# ICP PANEL-TEC

# MICROBRIDGE INSTALLATION AND OPERATION GUIDE

# ETHERNET/IP TO SIEMENS G110/G120/MM440 APPLICATION

Revision History

| Revision | Date | Author | Comments |
|---|---|---|---|
| 000 | 02 June 2009 | David Walker | Initial release. |
| 001 | 26 October 2009 | Keira Majors | • Changed Modbus References |
| 002 | 2 November 2009 | David Walker | • Added Data Type to Drive Data Reference table<br>• Updated Configuration Screenshot |
| 003 | 3 December 2009 | David Walker | • Corrected Data Reference Numbers in Data Reference table |
| 004 | 21 December 2009 | David Walker | • Added drawing of unit and dimensions to Hardware section |
| 005 | 18 February 2010 | David Walker | • Added support for Command Block |
| 006 | 4 March 2010 | David Walker | • Corrected configuration cable<br>• Changed configuration port from 'Local' to 'Network' |

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# INTRODUCTION

The Ethernet/IP to G110/G120/MM440 version of the MicroBridge connects one G110, G120, or MM440 drive to an Ethernet/IP Network via Ethernet. The actual I/O data to exchange through Ethernet/IP is selected from a pre-defined set of the most common drive parameters, monitor values, setpoint values, and control points for the drive. A data reference number is assigned to each value in the pre-defined set. The data to exchange is mapped using these drive data reference numbers.

The MicroBridge device is a light-weight DIN Rail Mountable unit with 2 serial ports, an Ethernet port, and 6 LED indicators. It is powered with a DC supply providing any voltage between 7 and 28 volts.

The MicroBridge has a built-in configuration utility. The configuration screens are accessed through any terminal communication program such as HyperTerminal.

## Serial Port Overview

The MicroBridge has two DB9 serial ports. Both ports can be used in either RS232 mode or 2-Wire RS485 mode. The RS485 signals are located on the same pins on both ports. They are placed on pins that are not generally used for RS232 communications so off-the-shelf RS232 cables can be used when operating in RS232 mode.

One DB9 port is a female port referred to as the Local port (LCL) and is used to connect the MicroBridge to the Siemens drive. A special cable is required to connect the Local port to an RS485 DB9 port on a Siemens drive. An LED indicator is used to reflect transmit/receive activity on this port.

The other DB9 port is a male port referred to as the Network port (NET) and is used to configure the MicroBridge using the built-in configuration utility. The RS232 signals on the Network port use a DTE configuration, requiring a null-modem cable to be used during configuration mode. An LED indicator is used to reflect transmit/receive activity on this port.

## Ethernet Port Overview

The MicroBridge has a single Ethernet port, implemented using an ©XPort module (information on the XPort can be found at www.gridconnect.com/gc-xport-eip.html). The Ethernet port supports both 10 and 100 Mbit/sec communications, and is used to connect the MicroBridge to an Ethernet/IP network.

## Ordering Information

The MicroBridge product is sold with several different software applications. To ensure that the correct version of the MicroBridge is procured, please include the correct part number when ordering. Part numbers for the MicroBridge, power supply and cables for the Ethernet/IP to G110/G120/MM440 application are as follows:

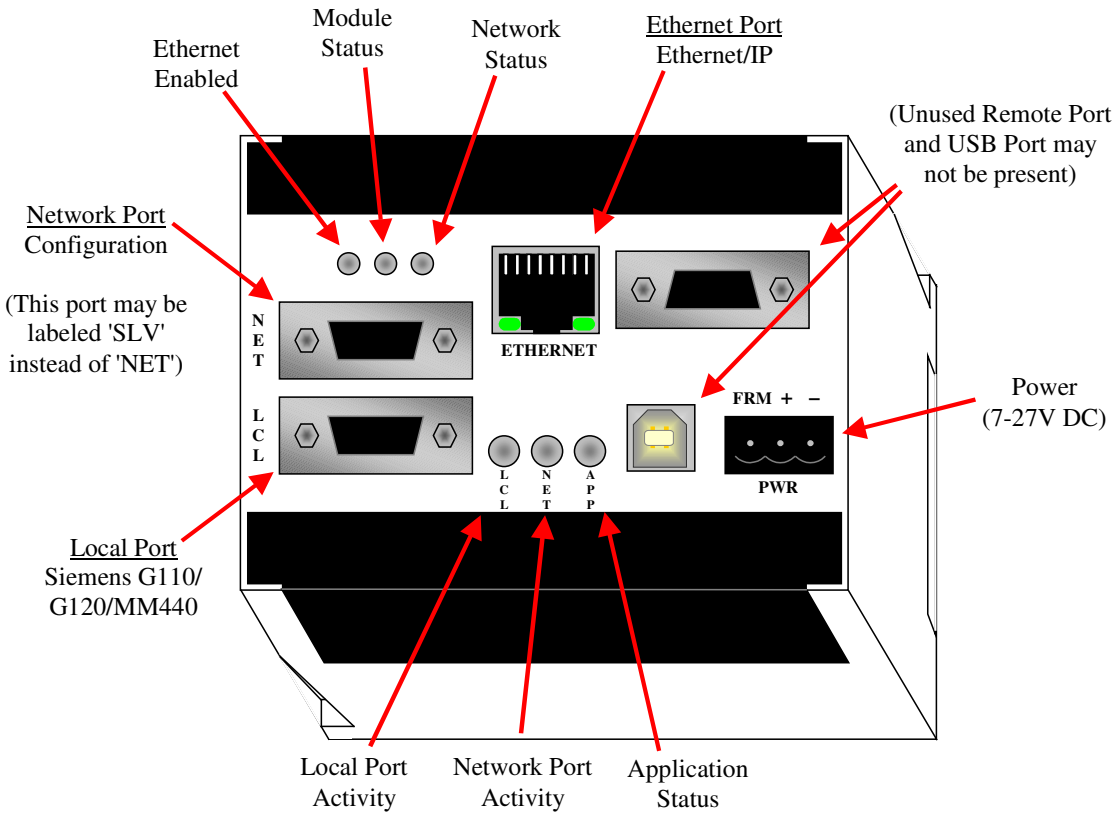
**Table 1 - Part Numbers**

| Part Number | Description |
|---|---|
| 5009-404-102 | MicroBridge with Ethernet/IP-G110/G120/MM440 Application |
| 4000-0205 | MicroBridge Power Supply |
| 6000-0003 | MicroBridge Local Port Drive Cable (RS485 cable with stripped wires for connection to terminal block) |
| 6000-0007 | MicroBridge Local Port G120 Drive Cable (RS485 cable for connection to DB9 on CU240S) |
| 6000-0010 | MicroBridge Configuration Cable (Null Modem) |

# HARDWARE

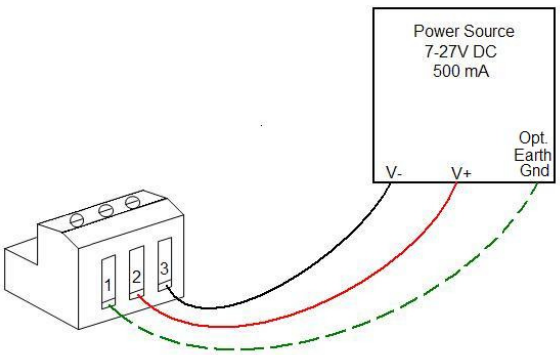
## Dimensions

The MicroBridge is packaged in a 10cm x 7.5cm x 11cm plastic box, with a din-rail mounting on the bottom. The serial and Ethernet ports, leds, and power connector are on the top of the unit.




## Power Supply

The MicroBridge requires a power supply of 7-27V DC at 500 mA. A 3-position pluggable terminal block is used to connect the power supply. The following diagram shows the wiring of the power supply.



## Serial Port Pinouts

The pin configuration for the two DB9 serial ports are shown in the table below.

**Table 2 - Serial Port Pinouts**

| Local: DB9-Female | | |
|---|---|---|
| **Pin** | **Label** | **Description** |
| 1 | 485+ | RS485 D+ |
| 2 | TXD | RS232 TxD |
| 3 | RXD | RS232 RxD |
| 4 | DTR | RS232 DTR |
| 5 | GND | Reference Ground |
| 6 | 485- | RS485 D- |
| 7 | RTS | RS232 RTS |
| 8 | CTS | RS232 CTS |
| 9 | VCC | +5VDC Input |

| Network: DB9-Male | | |
|---|---|---|
| **Pin** | **Label** | **Description** |
| 1 | 485+ | RS485 D+ |
| 2 | RXD | RS232 RxD |
| 3 | TXD | RS232 TxD |
| 4 | - | No Connect |
| 5 | GND | Reference Ground |
| 6 | 485- | RS485 D- |
| 7 | CTS | RS232 CTS |
| 8 | RTS | RS232 RTS |
| 9 | - | No Connect |

## Ethernet Port Pinout

The pin configuration of the Ethernet port is shown in the table below.

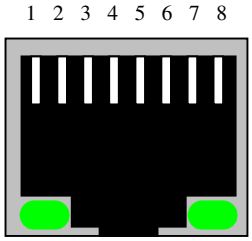



**Table 3 - Ethernet Port Pinout**

| Ethernet: RJ45 Socket | | |
|---|---|---|
| **Pin** | **Label** | **Description** |
| 1 | TD+ | Transmit Data+ |
| 2 | TD- | Transmit Data- |
| 3 | RD+ | Receive Data+ |
| 4 | - | no connection |
| 5 | - | no connection |
| 6 | RD- | Receive Data- |
| 7 | - | no connection |
| 8 | - | no connection |

## Siemens Drive Cable (G110 / G120 with CU240E / MM440)

One end of the RS485 Siemens Drive cable (Part # 6000-0003) connects to the DB9 Female Local port on the MicroBridge. The other end of the cable has stripped wires for connection to the corresponding terminals on the drive.

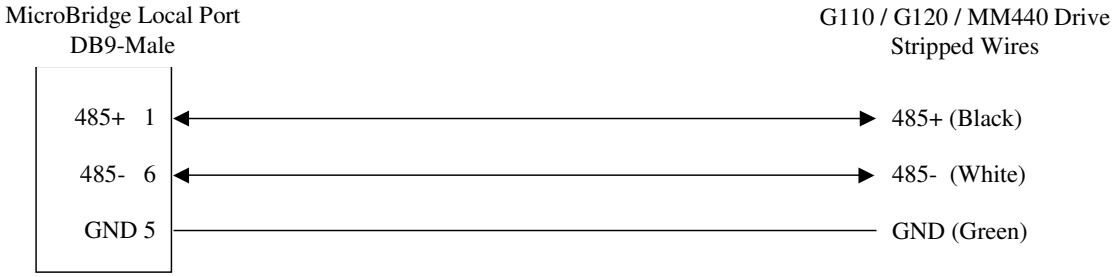



**Figure 1 - G110 / G120 / MM440 Drive Cable**

## Siemens Drive Cable (G120 with CU240S)

One end of the RS485 Siemens Drive cable (Part # 6000-0007) connects to the DB9 Female Local port on the MicroBridge. The other end of the cable connects to the DB9 Female connector on the CU240S module.

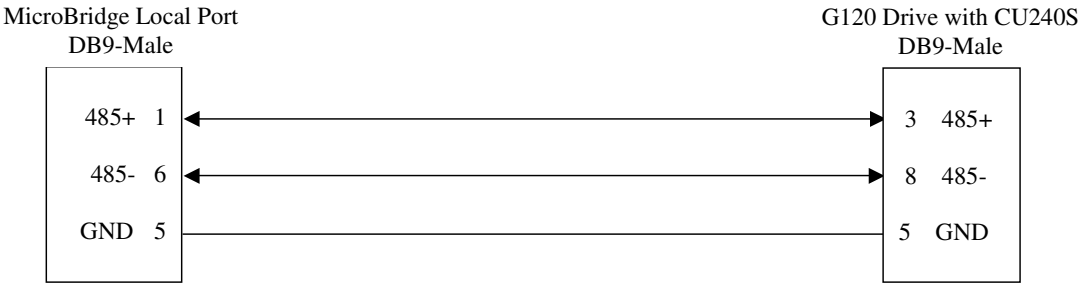



**Figure 3 - G120 with CU240S Cable**

## Configuration Cable

One end of the MicroBridge Configuration cable (Part # 6000-0010) connects to the DB9 Male Network port on the MicroBridge during configuration mode. The other end connects to a serial port on a PC. A standard off-the-shelf null-modem DB9-F to DB9-F cable (pins 2 and 3 crossed) can be used as well.

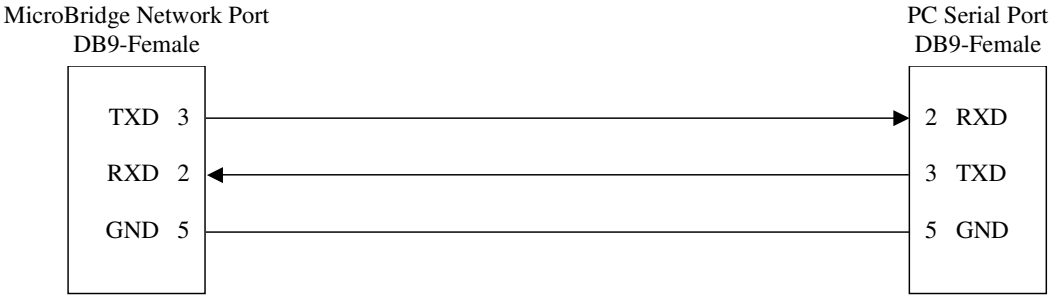



**Figure 4 - Configuration Cable (null-modem)**

## LED Indicators

There are a total of 6 Bi-color LED indicators on the MicroBridge. The LCL, NET, and APP LEDs are located next to the Local Port on the MicroBridge. The LCL LED displays communications activity on the Local (Siemens drive) port. The NET LED displays communications activity on the Network (Configuration) port during configuration mode, or between the MicroBridge and the XPort during run mode. The APP LED displays the overall status of the MicroBridge. During normal operations, the LCL and NET LEDs will quickly alternate red and green flashes, making them look almost amber. This is normal.

The other three LEDs are located next to the Ethernet port on the MicroBridge. The NS LED (closest to the Ethernet Port) displays the network status of the MicroBridge. The MS LED (the middle of the three) displays the module status of the MicroBridge. The ETH LED (farthest from the Ethernet port) indicates whether the Ethernet port is enabled on the MicroBridge.

**Table 3 – MicroBridge General Application LED (APP)**

| For this state: | LED is: | To indicate: |
|---|---|---|
| No Power | Off | There is no power applied to the device. |
| Run Mode | Flashing Green (250ms On, 250ms Off) | The MicroBridge is operating normally in RUN Mode. |
| Configuration Mode | Flashing Green (1.5 sec On, 1.5 sec Off) | The MicroBridge is in Configuration Mode. |
| Fatal Error | Flashing Yellow (250ms On, 250ms Off) | The MicroBridge has experienced a fatal error, and has halted communications. |

**Table 4 - Network Port Communications Activity LED (NET)**

| For this state: | LED is: | To indicate: |
|---|---|---|
| Receive Data | Red | The MicroBridge is receiving data from the XPort. |
| Transmit Data | Green | The MicroBridge is transmitting data to the XPort. |

**Table 5 - Local Port Communications Activity LED (LCL)**

| For this state: | LED is: | To indicate: |
|---|---|---|
| Receive Data | Red | The MicroBridge is receiving data from the Siemens Drive. |
| Transmit Data | Green | The MicroBridge is transmitting data to the Siemens Drive. |

**Table 4 - Network Status LED (NS)**

| For this state: | LED is: | To indicate: |
|---|---|---|
| No Power | Off | There is no power applied to the device, or the XPort is not active. |
| No connections | Flashing Green | The device has no established connections. |
| Connected | Steady Green | The device has at least one established connection. |
| Connection Timeout | Flashing Red | One or more connections to the device has timed out. |
| Duplicate IP | Steady Red | The device has detected that its IP address is already in use. |
| Self-test | Flashing Green/Red | The device is performing power-up testing. |

**Table 5 - Module Status LED (MS)**

| For this state: | LED is: | To indicate: |
|---|---|---|
| No Power | Off | There is no power applied to the device, or the XPort is not active. |
| Device Operational | Steady Green | The device is operating correctly. |
| Standby | Flashing Green | The device has not been configured, or is in standby mode. |
| Minor Fault | Flashing Red | The device has detected a recoverable minor fault. |
| Major Fault | Steady Red | The device has detected a non-recoverable major fault. |
| Self-test | Flashing Green/Red | The device is performing power-up testing. |

**Table 6 - Ethernet Enabled LED (ETH)**

| For this state: | LED is: | To indicate: |
|---|---|---|
| Disabled | Red | The Ethernet Port is not enabled on the MicroBridge. |
| Enabled | Green | The Ethernet Port is enabled on the MicroBridge. |

# MICROBRIDGE CONFIGURATION

## Default Configuration

The XPort module communicates with the MicroBridge via a fixed internal serial interface. If any of the settings required for this communications are changed via Ethernet/IP on the XPort module, the XPort may no longer communicate with the MicroBridge.

**Table 7 - G110/G120/MM440 Port Configuration Options**

| Parameter | Options | Default |
|---|---|---|
| Baud Rate | 2400 bps<br>4800 bps<br>9600 bps<br>19.2K bps<br>38.4K bps<br>57.6K bps<br>76.8K bps<br>93.75K bps<br>115.2K bps | 38.4K bps |
| Port Type | RS485<br>RS232 | RS485 |

**Siemens USS Baud Rate**

The baud rate used for communications between the MicroBridge and the Siemens Drive using the USS protocol must be set on the configuration screen.

**Ethernet IP Address and SubNet Mask**

The MicroBridge uses a fixed IP Address and SubNet Mask, which may be set on the configuration screen. Once these values are set and the configuration saved, the MicroBridge should be powered off then back on to ensure that the new IP Address is used by the XPort.

## Changing the Configuration

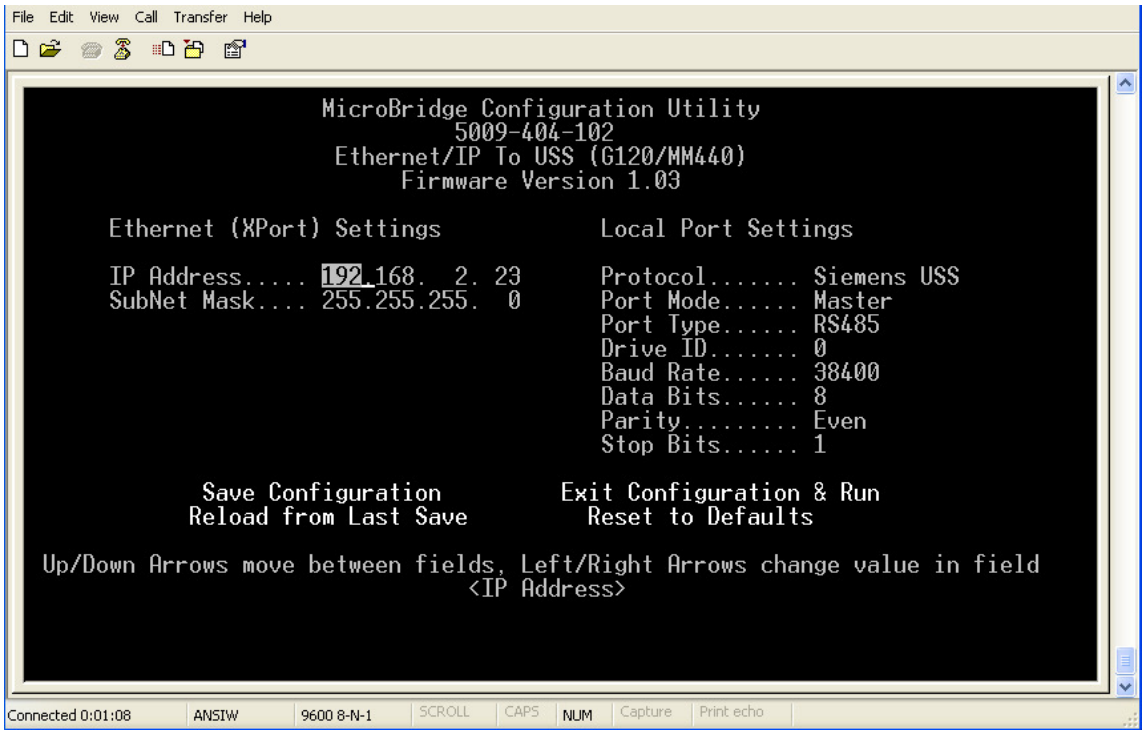
The configuration stored in the MicroBridge may be changed from the default configuration by entering Configuration Mode. The following steps are required to enter Configuration Mode.

1. Attach a configuration cable between the Network port on the MicroBridge and a serial port on a PC.
2. Start a terminal program, such as HyperTerminal, on the PC, and connect using the following settings:
   - Baud = 9600 bps
   - Data bits = 8
   - Parity = None
   - Stop Bits = 1
   - Flow Control = None
3. Apply power to the MicroBridge, and send a carriage return (press the **Enter** key) within 5 seconds of startup.

Once the MicroBridge is in Configuration Mode, it will send its current configuration information to the terminal program.

Use the **up** and **down** arrows on your keyboard to navigate to the field you want to change, then use the **left** and **right** arrows to change the value in that field. When you are finished, navigate to "Save Configuration" and press the **Enter** key to save the configuration information to the MicroBridge.

Once the configuration has been saved, remove power from the MicroBridge and remove the configuration cable.



# SIEMENS DRIVE SETUP

## Siemens Drive Parameter Configuration

The Siemens drive must be configured before the MicroBridge will communicate properly with the drive. The MicroBridge communicates with the drive through the USS interface. The baud-rate for the USS network is configurable but defaults to 38.4K baud.

To setup the drive for communications with a MicroBridge, the drive parameters in the following table must be configured with the values shown via the drive keypad or Starter software.

**Table 8 - Siemens Drive Parameter Configuration**

| G120 Parameter | Function | Set Value |
|---|---|---|
| P0003 | User Access Level | 3 (Expert Setting) |
| P0700[0] | Command Source | 5 if Starting/Stopping Drive from Ethernet/IP<br>Otherwise: **Do Not Change** |
| P1000[0] | Frequency Setpoint Source | 5 if Setting the Frequency from Ethernet/IP<br>Otherwise: **Do Not Change** |
| P2009[0] | USS Normalization | 0 (Disabled) **Only for MM440** |
| P2010[0] | USS Baud Rate | 8 (38.4K baud) |
| P2011[0] | USS Address | 0 |
| P2012[0] | USS PZD Length | 2 |
| P2013[0] | USS PKW Length | 127 (Variable) |
| P2014[0] | USS telegram off time | 0 to Disable the USS “watchdog” timer, or<br>> 0 to enable the USS “watchdog” timer<br>(NOTE: values less than 100ms are not recommended) |
| P2041[0] | Protocol Selection for RS485 port | 0 (USS Protocol) **Only for MM440** |

## USS Watchdog Timer Setup

The drive has a timeout function for the USS port, which is controlled by Parameter 2014, “USS telegram off time”. Once the MicroBridge has established communications with a drive with the watchdog function enabled, the watchdog timer is activated. If communications are subsequently lost for the specified length of time, the drive will automatically generate a F0072 fault. Setting Parameter 2014 in the drive to a value of 0 disables the watchdog timer function. Setting Parameter 2014 to a non-zero value enables the watchdog timer function with the specified time. Avoid setting this value too low, as that could result in false fault indications.

## Verifying the Installation

After all necessary connections have been made, power up the drive and the MicroBridge, and wait approximately 5 seconds. If the MicroBridge has been installed correctly, the STAT led will be flashing green, and the LCL led will be alternating so fast between red and green that it will appear to be glowing amber.

# ETHERNET/IP BASICS

Ethernet/IP is implemented on the MicroBridge using an XPort. The XPort on the MicroBridge comes preconfigured with the I/O data mapped to the Process Data (PZD) on the drive, and a command block allowing read/write of drive parameters. This configuration may only be changed while the XPort is unlocked, during which time I/O data is not exchanged. See "Ethernet/IP Advanced Configuration" for information on changing the XPort configuration.

## Basic Connection Information

The MicroBridge supports Class 1 and Class 3 connections. Class 3 connections are made using the TCP protocol, and are used for explicit requests. Class 1 connections transport implicit data using the UDP protocol.

Connections are opened in Ethernet/IP using the Unconnected Message Manager (UCMM). The MicroBridge supports two connection points, or Assembly Object Instances, for Class 1 connections. Output Data (T->O) is sent from the Ethernet/IP client to the MicroBridge using connection point 102. Input Data (O->T) is sent from the MicroBridge to the Ethernet/IP client using connection point 101. The MicroBridge also supports a dummy Configuration Assembly Object Instance (128), since some Ethernet/IP clients require one when setting up Class 1 connections, but no configuration data is transferred using this object.

When opening a Class 1 connection, the Input Data (O->T) should be set up as Point-to-Point, with a run/idle header. The Output Data (T->O) should be set up as Multicast, with no run/idle header. The data size for each will depend on the configuration of the XPort, but by default both the Input Data and Output Data are 12 bytes.

## Default Input Data (O->T) Format

By default, the MicroBridge comes preconfigured to support 12 bytes of Input Data, divided into 6 16-bit words. All 16-bit words are sent with the least signicant byte first (so byte 0 contains the least significant byte of word 0, byte 1 contains the most significant byte of word 0, etc.) The data is mapped as shown in the table below.

**Table 9 - Input Data Format**

| | bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| word | 0 | Comm Status | | | | | | | | | | | | | | | | Comm Status |
| | 1 | PZD Input Word 1 (Status Word 1/ZSW1) | | | | | | | | | | | | | | | | PZD Status |
| | 2 | PZD Input Word 2 (Actual Frequency/HIW) | | | | | | | | | | | | | | | | |
| | 3 | Read Status | | | | | | | | | | | | | | | | Command Block Input |
| | 4 | Read Value | | | | | | | | | | | | | | | | |
| | 5 | Write Status | | | | | | | | | | | | | | | | |

**Comm Status**

The Comm Status word reports the current status of internal communications between the XPort and the drive interface on the MicroBridge.

**Table 10 - Comm Status**

| Bit (0 = LSB) | Status Flag |
|---|---|
| 0 | The drive interface is responding with error codes (usually this means a drive parameter read/write failure). |
| 1 | Communications with the drive interface are timed-out (was previously established). |
| 2 | Communications with the drive interface cannot be established. |
| 3-7 | Reserved |
| 8 | XPort is currently active at factory defaults (this is not the same as the default configuration) |
| 9 | XPort has a new configuration that will take effect upon reset. |
| 10-15 | Reserved |

**PZD Input Word 1 (Status Word 1/ZSW1)**

PZD Input Word 1 reports the value of Status Word 1 (ZSW1) in the drive. Bits 0-16 of this word are mapped to data references 40-55 (see "Drive Data Reference Numbers"), respectively, such that bit 0 is mapped to data reference 40 (ZSW1:0), etc.

**PZD Input Word 2 (Actual Frequency/HIW)**

PZD Input Word 2 reports the value of the Actual Frequency (HIW) from the drive, converted to a percentage value. It is mapped to data reference 56 (see "Drive Data Reference Numbers").

**Read Status**

The Read Status is part of the Command Block. It is mapped to data reference 104 (see "Drive Data Reference Numbers"), and reports the current status of the Read Reference request. See "Command Block" for further details.

**Read Value**

The Read Value is part of the Command Block. It is mapped to data reference 105 (see "Drive Data Reference Numbers"), and reports the value of the parameter mapped to the Read Reference. See "Command Block" for further details.

**Write Status**

The Write Status is part of the Command Block. It is mapped to data reference 106 (see "Drive Data Reference Numbers"), and reports the current status of the Write Reference request. See "Command Block" for further details.

# Default Output Data (T->O) Format

By default, the MicroBridge comes preconfigured to support 12 bytes of Input Data, divided into 6 16-bit words. All 16-bit words are sent with the least signicant byte first (so byte 0 contains the least significant byte of word 0, byte 1 contains the most significant byte of word 0, etc.) The data is mapped as shown in the table below.

**Table 11 - Output Data Format**

| | bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| word | 0 | Run/Idle Header | | | | | | | | | | | | | | | | Run/Idle Header |
| | 1 | PZD Output Word 1 (Control Word 1/STW1) | | | | | | | | | | | | | | | | PZD Control |
| | 2 | PZD Output Word 2 (Main Setpoint/HSW) | | | | | | | | | | | | | | | | |
| | 3 | Read Reference | | | | | | | | | | | | | | | | Command Block Output |
| | 4 | Write Value | | | | | | | | | | | | | | | | |
| | 5 | Write Reference | | | | | | | | | | | | | | | | |

**Run/Idle Header**

Bit 0 of the Run/Idle Header controls whether the rest of the output data is acted upon. When bit 0 = 1 (Run), the output data is valid and will be processed. When bit 0 = 0 (Idle), the output data is not processed.

**PZD Output Word 1 (Control Word 1/STW1)**

PZD Output Word 1 set the value of Control Word 1 (STW1) in the drive. Bits 0-16 of this word are mapped to data references 3-18 (see "Drive Data Reference Numbers"), respectively, such that bit 0 is mapped to data reference 3 (STW1:0), etc.

**PZD Output Word 2 (Main Setpoint/HSW)**

PZD Output Word 2 sets the value of the Main Setpoint (HIW) in the drive, converted to a percentage value. It is mapped to data reference 19 (see "Drive Data Reference Numbers").

**Read Reference**

The Read Reference is part of the Command Block. It is mapped to data reference 101 (see "Drive Data Reference Numbers"), and is used to set the data reference number of a parameter to be read from the drive and reported in the Read Value in the Input Data. See "Command Block" for further details.

**Write Value**

The Write Value is part of the Command Block. It is mapped to data reference 102 (see "Drive Data Reference Numbers"), and is used to set the value of the parameter to be written to the drive. See "Command Block" for further details.

**Write Reference**

The Write Reference is part of the Command Block. It is mapped to data reference 103 (see "Drive Data Reference Numbers"), and is used to set the data reference number of the parameter to be written to the drive. See "Command Block" for further details.

# Command Block

The Command Block is a simple mechanism for reading and writing drive parameters without having to map them directly to the Input and Output Data (see "Ethernet/IP Advanced Configuration"). Simple procedures should be followed when using the Command Block to read or write parameters, in order to ensure data consistency.

Data References mapped to Output Parameters (20-32) may be read via the Read Reference, or written via the Write Reference.

Data References mapped to Input Parameters (57-92) may be read via the Read Reference, but may not be written via the Write Reference.

No other Data References are accessible via the Command Block.

**Setting a Null Reference**

Setting the Read Reference to zero (0) disables the Read command, and results in a Read Status of zero (0). Likewise, setting the Write Reference to zero (0) disables the Write command, and results in a Write Status of zero (0).

**Reading Parameters Using the Command Block**

To read the current value of a drive parameter mapped to a data reference, use the following procedure (steps 1 and 2 are optional):

1. Set the Read Reference in the Output Data to zero (0). This will clear out any old reference.
2. Wait for the Read Status in the Input Data to be zero (0).
3. Set the Read Reference in the Output Data to the data reference number of the parameter to be read from the drive.
4. Monitor the Read Status in the Input Data.
    a. If the Read Status matches the Read Reference, the Read Value in the Input Data contains the most recent value of the parameter read from the drive.
    b. If the Read Status is $FFFF_h$, the data reference contained in the Read Reference is not mapped to a valid drive parameter.
    c. If the Read Status is $FFFE_h$, the value of the parameter mapped to the Read Reference could not be read from the drive.
    d. If the Read Status is anything else, the Read Value has not yet been updated with the value of the parameter.

**Writing Parameters Using the Command Block**

To write a new value to a drive parameter mapped to and Output data reference, use the following procedure:

1. Set the Write Reference in the Output Data to 0 (this will prevent any inadvertant writes when the Write Value is changed).
2. Wait for the Write Status in the Input Data to be 0.
3. Set the Write Value in the Output Data to the value to be written to the drive parameter.
4. Set the Write Reference in the Output Data to the drive reference number of the drive parameter to be written.
5. Monitor the Write Status in the Input Data.
    a. If the Write Status matches the Write Reference, the Write Value has been successfully written to the drive.
    b. If the Write Status is $FFFF_h$, the data reference contained in the Write Reference is not mapped to a valid drive parameter.
    c. If the Write Status is $FFFE_h$, the data reference contained in the Write Reference is read only.
    d. If the Write Status is $FFFD_h$, the Write Value was not successfully written to the drive.
    e. If the Write Status is anything else, the Write Value has not yet been written to the drive.

Alternately, the Run/Idle bit in the Output Data may be used to prevent inadvertent writes. This method is safer if individual bits or bytes of the Write Value or Write Reference can be written independently instead of as a word. Use the following procedure to write parameters using this method:

1. Set the Run/Idle bit (bit 0) in the Output Data to 0 (this will disable processing of the Output Data).
2. Set the Write Value in the Output Data to the value to be written to the drive parameter.
3. Set the Write Reference in the Output Data to the drive reference number of the drive parameter to be written.
4. Set the Run/Idle bit (bit 0) in the Output Data to 1 (this will reenable processing of the Output Data).
5. Monitor the Write Status in the Input Data.
    a. If the Write Status matches the Write Reference, the Write Value has been successfully written to the drive.
    b. If the Write Status is $FFFF_h$, the data reference contained in the Write Reference is not mapped to a valid drive parameter.
    c. If the Write Status is $FFFE_h$, the data reference contained in the Write Reference is read only.
    d. If the Write Status is $FFFD_h$, the Write Value was not successfully written to the drive.
    e. If the Write Status is anything else, the Write Value has not yet been written to the drive.

# ETHERNET/IP ADVANCED CONFIGURATION

The XPort on the MicroBridge may be changed from its factory default configuration. However, as this may affect basic operation of the MicroBridge, caution should be used when making any changes.

Basic instructions for configuration of the XPort are given in the document "XPort_EIP-MB_v106.pdf", which is distributed by GridConnect. Pertinent sections of that document are reproduced in part within this application note. For full details on configuring the XPort, please refer to the GridConnect document.

## Locking & Unlocking the XPort

The XPort will come from the factory with the configuration locked. In order to make changes to its configuration, it must be unlocked.

Objects 0x64, 0x65, and 0x66 are read-only ("Set_Attribute_Single" service will fail) while the XPort is locked. In addition, Object 0x6E (the Identity Configuration object) is not visible while the XPort is locked.

To toggle the lock, the following Ethernet/IP explicit message must be sent to the XPort:

| Service Code | Class ID | Instance ID | Attribute ID | Data |
|---|---|---|---|---|
| 0x45 | 0x67 | 0x89 | 0xAB | 0xCD |

While the configuration is unlocked, the XPort will no longer exchange data with the Siemens drive.

## Bridge Configuration Object (Class 0x64)

Communications between the XPort and the MicroBridge are setup using this object. Modifications of attributes in this object may result in loss of internal communications between the XPort and the MicroBridge.

## Identity Configuration Object (Class 0x6E)

The Identity Configuration object in the XPort allows a user to customize the attributes in the Identity Object (Vendor ID, Product Name, etc.). These values are set by the factory, and should not be modified.

## Input (T->O) Assembly Object (Class 0x04, Instance 0x65)

The mappings defined by Vendor Specific Object Class 0x65 define the standard Ethernet/IP Assembly Object Instance 0x65.

## Output (O->T) Assembly Object (Class 0x04, Instance 0x66)

The mappings defined by Vendor Specific Object Class 0x66 define the standard Ethernet/IP Assembly Object Instance 0x66.

## Configuration Assembly Object (Class 0x04, Instance 0x80)

The Configuration Assembly Object is not implemented. However, some Ethernet/IP clients require one. If this is the case, use Instance ID 0x80 with a data length of 0.

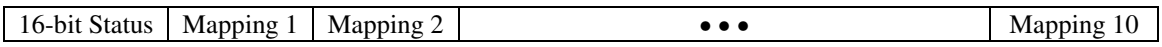
## Drive Data to Input (T->O) Ethernet/IP Mapping (Class 0x65)

The XPort maintains a table that contains the mapping of drive data to the Ethernet/IP Input (T->O) Assembly. This table is saved in non-volatile memory in the XPort. The drive data to map to this Assembly is configured through the Ethernet/IP via Get_Attribute_Single (0x0E) and Set_Attribute_Single(0x10) Services directed at Vendor Specific Object Class 101 (0x65), Instance 1.

| Attr ID (dec) | Access | Name | Data Type | Description |
|---|---|---|---|---|
| 100 | Get | Input Data Size | UINT | Current size of the Assembly data in 16-bit words. Whenever a Mapping is changed, this attribute will be immediately updated with the new size. |
| 101 | Get/Set | Mapping 1 | Struct of: | |
| | | | USINT | Data Type 0x01=Output bits packed into bytes/words (Usually Control Word)<br>0x02=Input bits packed into bytes/words (Usually Status Word)<br>0x03=16-bit values (Input or Output data words)<br>0x04=16-bit values (Input-Only data words) |
| | | | UINT | Starting Drive Data Reference Number (0x0001 - 0xFFFF) |
| | | | UINT | Quantity of bits (Data Types 0x01 or 0x02)<br>Quantity of words (Data Types 0x03 or 0x04) |
| 102 | Get/Set | Mapping 2 | Struct… | Same as Mapping 1 |
| 103 | Get/Set | Mapping 3 | Struct… | Same as Mapping 1 |
| 104 | Get/Set | Mapping 4 | Struct… | Same as Mapping 1 |
| 105 | Get/Set | Mapping 5 | Struct… | Same as Mapping 1 |
| 106 | Get/Set | Mapping 6 | Struct… | Same as Mapping 1 |
| 107 | Get/Set | Mapping 7 | Struct… | Same as Mapping 1 |
| 108 | Get/Set | Mapping 8 | Struct… | Same as Mapping 1 |
| 109 | Get/Set | Mapping 9 | Struct… | Same as Mapping 1 |
| 110 | Get/Set | Mapping 10 | Struct… | Same as Mapping 1 |
| 111 | | Reserved | | |

Once a Set_Attribute_Single message is received, the standard EtherNet/IP error checks will be performed. If all error checks pass, the values of the structure will be checked against the set of valid drive references. If this check passes, a USS telegram will be sent to the drive to test if the supplied data references are supported in the drive. If a success response is received from the drive, an EtherNet/IP success response is returned to indicate success. If an error response is received from the drive, an EtherNet/IP error code of 0x1F (Vendor Specific Error) response is sent with the data set to the exact error response received from the drive (1 byte error code + 1 byte exception code). If there is no response from the drive, the EtherNet/IP error code will be 0x02 (Resource Unavailable).

The mappings are used to construct the Input data message that will be sent from the XPort to the EtherNet/IP connection originator via an I/O message. The input data buffer is organized as follows:




The first two bytes provide the status of the device. This value is identical to Class 100, Instance 1, Attribute 100. It provides information about the status of the configuration, health of the device, and status of the link between the XPort and the MicroBridge..

Unused mappings will contain all zeros in the corresponding attribute structure and will not be included in the input data buffer. The input data buffer will be of dynamic total length up to 500 bytes (250 words) according to the combined length of all the mappings. If this length is exceeded, a CIP Error Response 0x1B (Routing Failure, Response Packet Too Large) will be generated for the Set_Attribute_Single message that caused the overflow and the target mapping will remain unchanged.

A mapping can be deleted by setting it to all zeroes.

The data length of the current configuration is in Attribute 100 of this class. The value in this attribute is automatically updated as mappings are changed. Note that the new configuration does not take effect until the power is cycled on the unit.

Therefore if the configuration is changed, Attribute 100 will contain the value of the *new* data size that will only take effect after a power cycle - not the size that is currently active.

By default, the MicroBridge comes from the factory with Mapping 1 mapped to Drive Data References 48-55 (PZD Status Word 1, ZSW1:0-15, using Data Type 2) , wth Mapping 2 mapped to Drive Data Reference 56, which maps to the PZD Actual Frequency (HIW), and with Mapping 3 mapped to Drive Data References 104-106. The total length of the default mapping is 6 16-bit words (or 12 bytes).

The default Input mappings are shown in the following table:

**Table 12 - Default Input Data Mapping**

| Attr ID | Name | Mapping (shown as an array of bytes, in hexidecimal format) |
|---|---|---|
| 101 ($65_h$) | Mapping 1 | 0F 03 00 10 00 |
| 102 ($66_h$) | Mapping 2 | 10 13 00 01 00 |
| 103 ($67_h$) | Mapping 3 | 10 65 00 03 00 |
| 104-110 | Mappings 4-10 | 00 00 00 00 00 |

## Output (O->T) Ethernet/IP to Drive Data Mapping (Class 0x66)

The XPort maintains a table that contains the mapping of Ethernet/IP Output (O->T) Assembly to drive data. This table is saved in non-volatile memory in the XPort. The drive data to map to this Assembly can be configured through Ethernet/IP via Get_Attribute_Single (0x0E) and Set_Attribute_Single(0x10) Services directed at Vendor Specific Object Class 102 (0x66), Instance 1.

| Attr ID (dec) | Access | Name | Data Type | Description |
|---|---|---|---|---|
| 100 | Get | Output Data Size | UINT | Current size of the Assembly data in 16-bit words. Whenever a Mapping is changed, this attribute will be immediately updated with the new size. |
| 101 | Get/Set | Mapping 1 | Struct of: | |
| | | | USINT | Data Type 0x0F=Output bits packed into words (Usually Control Word)<br>Data Type 0x10=16bit values (Output data words) |
| | | | UINT | Starting Drive Data Reference Number (0x0001 - 0xFFFF) |
| | | | UINT | Quantity of bits (Data Type 0x0F)<br>Quantity of words (Data Type 0x10) |
| 102 | Get/Set | Mapping 2 | Struct… | Same as Mapping 1 |
| 103 | Get/Set | Mapping 3 | Struct… | Same as Mapping 1 |
| 104 | Get/Set | Mapping 4 | Struct… | Same as Mapping 1 |
| 105 | Get/Set | Mapping 5 | Struct… | Same as Mapping 1 |
| 106 | Get/Set | Mapping 6 | Struct… | Same as Mapping 1 |
| 107 | Get/Set | Mapping 7 | Struct… | Same as Mapping 1 |
| 108 | Get/Set | Mapping 8 | Struct… | Same as Mapping 1 |
| 109 | Get/Set | Mapping 9 | Struct… | Same as Mapping 1 |
| 110 | Get/Set | Mapping 10 | Struct… | Same as Mapping 1 |
| 111 | | Reserved | | |

Once a Set_Attribute_Single message is received, the standard EtherNet/IP error checks will be performed. If all error checks pass, the values of the structure will be checked against the set of valid drive references. If this check passes, a USS telegram will be sent to the drive to test if the supplied data references are supported in the drive. Note: In this case, the XPort will not attempt to write the values specified by that mapping. If a success response is received from the drive, an EtherNet/IP success response is returned to indicate success. If an error response is received from the drive, an EtherNet/IP error code of 0x1F (Vendor Specific Error) response is sent with the data set to the exact error response received from the drive (1 byte error code + 1 byte exception code). If there is no response from the drive, the EtherNet/IP error code will be 0x02 (Resource Unavailable).

Actual writes are only performed when the XPort is in Run mode, so any possible errors (i.e. trying to write a read-only drive reference) are reported only when valid I/O is exchanged. The errors are accessible via the status word in the Input I/O data and the status attributes of the Bridge Configuration Object.

The mappings are used to parse the output data that will be sent from the EtherNet/IP connection originator to the XPort via an I/O message. The mappings are then translated to USS telegrams to send to the drive. The output data buffer is organized as follows:

| 16-bit Run/Idle | Mapping 1 | Mapping 2 | • • • | Mapping 10 |
|---|---|---|---|---|

Unused mappings will contain all zeros in the corresponding attribute structure and will not be included in the output data buffer. The output data buffer will be of dynamic total length up to 500 bytes (250 words) according to the combined length of all the mappings. If this length is exceeded, a CIP Error Response 0x1A (Routing Failure, Request Packet Too Large) will be generated for the Set_Attribute_Single message that caused the overflow and the target mapping will be unchanged.

A mapping can be deleted by setting it to all zeroes.

The data length of the current configuration is in Attribute 100 of this class. The value in this attribute is automatically updated as mappings are changed. Note that the new configuration does not take effect until the power is cycled on the unit.

Therefore if the configuration is changed, Attribute 100 will contain the value of the *new* data size that will only take effect after a power cycle - not the size that is currently active.

Only bit 0 of the first word is defined as the Run/Idle command for the MicroBridge. When an I/O connection is active, a zero (0) in this bit represents Idle Mode and a one (1) represents Run Mode. In Idle mode, the MicroBridge will only read the drive data. In Run mode, it will read and write the drive data.

By default, the MicroBridge comes from the factory with Mapping 1 mapped to Drive Data References 3-18 (PZD Status Word 1, STW1:0-15) in the drive, with Mapping 2 mapped to Drive Data Reference 19 (PZD Frequency Setpoint or HSW), and Mapping 3 mapped to Drive Data References 101-103 (Command Block Outputs). The total length of the default mapping is 6 16-bit words (or 12 bytes).

The default Output mappings are shown in the following table:

**Table 13 - Default Output Data Mapping**

| Attr ID | Name | Mapping (shown as an array of bytes, in hexidecimal format) |
|---|---|---|
| 101 ($65_h$) | Mapping 1 | 02 28 00 10 00 |
| 102 ($66_h$) | Mapping 2 | 03 38 00 01 00 |
| 103 ($67_h$) | Mapping 3 | 03 68 00 03 00 |
| 104-110 | Mappings 4-10 | 00 00 00 00 00 |

# DRIVE DATA REFERENCE NUMBERS

The following table contains the reference numbers assigned to the drive parameters, monitor values, setpoint values, and control points that are available for access through Ethernet I/P on the MicroBridge. Data References should be mapped according to their Data Type. Output Data References (O) may be mapped to the Output Assembly. Input Data References (I) may only be mapped to the Input Assembly. Bit Data References (b) may be mapped to bits or words (though only the least significant bit will contain the value). Word Data References (w) may only be mapped to words.

There is a scaling factor included for some of the data references. Because the XPort used by the MicroBridge does not represent floating point numbers, all floating point values in the drive are converted to integer values by applying a scaling (multiplication) factor. The scaling factors are in the range of 10 to 1000. For example: "Ramp Up Time" has a scaling factor of 100. If the drive contains a value of 20.50, then the "Ramp Up Time" data reference will contain a value of 2050.

STW and HSW refer to the 1st and 2nd words, respectively, of PZD data included in every poll sent from the MicroBridge to the drive via the USS protocol. ZSW and HIW refer to the 1st and 2nd words, respectively, of PZD data included in every poll response sent from the drive to the MicroBridge via the USS protocol. Data references mapped to PZD data are updated frequently.

All other data references (except "Watchdog Action" and "Watchdog Time", which are handled internally in the MicroBridge) are mapped to parameters in the drive, and are updated cyclically. Data references mapped to *monitor* parameters – parameters such as "Actual Current", or "Output Power", whose values change automatically during normal operation of the drive, without the intervention of an operator – are updated at a rate of approximately once per second. Data references mapped to *setup* parameters – parameters such as "Ramp Up Time" or "Frequency MAX Limit", whose values typically change only via intervention by an operator – are updated at a rate of approximately once every 5 seconds.

## Ethernet/IP Assembly Items Mapped to Unsupported Data References

If a particular data reference is not supported in a drive, then the corresponding drive data from the map will not be supported unless it is noted as reserved. Attempts to read or write that data reference will result in an exception response. Attempts to read or write a block of data including one or more unsupported data references (not reserved references which are ok) will result in an exception response. For example, if PID functionality is disabled in the drive, such that parameter r2260 is not supported, then attempts to read Data Reference 91 will result in an exception response.

## Ethernet/IP Watchdog Timer Setup

The MicroBridge includes a watchdog timer function for Ethernet/IP communications. When this function is enabled, the MicroBridge will stop the drive if it is running under Ethernet/IP control and Ethernet communications are lost for the specified period of time. The Ethernet/IP Client controls the watchdog timer function via data references 2 (Watchdog Time) and 2 (Watchdog Action) on the MicroBridge. To activate the watchdog timeout function, the Ethernet/IP client should map Data References 2 and 3 to the Output (O->T) Class then should set the "Watchdog Time" data to the desired timeout period (in milliseconds), then set the "Watchdog Action" data to a value of 1. To disable the Ethernet/IP watchdog timeout function, the Ethernet/IP client should set the "Watchdog Action" data to a value of 0.

## Drive Data Reference Table

| Reference | Description | Data Type | Units | Scaling Factor | 1 | 0 | Parameter Reference |
|---|---|---|---|---|---|---|---|
| | | | | | Range | | |
| **Null Reference** | | | | | | | |
| 0 | Reserved | -- | -- | -- | -- | | -- |
| **Watchdog References** | | | | | | | |
| 1 | Watchdog Time | O/w | ms | 1 | 0…65535 | | |
| 2 | Watchdog Action | O/b | -- | -- | Stop Drive | No Action | -- |
| **PZD Output Word 1 (Control Word 1/STW1)** | | | | | | | |
| 3 | ON/OFF1 | O/b | -- | -- | ON | OFF1 | STW1:0 |
| 4 | No OFF2 | O/b | -- | -- | No OFF2 | OFF2 | STW1:1 |
| 5 | No OFF3 | O/b | -- | -- | No OFF3 | OFF3 | STW1:2 |
| 6 | Pulse Enable | O/b | -- | -- | Enable | Off | STW1:3 |
| 7 | RFG Enable | O/b | -- | -- | Enable | Off | STW1:4 |
| 8 | RFG Start | O/b | -- | -- | Start | Off | STW1:5 |
| 9 | Setpoint Enable | O/b | -- | -- | Enable | Off | STW1:6 |
| 10 | Fault Acknowledge | O/b | -- | -- | Ack On | Off | STW1:7 |
| 11 | Jog Right | O/b | -- | -- | Yes | No | STW1:8 |
| 12 | Jog Left | O/b | -- | -- | Yes | No | STW1:9 |
| 13 | Control From PLC | O/b | -- | -- | Yes | No | STW1:10 |
| 14 | Reverse Command | O/b | -- | -- | Reverse | Forward | STW1:11 |
| 15 | Reserved | O/b | -- | -- | -- | -- | STW1:12 |
| 16 | MOP Up | O/b | -- | -- | Yes | No | STW1:13 |
| 17 | MOP Down | O/b | -- | -- | Yes | No | STW1:14 |
| 18 | CDS Bit 0,Local/Remote | O/b | -- | -- | Local | Remote | STW1:15 |
| **PZD Output Word 2 (HSW)** | | | | | | | |
| 19 | Main Setpoint | O/w | % | 100 | -200.00…200.00 | | HSW |
| **Output Parameters** (may be read or written via the Command Block) | | | | | | | |
| 20 | Ramp Up Time | O/w | sec | 100 | 0.00…650.00 | | P1120[0] |
| 21 | Ramp Down Time | O/w | sec | 100 | 0.00…650.00 | | P1121[0] |
| 22 | Current Limit | O/w | % | 10 | 10.0…400.0 | | P0640[0] |
| 23 | Frequency MAX Limit | O/w | Hz | 100 | 1.00…649.99 | | P1082[0] |

| Reference | Description | Data Type | Units | Scaling Factor | 1 | 0 | Parameter Reference |
|---|---|---|---|---|---|---|---|
| | | | | | Range | | |
| 24 | Frequency MIN Limit | O/w | Hz | 100 | 0.00…649.99 | | P1080[0] |
| 25 | OFF3 Ramp Down Time | O/w | sec | 100 | 0.00…650.00 | | P1135[0] |
| 26 | PID Enable | O/b | -- | -- | Enable | No | P2200[0] |
| 27 | PID Filter Time Constant | O/w | sec | 100 | 0.00…60.00 | | P2265 |
| 28 | PID D Gain | O/w | sec | 1000 | 0.000…60.000 | | P2274 |
| 29 | PID P Gain | O/w | -- | 1000 | 0.000…65.000 | | P2280 |
| 30 | PID I Gain | O/w | sec | 1000 | 0.000…60.000 | | P2285 |
| 31 | PID Up Limit | O/w | % | 100 | -200.00…200.00 | | P2291 |
| 32 | PID Down Limit | O/w | % | 100 | -200.00…200.00 | | P2292 |
| **(Reserved for future use)** | | | | | | | |
| 33 | Reserved | -- | -- | -- | -- | | -- |
| ….. | ….. | ….. | ….. | ….. | ….. | | ….. |
| 39 | Reserved | -- | -- | -- | -- | | -- |
| **PZD Input Word 1 (Status Word 1/ZSW1)** | | | | | | | |
| 40 | Drive Ready | I/b | -- | -- | Drive ready | No | ZSW1:0 |
| 41 | Drive Ready to Run | I/b | -- | -- | Ready to run | No | ZSW1:1 |
| 42 | Drive Running | I/b | -- | -- | Running | No | ZSW1:2 |
| 43 | Drive Fault Active | I/b | -- | -- | Fault | Ok | ZSW1:3 |
| 44 | No OFF2 Active | I/b | -- | -- | No OFF2 | OFF2 | ZSW1:4 |
| 45 | No OFF3 Active | I/b | -- | -- | No OFF3 | OFF3 | ZSW1:5 |
| 46 | On Inhibit Active | I/b | -- | -- | Inhibited | Ok | ZSW1:6 |
| 47 | Drive Alarm Active | I/b | -- | -- | Alarm | Ok | ZSW1:7 |
| 48 | Speed Setpoint Deviation | I/b | -- | -- | No | Yes | ZSW1:8 |
| 49 | PZD Control | I/b | -- | -- | Yes | No | ZSW1:9 |
| 50 | At Max Frequency | I/b | -- | -- | At Max | No | ZSW1:10 |
| 51 | Motor Current Alarm | I/b | -- | -- | No | Alarm | ZSW1:11 |
| 52 | Holding Brake Active | I/b | -- | -- | Active | No | ZSW1:12 |
| 53 | Motor Overload | I/b | -- | -- | No | Overload | ZSW1:13 |
| 54 | Motor Runs Forward | I/b | -- | -- | Forward | Reverse | ZSW1:14 |
| 55 | Inverter Overload | I/b | -- | -- | No | Overload | ZSW1:15 |

| Reference | Description | Data Type | Units | Scaling Factor | 1 | 0 | Parameter Reference |
|---|---|---|---|---|---|---|---|
| | | | | | Range | | |
| **PZD Input Word 2 (HIW)** | | | | | | | |
| 56 | Actual Frequency | I/w | % | 100 | -200.00…200.00 | | HIW |
| **Input Parameters** (may be read via the Command Block) | | | | | | | |
| 57 | Speed Setpoint | I/w | Hz | 10 | -3250.0…3250.0 | | r0020 |
| 58 | Output Frequency | I/w | Hz | 10 | -3250.0…3250.0 | | r0024 |
| 59 | Output Voltage | I/w | Vac | 10 | -3250.0…3250.0 | | r0025 |
| 60 | DC Link Voltage | I/w | Vac | 10 | -3250.0…3250.0 | | r0026[0] |
| 61 | Actual Current | I/w | A | 100 | 0.00…655.35 | | r0027 |
| 62 | Actual Torque | I/w | Nm | 10 | -3250.0…3250.0 | | r0031 |
| 63 | Output Power | I/w | kW/Hp | 100 | -325.00…325.00 | | r0032 |
| 64 | Motor Temperature | I/w | °C | 100 | 0.00…200.00 | | r0035[0] |
| 65 | Power Unit Temperature | I/w | °C | 100 | 0.00…200.00 | | r0037[0] |
| 66 | Energy kWh | I/w | kWh | 1 | 0…65535 | | r0039 |
| 67 | CDS Eff (Local Mode) | I/w | -- | 1 | 0…2 | | r0050 |
| 68 | Status Word 2 | I/w | -- | Bit Mask | 0000-FFFF | | r0053 |
| 69 | Control Word 1 | I/w | -- | Bit Mask | 0000-FFFF | | r0054 |
| 70 | Motor Speed (Encoder) | I/w | Hz | 10 | -650.0…650.0 | | r0061 |
| 71 | Digital Inputs | I/w | -- | Bit Mask | 0000-FFFF | | r0722 |
| 72 | Digital Outputs | I/w | -- | Bit Mask | 0000-FFFF | | r0747 |
| 73 | Analog Input 1 | I/w | V/ma | 1000 | -20.000…20.000 | | r0752[0] |
| 74 | Analog Input 2 | I/w | V/ma | 1000 | -20.000…20.000 | | r0752[1] |
| 75 | Analog Output 1 | I/w | V/ma | 1000 | -20.000…20.000 | | r0774[0] |
| 76 | Analog Output 2 | I/w | V/ma | 1000 | -20.000…20.000 | | r0774[1] |
| 77 | Fault Code 1 | I/w | -- | 1 | 0…65535 | | r0947[0] |
| 78 | Fault Code 2 | I/w | -- | 1 | 0…65535 | | r0947[1] |
| 79 | Fault Code 3 | I/w | -- | 1 | 0…65535 | | r0947[2] |
| 80 | Fault Code 4 | I/w | -- | 1 | 0…65535 | | r0947[3] |
| 81 | Fault Code 5 | I/w | -- | 1 | 0…65535 | | r0947[4] |

| Reference | Description | Data Type | Units | Scaling Factor | 1 / 0 Range | Parameter Reference |
|---|---|---|---|---|---|---|
| 82 | Fault Code 6 | I/w | -- | 1 | 0…65535 | r0947[5] |
| 83 | Fault Code 7 | I/w | -- | 1 | 0…65535 | r0947[6] |
| 84 | Fault Code 8 | I/w | -- | 1 | 0…65535 | r0947[7] |
| 85 | Pulse Frequency | I/w | kHz | 100 | 0…16 | r1801 |
| 86 | Alarm Code 1 | I/w | -- | 1 | 0…65535 | r2110[0] |
| 87 | Alarm Code 2 | I/w | -- | 1 | 0…65535 | r2110[1] |
| 88 | Alarm Code 3 | I/w | -- | 1 | 0…65535 | r2110[2] |
| 89 | Alarm Code 4 | I/w | -- | 1 | 0…65535 | r2110[3] |
| 90 | PID Setpoint Output | I/w | % | 100 | -100.00…100.00 | r2260 |
| 91 | PID Feedback | I/w | % | 100 | -100.00…100.00 | r2266 |
| 92 | PID Output | I/w | % | 100 | -100.00…100.00 | r2294 |
| **(Reserved for future use)** | | | | | | |
| 93 | Reserved | -- | -- | -- | -- | -- |
| ….. | ….. | ….. | ….. | ….. | ….. | ….. |
| 100 | Reserved | -- | -- | -- | -- | -- |
| **Command Block Outputs[1]** | | | | | | |
| 101 | Read Reference | O/w | -- | -- | 0 (null)<br>20…32 (Output Parameters)<br>57…92 (Input Parameters) | -- |
| 102 | Write Value | O/w | (Depends on Write Reference) | | | |
| 103 | Write Reference | O/w | -- | -- | 0 (null)<br>20…32 (Output Parameters) | -- |
| **Command Block Inputs[1]** | | | | | | |
| 104 | Read Status | I/w | -- | -- | 0 (null)<br>20…32 (Output Parameters)<br>57…92 (Input Parameters)<br>0xfff0…0xffff (error) | -- |
| 105 | Read Value | I/w | (Depends on Read Reference) | | | |
| 106 | Write Status | I/w | -- | -- | 0 (null)<br>20…32 (Output Parameters)<br>57…92 (Input Parameters)<br>0xfff0…0xffff (error) | -- |

[1] Part of the Command Block. See "Command Block" for details.