# Installation instructions for IZM91 and IZMX16 Modbus communications adapter module (MCAM)

**⚠ WARNING**

**(1) ONLY QUALIFIED ELECTRICAL PERSONNEL SHOULD BE PERMITTED TO WORK ON THE EQUIPMENT.**
**(2) ALWAYS DE-ENERGIZE PRIMARY AND SECONDARY CIRCUITS.**
**(3) DRAWOUT CIRCUIT BREAKERS SHOULD BE REMOVED FROM THEIR DRAWOUT CASSETTE.**
**(4) ALL CIRCUIT BREAKERS SHOULD BE SWITCHED TO THE OFF POSITION AND MECHANISM SPRINGS DISCHARGED.**
**FAILURE TO FOLLOW THESE STEPS FOR ALL PROCEDURES DESCRIBED IN THIS INSTRUCTION LEAFLET COULD RESULT IN DEATH, BODILY INJURY, OR PROPERTY DAMAGE.**

## Section 1: General information

The IZM91 and IZMX16 Modbus® communications adapter module (**Figure 1**) is an accessory that will operate as a communicating device in conjunction with a compatible IZM91 and IZMX16 trip unit/breaker in a master communications network (**Figure 2**). The catalog number of this module is MCAM.

The MCAM communicates to a master on a Modbus network using the Modbus RTU (remote terminal unit) protocol. Information is exchanged through the MCAM between the Modbus master and the trip unit using assigned registers.

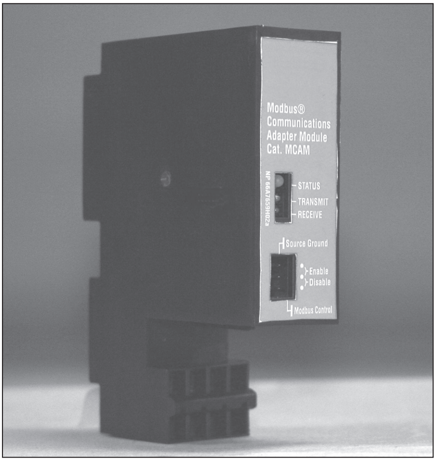


**Figure 1. IZM91 and IZMX16 Modbus Communications Adapter Module**

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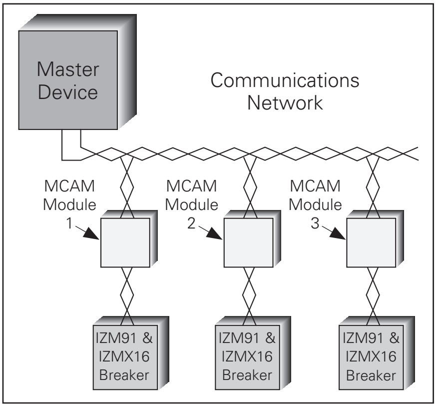



**Figure 2. Modbus Communications Adapter Modules in a Modbus Network**

The Modbus communications adapter module is a slave device and as such requires a master device for control command initiation. Each Modbus communications adapter module provides:

- Circuit breaker open/close/reset control
- Trip unit source/residual ground selection (if applicable)
- Flashing Status LED indicating module has power
- Modbus communication enable/disable selection jumper for remote open/close control
- DIN rail mounting (11 mm H, 28 mm W DIN rail minimum requirement)
- Input power for module from 24 Vdc

The Modbus communications adapter module is designed to be installed, operated, and maintained by adequately trained people. These instructions do not cover all details or variations of the equipment for its storage, delivery, installation, checkout, safe operation, or maintenance.

# Section 2: Installation of Modbus communications adapter module

The following steps outline the installation procedure for an IZM91 and IZMX16 Modbus communications adapter module in a drawout circuit breaker configuration only. For fixed-mounted circuit breakers, a separate DIN rail mounting configuration is preferred. Consult the customer support center for additional information.

The following tools should be available:

- #T-15 Torx
- Small flat blade screwdriver

For drawout circuit breakers, secondary terminal blocks as well as the Modbus communications adapter module are DIN rail mounted on the top front portion of the drawout cassette. The module is designed to install or replace the four terminal blocks (eight contacts in total) at secondary contacts 19–26. Refer to the master connection diagram that can be found in the breaker instruction manual AWB1230-1628. For additional information relative to secondary terminal block installation and/or removal beyond that which is presented in this section, refer to AWA1230-2610.

Proceed with the following seven steps:

**Step 1:** Using a T-15 Torx, remove the four mounting screws holding the terminal block alignment bracket in place.

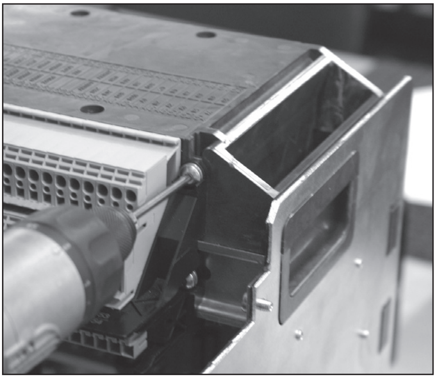


**Figure 3. Step 1**

**Step 2:** Carefully slide the alignment bracket out from between any mounted terminal blocks and put it aside with its mounting hardware for re-installment after the communications adapter module is connected to the DIN rail.

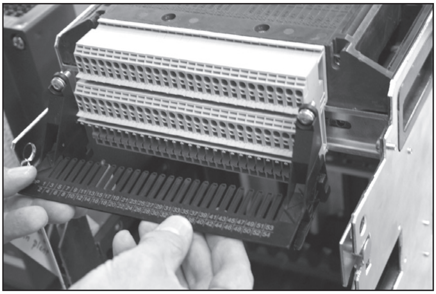


Figure 4. Step 2

**Step 3:** Remove the terminal block in location 19/20 by inserting a small screwdriver in the recessed area in the top front of the terminal block as shown, and gently pry down to release and remove the block from the DIN rail.

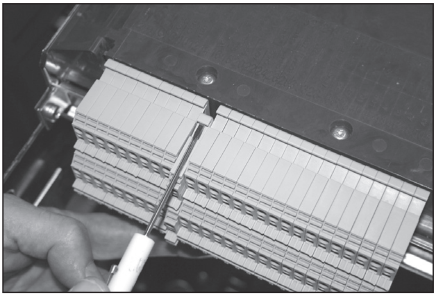


Figure 5. Step 3

**Step 4:** Repeat the same procedure performed in Step 3 to remove terminal blocks at locations 21/22, 23/24, and 25/26.

**Note:** The extra DIN rail mounting screw located in the space where the four terminal blocks were mounted may need to be removed to allow the unit's pogo pin ground to properly hit the metal DIN rail.

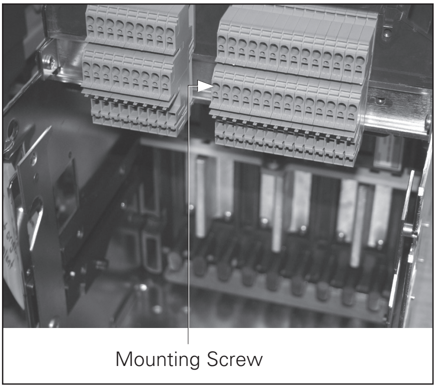



Figure 6. Step 4

**Step 5:** Tilt the communications module forward to engage the upper part of the DIN rail, and then snap it back into the DIN rail for complete engagement.

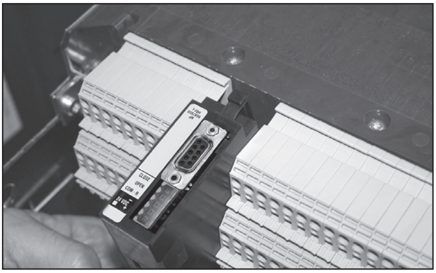


Figure 7. Step 5

**Step 6:** Carefully slide the terminal block alignment bracket back into position. **Before securing the bracket in place, inspect it from the bottom to ensure that the teeth on the bracket separate each individual terminal block. One installed terminal block only should be visible between two teeth when the alignment bracket is properly positioned.** Secure the terminal block alignment bracket using the four screws previously removed. Hand tighten the four mounting screws.

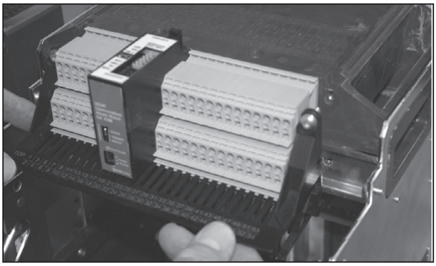


**Figure 8. Step 6**

**Step 7:** A mounted communications module appears as shown and the installation procedure is complete. The module can now be wired in keeping with the information presented in Section 3.

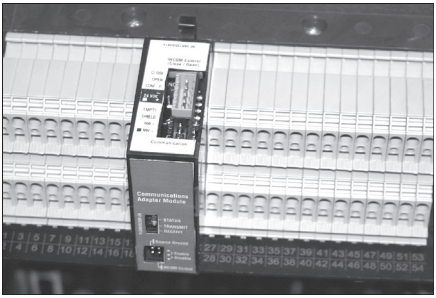



**Figure 9. Step 7**

## Section 3: Basic Modbus RS-485 Network Wiring

The following simplified rules apply to a given system consisting of a cable link between master and slave devices (**Figure 2**). For more complex considerations, please refer to standard Modbus RTU wiring specification rules for the RS-485 network.

1. The recommended Modbus cable has twisted-pair wires (24 AWG stranded 7 x 32 conductors with PVC insulation) having an aluminum/mylar foil shield with drain wire.
2. The maximum system capacity is 1,2 km of communications cable and 247 devices on the Modbus RTU network.
3. Make sure there is twisted-pair wire that is recommended for Modbus RTU network use. Use shielded twisted-pair wire to connect each slave to the Modbus RTU network, daisy-chain style. **The polarity of the twisted pair is CRITICALLY important.**

## Section 4: Modbus communications adapter module connections

**⚠ WARNING**

**ALL APPLICABLE SAFETY CODES, SAFETY STANDARDS, AND SAFETY REGULATIONS MUST BE STRICTLY ADHERED TO WHEN INSTALLING, OPERATING, OR MAINTAINING THIS EQUIPMENT. FAILURE TO COMPLY COULD RESULT IN DEATH, BODILY INJURY, OR PROPERTY DAMAGE.**

For installation specifics, refer to **Figure 3** and **Figure 4** on page 2 and page 3 respectively for wiring diagrams, as well as pin-out **Table 1** (power connections) and **Table 2** (Modbus connections).

**Table 1. Power Connector Pin-Outs** ①

| Pin Number | Input Signal |
|---|---|
| 1 | 24 Vdc + |
| 2 | 24 Vdc – |
| 3 | Control signal common |
| 4 | Control open signal |
| 5 | Control close signal |

① Module power uses a 5-pin input connector. Power requirement is 24 Vdc, 10 watts.

**Table 2. Modbus Connector Pin-Outs** ①②

| Pin Number | Input Signal |
|---|---|
| 1 | RS-485 Network-B (non-inverting) |
| 2 | RS-485 Network-A (inverting) |
| 3 | Common |
| 4 | Shield |

① This 4-pin connector provides the interface to the Modbus network.

② Connect shield wire to ground at master device end only. Interconnect shielding where devices are daisy-chained.

## Section 5: Jumpers and indicator LEDs

Refer to **Figure 10** to become familiar with specific jumper and LED locations on the Modbus communications adapter module.

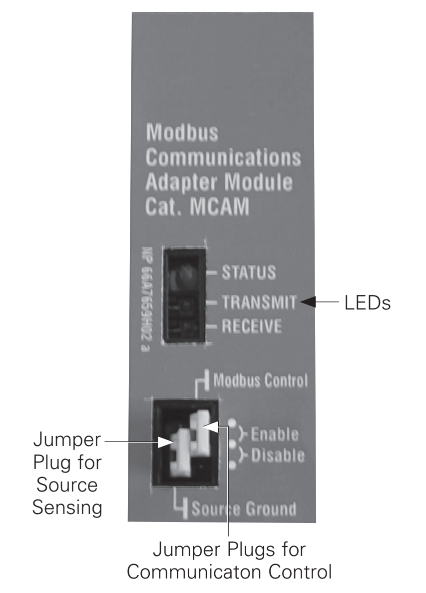



**Figure 10. Modbus Communications Adapter Module (Front View Closeup)**

### MicroController LED (Status)

This indicator will be flashing green whenever the module is powered up and when the microprocessor is executing instructions. When the IZM91 and IZMX16 Modbus communications adapter module is connected to a trip unit for the first time, this LED will alternately flash red and green to signal a learning process between both units. This automatic process will take approximately 15 seconds and occurs only once during the initial startup. The LED will also flash red if the module is not connected to or unable to communicate with an IZM91 and IZMX16 trip unit.

### Modbus RS-485 network Tx LED (Transmit)

This LED will be lit whenever the module is transmitting on the Modbus RTU network.

### Modbus RS-485 network Rx LED (Receive)

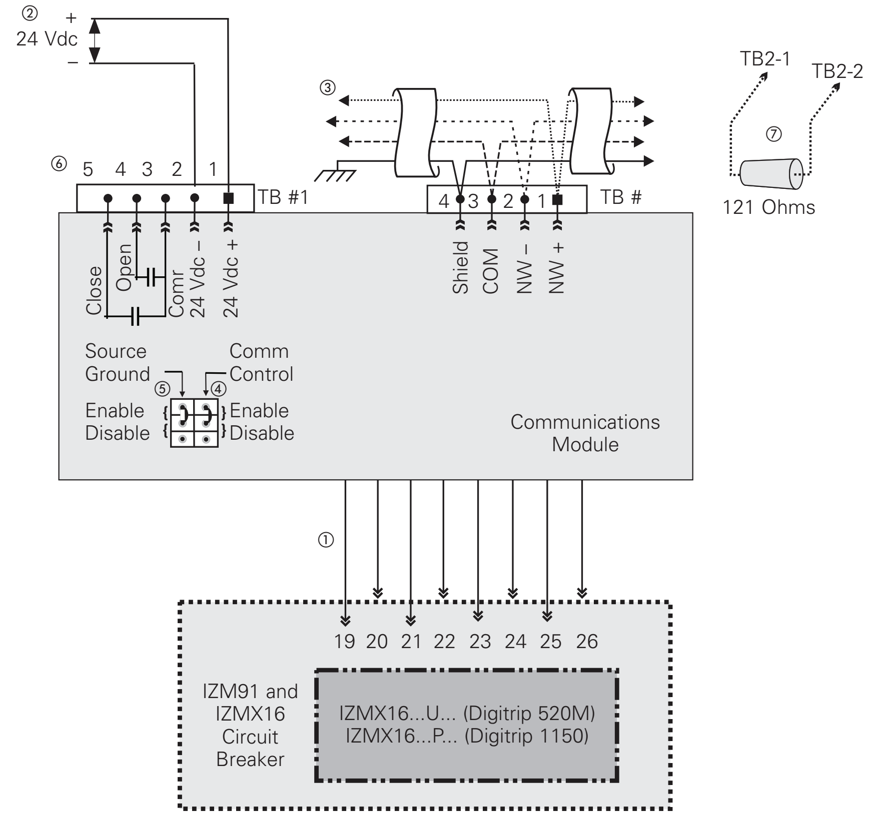
This LED will be lit whenever the module is receiving from the Modbus RTU network.

### Modbus control jumper

This jumper provides the user with a means of enabling or disabling remote communication control commands to the trip unit. With jumper placed in the ENABLE position, remote Open and Close Breaker commands can be acted upon. With the jumper in the DISABLE position, these commands will not be accepted.

### Source/residual ground selection jumper

This jumper selects the protection configuration for trip units with ground fault protection or ground fault alarm functionality. Consult IZM91 and IZMX16 trip unit instructions (AWB1230-1629) for further information on ground sensing. This jumper is not applicable and does not function for non-ground fault style trip units.




① The IZM91 and IZMX16 communications module is a separate device that snaps into the DIN rail starting at location 19–26. (Removal of the four contact blocks is required.)

② The trip unit auxiliary voltage is 24 Vdc ±10% and should be sourced from a reliable service.

③ Ground the shield at the master device and refer to Section 3 on page 4.

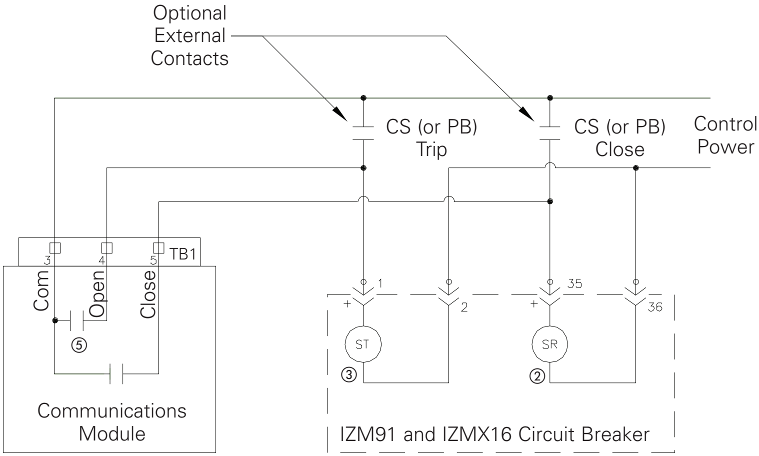
④ Set the jumper on the module to enable or disable the remote open and close communication control commands, as desired.

⑤ When the communications module is employed and source ground or zero sequence ground sensing method is required, the ground fault function is enabled by this jumper.

⑥ Connectors are UL®/CSA® rated 300V, VDE rated 250V. Recommended: Weidmuller (BL 3.5/90/5BK) Orientation: 90° lead exit, but other lead orientations are possible. Wire guage: #18 AWG/0.82 mm.

⑦ The final device in the daisy-chain configuration must have a 121 ohms termination resistor installed across terminals #1 and #2 on TB #2.

**Figure 11. IZM91 and IZMX16 Modbus Communication with Digitrip 520M**




① Spring release and shunt trip wiring as shown for optional communication close or open capability.

② Choose spring release coil voltage rating as desired if communications is required.

③ Choose shunt trip voltage rating to be the same as spring release voltage rating if communication is required.

④ Control power voltage rating must match ST and SR coil voltage rating.

⑤ Close duration is 2 seconds on communication activation when communication control is enabled.

**Figure 12. Communications Control (SR an ST wiring)**

## Section 6: Viewing/setting Modbus address

The IZM91 and IZMX16 trip unit is used as the means to display and modify the programmed Modbus address setting of the MCAM module. All modules are shipped with a factory set default address of 220. The allowable address range is 001–247.

A trip unit containing a full display, such as the 1150, will provide the MCAM settings in menu form. To set or view MCAM settings on a 520M limited display, the following sequence is used.

To set or view the address, depress and hold the Reset/Battery Test button located on the front of the trip unit for approximately 5 seconds until the address information is displayed. **This button must be held in continuously during the process.** The trip unit display will then alternate between **'SP00'** (denoting the address display mode) and the programmed Modbus address value.

To select a new address, depress the trip unit Scroll Display to increment the address value shown. Users may simultaneously depress and hold in the Scroll and Reset/Battery Test buttons for fast advance. The next setting will be displayed when the Reset/Battery Test button is released and then once again depressed.

Once the last setting (SP03) has been viewed and the Reset/Battery Test button has been released, the new Modbus settings will be saved.

A block diagram of the setting sequence and programming options is shown in **Figure 13**. For the Modbus communications adapter module, four communication settings are available and can be viewed as shown in **Table 3**.

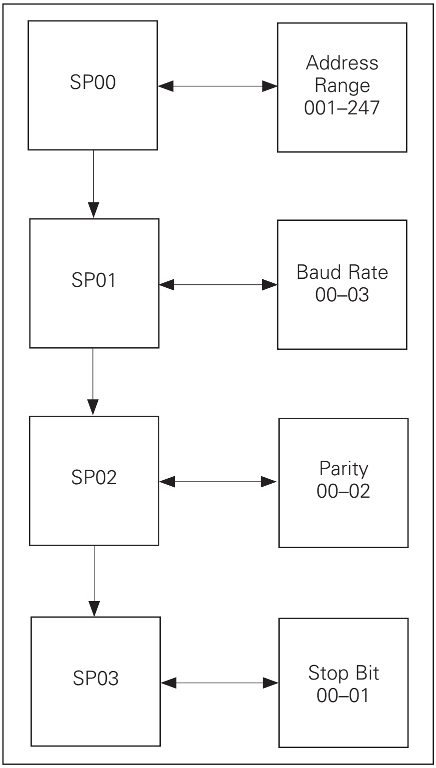



**Figure 13. Setting Sequence Programming Flow Chart for IZM91 and IZMX16 520M Trip Unit**

**Table 3. MCAM Communications Setting Ranges**

| | Setting Number | Allowable Range |
|---|---|---|
| Communication address | SP00 | 001–247 |
| Baud rate | SP01 | 00 = 1200<br>01 = 4800<br>02 = 9600<br>03 = 19200 |
| Parity | SP02 | 00 = None<br>01 = Odd<br>02 = Even |
| Stop bit | SP03 | 00 = 1 bit<br>01 = 2 bits |

# Section 7: Network communications protocol

In order to satisfy the MCAM communications needs, please refer to the following reference material:

"Modicon Modbus Protocol" http://www.modicon.com/techpubs/toc7.html

The contents of Modbus registers are product objects (for example, $I_A$—phase A current). The MCAM ensures that unique objects reside in identical registers independent of Eaton products. Consequently, Eaton products use a single register map of objects (**Table 4** or **Table 5**).

Objects occupy two registers except for certain energy (real and reactive) objects. These energy objects occupy four registers. The MCAM can support a maximum of 122 registers within a single Modbus transaction.

To accommodate Modbus masters that can only access to register 9999, some Eaton registers initially assigned above 9999 have been assigned dual access, both at the original register (to provide compatibility) and at a new register assignment below 9999. The format is given as low/high register numbers followed by ($low_{16}$/$high_{16}$ Modbus register addresses). An example is: 4xxxx/4yyyyy ($XXXX+1_{16}$/$YYYY+1_{16}$). Refer to **Table 6**.

Only the RTU communications mode is recognized by the MCAM.

## Function codes

The MCAM responds to a limited number of Modbus function codes. These are function codes 03, 04, 06, 08, and 16 ($10_{16}$). Function codes 03 and 04 are used interchangeably to obtain register data. Function code 06 can only be used to set the few single configuration registers (Section <Register Access Configuration>).

## Block of registers

A block of registers (from the register column of **Table 4** or **Table 5**) can be established in the MCAM to remap the object registers of an Eaton product. The block of registers list is stored in non-volatile memory.

Function code 16 ($10_{16}$) is used to load the object assignments for the block of registers. The block assignments are stored beginning at register 41001/420481 ($03E8_{16}$/$5000_{16}$). Only the first object register address is assigned within the block of registers. For example, although object $I_A$ occupies registers 404611 ($1202_{16}$) and 404612 ($1203_{16}$), only register address ($1202_{16}$) is loaded into the block of assignment registers. Verification of this block of assignment registers can be read from the MCAM by a read function code 03 or 04 from these 41001/420481 ($03E8_{16}$/$5000_{16}$) registers.

Data pertaining to the objects configured in the block of assignment registers is mapped into registers starting at 41201/420737 ($04B0_{16}$/$5100_{16}$) and continuing in successive order for each object assigned. The number of objects and their placement order in this data block of registers is dependent on the configuration of the block of assignment registers. The total number of data block of registers is limited to 100.

**Note:** An object can occupy two or four registers.

The data can be obtained from the data block of registers by a read function code 03 or 04. The address of the starting object must be aligned with a starting address of an object within the data block of registers. The number of registers to obtain must align with an ending address of an object within the data block of registers.

## Register access configurations

Non-volatile register 42001/425345 ($07D0_{16}$/$6300_{16}$) is used to configure the MCAM to respond to a group of data objects, of which some objects are invalid within that group. When non-zero (factory default value), any attempt to access a group of data objects that contain an invalid object will result in an illegal data object exception code 02. Refer to a later section entitled "Exception codes."

When register 42001/425345 ($07D0_{16}$/$6300_{16}$) is set to zero, however, the MCAM will respond to a group of objects with data contained in the valid objects of the group along with an illegal value, if available else $0000_{16}$ data contained in the invalid objects.

Non-volatile register 42002/425346 ($07D1_{16}$/$6301_{16}$) is used to configure 32-bit IEEE® floating point word order. When non-zero (factory default), the floating point low order word is first in the Modbus register space.

When register 42002/425346 ($07D1_{16}$/$6301_{16}$) is set to zero, however, the floating point high order word is first in the Modbus register space.

Non-volatile register 42002/425347 ($07D1_{16}$/$6302_{16}$) is used to configure 32-bit fixed point and 64-bit energy word order. When non-zero (factory default), the fixed point and energy low order word is first in the Modbus register space.

When register 42003/425347 ($07D2_{16}$/$6302_{16}$) is set to zero, however, the fixed point and energy high order word is first in the Modbus register space.

Registers not containing a 32-bit or 64-bit format, such as Status and Product ID binary encoded objects, and MCAM control of product registers are not affected by the word order configuration registers.

Configuring any or all registers 42001/425345 through 42003/425347 ($07D0_{16}$/$6300_{16}$ through $07D2_{16}$/$6302_{16}$) is accomplished using a write function code 06 or 16 ($10_{16}$).

## Control of product

Since a control error could result in unwanted actions initiated by a device, the MCAM requires a specific protocol by the Modbus master in order to perform control-related functions within the product.

A set of registers is reserved for the control protocol.

They begin at register 42901/425089 ($0B54_{16}$/$6200_{16}$) and extend through 42903/425091 ($0B56_{16}$/$6202_{16}$). These three registers are written with a ‘slave action number’ and its 1’s complement using function code 16 ($10_{16}$). The current ‘slave action numbers’, their support being product dependent, are listed in **Table 7**. The format of the data is shown in **Figure 14**. These three registers, and only these three registers, must be written in one Modbus transaction.

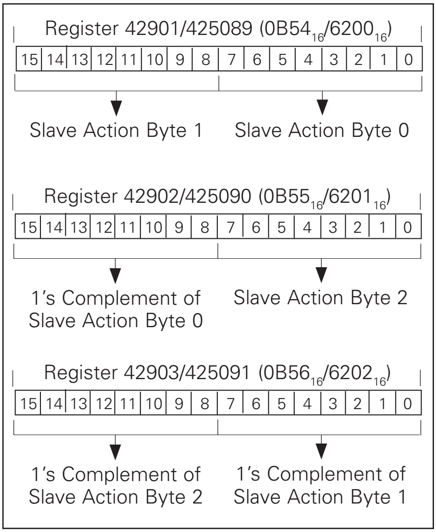



**Figure 14. Control of Product Data Format**

If the ‘slave action number’ and it 1’s complement are valid, the MCAM issues the ‘slave action’ control command to the product. If the slave action request is successfully acknowledged by the product, the MCAM returns a normal function code 16 ($10_{16}$) response to the Modbus master. The Modbus master may further determine if the product completed the slave action function successfully by interrogating the product, for example, by reading its status.

If the product does not acknowledge the slave action request, the MCAM returns an exception code 04. If the ‘slave action number’ and its 1’s complement are invalid, the MCAM responds to the Modbus master with a data value illegal exception code 03. Refer to a later section entitled “Exception codes.”

## Date and time registers

Access to date and time registers provide the opportunity for a Modbus master to set up and/or read real-time clock information within an Eaton product. Eight registers, beginning at register number 402921 (i.e., holding register address $0B68_{16}$), are reserved for this information, as defined in **Table 8**. Registers are read using function code 03 or 04 and written using function code 16 ($10_{16}$).

## Energy format

Energy objects in the MCAM are supported in two-register fixed point object format and a four-register power/mantissa format. These objects do not support IEEE floating point format.

The two-register format is presented in units of kilowatthours and is valid for products reporting energy in watthours or kilowatthours only. Products reporting in units greater than kilowatthours (for example, megawatthours) could not guarantee consistent kilowatthour resolution up to and through their rollover values.

All products reporting energy (independent of energy units) support the energy objects occupying four registers—Register 3 through Register 0. Register 3 is the high order register and Register 0 is the low order register.

Register 3 high byte contains a value corresponding to engineering units (power of 10 signed exponent). Register 3 low byte contains a mantissa multiplier value (power of 2 signed exponent).

Register 2 through Register 0 contains a 48-bit energy mantissa in units of watthours. Net and total energy objects are signed values. All other energy objects are unsigned values.

The data format of these four registers is given in **Figure 15**.

Energy = $2^{\text{Mantissa Multiplier}}$ x (48-bit energy value) x $10^{\text{Engineering Units}}$

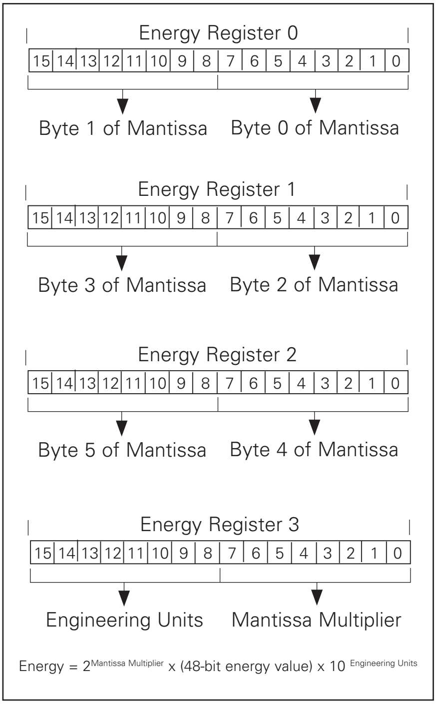



**Figure 15. Four-Register Energy Data Format**

## Supported diagnostic sub-functions

It is possible to obtain diagnostics from the MCAM or an attached product using function code 08. Refer to **Table 9**.

## Exception codes

Under certain circumstances, the MCAM will return an exception code.

- If the function in the query is not supported by the MCAM, exception code 01 is returned in the response
- If the data (object) register is illegal, exception code 02 is returned in the response
- If the data in the query is illegal, exception code 03 is returned
- If the attached product fails (usually a timeout), exception code 04 is returned
- In certain circumstances, an exception code 05 (NAK) is returned
- If the MCAM cannot perform the requested function, exception code 07 (NAK) is returned
- If only a partial register is used in the query, exception code 84 is returned

## Table 4. Modbus Register Map in Register Number Order

| Objects (Complete List) | | | Modbus Register Number | | Modbus Register Address | | | Modbus Products | |
|---|---|---|---|---|---|---|---|---|---|
| Name | Numeric | Units | IEEE Float | Fixed Point (FP) | IEEE Float (Hex) | Fixed Point (FP) (Hex) | FP Scale Factor | IZM91 and IZMX16 520M | IZM91 and IZMX16 1150 |
| Status cause ① | Primary | | 404609 or 406145 hi byte | | 1200 or 1800 hi byte | | | x | x |
| | Secondary | | 404609 or 406145 lo byte | | 1200 or 1800 lo byte | | | x | x |
| | Cause | | 404610 or 406146 | | 1201 or 1801 | | | x | x |
| Current | $I_A$ | A | 404611 | 406147 | 1202 | 1802 | 10 | x | x |
| | $I_B$ | A | 404613 | 406149 | 1204 | 1804 | 10 | x | x |
| | $I_C$ | A | 404615 | 406151 | 1206 | 1806 | 10 | x | x |
| | $I_G$ | A | 404617 | 406153 | 1208 | 1808 | 10 | x | x |
| | $I_N$ | A | 404619 | 406155 | 120A | 180A | 10 | x | x |
| L-L voltage | $V_{AB}$ | V | 404623 | 406159 | 120E | 180E | 10 | | x |
| | $V_{BC}$ | V | 404625 | 406161 | 1210 | 1810 | 10 | | x |
| | $V_{CA}$ | V | 404627 | 406163 | 1212 | 1812 | 10 | | x |
| L-N voltage | $V_{AN}$ | V | 404631 | 406167 | 1216 | 1816 | 10 | | x |
| | $V_{BN}$ | V | 404633 | 406169 | 1218 | 1818 | 10 | | x |
| | $V_{CN}$ | V | 404635 | 406171 | 121A | 181A | 10 | | x |
| Peak current | Peak $I_A$ demand | A | 404641 | 406177 | 1220 | 1820 | 10 | | x |
| | Peak $I_B$ demand | A | 404643 | 406179 | 1222 | 1822 | 10 | | x |
| | Peak $I_C$ demand | A | 404645 | 406181 | 1224 | 1824 | 10 | | x |
| Power | Real 3-phase (power) | W | 404651 | 406187 | 122A | 182A | 1 | | x |
| | Reactive 3-phase (power) | VAR | 404653 | 406189 | 122C | 182C | 1 | | x |
| | Apparent 3-phase (power) | VA | 404655 | 406191 | 122E | 182E | 1 | | x |
| Power factor | Apparent | pf | 404659 | 406195 | 1232 | 1832 | 100 | | x |

**Note:** Objects are two registers in length unless specified otherwise.

① The primary and secondary codes are mapped to the high and low bytes, respectively, of registers 404609 ($1200_{16}$) and 406145 ($1800_{16}$). The primary status codes are shown in **Table 10**. The secondary status codes are shown in **Table 11**. The cause-of-status codes are mapped to registers 404610 ($1201_{16}$) and 406146 ($1801_{16}$). The cause-of-status codes are shown in **Table 12**. The primary/secondary and cause-of-status must be read as a single two register object.

② These numeric entries have specific definitions dependent on the particular Eaton product.

## Modbus Register Map in Register Number Order (continued)

| Objects (Complete List) | | | Modbus Register Number | | Modbus Register Address | | | Modbus Products | |
|---|---|---|---|---|---|---|---|---|---|
| Name | Numeric | Units | IEEE Float | Fixed Point (FP) | IEEE Float (Hex) | Fixed Point (FP) (Hex) | FP Scale Factor | IZM91 and IZMX16 520M | IZM91 and IZMX16 1150 |
| Frequency | Freq | Hz | 404661 | 406197 | 1234 | 1834 | 10 | | x |
| Power | Peak demand | W | 404697 | 406233 | 1258 | 1858 | 1 | | x |
| | Real 3-phase (power) | W | 404715 | 406251 | 126A | 186A | 1 | | x |
| Power factor | pf ② | pf | 404717 | 406253 | 126C | 186C | 100 | | x |
| Product ID | Prod ID | | 404719 or 406255 | | 126E or 186E | | | x | x |
| Frequency | Freq | Hz | 404721 | 406257 | 1270 | 1870 | 100 | | x |
| (K) Energy | Forward | KWh | N/A | 406259 | N/A | 1872 | 1 | | x |
| | Reverse | KWh | N/A | 406261 | N/A | 1874 | 1 | | x |
| | Total ② | KWh | N/A | 406263 | N/A | 1876 | 1 | | x |
| | Apparent | KVAh | N/A | 406271 | N/A | 187E | 1 | | x |
| Energy (four reg. objects) | Forward | Wh | N/A | 406305 | N/A | 18A0 | 1 | | x |
| | Reverse | Wh | N/A | 406309 | N/A | 18A4 | 1 | | x |
| | Total ② | Wh | N/A | 406313 | N/A | 18A8 | 1 | | x |
| | Apparent | VAh | N/A | 406329 | N/A | 18B8 | 1 | | x |

**Note:** Objects are two registers in length unless specified otherwise.

① The primary and secondary codes are mapped to the high and low bytes, respectively, of registers 404609 ($1200_{16}$) and 406145 ($1800_{16}$). The primary status codes are shown in **Table 10**. The secondary status codes are shown in **Table 11**. The cause-of-status codes are mapped to registers 404610 ($1201_{16}$) and 406146 ($1801_{16}$). The cause-of-status codes are shown in **Table 12**. The primary/secondary and cause-of-status must be read as a single two register object.

② These numeric entries have specific definitions dependent on the particular Eaton product.

## Table 5. Modbus Register Map in Functional Number Order

| Objects (Complete List) | | | Modbus Register Number | | Modbus Register Address | | | Modbus Products | |
|---|---|---|---|---|---|---|---|---|---|
| Name | Numeric | Units | IEEE Float | Fixed Point (FP) | IEEE Float (Hex) | Fixed Point (FP) (Hex) | FP Scale Factor | IZM91 and IZMX16 520M | IZM91 and IZMX16 1150 |
| Product ID | Prod ID | | 404719 or 406255 | | 126E or 186E | | | x | x |
| Status cause ① | Primary | | 404609 or 406145 hi byte | | 1200 or 1800 hi byte | | | x | x |
| | Secondary | | 404609 or 406145 lo byte | | 1200 or 1800 lo byte | | | x | x |
| | Cause | | 404610 or 406146 | | 1201 or 1801 | | | x | x |
| Current | $I_A$ | A | 404611 | 406147 | 1202 | 1802 | 10 | x | x |
| | $I_B$ | A | 404613 | 406149 | 1204 | 1804 | 10 | x | x |
| | $I_C$ | A | 404615 | 406151 | 1206 | 1806 | 10 | x | x |
| | $I_G$ | A | 404617 | 406153 | 1208 | 1808 | 10 | x | x |
| | $I_N$ | A | 404619 | 406155 | 120A | 180A | 10 | x | x |
| | Peak $I_A$ demand | A | 404641 | 406177 | 1220 | 1820 | 10 | | x |
| | Peak $I_B$ demand | A | 404643 | 406179 | 1222 | 1822 | 10 | | x |
| | Peak $I_C$ demand | A | 404645 | 406181 | 1224 | 1824 | 10 | | x |
| L-L voltage | $V_{AB}$ | V | 404623 | 406159 | 120E | 180E | 10 | | x |
| | $V_{BC}$ | V | 404625 | 406161 | 1210 | 1810 | 10 | | x |
| | $V_{CA}$ | V | 404627 | 406163 | 1212 | 1812 | 10 | | x |
| L-N voltage | $V_{AN}$ | V | 404631 | 406167 | 1216 | 1816 | 10 | | x |
| | $V_{BN}$ | V | 404633 | 406169 | 1218 | 1818 | 10 | | x |
| | $V_{CN}$ | V | 404635 | 406171 | 121A | 181A | 10 | | x |
| Frequency | Freq | Hz | 404661 | 406197 | 1234 | 1834 | 10 | | x |
| | Freq | Hz | 404721 | 406257 | 1270 | 1870 | 100 | | x |

**Note:** All objects are two registers in length unless specified otherwise.

① The primary and secondary codes are mapped to the high and low bytes, respectively, of registers 404609 ($1200_{16}$) and 406145 ($1800_{16}$). The primary status codes are shown in **Table 10**. The secondary status codes are shown in **Table 11**. The cause-of-status codes are mapped to registers 404610 ($1201_{16}$) and 406146 ($1801_{16}$). The cause-of-status codes are shown in **Table 12**. The primary/secondary and cause-of-status must be read as a single two register object.

② These numeric entries have specific definitions dependent on the particular Eaton product.

## Modbus Register Map in Functional Number Order (continued)

| Objects (Complete List) | | | Modbus Register Number | | Modbus Register Address | | | Modbus Products | |
|---|---|---|---|---|---|---|---|---|---|
| Name | Numeric | Units | IEEE Float | Fixed Point (FP) | IEEE Float (Hex) | Fixed Point (FP) (Hex) | FP Scale Factor | IZM91 and IZMX16 520M | IZM91 and IZMX16 1150 |
| Power | Real 3-phase (power) | W | 404715 | 406251 | 126A | 186A | 1 | | x |
| | Peak demand | W | 404697 | 406233 | 1258 | 1858 | 1 | | x |
| | Real 3-phase (power) | W | 404651 | 406187 | 122A | 182A | 1 | | x |
| | Reactive 3-phase | VAR | 404653 | 406189 | 122C | 182C | 1 | | x |
| | Apparent 3-phase | VA | 404655 | 406191 | 122E | 182E | 1 | | x |
| Power factor | pf ② | pf | 404717 | 406253 | 126C | 186C | 100 | | x |
| | Apparent | pf | 404659 | 406195 | 1232 | 1832 | 100 | | x |
| (K) Energy | Forward | KWh | N/A | 406259 | N/A | 1872 | 1 | | x |
| | Reverse | KWh | N/A | 406261 | N/A | 1874 | 1 | | x |
| | Total ② | KWh | N/A | 406263 | N/A | 1876 | 1 | | x |
| | Apparent | KVAh | N/A | 406271 | N/A | 187E | 1 | | x |
| Energy (four reg. objects) | Forward | Wh | N/A | 406305 | N/A | 18A0 | 1 | | x |
| | Reverse | Wh | N/A | 406309 | N/A | 18A4 | 1 | | x |
| | Total ② | Wh | N/A | 406313 | N/A | 18A8 | 1 | | x |
| | Apparent | VAh | N/A | 406329 | N/A | 18B8 | 1 | | x |

**Note:** All objects are two registers in length unless specified otherwise.

① The primary and secondary codes are mapped to the high and low bytes, respectively, of registers 404609 ($1200_{16}$) and 406145 ($1800_{16}$). The primary status codes are shown in **Table 10**. The secondary status codes are shown in **Table 11**. The cause-of-status codes are mapped to registers 404610 ($1201_{16}$) and 406146 ($1801_{16}$). The cause-of-status codes are shown in **Table 12**. The primary/secondary and cause-of-status must be read as a single two register object.

② These numeric entries have specific definitions dependent on the particular Eaton product.

## Table 6. MCAM Configuration Registers

| Register Definition | R/W | Modbus Register$_{10}$ Number Low | Modbus Register$_{10}$ Number High | Modbus Register Address$_{16}$ Low | Modbus Register Address$_{16}$ High | Number of Registers$_{10}$ |
|---|---|---|---|---|---|---|
| Mapped block of registers configuration | R/W | 41001 | 420481 | 03E8 | 5000 | 100 |
| Mapped block of registers data | R | 41201 | 420737 | 04B0 | 5100 | 4 * 100 |
| Invalid object access configuration | R/W | 42001 | 425345 | 07D0 | 6300 | 1 |
| Floating Pt data word order configuration | R/W | 42002 | 425346 | 07D1 | 6301 | 1 |
| Fixed Pt data word order configuration | R/W | 42003 | 425347 | 07D2 | 6302 | 1 |
| Supervisory control query | R/W | 42901 | 425089 | 0B54 | 6200 | 3 |
| Date and time registers | R/W | 42921 | | 0B68 | | 8 |

## Table 7. Control 'Slave Action Number' Definitions

| Control Group | Definition | Byte 2 | Byte 1 | Byte 0 |
|---|---|---|---|---|
| Reset | Reset trip | 0 | 0 | 2 |
| | Reset (peak) demand-watts | 0 | 0 | 4 |
| | Reset (synchronize) demand watts window | 0 | 0 | 64 ($40_{16}$) |
| | Snapshot command | 0 | 0 | 128 ($80_{16}$) |
| | Reset (peak) demand-currents | 0 | 1 | 1 |
| | Reset all min./max. values | 0 | 1 | 4 |
| | Unlock waveform buffer (clear upload-in-progress) | 0 | 1 | 5 |
| | Reset min./max. currents | 0 | 1 | 13 |
| | Reset min./max. PF-apparent | 0 | 1 | 16 |
| Circuit breaker open-close | Open request | 1 | 0 | 0 |
| | Close request | 1 | 0 | 1 |
| | Enable Maintenance Mode | 1 | 0 | 8 |
| | Disable Maintenance Mode | 1 | 0 | 9 |

**Table 8. Date and Time Register Definitions**

| Definition | Register Number (Decimal) | Register Address (Hexadecimal) | Data Range (Decimal) |
|---|---|---|---|
| Month | 402921 | 0B68 | 1–12 |
| Day | 402922 | 0B69 | 1–31 |
| Year | 402923 | 0B6A | |
| Day of week | 402924 | 0B6B | 1=Sunday...7=Saturday |
| Hour | 402925 | 0B6C | 0–23 |
| Minute | 402926 | 0B6D | 0–59 |
| Second | 402927 | 0B6E | 0–59 |
| 1/100th second | 402928 | 0B6F | 0–99 |

**Table 9. Diagnostic Sub-Function Numbers**

| Sub-Function No. (Decimal) | Name |
|---|---|
| 0 | Echo query |
| 1 | Restart communications |
| 4 | Force listen |
| 10 | Clear MCAM/slave product counters |
| 11 | Modbus UART bus message count |
| 12 | Modbus UART communication error count |
| 13 | MCAM exception error count |
| 14 | MCAM message count |
| 15 | MCAM no response count |
| 16 | MCAM NAK count |
| 17 | MCAM busy count |
| 18 | Modbus UART over run error count |
| 20 | Clear Modbus UART counters |
| 21 | Slave product checksum error count |
| 22 | Slave product over run count |
| 23 | Modbus UART framing error count |
| 24 | Modbus UART noise error count |
| 25 | Modbus UART parity error count |
| 26 | MCAM firmware version & rev |
| 27 | MCAM firmware month & day |
| 28 | MCAM firmware year |
| 29 | Reset MCAM block-of-registers |

**Table 10. Primary Status Code Definitions**

| Code | Definition |
|---|---|
| 0 | Unknown |
| 1 | Open |
| 2 | Closed |
| 3 | Tripped |
| 4 | Alarmed |
| 13 | Pickup |

**Table 11. Secondary Status Code Definitions**

| Code | Definition |
|---|---|
| 0 | Unknown |
| 3 | Test mode |
| 7 | Powered up |
| 8 | Alarm |

**Table 12. Cause-of-Status Code Definitions**

| Code | Definition | Code | Definition |
|---|---|---|---|
| 0 | Unknown | 65 | Reverse power |
| 1 | Normal operating mode | 66 | Fixed instantaneous phase overcurrent #2 |
| 3 | Instantaneous phase overcurrent | 67 | Reverse phase |
| 11 | Overvoltage | 68 | Reverse sequence |
| 12 | Undervoltage | 69 | Phase current loss |
| 15 | Underfrequency | 71 | Alarm active |
| 16 | Overfrequency | 72 | Bad frame |
| 17 | Current unbalance | 73 | Phase currents near pickup |
| 18 | Voltage unbalance | 75 | Making current release |
| 19 | Apparent power factor | 76 | Fixed instantaneous phase overcurrent #3 |
| 26 | Power demand | 77 | Set points error |
| 27 | VA demand | 78 | Over-temperature |
| 30 | Total harmonic distortion | 80 | Long delay neutral overcurrent |
| 31 | Operations count | 82 | Historical data |
| 33 | Control via communications | 84 | Ground fault (instantaneous or delay) |
| 37 | Coil supervision | 85 | Earth fault (instantaneous or delay) |
| 39 | RAM error | 146 | Frequency out of range |
| 43 | EEROM error | 148 | Check auxiliary switch |
| 46 | Watchdog | 149 | Overcurrent |
| 61 | Long delay phase overcurrent | 153 | Maintenance mode |
| 62 | Short delay phase overcurrent | 154 | Breaker mech. fault |
| 63 | Fixed instantaneous phase overcurrent #1 | 156 | Disconnect position |
| 64 | Bad/missing rating plug | 157 | Shunt trip problem |

## Section 8: Troubleshooting

The following are the most common issues experienced with the installation of an IZM91 and IZMX16 Modbus communications adapter module.

**Observation 1—Status LED not flashing**

**Action**—Verify proper input power to module connectors.

**Observation 2—Status LED flashing green, but module does not change state in response to master command requests**

**Action**—Verify correct module address.

**Action**—Verify communication cable is connected correctly from master to module.

**Eaton Industries GmbH**
**Electrical Sector**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