

**ICP PANEL-TEC  
MICROGATE II**

**MODBUS TO  
SIEMENS MM440 DRIVE  
APPLICATION**

**INSTALLATION  
AND  
OPERATION  
GUIDE**

## **REVISION HISTORY**

| <b>Revision</b> | <b>Date</b> | <b>Author</b> | <b>Comments</b>  |
|-----------------|-------------|---------------|------------------|
| 000             | 13 Mar 2009 | David Walker  | Initial release. |

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## **INTRODUCTION**

The Modbus to MM440 version of the MicroGate connects one MM440 drive to a Modbus RTU/ASCII Network. A pre-defined set of Modbus Holding registers (4xxxx registers) are provided that allow access to the most common drive parameters, monitor values, setpoint values, and control points for the MM440 drive.

## **Part Numbers**

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

**Table 1 - Part Numbers**

| <b>Part Number</b> | <b>Description</b>        |
|--------------------|---------------------------|
| 5004-202-102       | MicroGate II Modbus-MM440 |
| 4000-0205          | MicroGate II Power Supply |

## HARDWARE

### Power Supply

The MicroGate II requires a 6-28 Volts DC power source, capable of supplying a minimum of 250mA. Power may be supplied to the MicroGate II by either connecting the MicroGate II Power Supply to the Input Power jack on the side of the unit, or by providing 6-28 Volts DC power to pin 9 of the Local serial port.

### Programming Switch

The Programming Switch on the MicroGate II should always be in the RUN position for normal operations and configuration. The PRG position is used strictly for loading firmware at the factory.

### Serial Port Pinouts

The MicroGate II comes with two serial ports. The pinouts for the serial ports are shown in the table below.

The Local port is for connection to a local device (in this case, an MM440 Drive), and supports both RS232 and RS485 (2-wire) communications. The Local port is also used for programming of the MicroGate II.

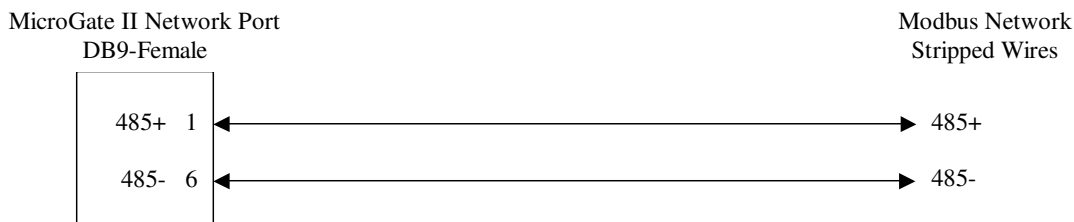
The Network port is for connection to a network (in this case, a Modbus network), and also supports both RS232 and RS485 (2-wire) communications. The Network port is also used for configuring the MicroGate II.

**Table 2 - Serial Port Pinouts**

| Local: DB9-Female |       |                  | Network: DB9-Male |       |                  |
|-------------------|-------|------------------|-------------------|-------|------------------|
| Pin               | Label | Description      | Pin               | Label | Description      |
| 1                 | 485+  | RS485 D+         | 1                 | 485+  | RS485 D+         |
| 2                 | TXD   | RS232 TxD        | 2                 | RXD   | RS232 RxD        |
| 3                 | RXD   | RS232 RxD        | 3                 | TXD   | RS232 TxD        |
| 4                 | DTR   | RS232 DTR        | 4                 | -     | not used         |
| 5                 | GND   | Reference Ground | 5                 | GND   | Reference Ground |
| 6                 | 485-  | RS485 D-         | 6                 | 485-  | RS485 D-         |
| 7                 | CTS   | RS232 CTS        | 7                 | RTS   | RS232 RTS        |
| 8                 | RTS   | RS232 RTS        | 8                 | CTS   | RS232 CTS        |
| 9                 | VCC   | +5VDC Input      | 9                 | -     | not used         |

### Modbus Network Cable

The MicroGate II is provided with a cable to connect the NETWORK port on the MicroGate II to a Modbus network. Because the network connection type may vary among different installations, the cable ends in stripped wires to provide maximum flexibility.



**Figure 1 - Modbus Network Cable**

## USS MM440 Drive Cable

The user must provide a cable to connect the LOCAL port on the MicroGate II to the MM440 drive. The cable should end in stripped wires to facilitate connection to the MM440 drive terminals shown in the table below. MM440 drive power should be off while connecting the wires to the drive terminals.

- ❑ If powering the MicroGate II from the MM440, connect the red and green wires to terminals 9 and 28 on the MM440, respectively.
- ❑ If powering the MicroGate II from an external 6-28 VDC power supply through the Local port, connect the red and green wires to the external power supply.
- ❑ If powering the MicroGate II through the Input Power jack on the side of the unit, leave the red and green wires unconnected.

**WARNING! Do not apply power to the MicroGate II through pin 9 of the Local port and through the Input Power jack on the side of the unit at the same time!**

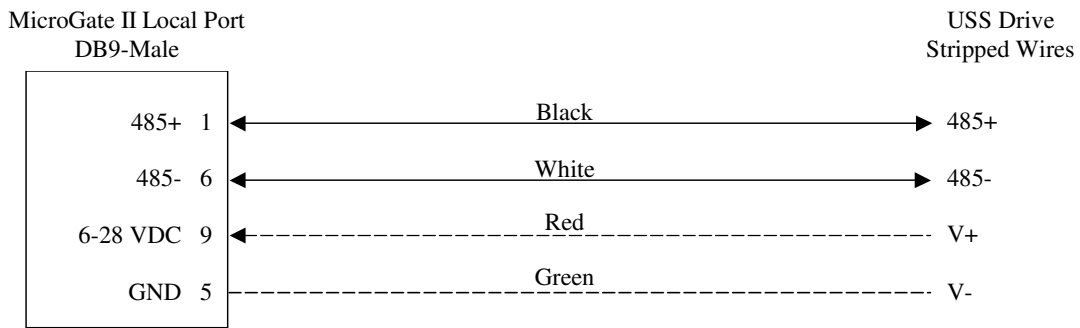


Figure 2 - USS Drive Cable

Table 3 – MM440 Cable Connections

| Signal      | Connection                    |
|-------------|-------------------------------|
| 485+        | MM440 Terminal #29            |
| 458-        | MM440 Terminal #30            |
| V+ (24 VDC) | MM440 Terminal #9 (optional)  |
| V- (0 VDC)  | MM440 Terminal #28 (optional) |

## LED Indicators

There are a total of 3 Bi-color LED indicators on the MicroGate II. The NET LED displays communications activity on the Network (Modbus) port. The STAT LED displays the overall status of the MicroGate II. The LCL LED displays communications activity on the Local (MM440) port. During normal operations, the NET and LCL LEDs will quickly alternate red and green flashes, making it look almost amber. This is normal.

**Table 4 – MicroGate II General Status LED (STAT)**

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

**Table 5 - Network Communications Activity LED (NET)**

| <b>For this state:</b> | <b>LED is:</b> | <b>To indicate:</b>  |
|------------------------|----------------|--|
| Receive Data           | Red            | The MicroGate II is receiving data from the Modbus Network.    |
| Transmit Data          | Green          | The MicroGate II is transmitting data onto the Modbus Network. |

**Table 6 - MM440 Communications Activity LED (LCL)**

| <b>For this state:</b> | <b>LED is:</b> | <b>To indicate:</b>                                       |
|------------------------|----------------|---|
| Receive Data           | Red            | The MicroGate II is receiving data from the MM440 drive.  |
| Transmit Data          | Green          | The MicroGate II is transmitting data to the MM440 drive. |

## MICROGATE II CONFIGURATION

### Configuration Cable

The network port on the MicroGate II includes RS232 signals for use in configuration, as shown in the pinout and cable diagram below. A standard null-modem DB9-F to DB9-F cable connects the MicroGate II to a serial port on a PC during configuration.

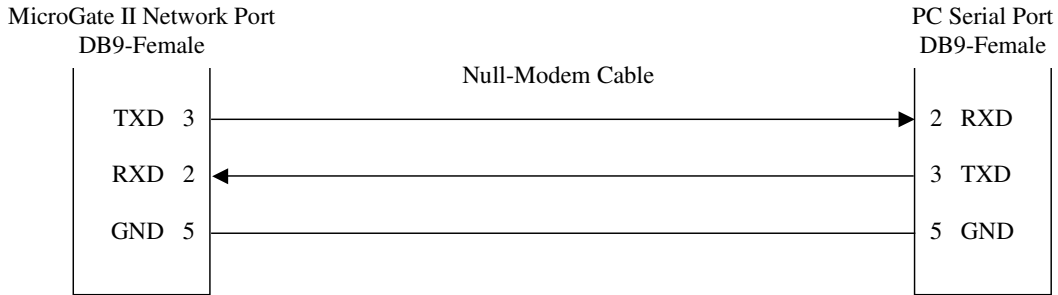


Figure 3 - Configuration Cable

### Default Configuration

The Modbus protocol on the Network Port of the MicroGate II is configurable to make it easy to add it to an existing Modbus network. The configuration parameters that may be changed are shown in the following table:

Table 7 - Configuration Options

| Parameter | Options   | Default      |
|-----------|---|--------------|
| Protocol  | Modbus ASCII<br>Modbus RTU  | Modbus RTU   |
| Port Type | RS232<br>2-wire RS485   | 2-wire RS485 |
| Modbus ID | 1... 254  | 2            |
| Baud Rate | 1200 bps<br>4800 bps<br>9600 bps<br>19200 bps<br>38400 bps<br>57600 bps<br>115200 bps | 9600 bps     |
| Data Bits | 7<br>8  | 8            |
| Parity    | None<br>Even<br>Odd   | Even         |
| Stop Bits | 1<br>2  | 1            |

## Changing the Configuration

The configuration stored in the MicroGate II may be changed from the default configuration by entering Configuration Mode.

1. Attach a configuration cable between the Network port on the MicroGate II and a serial port on a PC.
2. Start a terminal program, such as Hyper Terminal, on the PC, and connect using the following settings:
  - Baud = 9600 bps
  - Data bits = 8
  - Parity = None
  - Stop Bits = 1
  - Flow Control = None
3. With the Programming Switch set to “RUN”, apply power to the MicroGate II, and send a carriage return (press the **Enter** key) within 5 seconds of startup.

Once the MicroGate II is in Configuration Mode, it will send its current configuration information to the terminal program, as follows:

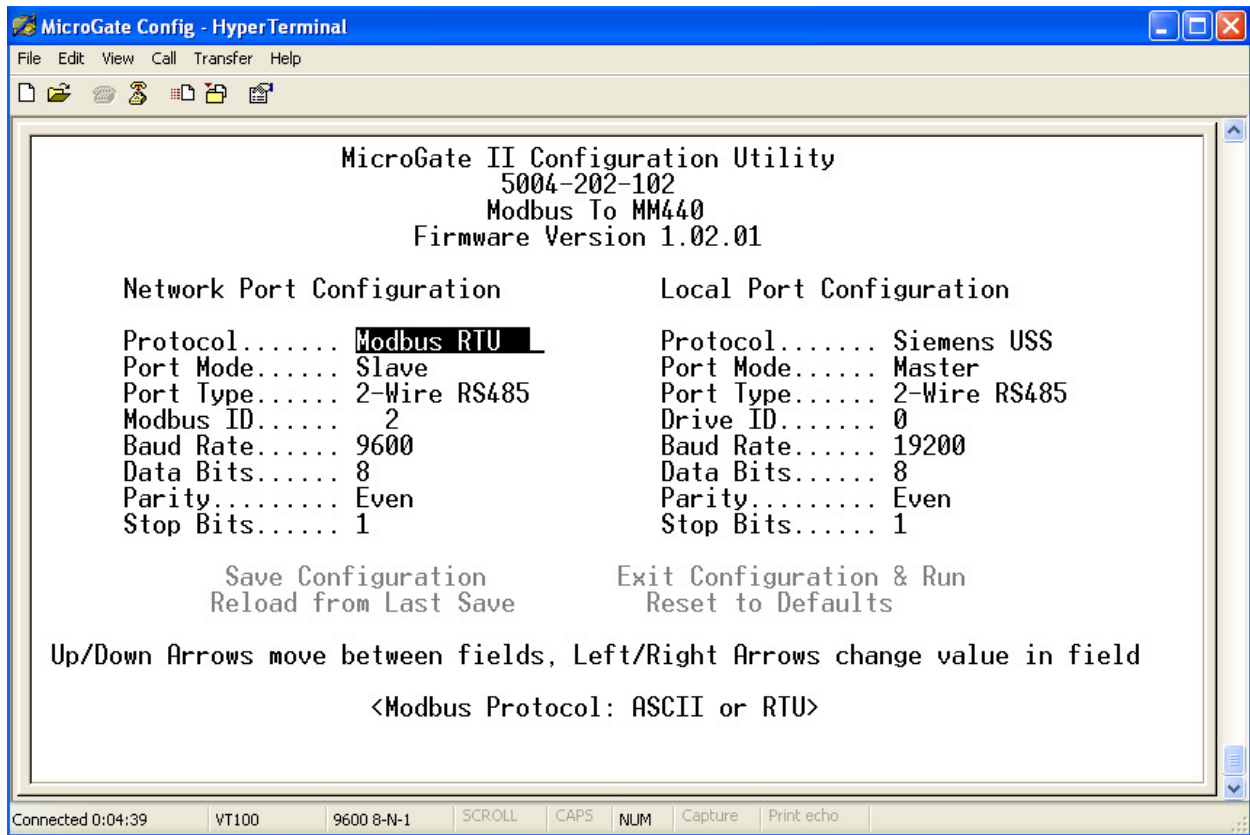


Figure 4 - MicroGate II Configuration Display

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 MicroGate II.

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

## MM440 DRIVE SETUP

### MM440 Drive Parameter Configuration

The Siemens MM440 drive must be configured before the MicroGate II will communicate with the drive. The MicroGate II communicates with the MM440 drive using the USS protocol, with the following configuration:

- 19200 baud
- 8 data bits
- even parity
- 1 stop bit
- drive id 0

To setup the MM440 drive for communications with a MicroGate II, the drive parameters in the following table must be configured with the values shown via the MM440 keypad.

**Table 8 - MM440 Parameter Configuration**

| MM440 Parameter | Function                          | Set Value   |
|-----------------|-----------------------------------|---|
| P0003           | User Access Level                 | 3 (Expert Setting)  |
| P0700[0]        | Command Source                    | 5 if Starting/Stopping Drive from Modbus Otherwise: <b>Do Not Change</b>  |
| P1000[0]        | Frequency Setpoint Source         | 5 if Setting the Frequency from Modbus Otherwise: <b>Do Not Change</b>  |
| P2009[0]        | USS Normalization                 | 0 (Disabled)  |
| P2010[0]        | USS Baud Rate                     | 7 (19.2K baud)  |
| P2011[0]        | USS Address                       | 0   |
| 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)  |

### USS Watchdog Timer Setup

The MM440 has a timeout function for the USS port, which is controlled by Parameter 2014, “USS telegram off time”. Once the MicroGate II has established communications with an MM440 drive with the watchdog function enabled, the watchdog timer is activated. If communications are subsequently lost for the specified length of time, the MM440 will automatically generate a F0070 fault. Setting Parameter 2014 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 MM440 drive and the MicroGate II, and wait approximately 5 seconds. If the MicroGate II 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.

To verify that the MicroGate II and drive are set up correctly, set P0700[0] to a value of 5 and P1000[0] to a value of 5 so that the drive can be controlled from the Modbus network. Then, from the Modbus host, issue a Modbus write with a value of 8192 (2000h, or 50% of the maximum frequency) to the FREQ REF register (40003) followed by a Modbus write with the value of 1 to the ENABLE register (40004). Then write a value of 1 to the CMD START register (40006), and the drive should start running. Write a value of 0 to the CMD START register to stop the drive again. The drive frequency can be changed at any time during this process by writing to the FREQ REF register (40003).

## MODBUS REGISTERS

The following table contains the list of all Modbus holding registers available on the MicroGate II. The Modbus host may write to Registers 40001 through 40023. All other registers are read-only.

There is a scaling factor included for some of the registers. Because Modbus does not represent floating point numbers, all floating point values in the drive are converted to integer register values by applying a scaling (multiplication) factor. The scaling factors are in the range of 10 to 1000. For example: ACCEL TIME has a scaling factor of 100. If the MM440 contains a value of 20.50, then the ACCEL TIME register will contain a value of 2050.

FREQ REF (40003) and FREQ ACTUAL (40063) are special case registers. FREQ REF contains the raw integer value passed in the HSW portion of a USS protocol request to the MM440 drive, and FREQ ACTUAL contains the raw integer value passed in the HIW portion of a USS protocol response from the MM440 drive. Both registers are scaled such that a value of 4000h represents 100% of the maximum frequency.

FREQ SCALED (40044) contains a scaled version of the HIW data, such that a value of 2000 in the register represents the value 4000h in the USS protocol response (and 100% of the maximum frequency). It is included in the Modbus register map as a legacy parameter for existing customers of our discontinued UFC Modbus to MM440 product.

STW and HSW refer to the 1<sup>st</sup> and 2<sup>nd</sup> words, respectively, of PZD data included in every poll sent from the MicroGate II to the MM440 drive via the USS protocol. ZSW and HIW refer to the 1<sup>st</sup> and 2<sup>nd</sup> words, respectively, of PZD data included in every poll response sent from the MM440 drive to the MicroGate II via the USS protocol. Registers mapped to PZD data are updated frequently.

All other parameters (except WDOG ACTION and WDOG TIME, which are handled internally in the MicroGate II) are mapped to parameters in the MM440 drive, and are updated cyclically. Registers mapped to *monitor* parameters – parameters such as CURRENT, or SPEED, 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. Registers mapped to *setup* parameters – parameters such as ACCEL TIME or FREQ MAX, whose values typically change only via intervention by an operator – are updated at a rate of approximately once every 5 seconds.

## Registers Mapped to Unsupported Parameters

If a particular parameter is not supported in an MM440 drive, then the corresponding Modbus register from the register map will not be supported, either. Attempts to read or write that register will result in an exception response. Attempts to read or write a block of register including one or more unsupported registers will result in an exception response. For example, if PID functionality is disabled in a particular MM440 drive, such that parameter P2240 is not supported, then attempts to read or write Modbus register 40008 will result in a Modbus exception response.

## Modbus Watchdog Timer Setup

The MicroGate II includes a watchdog timer function for Modbus communications. When this function is enabled, the MicroGate II will stop the drive if it is running under Modbus control and Modbus communications are lost for the specified period of time. This Modbus host controls the watchdog timer function via Modbus holding registers 40001 (WDOG TIME) and 40002 (WDOG ACTION) on the MicroGate II. To activate the Modbus watchdog timeout function, the Modbus host should set the WDOG TIME register to the desired timeout period (in milliseconds), then set the WDOG ACTION register to a value of 1. To disable the Modbus watchdog timeout function, the Modbus host should set the WDOG ACTION register to a value of 0.

Table 9 - Modbus Registers

| Register | Description   | Units | Scaling Factor | 1                        | 0         | MM440 Ref. |
|----------|---------------|-------|----------------|--------------------------|-----------|------------|
|          |               |       |                | Range                    |           |            |
| 40001    | WDOG TIME     | MS    | 1              | 0...65535                |           | --         |
| 40002    | WDOG ACTION   | --    | 1              | STOP DRIVE               | NO ACTION | --         |
| 40003    | FREQ REF      | --    | 1              | 0...4000h (4000h = 100%) |           | HSW        |
| 40004    | RUN ENABLE    | --    | 1              | ENABLE                   | OFF       | STW:3      |
| 40005    | CMD FWD REV   | --    | 1              | REV                      | FWD       | STW:11     |
| 40006    | CMD START     | --    | 1              | START                    | OFF       | STW:0      |
| 40007    | FAULT ACK     | --    | 1              | ACK                      | NO ACK    | STW:7      |
| 40008    | PID SETP REF  | PCT   | 10             | -200.0...200.0           |           | P2240      |
| 40009    | ENABLE PID    | --    | 1              | ENABLE                   | DISABLE   | P2200      |
| 40010    | CURRENT LMT   | PCT   | 10             | 10.0...400.0             |           | P0640      |
| 40011    | ACCEL TIME    | SEC   | 100            | 0.00...650.00            |           | P1120      |
| 40012    | DECEL TIME    | SEC   | 100            | 0.00...650.00            |           | P1121      |
| 40013    | DUMMY         | --    | 1              | --                       | --        | --         |
| 40014    | DIGITAL OUT 1 | --    | 1              | ON                       | OFF       | P0731      |
| 40015    | DIGITAL OUT 2 | --    | 1              | ON                       | OFF       | P0732      |
| 40016    | FREQ MAX      | HZ    | 100            | 1.00...650.00            |           | P2000      |
| 40017    | PID UP LMT    | PCT   | 10             | -200.0...200.0           |           | P2291      |
| 40018    | PID LO LMT    | PCT   | 10             | -200.0...200.0           |           | P2292      |
| 40019    | P GAIN        | --    | 1000           | 0.000...65.000           |           | P2280      |
| 40020    | I GAIN        | SEC   | 1              | 0...60                   |           | P2285      |
| 40021    | D GAIN        | --    | 1              | 0...60                   |           | P2274      |
| 40022    | FEEDBK GAIN   | PCT   | 100            | 0.00...500.00            |           | P2269      |
| 40023    | LOW PASS      | --    | 100            | 0.00...60.00             |           | P2265      |
| 40024    | FREQ OUTPUT   | HZ    | 10             | -650.0...650.0           |           | r0024      |
| 40025    | SPEED         | RPM   | 1              | -16250...16250           |           | r0022      |
| 40026    | CURRENT       | A     | 10             | 0.0...6553.5             |           | r0027      |
| 40027    | TORQUE        | NM    | 10             | -3250.0...3250.0         |           | r0031      |
| 40028    | ACTUAL PWR    | KW    | 100            | 0.00...655.35            |           | r0032      |
| 40029    | TOTAL KWH     | KWH   | 1              | 0...65535                |           | r0039      |
| 40030    | DC BUS VOLTS  | V     | 1              | 0...65535                |           | r0026      |
| 40031    | REFERENCE     | HZ    | 10             | -650.0...650.0           |           | r0020      |
| 40032    | RATED PWR     | KW    | 100            | 0.00...655.35            |           | r0206      |

| Register | Description           | Units | Scaling Factor | 1                        | 0     | MM440 Ref. |
|----------|-----------------------|-------|----------------|--------------------------|-------|------------|
|          |                       |       |                | Range                    |       |            |
| 40033    | OUTPUT VOLTS          | V     | 1              | 0...65535                |       | r0025      |
| 40034    | FWD REV               | --    | 1              | FWD                      | REV   | ZSW:14     |
| 40035    | STOP RUN              | --    | 1              | STOP                     | RUN   | ZSW:2      |
| 40036    | AT MAX FREQ           | --    | 1              | MAX                      | NO    | ZSW:10     |
| 40037    | CONTROL MODE          | --    | 1              | SERIAL                   | LOCAL | ZSW:9      |
| 40038    | ENABLED               | --    | 1              | ON                       | OFF   | ZSW:0      |
| 40039    | READY TO RUN          | --    | 1              | READY                    | OFF   | ZSW:1      |
| 40040    | ANALOG IN 1           | PCT   | 10             | -300.0...300.0           |       | r0754/0    |
| 40041    | ANALOG IN 2           | PCT   | 10             | -300.0...300.0           |       | r0754/1    |
| 40042    | ANALOG OUT 1          | PCT   | 10             | -100.0...100.0           |       | r0774/0    |
| 40043    | ANALOG OUT 2          | PCT   | 10             | -100.0...100.0           |       | r0774/1    |
| 40044    | FREQ SCALED           | PCT   | 20             | 0.0...100.0              |       | HIW        |
| 40045    | PID SETP OUT          | PCT   | 10             | -100.0...100.0           |       | r2250      |
| 40046    | PID OUTPUT            | PCT   | 10             | -100.0...100.0           |       | r2294      |
| 40047    | PI FEEDBACK           | PCT   | 10             | -100.0...100.0           |       | r2266      |
| 40048    | DIGITAL IN 1          | --    | 1              | ON                       | OFF   | r0722:0    |
| 40049    | DIGITAL IN 2          | --    | 1              | ON                       | OFF   | r0722:1    |
| 40050    | DIGITAL IN 3          | --    | 1              | ON                       | OFF   | r0722:2    |
| 40051    | DIGITAL IN 4          | --    | 1              | ON                       | OFF   | r0722:3    |
| 40052    | DIGITAL IN 5          | --    | 1              | ON                       | OFF   | r0722:4    |
| 40053    | DIGITAL IN 6          | --    | 1              | ON                       | OFF   | r0722:5    |
| 40054    | FAULT                 | --    | 1              | FAULT                    | OK    | ZSW:3      |
| 40055    | LAST FAULT            | --    | 1              | 0...65535                |       | r0947      |
| 40056    | 1 <sup>ST</sup> FAULT | --    | 1              | 0...65535                |       | r0947      |
| 40057    | 2 <sup>ND</sup> FAULT | --    | 1              | 0...65535                |       | r0947      |
| 40058    | 3 <sup>RD</sup> FAULT | --    | 1              | 0...65535                |       | r0947      |
| 40059    | WARNING               | --    | 1              | WARN                     | OK    | ZSW:7      |
| 40060    | LAST WARNING          | --    | 1              | 0...65535                |       | r2110      |
| 40061    | INVERTER VER          | --    | 100            | 0.00...655.35            |       | r0018      |
| 40062    | DRIVE MODEL           | --    | 1              | 0...65535                |       | r0200      |
| 40063    | FREQ ACTUAL           | --    | 1              | 0...4000h (4000h = 100%) |       | HIW        |
| 40064    | DIGITAL OUT 3         | --    | 1              | ON                       | OFF   | P0733      |
| 40065    | RUN CMD 2             | --    | 1              | ON                       | OFF   | STW:1      |

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| Register | Description  | Units | Scaling Factor | 1     | 0   | MM440 Ref. |
|----------|--------------|-------|----------------|-------|-----|------------|
|          |              |       |                | Range |     |            |
| 40066    | RUN CMD 3    | --    | 1              | ON    | OFF | STW:2      |
| 40067    | CDS          | --    | 1              | ON    | OFF | STW:15     |
| 40068    | DIGITAL IN 7 | --    | 1              | ON    | OFF | r0722:6    |
| 40069    | DIGITAL IN 8 | --    | 1              | ON    | OFF | r0722:7    |

**MECHANICAL**

