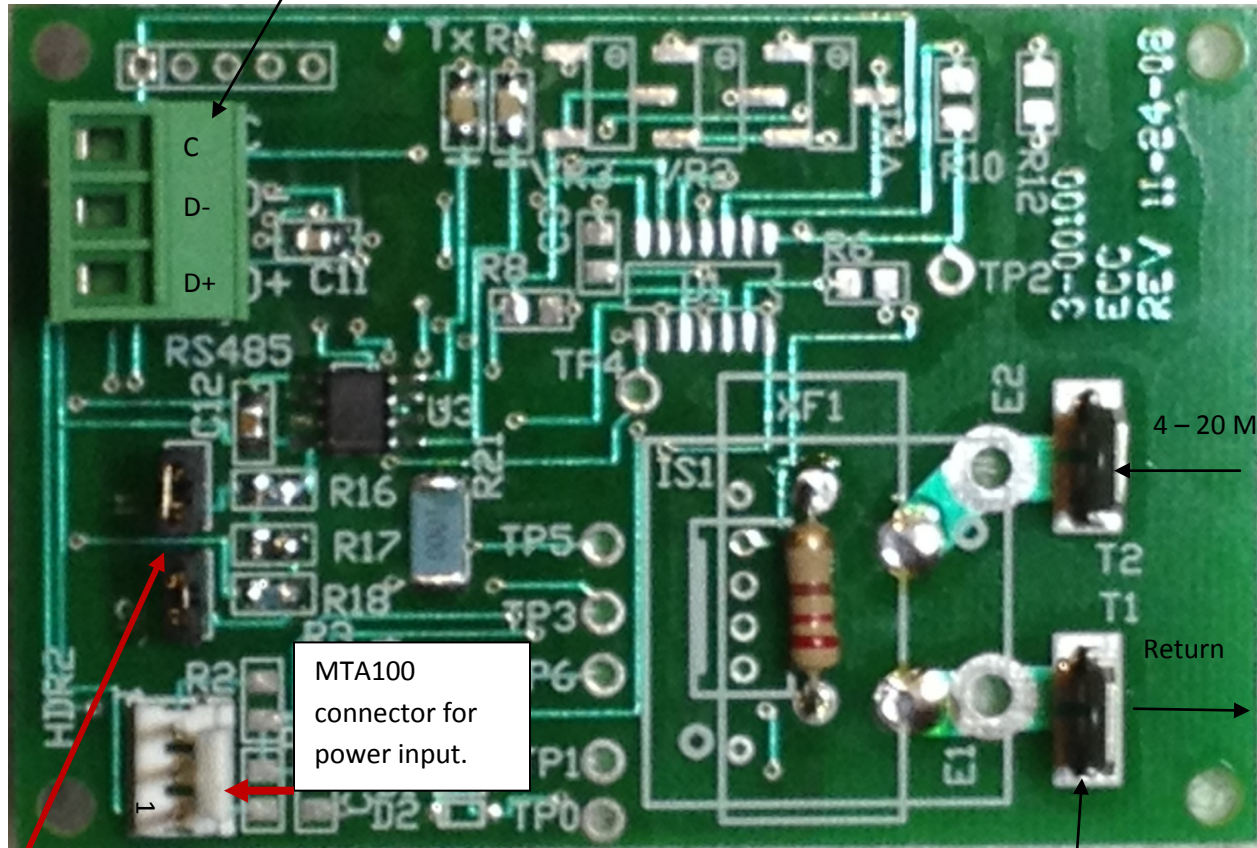


Signal Conditioner 4 to 20 MA with Modbus Communications

January 23, 2014

Modbus/RS485 connector.



Jumpers for RS485 bus load.

0.250 Faston Terminals

4 – 20 MA input

Return

Model Number: MOD4-20

Features:

- Converts the output from a 4 to 20 milliamp device to 0.88 – 4.4 VDC.
- The voltage is converted by a 10 bit ADC to a count from 180 to 901.
- The count is transferred to the master controller when the MOD4-20 slave is polled.
- The count transferred is the average of eight readings.
- The MOD4-20 can be configured to retain the highest average reading until polled.
- The MOD4-20 requires a +5 VDC @ 100 MA power supply.
- Protocol can be switched from Modbus to Simple ASCII Protocol.
- Operating temperature -40 to +85°C.

Note: The voltage greater than 4.4 (ADC count greater than 901) is reserved for devices using current greater than 20 MA to indicate out of range conditions.

Mounting: The MOD4-20 can be panel mounted, three inch Snap Track mounted, or optional adapters can be added to the Snap Track for DIN Rail mounting. The circuit board measures 2.0 x 2.95 inches.

The MOD4-20 uses default values at power up/reset if not previously programmed. To restore defaults to a programmed device, jumper pins 2 and 5 on program header and cycle power, or use the reset command.

Defaults:

- Unit address: 0x01.
- MODBUS Protocol: RTU
- Baud Rate: 19.2K, 8, N, 2 - Compatible with Automation Direct PLCs and VFDs.

Applications:

- Use the MOD4-20 in any application where a 4 to 20 MA device's output needs to be converted to digital information.
- Especially useful when the circuit to be monitored is not near the master controller. RS485 [twisted pair bus](#) can operate up to 4000 ft.
- Especially useful when no other analog to digital modules are available.
- Use when a PLC can't take the heat.

The MOD4-20 was designed to operate as a slave device on a RS485, Modbus network. The master can be any controller such as a PC or PLC that communicates using a RS485 network and the Modbus protocol. It can be slaved to ECC's DCB2620 when operating as a network master.

The MOD4-20 has a PIC18F1320 microcontroller which can be re-programmed in circuit. Code developers can refer to the DCB2620 manual for instructions on programming PIC18Fxxxx units.

MODBUS Read and Write Commands:

MOD4-20 uses MODBUS read command (0x03) and write one word command (0x06). If a RS485 master such as the Automation Direct DL06 sends command 0x10 i.e. write multiple words command, the MOD4-20 will process it as command 0x06 and write the first data word to memory.

Command Table:

Hex Write Addr	(MODBUS)	CMD	Function
0x280	V1200	0x03	Master writes to slave – Slave returns ADC count.
0x281	V1201	0x06	Writes LS byte of data word to EEPROM unit address. *1, *2
0x282	V1202	0x06	Writes LS byte of data word to EEPROM baud rate address. *2
0x283	V1203	0x06	Writes LS byte of data word to EEPROM protocol address. *2
0x288	V1210	0x06	Writes LS byte of data word to EEPROM ADC hold until read config.
0x299	V1231	0x06	Writes LS byte of data word to RESET unit. *3

NOTE: Configuration commands 0x281 – 0x283 do not take effect until the unit is reset. The changes are stored in non-volatile memory and become the operating parameters after a power cycle, or after a reset command.

NOTES:

*1 The default address is 0x01. If multiple units are on the same RS485 network, the addresses must be changed for all but one of the units. This is normally done using a free Configuration program that can be downloaded from ECC's Website.

The address can also be changed using an ASCII terminal program as follows:

- RESET MOD4-20
- Send keyboard <ESC> character (decimal 27, or hex 0x1B).
- Address MS character <MS> + <LS> +<E> excluding 27 and 69, the allowable address range is 01 to 99.

Example: Enter address 16 (0x10).

RESET unit.

Enter keys: <ESC> <1> <6> <E>

No spaces between keys.

This is only place where decimal data are entered. RTU data is HEX.

To enter addresses 1 – 9: <ESC> <0> <n> <E>

If the address is set this way, the unit does a self reset. The programming device can be removed, and the network RS485 terminal block plugged in. The unit will start responding to its new address.

*2. New values take effect after RESET (command or power cycle).

*3. This command can be used to reset a unit instead of a power cycle.

Broadcast Data:

If it is desirable to change a parameter in all networked devices, the broadcast slave address can be used. The slave address of zero (0x00) causes all units on the network to receive the command. For example, a broadcast command to change the baud rate, followed by a broadcast reset command would cause all units to switch baud rates at the same time.

MODBUS write (one word) command 6, 0x06:

Send: |slave addr.|CMD 6|write Hi addr.|write Low addr.|data Hi|data low|crc Low|crc Hi|

Example: Address slave 5 and write 0x03 to 0x281 i.e. change slave address to 0x03 .
|0x05|0x06|0x02|0x81|0x00|0x03|crc Low|crc Hi|

Response:

The response is the same as the data sent if the slave received valid data. If invalid data was received, the slave will not respond – master must time out and continue.

MODBUS read command 3, 0x03:

Send: |slave addr.|CMD 3|starting Hi addr.|starting Low addr.|#words Hi|#words low|crc Low|crc Hi|

Response:

|slave addr.|CMD 3|#bytes|data Hi|data Low|-----| data n Hi|data n Low| crc Low|crc Hi|

Status Returned from MOD4-20 Response to Command 0x03 Read 0x280:

MODBUS RTU Serial Data Format:

|Unit Addr|CMD 0x03|#data bytes|data|CRC LO|CRC HI|

#data bytes = 2.

High data = ob000000nn where nn is bits 9 and 8 of the 10 bit ADC count.

Low data is the least significant byte of the ADC count.

This is the reading taken at TP2.

Write one word Command 0x06 – format above.

Unit Address 0x281:

Write data word:

High byte = 0x00

Low byte = 0x01 – 0x63 excluding 27 and 69, allowable addresses are 1 thru 99.

Unit Baud Rate 0x282:

Write data word:
High byte = 0x00
Low byte = 0x51 for 19.2k
Low byte = 0x52 for 9600

Unit Protocol 0x283:

Write data word:
High byte = 0x00

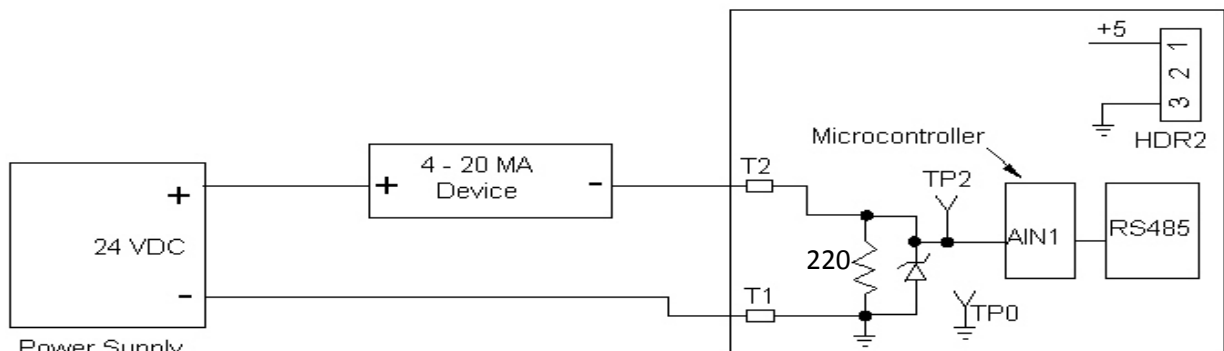
Low Byte	Meaning
0x51	MODBUS RTU, 8 data bits, no parity, 2 stop bits.
0x52	MODBUS RTU, 8 data bits, even parity, 1 stop bit.
0x53	MODBUS RTU, 8 data bits, odd parity, 1 stop bit.
0x54	Future

Unit Analog Channel Configured to Hold Highest Reading Until it is Read by Master 0x288:

Write data word:
High byte = 0x00
Low byte = 0x00 for no hold.
Low byte = 0x01 for hold.

The returned ADC value is the average of eight readings.

For additional protocol information, see the manual for DCB2620.



Signal Conditioner 4 - 20 MA to Volts with Modbus Communications

Typical Connection for a 4 – 20 MA Device.

Typical Use Example:

A 0 to 15 PSI pressure sensor produces a 4 to 20 MA output. What is the count for 9 PSI?

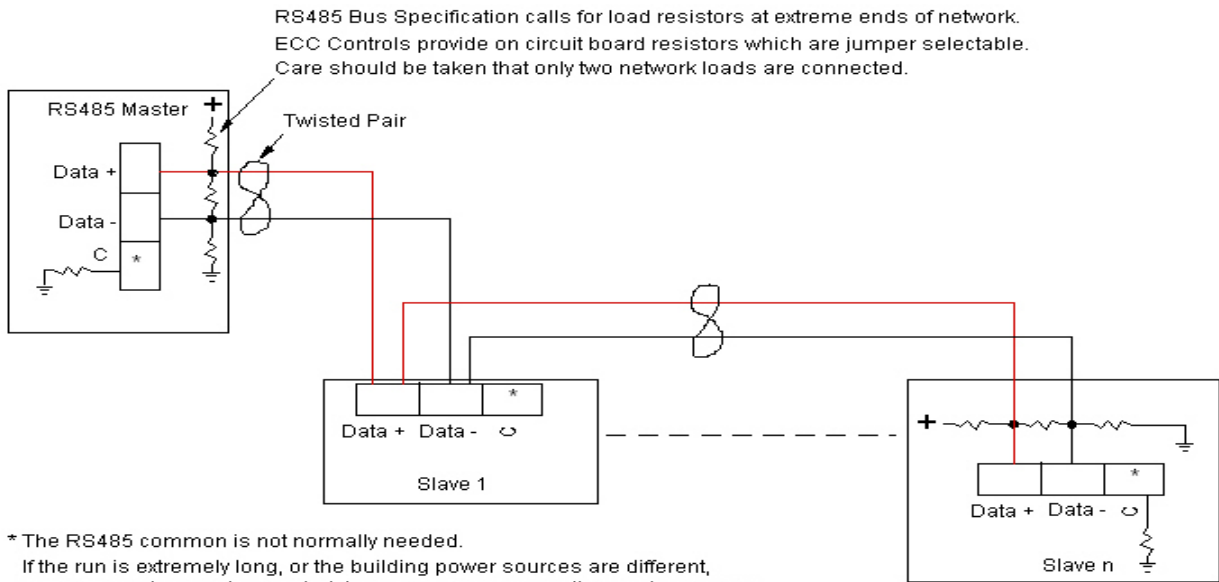
Count for 4 MA: $V = 0.004 \times 220 = 0.88 \text{ V}$. $\text{Count} = (1024 \text{ cnts}/5\text{v}) \times 0.88 = 180$.

Count for 20 MA: $V = 0.02 \times 220 = 4.4 \text{ V}$. $\text{Count} = (1024 \text{ cnts}/5\text{v}) \times 4.4 = 901$.

Counts/PSI = $(901-180)/15 = 48$.

Counts for 9 PSI = $48 \times 9 = 432$.

Counts delivered to master controller = $180 + 432 = 612$.



Typical RS485 Bus Network.