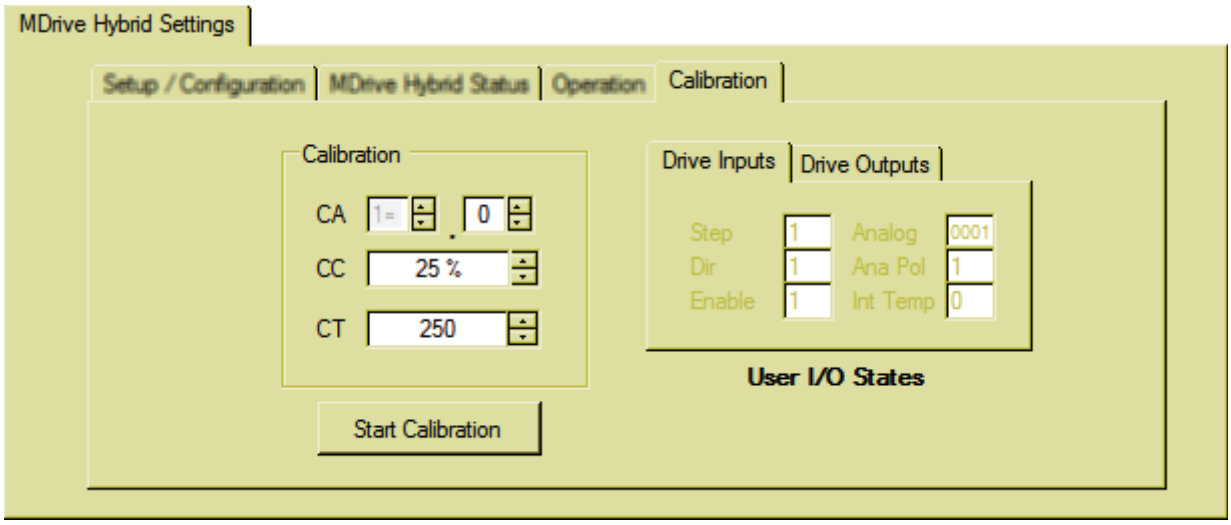

Figure 5.6: Calibration tab

Name	ASCII	Description / Value	Range	Default
Calibration mode	CA	Calibration mode. **Value** / **Meaning** 0 — Hard stop tolerant (HST) is the only calibration mode. In HST. the motor shaft will mof 6 full steps CW, then 3 fullsteps CCW before settling into alignment. During this period the motr shaft MUST be free to move in order to complete the alignment proces. If the shaft is unable to move an error 89 (calibration fault) is generated. If shaft loading is in place, the torque compensation parameter may be used to align the rotor and stator with shaft loading in place.	0	0
		Torque compensation on/off **Value** / **Meaning** 0 — Off 1 — On	0/1	0
Calibration current	CC	Calibration current sets the motor current for calibration in percent.	0 ... 100	25
Calibration time	CT	Calibration time sets the timing for timed calibration in milliseconds.	2-65535	250
Start calibration	—	Clicking this button will initiate the calibration sequence. The motor cannot be in motion or an error 87 will occur.		

5.3.2 IO Settings tab - step/direction mode

The IO Settings defines the functional parameters of the step, direction and enable inputs and the attention output.

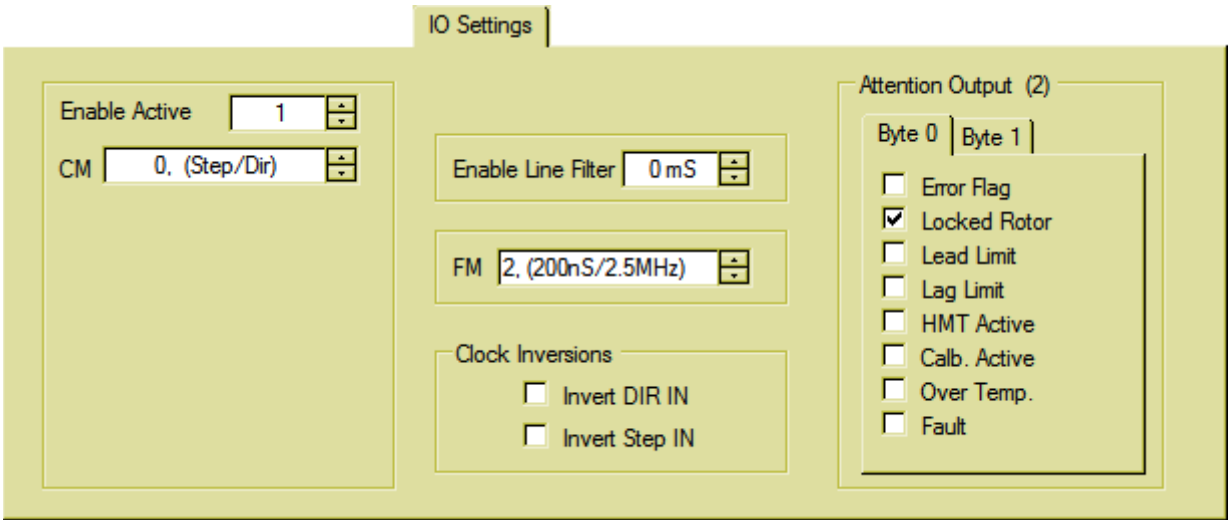

Figure 5.7: IO Settings tab

Name	ASCII	Description / Value	Range	Default
Enable active	EA	Sets the active logic state of the enable input. **Value** / **Meaning** 0 – Input is active when logic LOW 1 – Input is active when logic HIGH	0/1	0
Clock mode	CM	Sets the clock input mode to pulse/direction, quadrature or CW/CCW inputs. **Value** / **Meaning** 0 – Step/direction mode 1 – Quadrature or A/B mode 2 – CW/CCW or up/down mode	0 ... 2	0
Enable input filter	FE	Filter enable input in milliseconds **Value** / **Meaning** 0 – No filtering of input 1 - 255 – Input filter time in milliseconds	0 ... 255	0

<table>
<tr><th>Name</th><th>ASCII</th><th>Description / Value</th><th>Range</th><th>Default</th></tr>
<tr><td>Filter motion</td><td>FM</td><td>Sets the filtering for the pulse/direction inputs.
<table><tr><th>Value</th><th>Meaning</th><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>50 ns/10 MHz</td><td>5</td><td>900 ns/555 kHz</td></tr><tr><td>1</td><td>150 ns/3.3 MHz</td><td>6</td><td>1.7 µs/294 kHz</td></tr><tr><td>2</td><td>200 ns/2.5 MHz</td><td>7</td><td>3.3 µs/151 kHz</td></tr><tr><td>3</td><td>300 ns/1.67 MHz</td><td>8</td><td>6.5 µs/76.9 kHz</td></tr><tr><td>4</td><td>500 ns/1.0 MHz</td><td>9</td><td>12.9 µs/37.8 kHz</td></tr></table></td><td>0 ... 9</td><td>2</td></tr>
<tr><td>Invert clock</td><td>CI</td><td>Allows the user to invert the pulse/direction inputs.
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>No inversion</td></tr><tr><td>1</td><td>Invert the step input</td></tr><tr><td>2</td><td>Invert the direction input</td></tr><tr><td>4</td><td>Invert both step and direction inputs</td></tr></table></td><td>0 ... 4</td><td>0</td></tr>
<tr><td>Attention output</td><td>AO</td><td>Configures the attention output to activate on specified condition by checking the box.
<table><tr><th>Value</th><th>Meaning</th><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Software error</td><td>128</td><td>Reserved</td></tr><tr><td>2</td><td>Locked rotor</td><td>256</td><td>At zero crossing</td></tr><tr><td>4</td><td>Lead limit reached</td><td>512</td><td>Hold current active</td></tr><tr><td>8</td><td>Lag limit reached</td><td>1024</td><td>Make-up active</td></tr><tr><td>16</td><td>HMT active</td><td>2048</td><td>Calibration fault</td></tr><tr><td>32</td><td>Calibration active</td><td>4096</td><td>Drive enable false</td></tr><tr><td>64</td><td>Over-temperature</td><td></td><td></td></tr></table></td><td>0 ... 8191</td><td>0</td></tr>
</table>

5.3.3 Motion Settings tab - step/direction mode

The Motion Settings tab facilitates the current settings and microstep resolution, as well as a software override for the drive enable line.

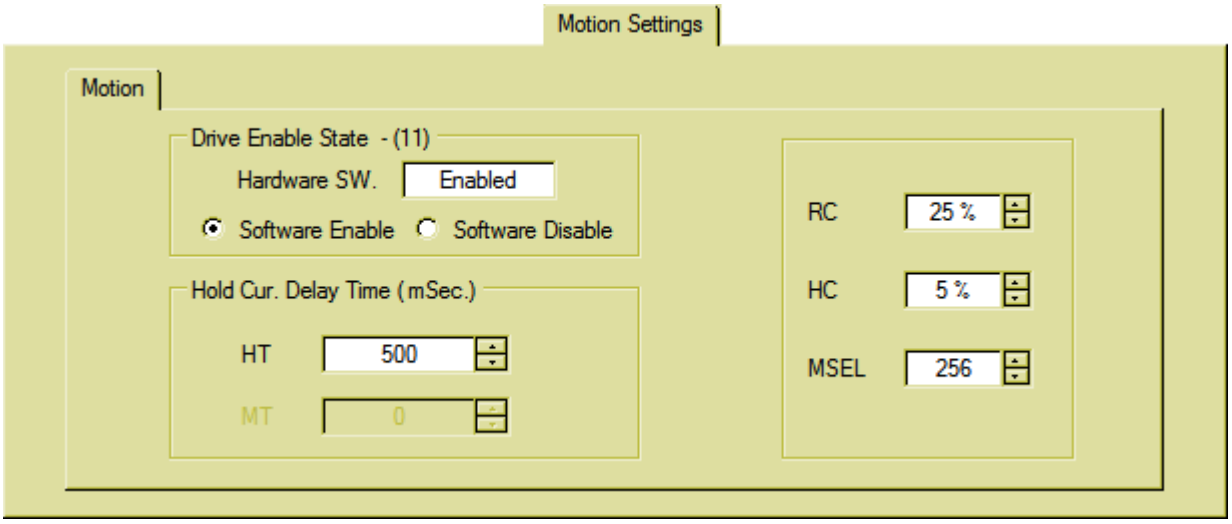

Figure 5.8: Motion Settings tab

Name	ASCII	Description / Value	Range	Default
Hold current delay time	HT	Represents the time delay in milliseconds between the last motion input and the shift to the commanded holding current.	0 ... 65000	500
Hardware Switch	—	Read-only field displayes the enabled/disabled state of the enable input	—	Enabled
Enable override	—	Allows the enable input to be overridden in software	—	Enabled
Hold current	HC	Motor holding (reduction) current in percent.	0 ... 100	5
Run current	RC	Motor running current in percent.	1 ... 100	25
Microstep resolution	MS	Sets the microstep resolution in microsteps/fullstep.	See table below	256

Binary

microsteps/step	steps/revolution
1	200
2	400
4	800
8	1600
16	3200
32	6400
64	12800
128	25600
256	52100
Additional resolution settings	
180	36000 (0.01°/µstep)
108	21600 (1 arc-min/µstep)
127	25400 (0.001 mm/µstep)

Decimal

microsteps/step	steps/revolution
5	1000
10	2000
25	5000
50	10000
100	20000
125	25000
200	40000
250	50000

5.4 Torque mode (AST)

5.4.1 MDrive Hybrid Settings tab - torque mode

The MDrive Hybrid Settings tab and subtabs contain the parameters to setup and monitor the status of the Hybrid Motion Technology block of the device.

Setup / Configuration

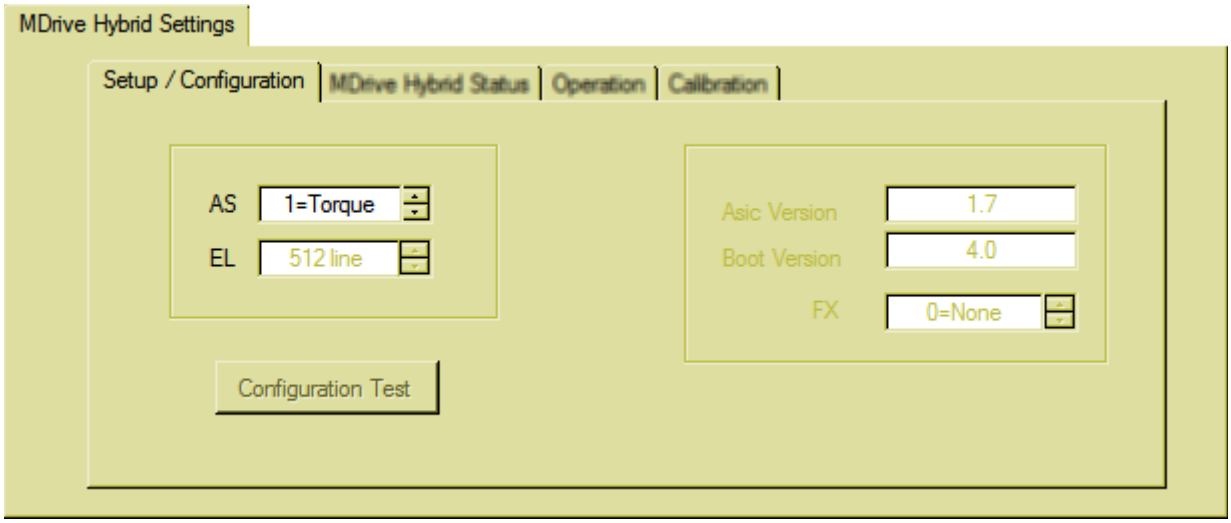

Figure 5.9: HMT setup and configuration (AST)

Name	ASCII	Description / Value	Range	Default
Hybrid mode	AS	Hybrid mode defines the enable/disable state of the HMT and the current mode.	0 / 1	1

Value	Meaning
0	HMT disabled, anti-stall and encoder functions unavailable
1	HMT enabled in torque mode. HMT block will control the motor current and speed as required to maintain the specified torque.

MDrive Hybrid Status Read-only tab displays the status of the HMT block. Active conditions will display as checked, and as a BCD integer in the text field on the upper right.

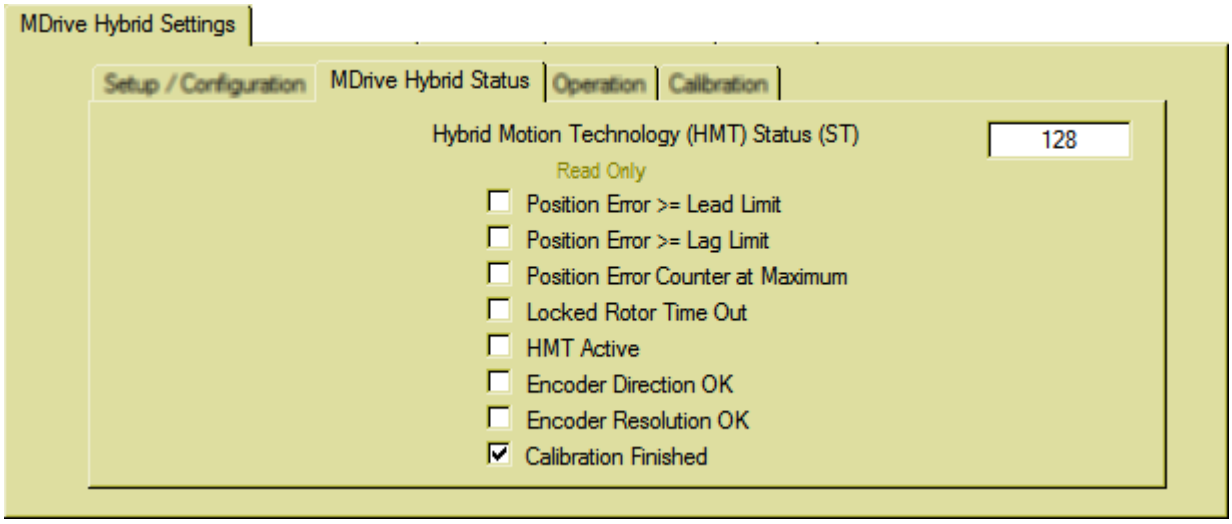

Figure 5.10: MDrive Hybrid Status tab (AST)

Operation Parameters on this sub-tab define the operational characteristics of the HMT block of the device.

NOTE: If the Hybrid mode is disabled (AS=0), these parameters will be settable, but will have no impact on the operation of the device UNTIL HMT is enabled (AS=1).

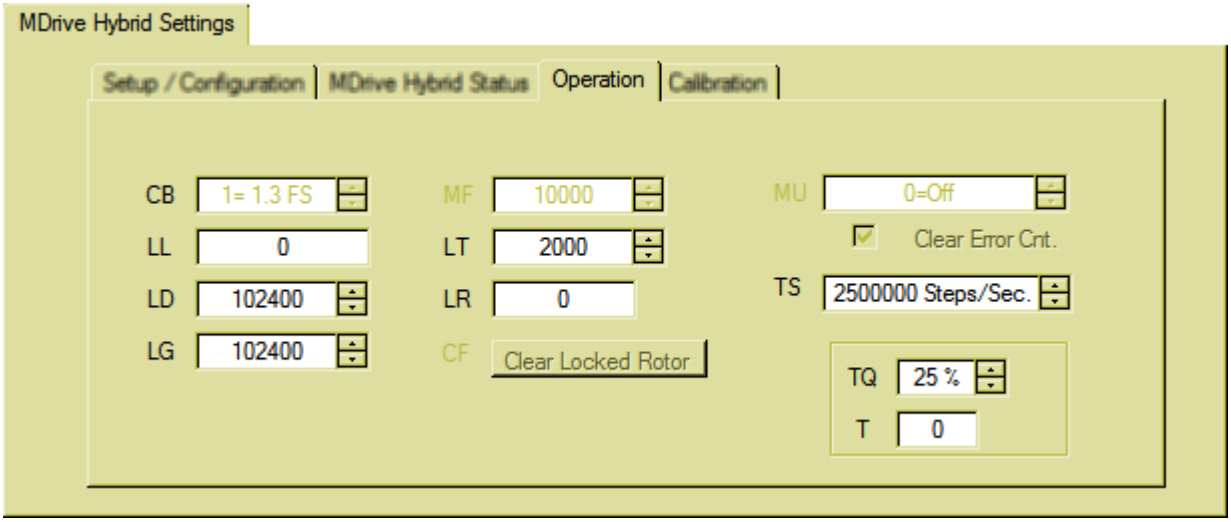

Figure 5.11: Operation tab (AST)

Name	ASCII	Description / Value	Range	Default
Control bounds	CB	Disabled for torque mode, CB is fixed at 1.3 full steps.	—	—
Lead/lag counter	LL	In torque mode this register has no impact on operation. May be used for system monitoring.	—	—
Lead limit	LD	In torque mode this register has no impact on operation. May be used for system monitoring.	0 ... 2147483647	102400
Lag limit	LG	In torque mode this register has no impact on operation. May be used for system monitoring.	0 ... 2147483647	102400
Position make up Speed	MF	Disabled for torque mode	306 ... 5000000	10000
Locked rotor Timeout	LT	In torque mode this register has no impact on operation.	2 ... 65535	2000
Locked rotor	LR	In torque mode the rotor can indicate a locked state but will not disable the motor bridge driver.	—	—
Clear locked rotor	CF	Disabled for torque mode	—	—
Make-up mode	MU	Disabled for torque mode	0 ... 2	0
Torque speed	TS	Torque speed sets maximum response frequency for torque mode. To switch the units to step width time in nSec, double click inside the field.	0 ... 5000000	2500000
Torque percent	TQ	Sets the percentage of motor torque the device will maintain.	0 ... 100	25
Actual torque	T	Read-only field displays the current motor torque.	0 ... 100	0

Calibration

Calibration is the process where the HMT aligns the rotor and the stator. This occurs automatically on power-up, and can be initiated manually provided the motor is not in motion.

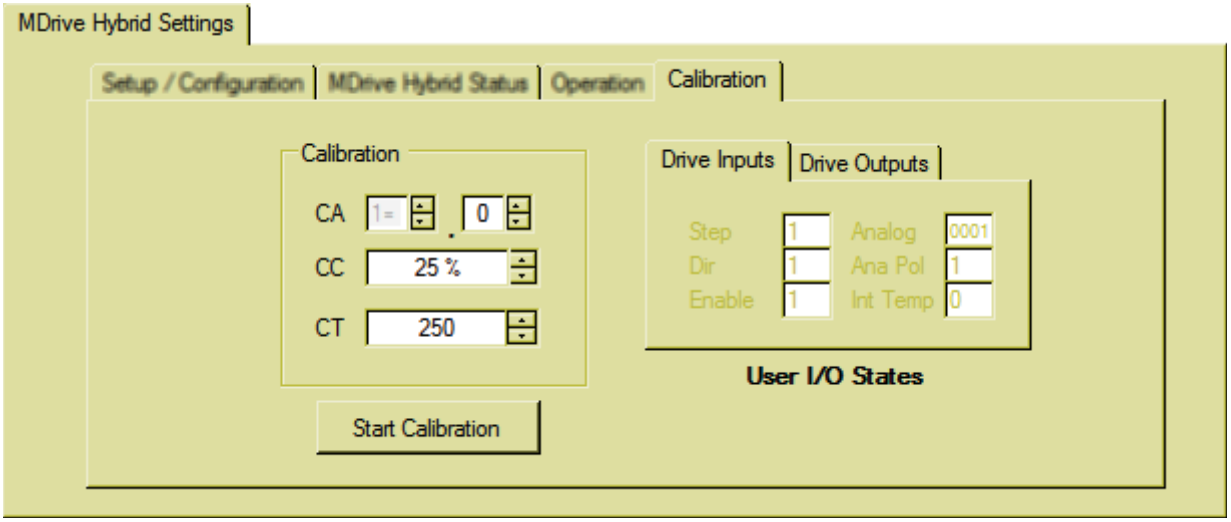

Figure 5.12: Calibration tab (AST)

Name	ASCII	Description / Value	Range	Default
Calibration mode	CA	Calibration mode. **Value** / **Meaning** 0 — Hard stop tolerant (HST) is the only calibration mode. In HST. the motor shaft will mof 6 full steps CW, then 3 fullsteps CCW before settling into alignment. During this period the motr shaft MUST be free to move in order to complete the alignment proces. If the shaft is unable to move an error 89 (calibration fault) is generated. If shaft loading is in place, the torque compensation parameter may be used to align the rotor and stator with shaft loading in place.	0	0
		Torque compensation on/off **Value** / **Meaning** 0 — Off 1 — On	0/1	0
Calibration current	CC	Calibration current sets the motor current for calibration in percent.	0 ... 100	25
Calibration time	CT	Calibration time sets the timing for timed calibration in milliseconds.	2-65535	250
Start calibration	—	Clicking this button will initiate the calibration sequence. The motor cannot be in motion or an error 87 will occur.		

5.4.2 Analog Settings tab - torque mode

The Analog settings tab deifines the input mode and parameter settings of the analog input. I torque mode, the signal on the analog input controls the motor torque percent between 0 and TQ.

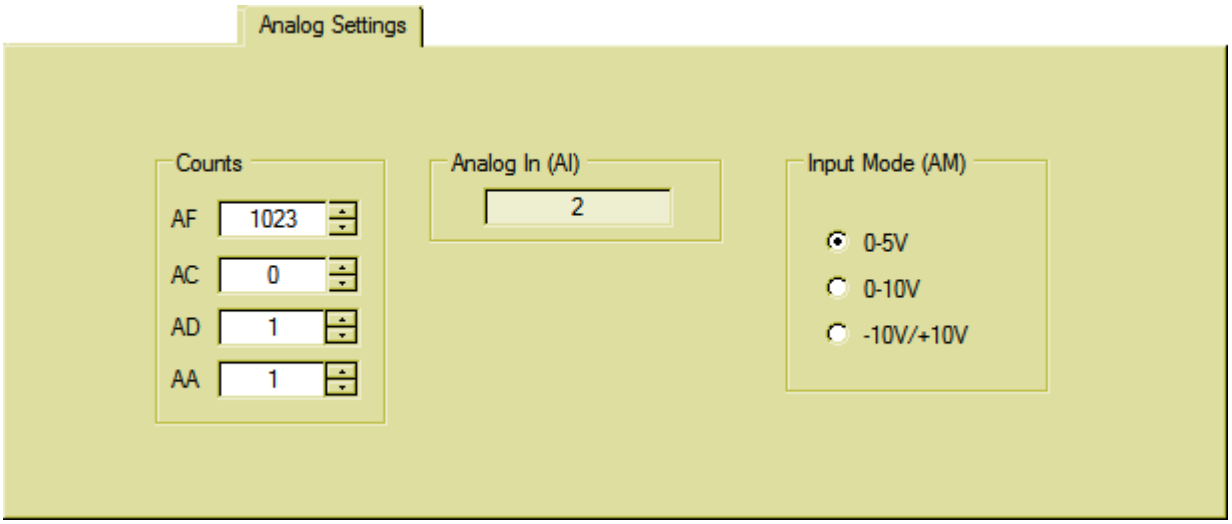

Figure 5.13: Analog settings tab (AST)

Name	ASCII	Description / Value	Range	Default
Analog full scale	AF	Sets the full scale range of the analog input. By default it is at the maximum allowed range. The max voltage of the selected input mode will = 100% of the preset torque.	0 ... 1023	1023
Analog center	AC	Sets the center point of the analog full scale for directional control using the analog input.	0 ... 1023	0
Analog deadband	AD	Sets the ± deadband for the analog center (AC).	0 ... 255	1
Analog average	AA	Input filtering for the analog input.	1 ... 1000	1
Analog mode	AM	Sets the analog input to respond to:	0 ... 2	0

Value	Meaning
0	0 to 5 V
1	0 to 10 V
2	0 to 20 mA

5.4.3 IO Settings tab - torque mode

The IO Settings defines the functional parameters of the step, direction and enable inputs and the attention output.

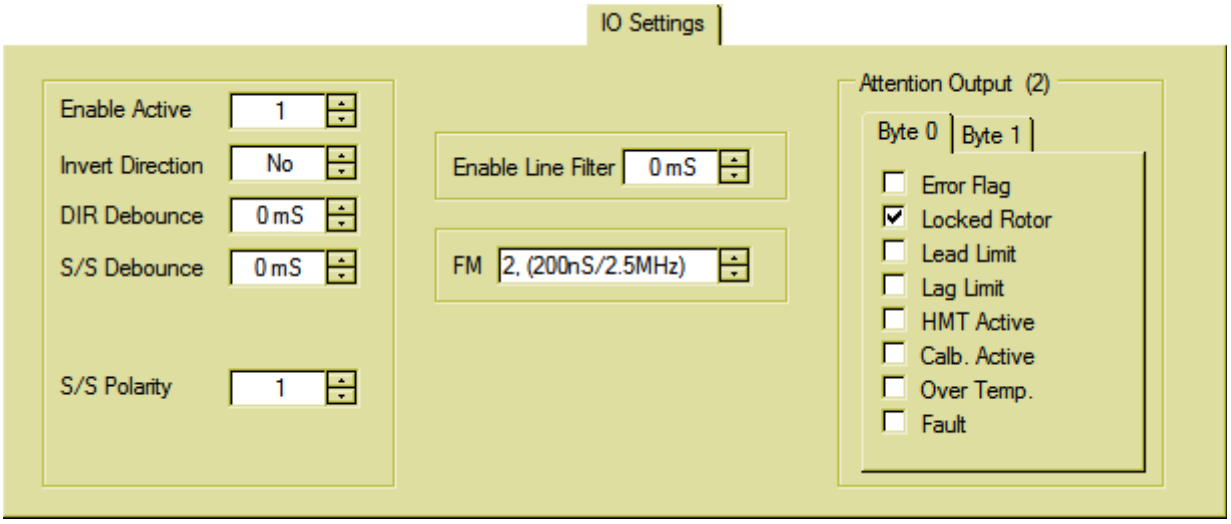

Figure 5.14: IO Settings tab (AST)

Name	ASCII	Description / Value	Range	Default
Enable active	EA	Sets the active logic state of the enable input. **Value** / **Meaning** 0 – Input is active when logic LOW 1 – Input is active when logic HIGH	0/1	0
Invert direction	—	Allows the user to invert the direction input **Value** / **Meaning** 0 – Do not invert direction 1 – Invert direction	0/1	0
Direction filter	—	Filter direction input in milliseconds **Value** / **Meaning** 0 – No filtering of input 1 - 255 – Input filter time in milliseconds	0 ... 255	0
Stop/start filter	—	Filter stop/start input in milliseconds **Value** / **Meaning** 0 – No filtering of input 1 - 255 – Input filter time in milliseconds	0 ... 255	0
Stop/Start polarity	—	Allows the user to invert the stop/start input **Value** / **Meaning** 0 – Input is active when logic LOW 1 – Input is active when logic HIGH	0/1	01

<table>
<tr><th>Name</th><th>ASCII</th><th>Description / Value</th><th>Range</th><th>Default</th></tr>
<tr><td>Enable input filter</td><td>FE</td><td>Filter enable input in milliseconds
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>No filtering of input</td></tr><tr><td>1 - 255</td><td>Input filter time in milliseconds</td></tr></table></td><td>0 ... 255</td><td>0</td></tr>
<tr><td>Filter motion</td><td>FM</td><td>Sets the filtering for the velocity generator.
<table><tr><th>Value</th><th>Meaning</th><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>50 ns/10 MHz</td><td>5</td><td>900 ns/555 kHz</td></tr><tr><td>1</td><td>150 ns/3.3 MHz</td><td>6</td><td>1.7 µs/294 kHz</td></tr><tr><td>2</td><td>200 ns/2.5 MHz</td><td>7</td><td>3.3 µs/151 kHz</td></tr><tr><td>3</td><td>300 ns/1.67 MHz</td><td>8</td><td>6.5 µs/76.9 kHz</td></tr><tr><td>4</td><td>500 ns/1.0 MHz</td><td>9</td><td>12.9 µs/37.8 kHz</td></tr></table></td><td>—</td><td>2</td></tr>
<tr><td>Attention output</td><td>AO</td><td>Configures the attention output to activate on desired condition
<table><tr><th>Value</th><th>Meaning</th><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Software error</td><td>128</td><td>Reserved</td></tr><tr><td>2</td><td>Locked rotor</td><td>256</td><td>At zero crossing</td></tr><tr><td>4</td><td>Lead limit reached</td><td>512</td><td>Hold current active</td></tr><tr><td>8</td><td>Lag limit reached</td><td>1024</td><td>Make-up active</td></tr><tr><td>16</td><td>HMT active</td><td>2048</td><td>Calibration fault</td></tr><tr><td>32</td><td>Calibration active</td><td>4096</td><td>Drive enable false</td></tr><tr><td>64</td><td>Over-temperature</td><td></td><td></td></tr></table></td><td>0 ... 8191</td><td>0</td></tr>
</table>

5.4.4 Motion Settings tab - torque mode

The Motion Settings tab facilitates the current settings and microstep resolution, as well as a software override for the drive enable line.

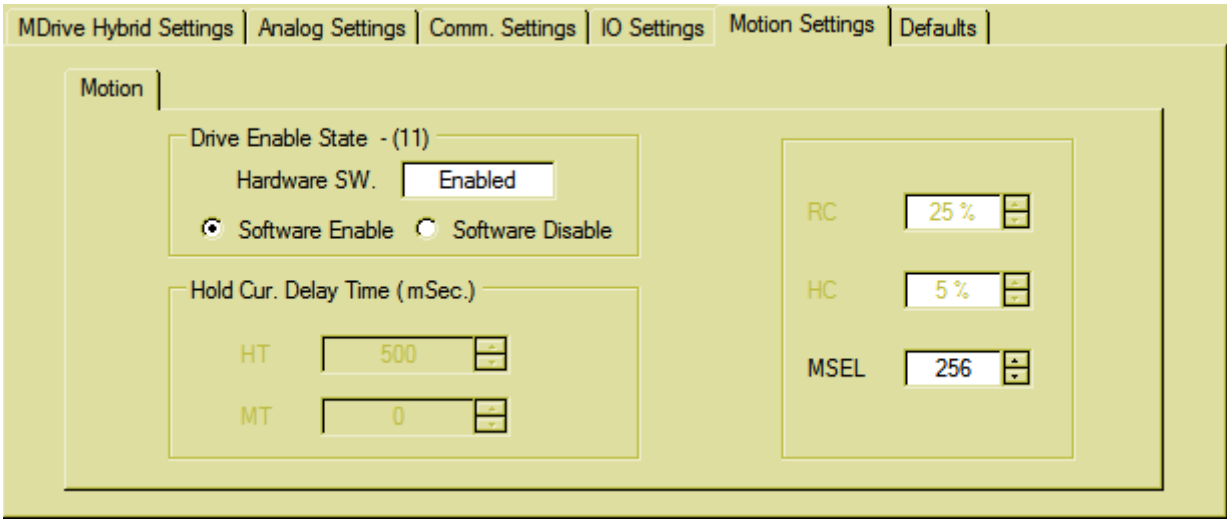

Figure 5.15: Motion Settings tab (AST)

Name	ASCII	Description / Value	Range	Default
Hold current delay time	HT	Disabled for torque mode	—	—
Hardware Switch	—	Read-only field displayes the enabled/disabled state of the enable input	—	Enabled
Enable override	—	Allows the enable input to be overridden in software	—	Enabled
Hold current	HC	Disabled for torque mode	—	—
Run current	RC	Disabled for torque mode	—	—
Microstep resolution	MS	Sets the microstep resolution in microsteps/fullstep.	See table below	256

Binary

microsteps/step	steps/revolution
1	200
2	400
4	800
8	1600
16	3200
32	6400
64	12800
128	25600
256	52100
Additional resolution settings	
180	36000 (0.01°/µstep)
108	21600 (1 arc-min/µstep)
127	25400 (0.001 mm/µstep)

Decimal

microsteps/step	steps/revolution
5	1000
10	2000
25	5000
50	10000
100	20000
125	25000
200	40000
250	50000

5.5 Speed Control mode (ASO)

5.5.1 MDrive Hybrid Settings tab - speed control mode

The MDrive Hybrid Settings tab and subtabs contain the parameters to setup and monitor the status of the Hybrid Motion Technology block of the device.

Setup / Configuration

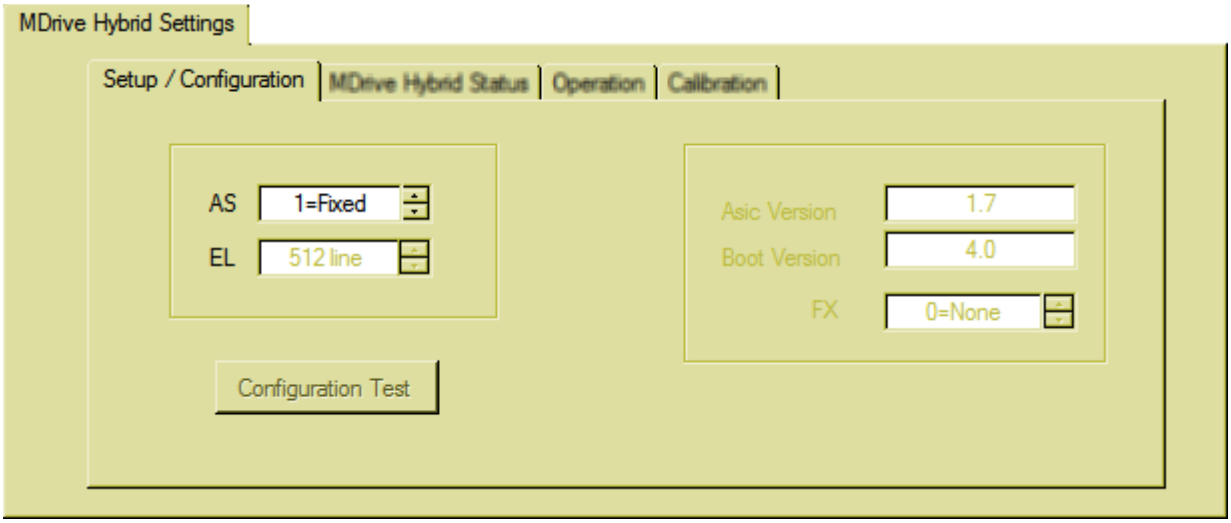

Figure 5.16: HMT setup and configuration (ASO)

Name	ASCII	Description / Value	Range	Default
Hybrid mode	AS	Hybrid mode defines the enable/disable state of the HMT and the current mode.	0 ... 2	2

Value	Meaning
0	HMT disabled, anti-stall and encoder functions unavailable
1	HMT enabled, current control at fixed run (RC) and hold (HC) current settings as set on Motion Settings Tab.
2	HMT enabled, current control varies as needed to perform move

MDrive Hybrid Status

Read-only tab displays the status of the HMT block. Active conditions will display as checked, and as a BCD integer in the text field on the upper right.

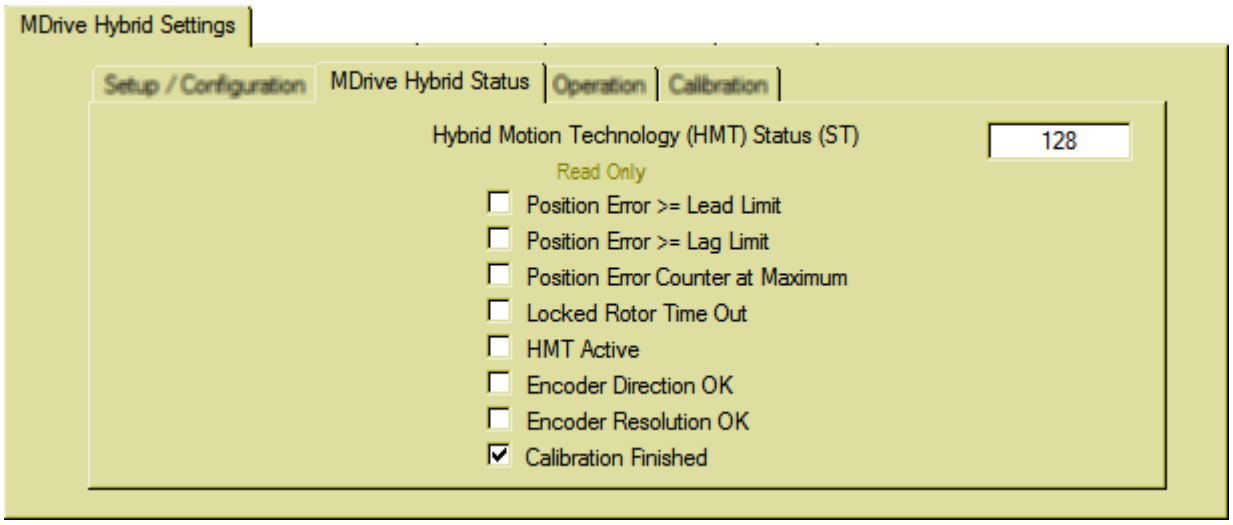

Figure 5.17: MDrive Hybrid Status tab (ASO)

Operation

Parameters on this sub-tab define the operational characteristics of the HMT block of the device.

NOTE: If the Hybrid mode is disabled (AS=0), these parameters will be settable, but will have no impact on the operation of the device UNTIL HMT is enabled (AS=1/AS=2).

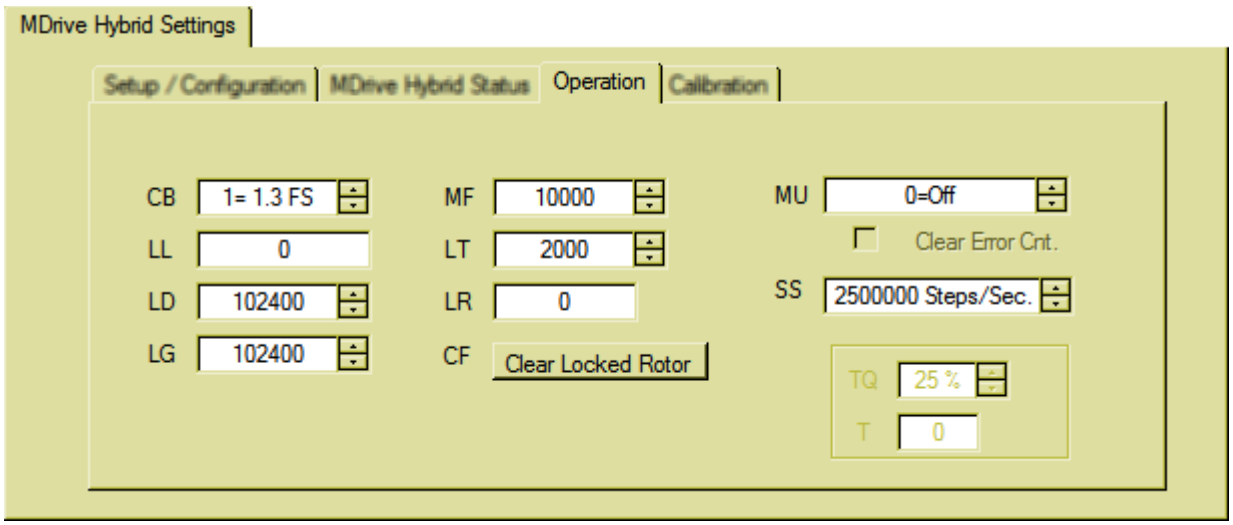

Figure 5.18: Operation tab (ASO)

<table>
<tr><th>Name</th><th>ASCII</th><th>Description / Value</th><th>Range</th><th>Default</th></tr>
<tr><td>Control bounds</td><td>CB</td><td>Control bounds defines the limits in which HMT will maintain the rotor-stator relationship in full motor steps to eliminate a stall.
<table><tr><th>Value</th><th colspan="2">Meaning</th></tr><tr><td>0</td><td colspan="2">1.1 — highest torque</td></tr><tr><td>1</td><td>1.3 — high torque, medium speed</td><td rowspan="2">Best overall performance</td></tr><tr><td>2</td><td>1.5 — high speed, medium torque</td></tr><tr><td>3</td><td colspan="2">1.7 — highest speed</td></tr></table></td><td>0 ... 3</td><td>1</td></tr>
<tr><td>Lead/lag counter</td><td>LL</td><td>Read-only field displays the position lead/lag step count. To clear, select a value for MU, check “Clear Error Cnt.” Click set, then click Recall. The count will be zero. Calibrating will also reset the count.</td><td></td><td></td></tr>
<tr><td>Lead limit</td><td>LD</td><td>Sets the position lead limit in counts at which position a locked rotor condition will assert.</td><td>0 ... 2147483647</td><td>102400</td></tr>
<tr><td>Lag limit</td><td>LG</td><td>Sets the position lag limit in counts at which position a locked rotor condition will assert.</td><td>0 ... 2147483647</td><td>102400</td></tr>
<tr><td>Position make up Speed</td><td>MF</td><td>Make up frequency sets the velocity during position make up when make up mode MU=1.</td><td>306 ... 5000000</td><td>10000</td></tr>
<tr><td>Locked rotor Timeout</td><td>LT</td><td>Locked rotor time-out in milliseconds. This is the time from the locked rotor flag activates to the disabling of the output bridge.</td><td>2 ... 65535</td><td>2000</td></tr>
<tr><td>Locked rotor</td><td>LR</td><td>Read-only field indicating the free/locked state of the rotor.
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Rotor is not locked</td></tr><tr><td>1</td><td>Rotor is locked</td></tr></table></td><td></td><td></td></tr>
<tr><td>Clear locked rotor</td><td>CF</td><td>Clicking this button will clear the locked rotor error (LR).</td><td></td><td></td></tr>
<tr><td>Make-up mode</td><td>MU</td><td>Make up selection for position make up.
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Position make-up disabled</td></tr><tr><td>1</td><td>Use make-up speed (MF) as make-up speed</td></tr><tr><td>2</td><td>Use system speed (SS) as make-up speed</td></tr></table></td><td>0 ... 2</td><td>0</td></tr>
<tr><td></td><td></td><td>Clear error count. If checked, LL count will be cleared on an MU change and set.
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>Unchecked</td><td>Do not clear lead/lag counter (LL)</td></tr><tr><td>Checked</td><td>Clear lead/lag counter (LL)</td></tr></table></td><td>0/1</td><td>0</td></tr>
<tr><td>System speed</td><td>SS</td><td>System speed Sets maximum response frequency for fixed or variable current modes. To switch the units to step width time in nSec, double click inside the field.</td><td>0 ... 5000000</td><td>2500000</td></tr>
</table>

Calibration

Calibration is the process where the HMT aligns the rotor and the stator. This occurs automatically on power-up, and can be initiated manually provided the motor is not in motion.

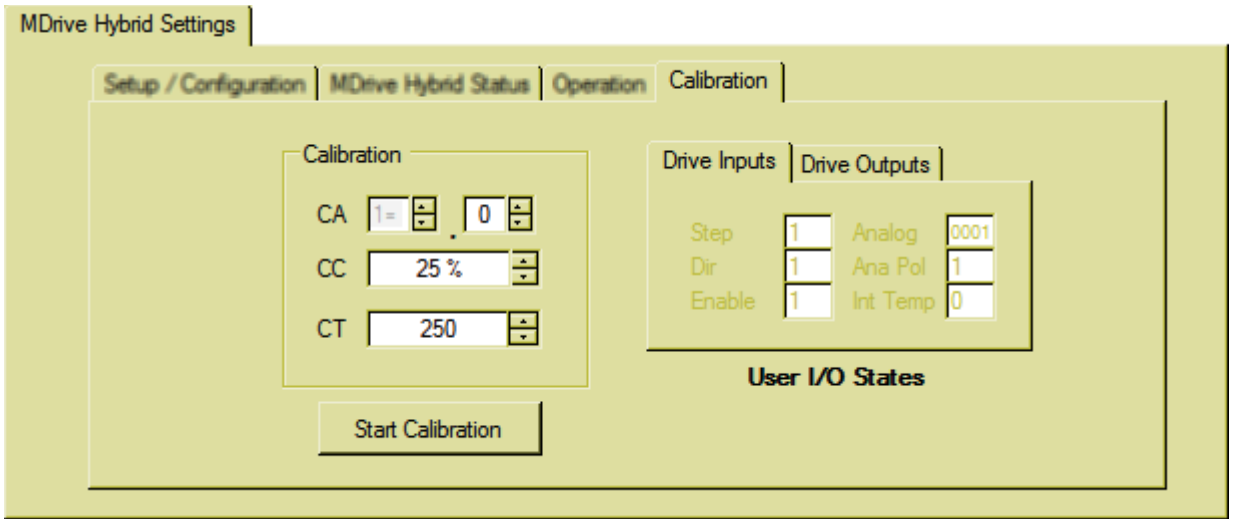

Figure 5.19: Calibration tab (ASO)

Name	ASCII	Description / Value	Range	Default
Calibration mode	CA	Calibration mode. **Value** / **Meaning** 0 — Hard stop tolerant (HST) is the only calibration mode. In HST. the motor shaft will mof 6 full steps CW, then 3 fullsteps CCW before settling into alignment. During this period the motr shaft MUST be free to move in order to complete the alignment proces. If the shaft is unable to move an error 89 (calibration fault) is generated. If shaft loading is in place, the torque compensation parameter may be used to align the rotor and stator with shaft loading in place.	0	0
		Torque compensation on/off **Value** / **Meaning** 0 — Off 1 — On	0/1	0
Calibration current	CC	Calibration current sets the motor current for calibration in percent.	0 ... 100	25
Calibration time	CT	Calibration time sets the timing for timed calibration in milliseconds.	2-65535	250
Start calibration	—	Clicking this button will initiate the calibration sequence. The motor cannot be in motion or an error 87 will occur.		

5.5.2 Analog Settings tab - speed control mode

The Analog settings tab deifines the input mode and parameter settings of the analog input. In speed control mode, the signal on the analog input controls the motor speed between 0 and VM.

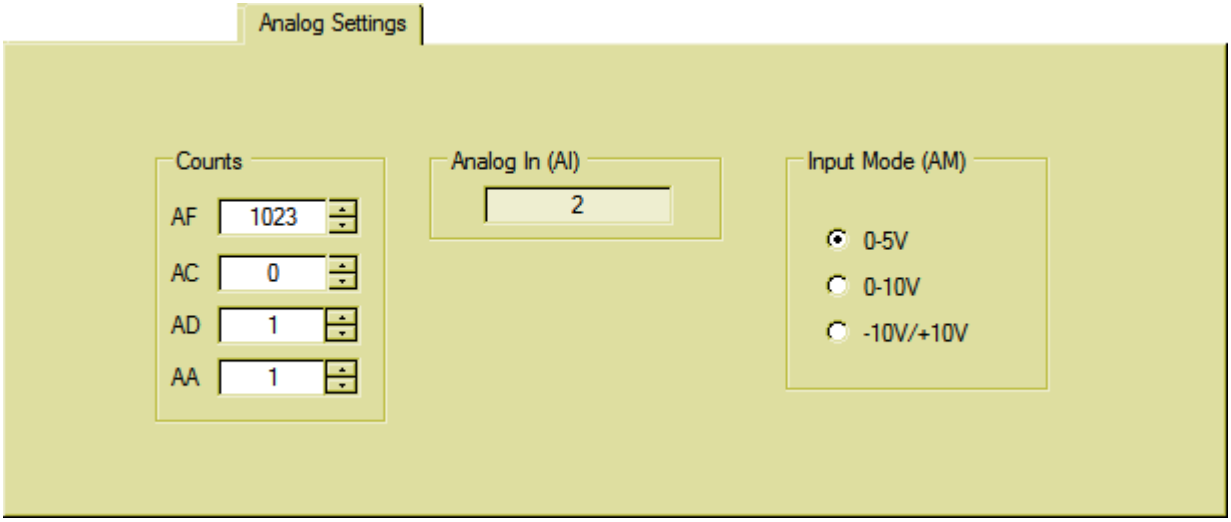

Figure 5.20: Analog settings tab (ASO)

Name	ASCII	Description / Value	Range	Default
Analog full scale	AF	Sets the full scale range of the analog input. By default it is at the maximum allowed range. The max voltage of the selected input mode will = 100% of the preset torque.	0 ... 1023	1023
Analog center	AC	Sets the center point of the analog full scale for directional control using the analog input.	0 ... 1023	0
Analog deadband	AD	Sets the ± deadband for the analog center (AC).	0 ... 255	1
Analog average	AA	Input filtering for the analog input.	1 ... 1000	1
Analog mode	AM	Sets the analog input to respond to:	0 ... 2	0

Value	Meaning
0	0 to 5 V
1	0 to 10 V
2	0 to 20 mA

5.5.3 IO Settings tab - speed control mode

The IO Settings defines the functional parameters of the step, direction and enable inputs and the attention output.

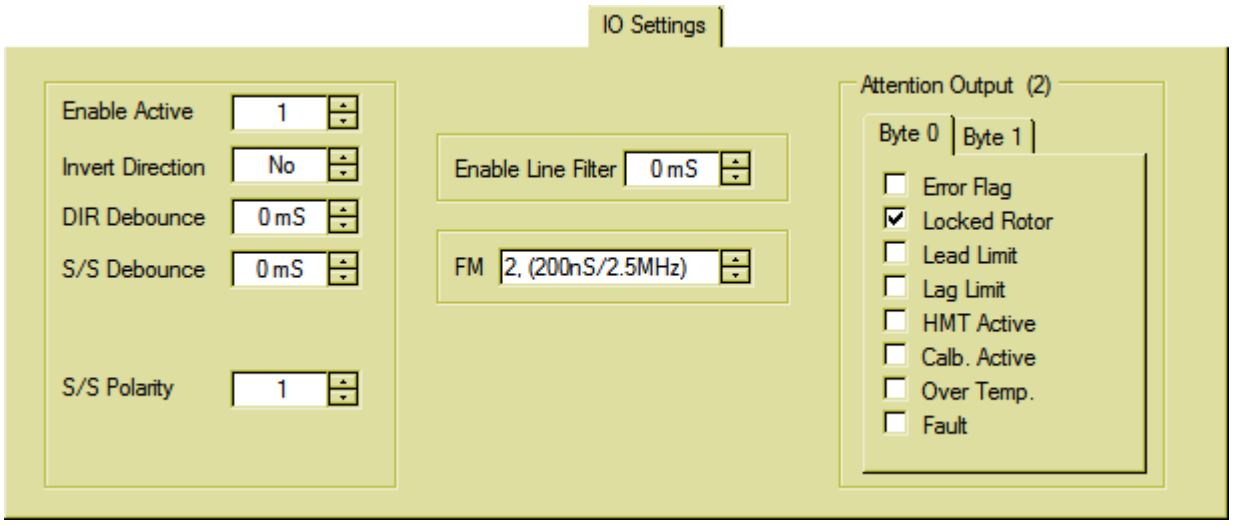

Figure 5.20: IO Settings tab (ASO)

Name	ASCII	Description / Value	Range	Default
Enable active	EA	Sets the active logic state of the enable input. **Value** / **Meaning** 0 – Input is active when logic LOW 1 – Input is active when logic HIGH	0/1	0
Invert direction	—	Allows the user to invert the direction input **Value** / **Meaning** 0 – Do not invert direction 1 – Invert direction	0/1	0
Direction filter	—	Filter direction input in milliseconds **Value** / **Meaning** 0 – No filtering of input 1 - 255 – Input filter time in milliseconds	0 ... 255	0
Stop/start filter	—	Filter stop/start input in milliseconds **Value** / **Meaning** 0 – No filtering of input 1 - 255 – Input filter time in milliseconds	0 ... 255	0
Stop/Start polarity	—	Allows the user to invert the stop/start input **Value** / **Meaning** 0 – Input is active when logic LOW 1 – Input is active when logic HIGH	0/1	01

<table>
<tr><th>Name</th><th>ASCII</th><th>Description / Value</th><th>Range</th><th>Default</th></tr>
<tr><td>Enable input filter</td><td>FE</td><td>Filter enable input in milliseconds
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>No filtering of input</td></tr><tr><td>1 - 255</td><td>Input filter time in milliseconds</td></tr></table></td><td>0 ... 255</td><td>0</td></tr>
<tr><td>Filter motion</td><td>FM</td><td>Sets the filtering for the velocity generator.
<table><tr><th>Value</th><th>Meaning</th><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>50 ns/10 MHz</td><td>5</td><td>900 ns/555 kHz</td></tr><tr><td>1</td><td>150 ns/3.3 MHz</td><td>6</td><td>1.7 µs/294 kHz</td></tr><tr><td>2</td><td>200 ns/2.5 MHz</td><td>7</td><td>3.3 µs/151 kHz</td></tr><tr><td>3</td><td>300 ns/1.67 MHz</td><td>8</td><td>6.5 µs/76.9 kHz</td></tr><tr><td>4</td><td>500 ns/1.0 MHz</td><td>9</td><td>12.9 µs/37.8 kHz</td></tr></table></td><td>—</td><td>2</td></tr>
<tr><td>Attention output</td><td>AO</td><td>Configures the attention output to activate on desired condition
<table><tr><th>Value</th><th>Meaning</th><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Software error</td><td>128</td><td>Reserved</td></tr><tr><td>2</td><td>Locked rotor</td><td>256</td><td>At zero crossing</td></tr><tr><td>4</td><td>Lead limit reached</td><td>512</td><td>Hold current active</td></tr><tr><td>8</td><td>Lag limit reached</td><td>1024</td><td>Make-up active</td></tr><tr><td>16</td><td>HMT active</td><td>2048</td><td>Calibration fault</td></tr><tr><td>32</td><td>Calibration active</td><td>4096</td><td>Drive enable false</td></tr><tr><td>64</td><td>Over-temperature</td><td></td><td></td></tr></table></td><td>0 ... 8191</td><td>0</td></tr>
</table>

5.5.4 Motion Settings tab - speed control mode

Motion subtab The Motion Settings tab facilitates the current settings and microstep resolution, as well as a software override for the drive enable line.

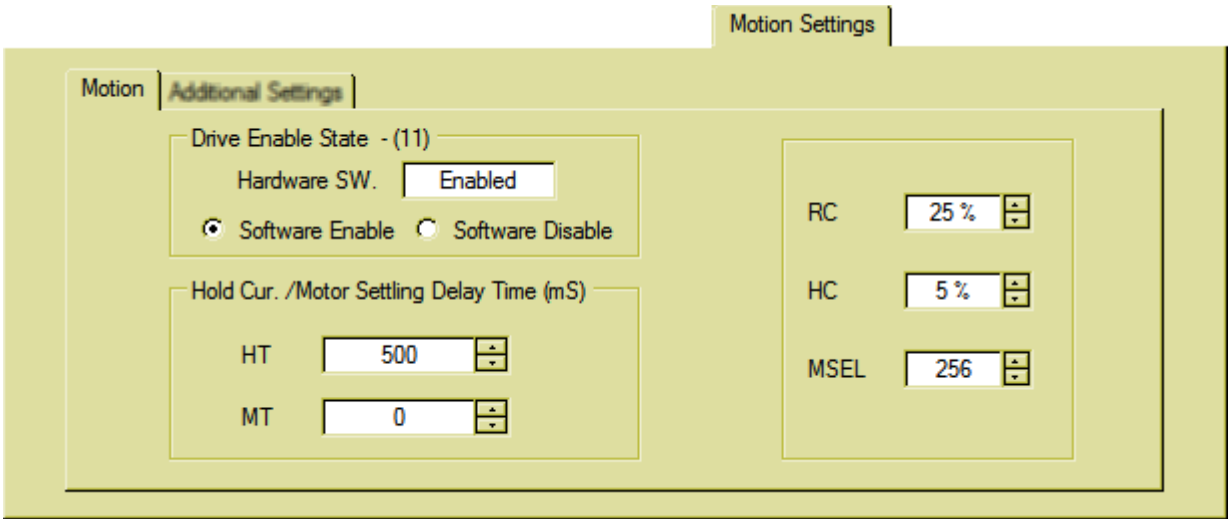

Figure 5.22: Motion Settings tab (ASO)

Name	ASCII	Description / Value	Range	Default
Hold current delay time	HT	Represents the time delay in milliseconds between the last motion input and the shift to the commanded holding current.	0 ... 65000	500
Motor settling delay time	HT	Represents the time delay in milliseconds the shaft is allowed to settlebefore shifting to hold current.	0 ... 65000	500
Hardware Switch	—	Read-only field displayes the state of the enable input	—	Enabled
Enable override	—	Allows the enable input to be overridden in software	—	Enabled
Hold current	HC	Motor holding (reduction) current in percent.	0 ... 100	5
Run current	RC	Motor running current in percent.	1 ... 100	25
Step resolution	MS	Sets the microstep resolution in microsteps/fullstep.	See table below	256

Binary

microsteps/step	steps/revolution
1	200
2	400
4	800
8	1600
16	3200
32	6400
64	12800
128	25600
256	52100
Additional resolution settings	
180	36000 (0.01°/µstep)
108	21600 (1 arc-min/µstep)
127	25400 (0.001 mm/µstep)

Decimal

microsteps/step	steps/revolution
5	1000
10	2000
25	5000
50	10000
100	20000
125	25000
200	40000
250	50000

Additional settings subtab

The Additional settings subtab defines the acceleration and deceleration characteristics of the device for speed and velocity control modes.

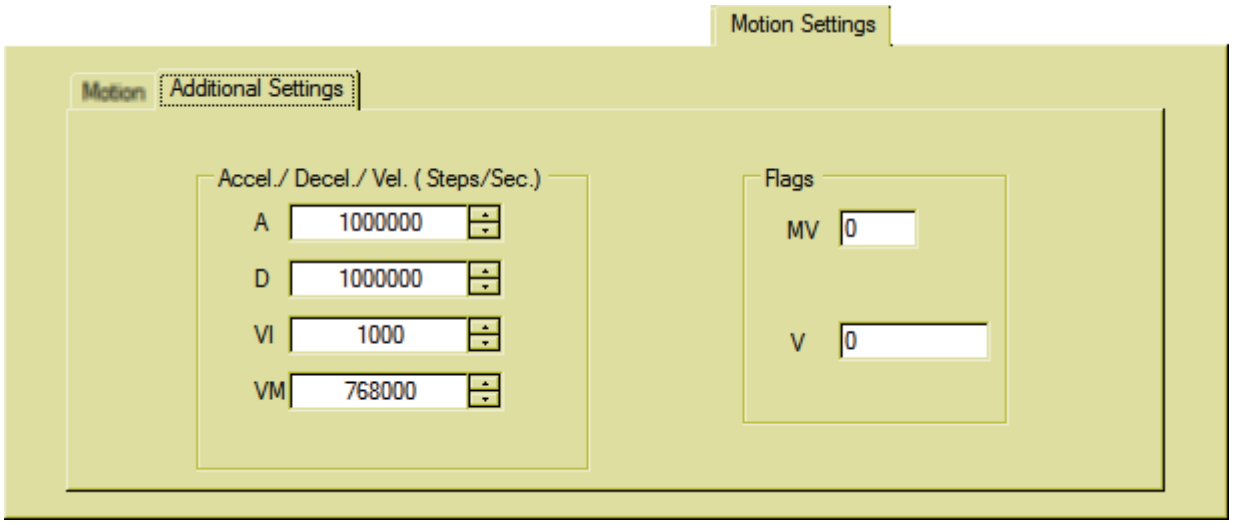

Figure 5.23: Additional settings tab (ASO)

Name	ASCII	Description / Value	Range	Default
Acceleration	A	Motor acceleration in steps/second^2.	1000000000	1000000
Deceleration	D	Motor deceleration in steps/second^2.	1000000000	1000000
Initial velocity	VI	Start velocity of the motor. Motor will accelerate from VI to VM based on the voltage measured on the analog input.	1 ... 5000000	1000
Maximum velocity	VM	Maximum velocity the motor will attain at the maximum voltage measured at the analog input.	1 ... 5000000	768000
Moving	MV	Read-only status flag indicates whether or not the axis is in motion.		
Current Velocity	V	Read-only register displays the current velocity of the axis.		

Value	Meaning
0	Motor is not moving
1	Motor shaft is in motion

5.6 Velocity mode (ASV)

5.5.1 MDrive Hybrid Settings tab - velocity mode

The MDrive Hybrid Settings tab and subtabs contain the parameters to setup and monitor the status of the Hybrid Motion Technology block of the device.

Setup / Configuration

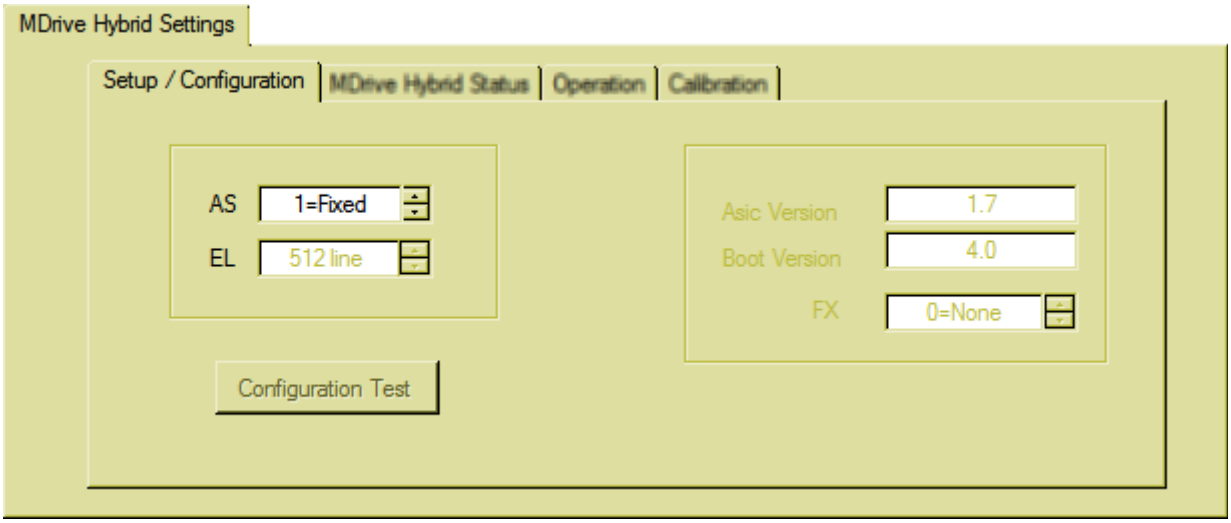

Figure 5.24: HMT setup and configuration (ASV)

Name	ASCII	Description / Value	Range	Default
Hybrid mode	AS	Hybrid mode defines the enable/disable state of the HMT and the current mode.	0 ... 2	2

Value	Meaning
0	HMT disabled, anti-stall and encoder functions unavailable
1	HMT enabled, current control at fixed run (RC) and hold (HC) current settings as set on Motion Settings Tab.
2	HMT enabled, current control varies as needed to perform move

MDrive Hybrid Status

Read-only tab displays the status of the HMT block. Active conditions will display as checked, and as a BCD integer in the text field on the upper right.

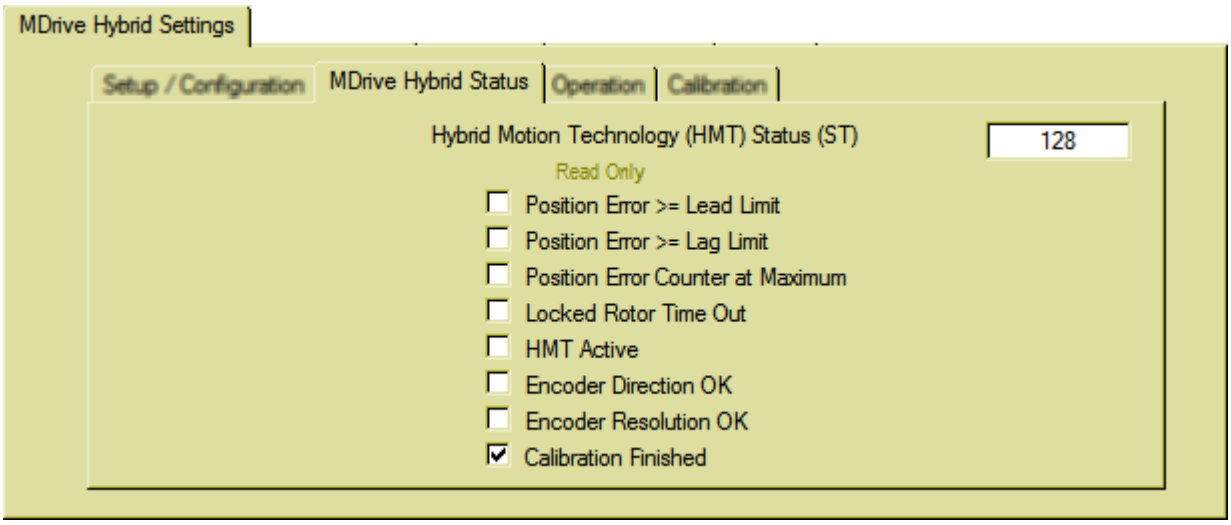

Figure 5.25: MDrive Hybrid Status tab (ASV)

Operation

Parameters on this sub-tab define the operational characteristics of the HMT block of the device.

NOTE: If the Hybrid mode is disabled (AS=0), these parameters will be settable, but will have no impact on the operation of the device UNTIL HMT is enabled (AS=1/AS=2).

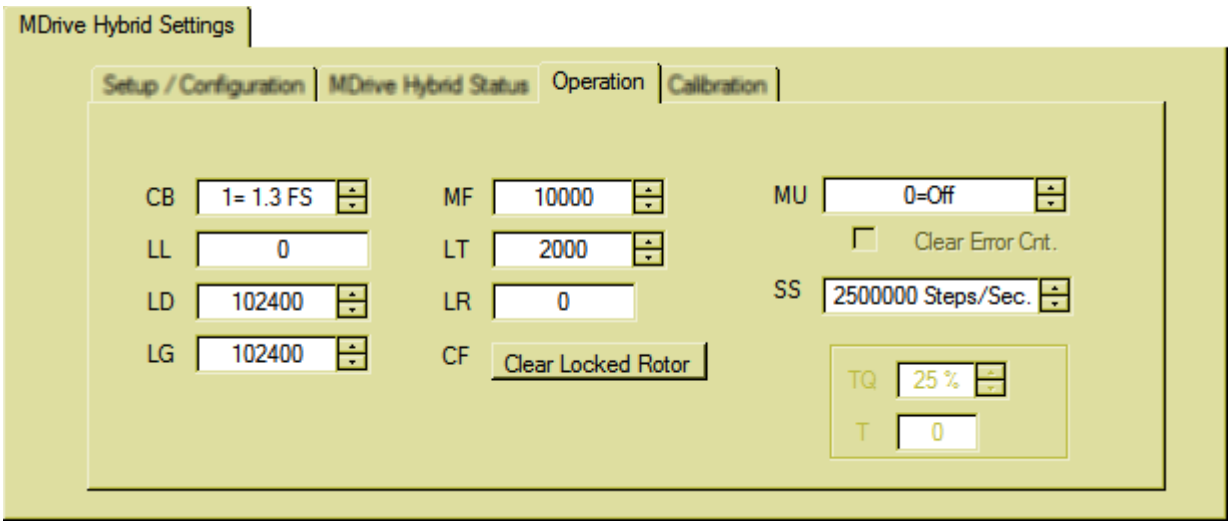

Figure 5.26: Operation tab (ASV)

<table>
<tr><th>Name</th><th>ASCII</th><th>Description / Value</th><th>Range</th><th>Default</th></tr>
<tr><td>Control bounds</td><td>CB</td><td>Control bounds defines the limits in which HMT will maintain the rotor-stator relationship in full motor steps to eliminate a stall.
<table><tr><th>Value</th><th colspan="2">Meaning</th></tr><tr><td>0</td><td colspan="2">1.1 — highest torque</td></tr><tr><td>1</td><td>1.3 — high torque, medium speed</td><td rowspan="2">Best overall performance</td></tr><tr><td>2</td><td>1.5 — high speed, medium torque</td></tr><tr><td>3</td><td colspan="2">1.7 — highest speed</td></tr></table></td><td>0 ... 3</td><td>1</td></tr>
<tr><td>Lead/lag counter</td><td>LL</td><td>Read-only field displays the position lead/lag step count. To clear, select a value for MU, check “Clear Error Cnt.” Click set, then click Recall. The count will be zero. Calibrating will also reset the count.</td><td></td><td></td></tr>
<tr><td>Lead limit</td><td>LD</td><td>Sets the position lead limit in counts at which position a locked rotor condition will assert.</td><td>0 ... 2147483647</td><td>102400</td></tr>
<tr><td>Lag limit</td><td>LG</td><td>Sets the position lag limit in counts at which position a locked rotor condition will assert.</td><td>0 ... 2147483647</td><td>102400</td></tr>
<tr><td>Position make up Speed</td><td>MF</td><td>Make up frequency sets the velocity during position make up when make up mode MU=1.</td><td>306 ... 5000000</td><td>10000</td></tr>
<tr><td>Locked rotor Timeout</td><td>LT</td><td>Locked rotor time-out in milliseconds. This is the time from the locked rotor flag activates to the disabling of the output bridge.</td><td>2 ... 65535</td><td>2000</td></tr>
<tr><td>Locked rotor</td><td>LR</td><td>Read-only field indicating the free/locked state of the rotor.
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Rotor is not locked</td></tr><tr><td>1</td><td>Rotor is locked</td></tr></table></td><td></td><td></td></tr>
<tr><td>Clear locked rotor</td><td>CF</td><td>Clicking this button will clear the locked rotor error (LR).</td><td></td><td></td></tr>
<tr><td>Make-up mode</td><td>MU</td><td>Make up selection for position make up.
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Position make-up disabled</td></tr><tr><td>1</td><td>Use make-up speed (MF) as make-up speed</td></tr><tr><td>2</td><td>Use system speed (SS) as make-up speed</td></tr></table></td><td>0 ... 2</td><td>0</td></tr>
<tr><td></td><td></td><td>Clear error count. If checked, LL count will be cleared on an MU change and set.
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>Unchecked</td><td>Do not clear lead/lag counter (LL)</td></tr><tr><td>Checked</td><td>Clear lead/lag counter (LL)</td></tr></table></td><td>0/1</td><td>0</td></tr>
<tr><td>System speed</td><td>SS</td><td>System speed Sets maximum response frequency for fixed or variable current modes. To switch the units to step width time in nSec, double click inside the field.</td><td>0 ... 5000000</td><td>2500000</td></tr>
</table>

Calibration

Calibration is the process where the HMT aligns the rotor and the stator. This occurs automatically on power-up, and can be initiated manually provided the motor is not in motion.

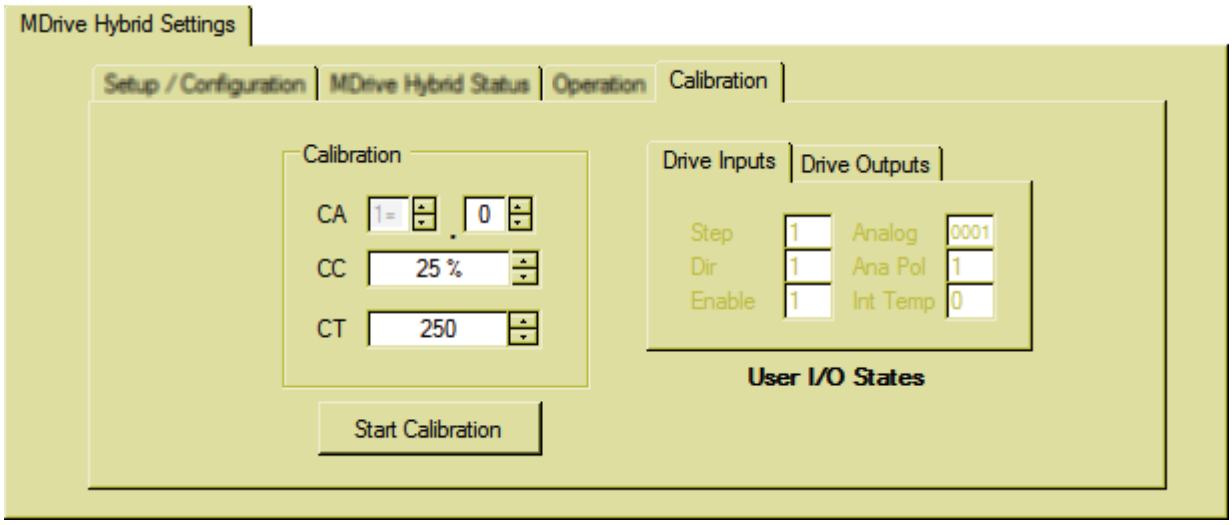

Figure 5.26: Calibration tab (ASV)

Name	ASCII	Description / Value	Range	Default
Calibration mode	CA	Calibration mode. 0: Hard stop tolerant (HST) is the only calibration mode. In HST. the motor shaft will mof 6 full steps CW, then 3 fullsteps CCW before settling into alignment. During this period the motr shaft MUST be free to move in order to complete the alignment proces. If the shaft is unable to move an error 89 (calibration fault) is generated. If shaft loading is in place, the torque compensation parameter may be used to align the rotor and stator with shaft loading in place.	0	0
		Torque compensation on/off 0: Off 1: On	0/1	0
Calibration current	CC	Calibration current sets the motor current for calibration in percent.	0 ... 100	25
Calibration time	CT	Calibration time sets the timing for timed calibration in milliseconds.	2-65535	250
Start calibration	—	Clicking this button will initiate the calibration sequence. The motor cannot be in motion or an error 87 will occur.		

5.6.2 IO Settings tab - Velocity mode

The IO Settings defines the functional parameters of the step, direction and enable inputs and the attention output.

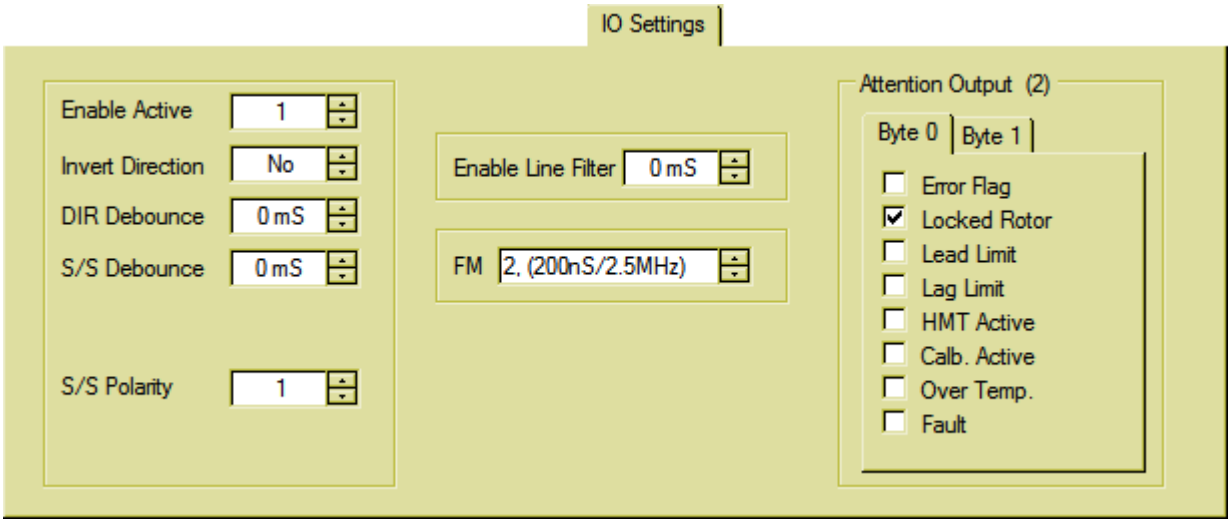

Figure 5.27: IO Settings tab (ASV)

Name	ASCII	Description / Value	Range	Default
Enable active	EA	Sets the active logic state of the enable input. **Value** / **Meaning** 0 – Input is active when logic LOW 1 – Input is active when logic HIGH	0/1	0
Invert direction	—	Allows the user to invert the direction input **Value** / **Meaning** 0 – Do not invert direction 1 – Invert direction	0/1	0
Direction filter	—	Filter direction input in milliseconds **Value** / **Meaning** 0 – No filtering of input 1 - 255 – Input filter time in milliseconds	0 ... 255	0
Stop/start filter	—	Filter stop/start input in milliseconds **Value** / **Meaning** 0 – No filtering of input 1 - 255 – Input filter time in milliseconds	0 ... 255	0
Stop/Start polarity	—	Allows the user to invert the stop/start input **Value** / **Meaning** 0 – Input is active when logic LOW 1 – Input is active when logic HIGH	0/1	01

<table>
<tr><th>Name</th><th>ASCII</th><th>Description / Value</th><th>Range</th><th>Default</th></tr>
<tr><td>Enable input filter</td><td>FE</td><td>Filter enable input in milliseconds
<table><tr><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>No filtering of input</td></tr><tr><td>1 - 255</td><td>Input filter time in milliseconds</td></tr></table></td><td>0 ... 255</td><td>0</td></tr>
<tr><td>Filter motion</td><td>FM</td><td>Sets the filtering for the velocity generator.
<table><tr><th>Value</th><th>Meaning</th><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>50 ns/10 MHz</td><td>5</td><td>900 ns/555 kHz</td></tr><tr><td>1</td><td>150 ns/3.3 MHz</td><td>6</td><td>1.7 µs/294 kHz</td></tr><tr><td>2</td><td>200 ns/2.5 MHz</td><td>7</td><td>3.3 µs/151 kHz</td></tr><tr><td>3</td><td>300 ns/1.67 MHz</td><td>8</td><td>6.5 µs/76.9 kHz</td></tr><tr><td>4</td><td>500 ns/1.0 MHz</td><td>9</td><td>12.9 µs/37.8 kHz</td></tr></table></td><td>—</td><td>2</td></tr>
<tr><td>Attention output</td><td>AO</td><td>Configures the attention output to activate on desired condition
<table><tr><th>Value</th><th>Meaning</th><th>Value</th><th>Meaning</th></tr><tr><td>0</td><td>Software error</td><td>128</td><td>Reserved</td></tr><tr><td>2</td><td>Locked rotor</td><td>256</td><td>At zero crossing</td></tr><tr><td>4</td><td>Lead limit reached</td><td>512</td><td>Hold current active</td></tr><tr><td>8</td><td>Lag limit reached</td><td>1024</td><td>Make-up active</td></tr><tr><td>16</td><td>HMT active</td><td>2048</td><td>Calibration fault</td></tr><tr><td>32</td><td>Calibration active</td><td>4096</td><td>Drive enable false</td></tr><tr><td>64</td><td>Over-temperature</td><td></td><td></td></tr></table></td><td>0 ... 8191</td><td>0</td></tr>
</table>

5.6.3 Motion Settings tab - Velocity mode

Motion subtab

The Motion Settings tab facilitates the current settings and microstep resolution, as well as a software override for the drive enable line.

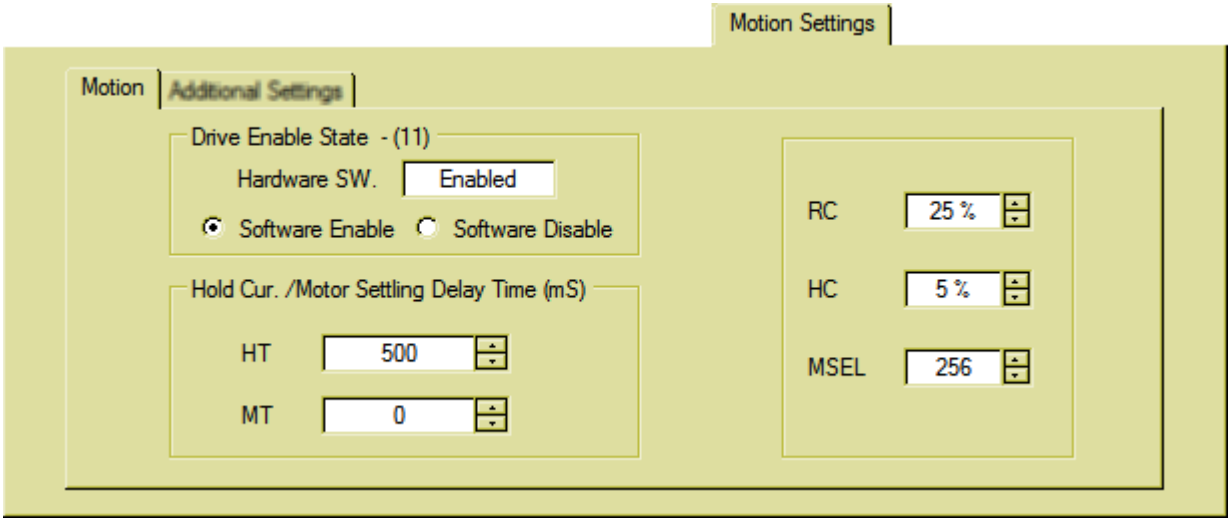

Figure 5.28: Motion Settings tab (ASV)

Name	ASCII	Description / Value	Range	Default
Hold current delay time	HT	Represents the time delay in milliseconds between the last motion input and the shift to the commanded holding current.	0 ... 65000	500
Motor settling delay time	HT	Represents the time delay in milliseconds the shaft is allowed to settlebefore shifting to hold current.	0 ... 65000	500
Hardware Switch	—	Read-only field displayes the state of the enable input	—	Enabled
Enable override	—	Allows the enable input to be overridden in software	—	Enabled
Hold current	HC	Motor holding (reduction) current in percent.	0 ... 100	5
Run current	RC	Motor running current in percent.	1 ... 100	25
Step resolution	MS	Sets the microstep resolution in microsteps/fullstep.	See table below	256

Binary

microsteps/step	steps/revolution
1	200
2	400
4	800
8	1600
16	3200
32	6400
64	12800
128	25600
256	52100
Additional resolution settings	
180	36000 (0.01°/µstep)
108	21600 (1 arc-min/µstep)
127	25400 (0.001 mm/µstep)

Decimal

microsteps/step	steps/revolution
5	1000
10	2000
25	5000
50	10000
100	20000
125	25000
200	40000
250	50000

Additional settings subtab

The Additional settings subtab defines the acceleration and deceleration characteristics of the device for speed and velocity control modes.

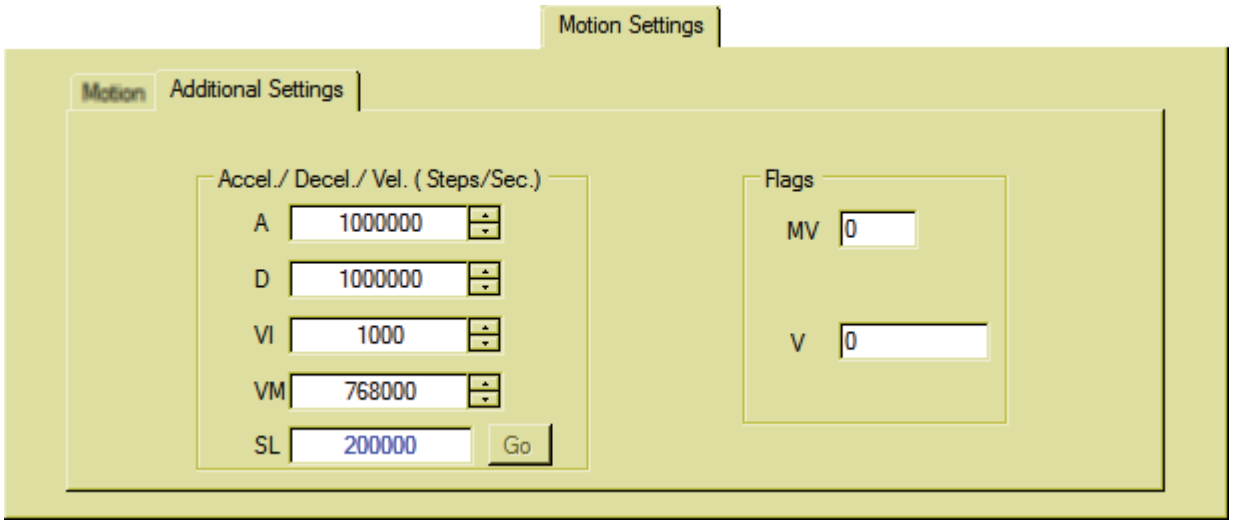

Figure 5.29: Additional settings tab (ASV)

Name	ASCII	Description / Value	Range	Default
Acceleration	A	Motor acceleration in steps/second^2.	1000000000	1000000
Deceleration	D	Motor deceleration in steps/second^2.	1000000000	1000000
Initial velocity	VI	Start velocity of the motor. Motor will accelerate from VI to VM based on the voltage measured on the analog input.	1 ... 5000000	1000
Maximum velocity	VM	Maximum velocity the motor will attain at the maximum voltage measured at the analog input.	1 ... 5000000	768000
Slew	SL	Command to slew at constant velocity. Slew rate may be changed on the fly. SL=0 will decelerate to stop.		
Moving	MV	Read-only status flag indicates whether or not the axis is in motion. **Value** / **Meaning** 0 / Motor is not moving 1 / Motor shaft is in motion		
Velocity changing	VC	Read-only status flag indicates wether or not the axis is accelerating or decelerating. **Value** / **Meaning** 0 / Velocity is not changing 1 / Velocity is changing		
Current Velocity	V	Read-only register displays the current velocity of the axis.		

Procedure: slewing the motor in ASV mode

The following example will illustrate slewing the motor in Velocity mode. Required connections are:

- RS422/485
- Supply voltage VDC

▶ Apply power to the device.
▶ Open the Hybrid Configurator Utility, initiate a communication connection.
▶ Load the “ASV - Velocity Control” application.
▶ Browse to the IO Settings tab.
▶ Set “S/S Polarity” to 0.
▶ Browse to the “Motion Settings ⇨ Additional Settings” tab.
▶ Enter a value, eg 300000, into the SL field.
▶ Click the “Go” button.
▶ Click the “Recall” button to view the flag states and velocity.
▶ Enter 0 into the SL field.
◁ The axis will decelerate to a stop.

5.7 Error codes

	0	no error
IO 1 - 19		
DATA 20 - 39		
	20	Tried to SET Unknown Variable/Flag
	21	Tried to SET to an incorrect value
	22	VI set greater than or equal to VM
	23	VM set less than or equal to VI
	24	Illegal Data Entered.
	25	Variable of Flag is Read Only
	35	Trying to Print Illegal variable or flag
	37	Command, Variable or Flag Not Available in Drive
	38	Missing parameter separator
FLASH 40 - 59		
	40	FLASH Check Sum Fault
	41	Boot Data Blank
COMM 60 - 69		
	60	Tried to Enter Unknown Command
	61	Trying to set illegal baud rate
SYSTEM 70 - 79		
	70	Internal Temperature Warning
	71	Internal OVER TEMP Fault, Disabling Drive
	72	Tried to SAVE while Moving
	73	Drive Over Current
MOTION 80 - 99		
	80	Stall Detected
	81	Locked Rotor
	82	Config Test Done - Encoder Res Mismatch
	83	Config Test Done - Encoder Dir Wrong
	84	Config Test Done - Encoder Res + Dir Wrong
	85	Config NOT Done - Drive not enabled
	86	SLEW not allowed when calibration is in progress
	87	Calibration not allowed while in motion
	88	Motion stopped by stop/start switch
	89	Calibration Fault

6 Glossary

6

6.1 Units and conversion tables

The value in the specified unit (left column) is calculated for the desired unit (top row) with the formula (in the field).

Example: conversion of 5 meters [m] to yards [yd]
5 m / 0.9144 = 5.468 yd

6.1.1 Length

	in	ft	yd	m	cm	mm
in	—	/ 12	/ 36	* 0.0254	* 2.54	* 25.4
ft	* 12	—	/ 3	* 0.30479	* 30.479	* 304.79
yd	* 36	* 3	—	* 0.9144	* 91.44	* 914.4
m	/ 0.0254	/ 0.30479	/ 0.9144	—	* 100	* 1000
cm	/ 2.54	/ 30.479	/ 91.44	/ 100	—	* 10
mm	/ 25.4	/ 304.79	/ 914.4	/ 1000	/ 10	—

6.1.2 Mass

	lb	oz	slug	kg	g
lb	—	* 16	* 0.03108095	* 0.4535924	* 453.5924
oz	/ 16	—	* $1.942559*10^{-3}$	* 0.02834952	* 28.34952
slug	/ 0.03108095	* $1.942559*10^{-3}$	—	* 14.5939	* 14593.9
kg	/ 0.453592370	/ 0.02834952	/ 14.5939	—	* 1000
g	/ 453.592370	/ 28.34952	/ 14593.9	/ 1000	—

6.1.3 Force

	lb	oz	p	dyne	N
lb	—	* 16	* 453.55358	* 444822.2	* 4.448222
oz	/ 16	—	* 28.349524	* 27801	* 0.27801
p	/ 453.55358	/ 28.349524	—	* 980.7	* $9.807*10^{-3}$
dyne	/ 444822.2	/ 27801	/ 980.7	—	/ $100*10^{3}$
N	/ 4.448222	/ 0.27801	/ $9.807*10^{-3}$	* $100*10^{3}$	—

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6.1.4 Power

	HP	W
HP	—	* 745.72218
W	/ 745.72218	—

6.1.5 Rotation

	min^{-1} (RPM)	rad/s	deg./s
min^{-1} (RPM)	—	* π / 30	* 6
rad/s	* 30 / π	—	* 57.295
deg./s	/ 6	/ 57.295	—

6.1.6 Torque

	lb·in	lb·ft	oz·in	Nm	kp·m	kp·cm	dyne·cm
lb·in	—	/ 12	* 16	* 0.112985	* 0.011521	* 1.1521	* $1.129*10^6$
lb·ft	* 12	—	* 192	* 1.355822	* 0.138255	* 13.8255	* $13.558*10^6$
oz·in	/ 16	/ 192	—	* $7.0616*10^{-3}$	* $720.07*10^{-6}$	* $72.007*10^{-3}$	* 70615.5
Nm	/ 0.112985	/ 1.355822	/ $7.0616*10^{-3}$	—	* 0.101972	* 10.1972	* $10*10^6$
kp·m	/ 0.011521	/ 0.138255	/ $720.07*10^{-6}$	/ 0.101972	—	* 100	* $98.066*10^6$
kp·cm	/ 1.1521	/ 13.8255	/ $72.007*10^{-3}$	/ 10.1972	/ 100	—	* $0.9806*10^6$
dyne·cm	/ $1.129*10^6$	/ $13.558*10^6$	/ 70615.5	/ $10*10^6$	/ $98.066*10^6$	/ $0.9806*10^6$	—

6.1.7 Moment of inertia

	$lb·in^2$	$lb·ft^2$	$kg·m^2$	$kg·cm^2$	$kp·cm·s^2$	$oz·in^2$
$lb·in^2$	—	/ 144	/ 3417.16	/ 0.341716	/ 335.109	* 16
$lb·ft^2$	* 144	—	* 0.04214	* 421.4	* 0.429711	* 2304
$kg·m^2$	* 3417.16	/ 0.04214	—	* $10*10^3$	* 10.1972	* 54674
$kg·cm^2$	* 0.341716	/ 421.4	/ $10*10^3$	—	/ 980.665	* 5.46
$kp·cm·s^2$	* 335.109	/ 0.429711	/ 10.1972	* 980.665	—	* 5361.74
$oz·in^2$	/ 16	/ 2304	/ 54674	/ 5.46	/ 5361.74	—

6.1.8 Temperature

	°F	°C	K
°F	—	(°F - 32) * 5/9	(°F - 32) * 5/9 + 273.15
°C	°C * 9/5 + 32	—	°C + 273,15
K	(K - 273.15) * 9/5 + 32	K - 273.15	—

6.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm^2	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm^2	2.1	1.7	1.3	1.0	0.82	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.13

6.2 Terms and Abbreviations

AC Alternating current

Acceleration The time rate of change of velocity with respect to a fixed reference frame. The commanded step rate is started at a base velocity and accelerated at a slew velocity at a defined and controlled rate or rate of changes.

ASCII American Standard Code for Information Interchange. Standard for coding of characters.

Back Electro-Motive Force (Back EMF) Also known as regeneration current, the reversed bias generated by rotation of the magnetic field across a stator's windings. Sometimes referred to as counter EMF.

CAN (Controller Area Network), standardized open fieldbus as per ISO 11898, allows drives and other devices from different manufacturers to communicate.

CANopen CANopen is a CAN-based higher layer protocol. It was developed as a standardized embedded network with highly flexible configuration capabilities. CANopen was designed motion oriented machine control networks, such as handling systems. It is used in many various fields, such as medical equipment, off-road vehicles, maritime electronics, public transportation, building automation, etc

Closed Loop System In motion control, this term describes a system wherein a velocity or position (or both) sensor is used to generate signals for comparison to desired parameters. For cases where loads are not predictable, the closed loop feedback from an external encoder to the controller may be used for stall detection, position maintenance or position verification.

Daisy Chain This term is used to describe the linking of several devices in sequence, such that a single signal stream flows through one device and on to another

DC	Direct current
Deadband	A range of input signals for which there is no system response.
Default value	Factory setting.
Detent Torque	The periodic torque ripple resulting from the tendency of the magnetic rotor and stator poles to align themselves to positions of minimal reluctance. The measurement is taken with all phases de-energized.
Direction of rotation	Rotation of the motor shaft in a clockwise or counterclockwise direction of rotation. Clockwise rotation is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.
DOM	The Date of manufacturing on the nameplate of the device is shown in the format DD.MM.YY, e.g. 31.12.06 (December 31, 2006).
Duty Cycle	For a repetitive cycle, the ratio of on time to total cycle time.
EMC	Electromagnetic compatibility
Encoder	Sensor for detection of the angular position of a rotating component. The motor encoder shows the angular position of the rotor.
Error class	Classification of errors into groups. The different error classes allow for specific responses to faults, e.g. by severity.
Fatal error	In the case of fatal error, the drive is not longer able to control the motor, so that an immediate switch-off of the drive is necessary.
Fault	Operating state of the drive caused as a result of a discrepancy between a detected (computed, measured or signaled) value or condition and the specified or theoretically correct value or condition.
Fault reset	A function used to restore the drive to an operational state after a detected fault is cleared by removing the cause of the fault so that the fault is no longer active (transition from state “Fault” to state “Operation Enable”).
Forcing	Forcing switching states of inputs/outputs. Forcing switching states of inputs/outputs.
Full Duplex	The transmission of data in two directions simultaneously. For example, a telephone is a full-duplex device because both parties can talk at the same time.

Ground Loop A ground loop is any part of the DC return path (ground) that has more than one possible path between any two points.

Half Duplex A ground loop is any part of the DC return path (ground) that has more than one possible path between any two points.

Half Step This term means that the motor shaft will move a distance of 0.9 degree (400 steps per shaft revolution) instead of moving 1.8 degree per digital pulse.

Hybrid Motion Technology™ (HMT) A motor control technology representing a new paradigm in brushless motor control. By bridging the gap between stepper and servo performance, HMT offers system integrators a third choice in motion system design.

Hybrid Motors Hybrid stepper motors feature the best characteristics of PM and VR motors. Hybrid steppers are best suited for industrial applications because of high static and run torque, a standard low step angle of 1.8°, and the ability to Microstep. Hybrid stepper motors offer the ability to precisely position a load without using a closed-loop feedback device such as an encoder.

Holding Torque The maximum torque or force that can be externally applied to a stopped, energized motor without causing the rotor to rotate continuously. This is also called “static torque”.

I/O Inputs/outputs

Inc Increments

Index pulse Signal of an encoder to reference the rotor position in the motor. The encoder returns one index pulse per revolution.

Inertia A measure of an object’s resistance to a change in velocity. The larger an object’s inertia, the greater the torque required to accelerate or decelerate it. Inertia is a function of an object’s mass and shape. For the most efficient operation, the system-coupling ratio should be selected so that the reflected inertia of the load is equal to or no greater than 10 times the rotor inertia of the stepper motor.

Inertia (Reflected) Inertia as seen by the stepper motor when driving through a speed change, reducer or gear train.

Lag The amount (in full motor steps) that the rotor lags the stator. Lag conditions are caused by loading on the motor shaft, as during transient loading or rapid acceleration.

Lead The amount (in full motor steps) that the rotor leads the stator. Lead conditions are caused by an overhauling load, as during periods of rapid deceleration.

Limit switch Switch that signals overtravel of the permissible range of travel.

Load Any external resistance (static or dynamic) to motion that is applied to the motor.

Locked rotor When the lag/lead limit is reached, a timer starts a countdown that is determined by the user. The locked rotor will assert itself by triggering a flag and, depending on the selected mode, by disabling the output bridge.

Loss of synchronization In traditional stepper systems, when the lead/lag relationship of the rotor and stator reaches two full motor steps, the alignment of the magnetic fields is broken and the motor will stall in a freewheeling state. Hybrid Motion Technology eliminates this.

Microstepping A control electronic technique that proportions the current in a stepper motor's windings to provide additional intermediate positions between poles. Produces smooth rotation over a wide range and high positional resolution. Typically, step resolutions range from 400 to 51,200 steps per shaft revolution.

Motor phase current The available torque of a stepper motor is determined by the motor phase current. The higher the motor phase current the higher the torque.

Multidrop A communications configuration in which several devices share the same transmission line, although generally only one may transmit at a time. This configuration usually uses some kind of polling mechanism to address each connected device with a unique address code.

NEMA The acronym for the National Electrical Manufacturer's Association, an organization that sets standards for motors and other industrial electrical equipment.

Node guarding Monitoring of the connection with the slave at an interface for cyclic data traffic.

Open Loop System An open loop motion control system is where no external sensors are used to provide position or velocity feedback signals, such as encoder feedback of position.

Opto-Isolated A method of sending a signal from one piece of equipment to another without the usual requirement of common ground potentials. The signal is transmitted optically with a light source (usually a Light Emitting Diode) and a light sensor (usually a photo-sensitive transistor). These optical components provide electrical isolation.

Parameter Device data and values that can be set by the user.

Persistent Indicates whether the value of the parameter remains in the memory after the device is switched off.

PLC Programmable logic controller

Position lead/lag The HMT circuitry continually tracks the position lead or lag error, and may use it to correct position.

Position make-up When active, the position make-up can correct for position errors occurring due to transient loads. The lost steps may be interleaved with incoming steps, or reinserted into the profile at the end of a move.

Power stage The power stage controls the motor. The power stage generates currents for controlling the motor on the basis of the positioning signals from the controller.

Pull-In Torque This is the maximum torque the stepper motor can develop when instantaneously started at that speed.

Pull-Out Torque This is the maximum torque that the stepper can develop once an acceleration profile has been used to “ramp” it to the target speed.

Quick Stop Function used to enable fast deceleration of the motor via a command or in the event of a malfunction.

Resolution The smallest positioning increment that can be achieved.

Resonance The frequency that a stepper motor system may begin to oscillate. Primary resonance frequency occurs at about one revolution per second. This oscillation will cause a loss of effective torque and may result in loss of synchronism. The designer should consider reducing or shifting the resonance frequency by utilizing half step or micro-step techniques or work outside the primary resonance frequency.

Rotor The moving part of the motor, consisting of the shaft and the magnets. These magnets are similar to the field winding of a brush type DC motor

. Rotor Inertia	The rotational inertia of the rotor and shaft.
RS485	Commissioning software as per EIA-485 which enables serial data transmission with multiple devices.
Sinking Current	Refers to the current flowing into the output of the chip. This means that a device connected between the positive supply and the chip output will be switched on when the output is low.
Slew	The position of a move profile where the motor is operating at a constant velocity
Sourcing Current	Refers to the current flowing out of the output of the chip. This means that a device connected between the chip output and the negative supply will be switched on when the output is high.
SSM	Shaft Snap Minimization, a calibration technique to reduce the “clunk” that is characteristic of step motors when powered.
Stall detection	Stall detection monitors whether the index pulse is always correctly triggered at the same angle position of the motor shaft.
Stator	The stationary part of the motor. Specifically, it is the iron core with the wire winding in it that is pressed into the shell of the frame. The winding pattern determines the voltage constant of the motor.
Torque ramp	Deceleration of the motor with the maximum possible deceleration, which is only limited by the maximum permissible current. The higher the permissible braking current, the stronger the deceleration. Because energy is recovered up depending on the coupled load, the voltage may increase to excessively high values. In this case the maximum permissible current must be reduced.
Variable current control	When active, variable current control will control the motor current as such to maintain the torque and speed on the load to what is required by the profile. This leads to reduced motor heating and greater system efficiency.
Warning	If not used within the context of safety instructions, a warning alerts to a potential problem detected by a monitoring function. A warning is not a fault and does not cause a transition of the operating state. Warnings belong to error class 0.
Watchdog	Unit that monitors cyclic basic functions in the product. Power stage and outputs are switched off in the event of faults.
Zero crossing	The point in a stepper motor where one phase is at 100% current and the other is at 0% current.

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TWENTY-FOUR (24) MONTH LIMITED WARRANTY

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NOTE: MDrive Motion Control electronics are not removable from the motor in the field. The entire unit must be returned to the factory for repair.

This Limited Warranty does not extend to any Product damaged by reason of alteration, accident, abuse, neglect or misuse or improper or inadequate handling; improper or inadequate wiring utilized or installed in connection with the Product; installation, operation or use of the Product not made in strict accordance with the specifications and written instructions provided by IMS; use of the Product for any purpose other than those for which it was designed; ordinary wear and tear; disasters or Acts of God; unauthorized attachments, alterations or modifications to the Product; the misuse or failure of any item or equipment connected to the Product not supplied by Schneider Electric Motion USA; improper maintenance or repair of the Product; or any other reason or event not caused by Schneider Electric Motion USA.

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