# CARD-CDC-40
# MODBUS OUTPUT OPTION CARD
MANUAL

## 1. DESCRIPTION

This product bulletin covers the MODBUS Communication Card for the PAX family of Meters. The card will allow the Meters to transmit Display Values, Setpoints and Reset Values via MODBUS RS485 communication, in the RTU and ASCII modes.

## 2. MODBUS SPECIFICATIONS

### 2.1. Types

RS485; RTU and ASCII MODBUS modes

### 2.2. Isolation to sensor & user input commons

500Vrms for 1 min. Working Voltage: 50V. Not isolated from all other commons.

### 2.3. Baud rate

300 to 38400 Bauds

### 2.4. Data format

7/8 bits

### 2.5. Parity

No, Odd or Even

### 2.6. Address

1 to 247

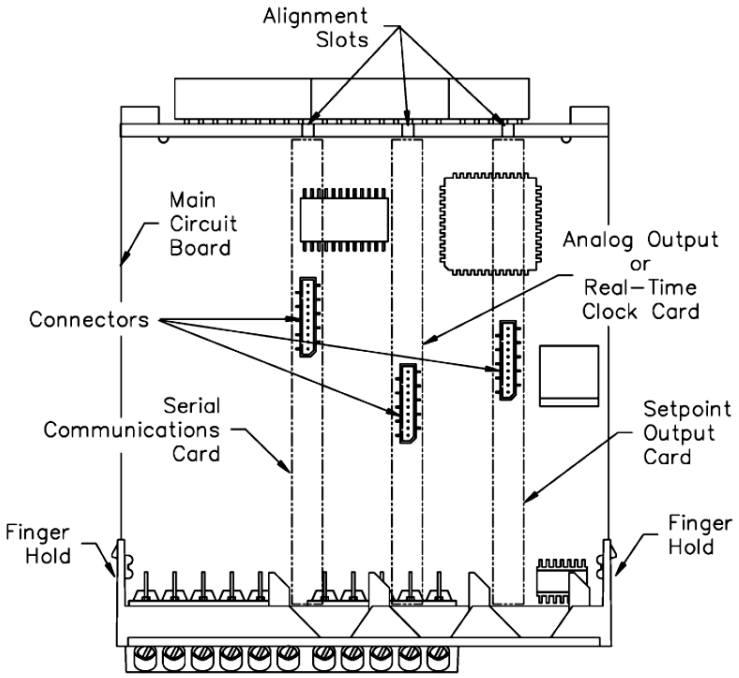
### 2.7. Transmit delay

Programmable; see transmit delay explanation.

## 3. INSTALLING AN OPTION CARD

**Caution:** The option and main circuit cards contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.

**Warning:** Exposed line voltage exists on the circuit boards. Remove all power to the meter AND load circuits before accessing the unit.



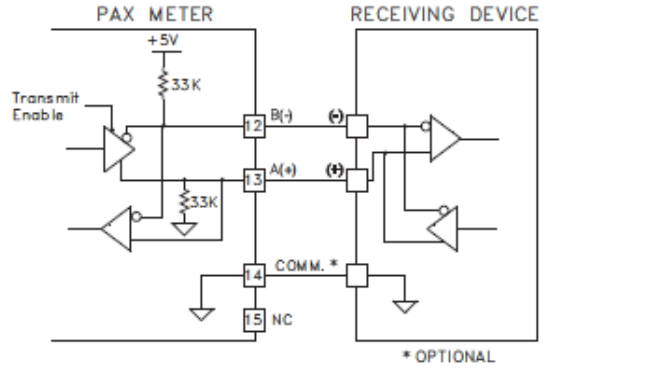
1. Remove the main assembly from the rear of the case. Squeeze the finger holds on the rear cover, or use a small screwdriver to depress the side latches to release it from the case. It is not necessary to separate the rear cover from the main circuit card.
2. Locate the option card connector for the serial communication card. Hold the unit by the rear cover, not the display board, when installing an option card.
3. Install the option card by aligning the option card with the slot in the rear cover. Be sure the connector is fully engaged and the tab on the option card rests in the alignment slot on the display board.
4. Slide the assembly back into the case. Be sure the rear cover latches fully into the case.

## 4. ORDERING INFORMATION

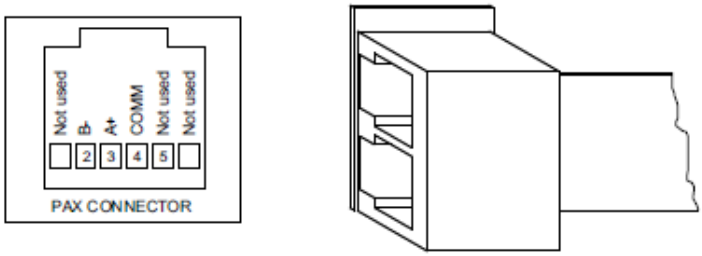
| MODEL NO. | DESCRIPTION | PART NUMBER |
|---|---|---|
| CARD-CDC | MODBUS Output Card | CARD-CDC-40 |
| | MODBUS Output Card with RJ11 Connector | CARD-CDC-4C |

## 5. RS485 COMMUNICATIONS

The RS485 communication standard allows the connection of up to 32 devices on a single pair of wires, distances up to 4,000 ft. and data rates as high as 10M baud (the PAX is limited to 19.2k baud). The same pair of wires is used to both transmit and receive data. An RS485 bus is therefore always half-duplex, that is, data cannot be received and transmitted simultaneously.



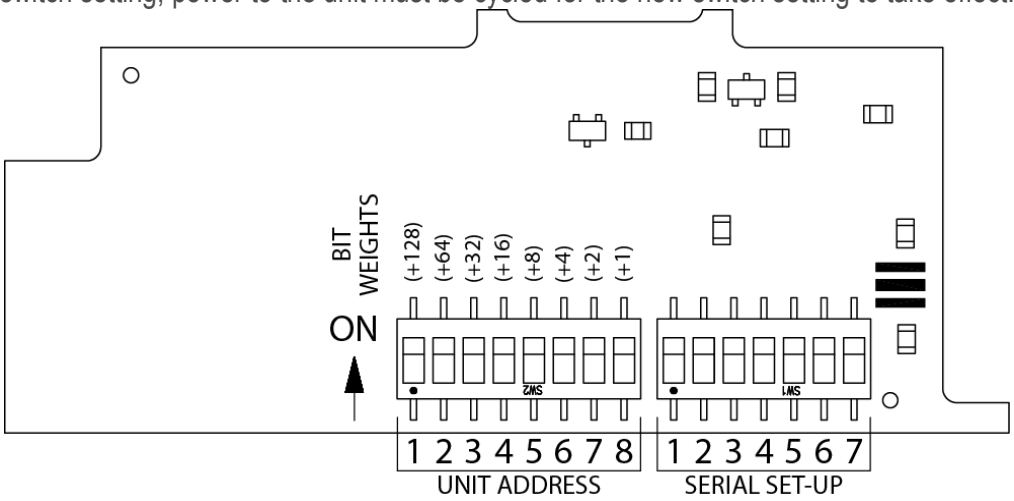

Terminal Block Connection Figure




Extended Comms Connection Figure

## 6. SERIAL SET-UP DIP SWITCH OPERATION

Serial port configuration is accomplished through two banks of DIP switches on the MODBUS card. The bank of 8 switches sets the Unit Address, the bank of 7 switches sets the Serial port parameters (ASCII/RTU, 7/8 bits, Parity, and Baud rate). Changes to the switch settings are only detected on power-up of the unit. After changing a switch setting, power to the unit must be cycled for the new switch setting to take effect.




Both unit address and serial set-up are set via DIP switches on the MODBUS option card. See the DIP switch setting table for more details on these DIP switches.
For the Unit Address bank, the high order bit is switch 1, and the ON position is a '1', the OFF position is a '0'. Legal unit addresses are 1 to 247. When a Unit Address of 0 is selected, the card responds to Unit Address 1. When a Unit Address of 248 through 255 is selected, the card responds to Unit Address 247.
For the serial bank, the following settings apply:

| SWITCH | SETTING AVAILABLE | | FACTORY SETTINGS |
|---|---|---|---|
| 1 | OFF: ASCII | ON: RTU | RTU |
| 2 | OFF:7 bits | ON: 8 Bits | 8 Bits |
| 3 | OFF: None | ON: Parity | No Parity |
| 4 | OFF: Even | ON: Odd | OFF |
| 5 | Baud Rate | See Baud Switch Selections | 9600 |
| 6 | Baud Rate | | |
| 7 | Baud Rate | | |

### 6.1. Baud rate switch selection

| | 5 | 6 | 7 |
|---|---|---|---|
| 38400 | ON | ON | ON |
| 19200 | ON | ON | OFF |
| 9600 | ON | OFF | ON |
| 4800 | ON | OFF | OFF |
| 2400 | OFF | ON | ON |
| 1200 | OFF | ON | OFF |
| 600 | OFF | OFF | ON |
| 300 | OFF | OFF | OFF |

## 7. MODBUS SUPPORTED FUNCTION CODES

### 7.1. Coil functions

FC01: Read Coils

FC05: Force Single Coil, FC15: Force Multiple Coils.

1. Valid coil addresses are 1-49.
2. Block starting point can not exceed coil 49.

### 7.2. Hold registers functions

FC03: Read Holding Registers.

FC06: Preset Single Register, FC16: Preset Multiple Registers.

1. Valid register address are 40001 – 40039, 40041, 40042, 41001 – 41010.
2. Up to 16 registers can be requested at one time.
3. Block starting point can not exceed the register boundaries.
4. Holding registers are a mirror of Input registers (FC04).
5. Unused registers will return a value of HEX <8000>.
6. If a register is implemented, but does not exist for a particular unit configuration (such as SP3, SP4) a value of HEX <0000> will be returned.
7. Registers 41001 – 41010 contain the slave ID. See FC17.
8. Broadcast write is supported for FC06 & FC16. Register writes using address "0" will be recognized by the MODBUS card, regardless of address DIP switch setting.

### 7.3. Other supported functions

FC04: Returns the same values as FC03, except the register number starts with "3" (Ex: Pax Input Hi is 30001)

FC08 – Fetch Comm. Event Counter.

The MODBUS response breaks down as follows:

":010804"<TOT HI><TOT LO><GOOD HI><GOOD LO>XX<CR><LF>

The "TOT HI" and "TOT LO" values are the total number of messages that were received, that started with the card's address. The "GOOD HI" and "GOOD LO" are "good" messages (correct address, parity, and checksum). The values are reset on power up and every time the FC08 function is requested.

FC17 - Report Slave ID.

The following is sent upon FC17 request: Unit Address, 17 (FC code), RLC-PAX? 00?0, 0100 (for code version 1.00), 16 (number of read supported registers), 16 (number of write supported registers), 00 (number of registers available for GUID/Scratch pad memory), checksum of the string.

## 8. MANUAL MODE DESCRIPTION

### 8.1. (CSR) Control Status Register [40021]

The Control Status Register is used to directly control the meter's outputs (setpoints and analog output). The register is bit mapped with each bit position within the register assigned to a particular control function. The control functions are invoked by writing to each bit position. The bit position definitions are:

Bit 0: SP1 Output
Bit 1: SP2 Output
Bit 2: SP3 Output
Bit 3: SP4 Output

0 = output off
1 = output on

Bit 4: Manual mode

0 = automatic mode
1 = manual mode

Bit 5: Always stays 0, even if 1 is sent.
Bit 7: Always stays 0, even if 1 is sent.
In Manual Mode, the setpoint outputs are defined by the values written to bits b0, b1, b2, b3; and the analog output is defined by the value written to the AOR. Internal control of these outputs is then overridden. In automatic mode, the setpoint outputs can only be reset off.

### 8.2. (AOR) Analog Output Register

The Analog Output Register controls the analog output of the meter. The manual mode must first be engaged by setting bit 4 of the CSR. The range of values of this register is 0 to 4095, which corresponds to 0 mA, 0 V and 20 mA, 10 V; respectively. If a value larger than 4095 is written to the AOR register, 4095 will be loaded. The table lists correspondence of the output signal with the register value.

| REGISTER VALUE | OUTPUT SIGNAL* I (mA) | V (V) |
|---|---|---|
| 0 | 0.000 | 0.000 |
| 1 | 0.005 | 0.0025 |
| 2047 | 10.000 | 5.000 |
| 4094 | 19.995 | 9.9975 |
| 4095 | 20.000 | 10.000 |

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (20 mA or 10 V)*

Writing to this register while the meter is in the manual mode causes the output signal to update immediately. While in the automatic mode, this register may be written to, but the output will not update until the meter is placed in manual mode.
Examples:

1. Set output to full scale:
   Value to write to holding register 40020
2. Set output to zero scale:
   Value to write to holding register 40020

## 9. HOLDING REGISTERS

Values less than 65,535 will be in (LO word). Values greater than 65,535 will continue into (HI word). Negative values are represented by two's complement of the combined (HI word) and (LO word).
Numeric data is limited to value -19999 to 99999. Any unused register will return a value of HEX <8000>.

| HOLDING REGISTER | | ACCESS |
|---|---|---|
| 40001 | Input (HI) | Read only |
| 40002 | Input (LO) | Read only |
| 40003 | Total (HI) | Read only |
| 40004 | Total (LO) | Read only |
| 40005 | Min (HI) | Read only |
| 40006 | Min (LO) | Read only |
| 40007 | Max (HI) | Read only |
| 40008 | Max (LO) | Read only |
| 40009 | SP1 (HI) | Read/Write |
| 40010 | SP1 (LO) | Read/Write |
| 40011 | SP2 (HI) | Read/Write |
| 40012 | SP2 (LO) | Read/Write |

| HOLDING REGISTER | | ACCESS |
|---|---|---|
| 40013 | SP3 (HI) | Read/Write |
| 40014 | SP3 (LO) | Read/Write |
| 40015 | SP4 (HI) | Read/Write |
| 40016 | SP4 (LO) | Read/Write |
| 40017 | Polling1 | Read/Write |
| 40018 | Reset | Read/Write |
| 40019 | TRX Delay[1] | Read/Write |
| 40020 | AOR[2] | Read/Write |
| 40021 | CSR | Read/Write |
| 40022 | Terminate1 | Read/Write |

## 10. COIL TABLE

Any unused register will return a value of HEX <8000>.

| COIL ADDRESS | COIL NUMBER | COIL NAME | MIRROR REGISTER |
|---|---|---|---|
| 01 | 0 | SP1 Output | 40021 (bit 0) |
| 02 | 1 | SP2 Output | 40021 (bit 1) |
| 03 | 2 | SP3 Output | 40021 (bit 2) |
| 04 | 3 | SP4 Output | 40021 (bit 3) |
| 05 | 4 | Reset max | 40018 (bit 2) |
| 06 | 5 | Reset min | 40018 (bit 3) |
| 10 | 9 | Reset total | 40018 (bit 4) |
| 11 | 10 | Poll input | 40017 (bit 0) |
| 12 | 11 | Poll total | 40017 (bit 1) |
| 13 | 12 | Poll max | 40017 (bit 2) |
| 14 | 13 | Poll min | 40017 (bit 3) |
| 15 | 14 | Poll SP1I | 40017 (bit 4) |
| 16 | 15 | Poll SP2 | 40017 (bit 5) |
| 17 | 16 | Poll SP3 | 40017 (bit 6) |
| 18 | 17 | Poll SP4 | 40017 (bit 7) |
| 19 | 18 | Poll AOR | 40017 (bit 8) |
| 20 | 19 | Poll CSR | 40017 (bit 9) |
| 21 | 20 | Team total | 40022 (bit 0) |
| 22 | 21 | Team max | 40022 (bit 1) |
| 23 | 22 | Team min | 40022 (bit 2) |
| 24 | 23 | Team SP1 | 40022 (bit 3) |
| 25 | 24 | Team SP2 | 40022 (bit 4) |

[1] TRX delay is the minimum time from the reception of the last character in the MODBUS Query until the response is started. The minimum delay value is equal to 2 character times (2 msec min.). The user can increase the delay time by writing to the TRX Delay register. Any value written to the TRX Delay register that is less than the value calculated at power up will be ignored. The TRX Delay value is stored in EEPROM memory. On power-up, the calculated value is compared to the value read back from the EEPROM. The greater of the 2 values will be used as the TRX Delay value and will be written to the TRX Delay register.

[2] If a value larger than 4095 is written to the AOR register, 4095 will be loaded.

| COIL ADDRESS | COIL NUMBER | COIL NAME | MIRROR REGISTER |
|---|---|---|---|
| 26 | 25 | Team SP3 | 40022 (bit 5) |
| 27 | 26 | Team SP4 | 40022 (bit 6) |
| 28 | 27 | Team AOR | 40022 (bit 7) |
| 29 | 28 | Team CSR | 40022 (bit 8) |
| 30 | 29 | Response delay | 40017 (bit 10) |

## 11. COIL DESCRIPTIONS

### 11.1. Coils 1-4: Output Coils

These coils are used to read or change the states of the Setpoint Outputs. To change the state of the output(s), the output(s) must be in manual mode. Refer to the CSR or MMR/SOR registers in the Manual Mode Description section.

### 11.2. Coils 5-10: Reset Coils

These coils are used to perform the Reset command for the values listed. Forcing the coil "on" causes the appropriate value in the unit to be reset. The coil is cleared after the command is executed, therefore, the coil value read will always be 0 (zero).

### 11.3. Coils 11-29: Polling Coils

The MODBUS card is continually requesting values from the meter. The polling bit coils determine what values are requested during each loop. Setting the coils to "1" enables the card to poll that particular value. A "0" value disables it. Turning polling coils off allows the user to request fewer values and therefore decreases the internal loop time, which allows the values that are polled to be updated more often.
If a MODBUS read is issued for any value, that value is automatically updated to the latest value, regardless of whether the polling bit is on or off. On power up, all values are updated regardless of Polling bit settings. Polling coil values are saved in EEPROM memory. Factory settings are "on" for all Polling coils.

| TYPICAL UPDATE TIMES** |
|---|
| All values (10) – 1,15ms |
| 5 values – 500ms |
| 1 value – 100ms |

***Update time is the typical time to update the internal memory provided no MODBUS requests are incoming.*

### 11.4. Coils 21-29: Terminating Coils

This set of coils determines what terminating character is sent to the meter when a write command is executed. If the flag is 0, a $ is used as the terminating character and the value is not saved to EEPROM memory in the meter. If the flag is 1, an * is used as the terminating character and the value is saved to EEPROM memory.

### 11.5. Coil 30: Response Delay

When a write command is issued, the new value is written to the meter. If the coil is off, the MODBUS write response is not issued until the value is read back from the meter. For MODBUS reads, if a polling coil is off, the response is not issued until the latest value is read back from the meter. If the coil is set "on" the MODBUS response is issued as soon the received command is complete. The write coil is saved in EEPROM memory. Factory setting is on.