

# PRECISION DIGITAL CORPORATION

## Serial Communication Protocol

This document describes how to communicate with the Trident Model PD765 and Javelin D Model PD644 meters using the Precision Digital Serial Communication Protocol. The user should be familiar with serial communications and the meters. Refer to the meter instruction manual and the serial communication adapters for setup and wiring instructions.

Serial communications uses 8 data bits, 1 start bit and 1 stop bit. Data is standard 7-bit ASCII, with the 8<sup>th</sup> bit ignored for received data and cleared for transmitted data.

Note that in this document, hex data is indicated by a "0x" prefix, ASCII characters are shown with single quotes, as in '8' (= 0x38), and ASCII strings

are shown with double quotes, as in "SFT013".

To accommodate multiple devices sharing a common serial network (RS-485), there is a programmable address code. The address code is selected from the front panel or via serial command 38. Note that the address is required even for point-to-point configurations (RS-232 and RS-422).

All data transfers are initiated by a request from the host computer and completed by a reply from the meter. Multiple requests cannot be processed simultaneously. It is the responsibility of the host to wait at least 500 milliseconds after completing a request before assuming that the message was not received correctly.

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## Firmware Revision Versus Available Commands Matrix

This table shows available serial commands versus firmware versions. If a command is not listed in a particular version, sending that command will result in a Z2, "Invalid command code" error from the meter.

PD765				PD644
Version 1.000	Version 2.000	Version 2.5xx	Version 3.0xx	Version 1.xxx
10*	10	10	10	10
11	11	11	11	11
12	12	12	12	12
			19	19
20	20	20	20	20
21	21	21	21	21
22	22	22	22	22
23	23	23	23	23
24	24	24	24	
	26	26	26	26
	27	27	27	27
	28	28	28	28
	29	29	29	29
30	30	30	30	30
31	31	31	31	31
32	32	32	32	32
	37	37	37	37
	39	39	39	39
		40	40	40
		41	41	41
		42	42	42
		43	43	43
		44	44	44
		47	47	
		48	48	
F0	F0	F0	F0	F0
F1	F1	F1	F1	F1

\* Command 10 in PD765 Version 1.000 does not have the relay status character.

## Command Packet Format

SOH (0x01)	Meter Address	Meter Address	Command Code	Command Code	Data (as reqd.)	Check- sum	Check- sum	ETX (0x03)
---------------	------------------	------------------	-----------------	-----------------	--------------------	---------------	---------------	---------------

1. SOH (0x01) - Unconditional start of message character. Valid anytime except while a reply is in progress.
2. Two character meter address code (00 - 99).
3. Two character command code.
4. Data or argument field(s) if required.
5. Two character ASCII hex checksum (0x00 – 0xFF) which represents the 8 bit result of the negative of the sum of all data characters in the command code and data fields. Parity bits are excluded from the calculation.  
Checksum = 1 + not(Command Code[high] +  
Command Code[low] + any data or arguments)
6. ETX (0x03) - Terminator character.

Example: Read the set point for Relay #1 of meter 00:

Address: 00

Command Code: 26

Arguments: "S0". 'S' = Set point; '0' = Relay #1 (relay numbering starts with 0)

$$\begin{aligned}
 \text{Checksum} &= 1 + \text{not}('2' + '6' + 'S' + '0') \\
 &= 1 + \text{not}(0x32 + 0x36 + 0x53 + 0x30) \\
 &= 1 + \text{not}(0xEB) \\
 &= 1 + 0x14 \\
 &= 0x15
 \end{aligned}$$

Therefore, the complete command packet that is sent = 0x01, "0026S015", 0x03

In hex form = 0x01 0x30 0x30 0x32 0x36 0x53 0x30  
0x31 0x35 0x03

**Reply Packet Format**

STX (0x02)	Command Code	Command Code	Data (as req'd.)	Check- sum	Check- sum	ETX (0x03)
---------------	-----------------	-----------------	---------------------	---------------	---------------	---------------

1. STX (0x02) - Start character.
2. Two character command code.
3. Data field if required.
4. Two character ASCII hex checksum (00 - FF), which represents the negative of the sum of all data characters in the command code and data fields.
5. ETX (0x03) - Terminator character.

All received data is thoroughly checked for errors. To prevent serial bus conflicts no reply is sent unless valid start and end characters and the proper address code are received. Invalid messages longer than 22 characters will result in a receive-buffer overflow and will not generate a reply. Normal operation resumes with the reception of the next start of message character.

To aid in the development of application software, certain syntax errors will result in replies containing special error codes in the command code field.

<b>ERROR CODE</b>	<b>DESCRIPTION</b>
Z0	Message too short to be valid
Z1	Checksum error
Z2	Invalid command code
Z4	Incorrect amount of data in the data field
Z6	Invalid data in the data field
Z7	EEPROM write error

## I. Read Only Commands

### CODE DESCRIPTION

#### 10 Read Process Value

##### Command

SOH (0x01)	Meter Address	Meter Address	'1'	'0'	'9'	'F'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

##### Reply

STX (0x02)	'1'	'0'	Relay Status	'U' 'O' 'P' '+' '-'	n	n	n	n	n	n	n	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	-----------------	---------------------------------	---	---	---	---	---	---	---	---------------	---------------	---------------

The reply data is nine characters consisting of a relay status character, followed by 'U' (Under Range), 'O' (Over Range), 'P' (Open), '+', or '-' followed by a number string including a decimal point, if it is selected for display. The number string is always seven characters, consisting of either six digits and a decimal point, or six digits with a leading zero if no decimal point is selected. The Open character indicates an overrange condition for a temperature input. The relay status represents the energized or de-energized state of the relay(s), and is active low logic (status 0 = relay energized). For units with only two relays, only the first four status characters (0 to 3) are valid.

##### Relay Status Character

Relay 4	Relay 3	Relay 2	Relay 1	Hex character
On	On	On	On	0
On	On	On	Off	1
On	On	Off	On	2
On	On	Off	Off	3
On	Off	On	On	4
On	Off	On	Off	5
On	Off	Off	On	6
On	Off	Off	Off	7
Off	On	On	On	8
Off	On	On	Off	9
Off	On	Off	On	A
Off	On	Off	Off	B
Off	Off	On	On	C
Off	Off	On	Off	D
Off	Off	Off	On	E
Off	Off	Off	Off	F

**11 Read Maximum Process Value***Command*

SOH (0x01)	Meter Address	Meter Address	'1'	'1'	'9'	'E'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Reply*

STX (0x02)	'1'	'1'	'+' -'	n	n	n	n	n	n	n	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	-----------	---	---	---	---	---	---	---	---------------	---------------	---------------

The reply data format is eight characters consisting of '+' or '-' followed by a number string. The number string is always seven characters, consisting of either six digits and a decimal point, or six digits with a leading zero if no decimal point is selected.

**12 Read Minimum Process Value***Command*

SOH (0x01)	Meter Address	Meter Address	'1'	'2'	'9'	'D'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Reply*

STX (0x02)	'1'	'2'	'+' -'	n	n	n	n	n	n	n	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	-----------	---	---	---	---	---	---	---	---------------	---------------	---------------

The reply data format is eight characters consisting of '+' or '-' followed by a number string. The number string is always seven characters, consisting of either six digits and a decimal point, or six digits with a leading zero if no decimal point is selected.

**F0 Read Product Identifier***Command*

SOH (0x01)	Meter Address	Meter Address	'F'	'0'	'8'	'A'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Reply*

STX (0x02)	'F'	'0'	" "	'S'	'F'	'T'	'0'	'1'	'3'	" "	'3'	'B'	ETX (0x03)
---------------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	---------------

The reply data is eight characters consisting of a product identification string enclosed in quotation marks. An example is shown for "SFT013".

**F1 Read Firmware Version***Command*

SOH (0x01)	Meter Address	Meter Address	'F'	'1'	'8'	'9'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Reply*

STX (0x02)	'F'	'1'	" "	'0'	'1'	'.'	'2'	'3'	'4'	" "	'9'	'4'	ETX (0x03)
---------------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	---------------

The reply data is eight characters consisting of the version code enclosed in quotation marks. An example is shown for "01.234".

## II. No-Data Commands

### CODE DESCRIPTION

#### 30 Reset the Maximum Process Value

##### *Command*

SOH (0x01)	Meter Address	Meter Address	'3'	'0'	'9'	'D'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

##### *Reply*

STX (0x02)	'3'	'0'	'9'	'D'	ETX (0x03)
---------------	-----	-----	-----	-----	---------------

#### 31 Reset the Minimum Process Value

##### *Command*

SOH (0x01)	Meter Address	Meter Address	'3'	'1'	'9'	'C'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

##### *Reply*

STX (0x02)	'3'	'1'	'9'	'C'	ETX (0x03)
---------------	-----	-----	-----	-----	---------------

#### 32 Initialize Meter

##### *Command*

SOH (0x01)	Meter Address	Meter Address	'3'	'2'	'9'	'B'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

##### *Reply*

STX (0x02)	'3'	'2'	'9'	'B'	ETX (0x03)
---------------	-----	-----	-----	-----	---------------

Initializes the meter in the following order:

- Input configuration
- Bypass and Filter values
- Adjust value
- Relay parameters (whether installed or not)
- 4-20 mA output parameters (whether installed or not)
- Serial parameters and address

There is no data in the reply.

### III. Read/Write Commands

#### CODE DESCRIPTION

#### 19 Display Intensity

*Command: Read*

SOH (0x01)	Meter Address	Meter Address	'1'	'9'	'9'	'6'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'1'	'9'	'1' to '8'	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------------	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'1'	'9'	'1' to '8'	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	------------------	---------------	---------------	---------------

Read and write the LED display intensity: '8' is the brightest level.

#### 20 Input Selection Parameters

*Command: Read*

SOH (0x01)	Meter Address	Meter Address	'2'	'0'	'9'	'E'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'2'	'0'	X	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	---	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'2'	'0'	X	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	---	---	---	---	---------------	---------------	---------------

The data field is four ASCII hex characters representing a 16-bit value. These settings become effective only after an initialize command (Command 32) or a power down/power up cycle. Combinations other than those shown are reserved for future use and their use may result in improper operation.

#### Bits Description

##### 15 - 8 Input Selection (Not for PD644)

00000000	Volts
00010001	Current
00100010	RTD
00100011	Thermocouple (00110010 also valid, but 00100011 preferred)

##### 7 Temperature Units (Not for PD644)

0	Display temperature in C
1	Display temperature in F

6 - 4 Volts or Current Decimal Point Selection (Ignored for all other input selections.)

000	dddddd.
001	dddd.d
010	ddd.dd
011	dd.d
100	dd.d
101	d.d
110	dddddd (no decimal)
111	Not valid

3 - 0 Sensor Type (Not for PD644)

0000	Type J thermocouple
0001	Type K thermocouple
0010	Type T thermocouple
0011	Type T thermocouple (0.1°)
0100	Type E thermocouple
0101	100 Ω Platinum RTD (385)
0110	100 Ω Platinum RTD (392)

Example: To program meter 00 for Type J thermocouple in degrees F:

Command packet: = 0x01, "00202380D1", 0x03

In hex form = 0x01 0x30 0x30 0x32 0x30 0x32 0x33 0x38 0x30 0x44 0x31 0x03

Note:

*If the input selection is Thermocouple or RTD, the decimal point should be selected for 123456 (110), except for Type T thermocouple with 0.1° resolution when it would be set to 12345.6 (001).*

### CAUTION!

#### **PD765 Version 2.000 Firmware:**

*If the input selected is either current or voltage, Command 20 should be followed by Command 37 read/write.*

*To update the voltage (current) decimal point:*

- 1. Use Command 37 to read the current and voltage decimal points.*
- 2. Combine the new voltage (current) decimal point setting with the old current (voltage) setting and save them in the meter by using Command 37.*

*Again, this is only for current or voltage inputs, if the input selected is Thermocouple or RTD, Command 37 does not need to be used after Command 20. Use Command F1 to determine firmware revision. This requirement is due to a bug in the Version 2.000 Firmware.*

## 21 Lockout Code

Command: Write only

SOH (0x01)	Meter Address	Meter Address	'2'	'1'	X	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	---	---	---	---	---------------	---------------	---------------

Reply

STX (0x02)	'2'	'1'	'9'	'D'	ETX (0x03)
---------------	-----	-----	-----	-----	---------------

The data field consists of a four-digit number, 0000 through 9999. For security reasons the code cannot be read. The reply is "21".

**22 Filter Value***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'2'	'2'	'9'	'C'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'2'	'2'	'+'	'0'	'0'	'0'	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	-----	-----	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'2'	'2'	'+'	'0'	'0'	'0'	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	-----	-----	-----	-----	---	---	---	---------------	---------------	---------------

The data field is 7 characters consisting of "+000" followed by the value. Valid values are 000, and 002 to 199.

**23 Bypass Value***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'2'	'3'	'9'	'B'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'2'	'3'	'+'	'0'	'0'	'0'	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	-----	-----	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'2'	'3'	'+'	'0'	'0'	'0'	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	-----	-----	-----	-----	---	---	---	---------------	---------------	---------------

The data field is 7 characters consisting of "+000" followed by the value. The range is 002 to 999. Note that these values actually represent 0.2 to 99.9. The decimal point is implied.

**24 Adjustment Value***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'2'	'4'	'9'	'A'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'2'	'4'	'+' '-'	'0'	'0'	'0'	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------	-----	-----	-----	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'2'	'4'	'+' '-'	'0'	'0'	'0'	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	------------	-----	-----	-----	---	---	---	---------------	---------------	---------------

The data field is 7 characters. The range is -199 to +199. Note that these values actually represent -19.9 to +19.9. The decimal point is implied.

**26 Relay Set and Reset Points***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'2'	'6'	'S' 'R'	Relay #	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------	------------	---------------	---------------	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'2'	'6'	'S' 'R'	Relay #	'+' '-'	'0'	'0'	X	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------	------------	------------	-----	-----	---	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'2'	'6'	'+' '-'	'0'	'0'	X	X	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	------------	-----	-----	---	---	---	---	---	---------------	---------------	---------------

To read or write Reset Points, follow the command code with an 'R'. Use an 'S' for Set Points.

*Note: Relay numbers start with zero, but in the meter instruction manuals, relay numbering starts with one.*

The reply data format is eight characters consisting of '+' or '-' followed by a number string. The number string is always seven characters, consisting of either six digits and a decimal point, or six digits with a leading zero if no decimal point is selected. Note that the write command does not include the decimal point regardless of the decimal point setting.

**27 Relay Operating Parameters***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'2'	'7'	Relay #	Check -sum	Check- sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------	---------------	---------------	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'2'	'7'	Relay #	'0' '1'	'0' '1' '2' '3' '4' '7'	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------	------------	--	---------------	---------------	---------------

*Reply: Write and Read*

SOH (0x01)	'2'	'7'	'0' '1'	'0' '1' '2' '3' '4' '7'	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	------------	--	---------------	---------------	---------------

Relay numbers start with zero. In the manuals, relay numbering starts with one.

The operating parameters consist of two digits, representing fail-safe and mode:

First Digit

- 0 – Fail Safe off
- 1 – Fail Safe on

Second Digit

- 0 – Automatic Reset
- 1 – Automatic and Manual Reset
- 2 – Latched Operation
- 3 – Latched Operation with Clear
- 4 – Alternating Operation
- 5 – Reserved. Do Not Use!
- 6 – Reserved. Do Not Use!
- 7 – Relay Disabled

**28 Relay Turn-Off and Turn-On Time Delay***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'2'	'8'	'0' '1'	Relay #	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------	------------	---------------	---------------	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'2'	'8'	'0' '1'	Relay #	'+'	'0'	'0'	'0'	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------	------------	-----	-----	-----	-----	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'2'	'8'	'+'	'0'	'0'	'0'	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	-----	-----	-----	-----	---	---	---	---------------	---------------	---------------

To read or write Turn-Off Time Delay, follow the command code with a '0'. Use a '1' for Turn-On Time Delay. The delay number is "+000" followed by the value in seconds. The range is 000 to 199.

*Note: Relay numbers start with zero, but in the meter instruction manuals, relay numbering starts with one.*

**29 Serial Transmission Time Delay***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'2'	'9'	'9'	'5'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'2'	'9'	'+'	'0'	'0'	'0'	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	-----	-----	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'2'	'9'	'+'	'0'	'0'	'0'	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	-----	-----	-----	-----	---	---	---	---------------	---------------	---------------

The data field is 7 characters consisting of "+000" followed by the value in milliseconds. The range is 000 to 199.

**39 Relay Acknowledge***Command:*

SOH (0x01)	Meter Address	Meter Address	'3'	'9'	'0' '1' 'L'	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	-------------------	---------------	---------------	---------------

*Reply:*

STX (0x02)	'3'	'9'	'9'	'4'	ETX (0x03)
---------------	-----	-----	-----	-----	---------------

The data field is 1 character representing which relay(s) to acknowledge. 'L' will acknowledge all relays. Note that if a relay is not in a mode that allows acknowledgement, it will not be acknowledged.

*Note: Relay numbers start with zero, but in the meter instruction manuals, relay numbering starts with one.*

**37 Current and Voltage Decimal Points***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'3'	'7'	'9'	'6'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'3'	'7'	Current decimal point	Voltage decimal point	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----------------------------	-----------------------------	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'3'	'7'	Current	Voltage	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	---------	---------	---------------	---------------	---------------

Read or write the current and voltage (respectively) decimal point selections. The data field consists of two numbers representing the decimal point position. The range of each number is 0 to 6. This is the same data as described in command 20.

'0'	dddddd.
'1'	dddd.d
'2'	ddd.dd
'3'	dd.ddd
'4'	dd.dddd
'5'	d.ddddd
'6'	dddddd (no decimal)

**Note: PD765 Version 2.000 Firmware**

*This command should only be used in conjunction with Command 20 when interfacing with PD765 Version 2.000 Firmware. See the caution in Command 20 for usage. Using this command at other times may cause confusion in the PD765 user interface operation. Contact Precision Digital for further information.*

**Note: PD765 Version 3.0xx Firmware**

*Starting with PD765 Version 3.000, if the presently selected input is either mA or V, writing a new decimal point using this command will immediately update the displayed decimal point also. This did not occur in the previous versions and required use of other commands to accomplish. See Command 20 for older version use with Command 37.*

**Note: PD644**

*The current decimal point field is irrelevant.*

**40 4-20 mA Output – Data***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'4'	'0'	'9'	'C'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'4'	'0'	'+'	'0'	'0'	X	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	-----	---	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'4'	'0'	'+'	'0'	'0'	X	X	'.'	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	-----	-----	-----	---	---	-----	---	---	---------------	---------------	---------------

The data field is 7 characters. The range is 0 to +2399. Note that these values actually represent 0.00 to +23.99 milliamps. Note that the write command does not include a decimal point.

The reply data format is eight characters consisting of '+' followed by a number string. The number string is always seven characters, consisting of either six digits and a decimal point, or six digits with a leading zero if no decimal point is selected.

*Note:*

*Although the data range is 0.00 to 23.99 mA, the actual minimum and maximum outputs available may be different from this range, depending on hardware tolerances. The hardware is designed for a nominal range of 1.00 to 23.00 mA.*

*Note:*

*If the 4-20 mA source selection is not Serial Communication(mA), this command will have no effect on the 4-20 mA output. The reply will be -99.99 to indicate this improper operation. Refer to Command 41 (next) for Modes.*

**41 4-20 mA Output – Mode***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'4'	'1'	'9'	'B'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'4'	'1'	'0'	'0'	Check -sum	Check -sum	ETX (0x03)
					'8'	to '4'			

*Reply: Write and Read*

STX (0x02)	'4'	'1'	'0'	'0'	Check -sum	Check -sum	ETX (0x03)
			'8'	to '4'			

The operating parameters consist of two digits, representing 4-20 mA Output Installed Status and data source:

First Digit

0 – No 4-20 mA Output  
8 – 4-20 mA Output

Second Digit

0 – Display Value  
1 – Max Display Value  
2 – Min Display Value  
3 – Serial Communication: Data in mA.  
4 – Factory Use Only: Serial Comm: Data in counts.

**42 4-20 mA Output – Filter Value***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'4'	'2'	'9'	'A'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'4'	'2'	'+'	'0'	'0'	'0'	'0'	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	-----	-----	-----	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'4'	'2'	'+'	'0'	'0'	'0'	'0'	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	-----	-----	-----	-----	-----	---	---	---------------	---------------	---------------

The data field is 7 characters consisting of "+0000" followed by the value. Valid values are 00, and 02 to 19. Note that this filtering is in addition to the display filtering.

*Note:*

*Filter Value cannot be accessed through the front panel menu.*

**43 4-20 mA Output – Limits***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'4'	'3'	'0' to '4'	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------------	---------------	---------------	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'4'	'3'	'0' to '4'	'+'	'0'	'0'	X	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------------	-----	-----	-----	---	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'4'	'3'	'+'	'0'	'0'	X	X	'.'	X	X	Check- sum	Check -sum	ETX (0x03)
---------------	-----	-----	-----	-----	-----	---	---	-----	---	---	---------------	---------------	---------------

Read and write the value for 4-20 mA Output Limit parameters. The first argument specifies which limit is to be accessed. The data field following it is 7 characters. The range is 0 to +2399. Note that these values actually represent 0.00 to +23.99 milliamps. The decimal point in the write command is implied. The following table shows the arguments for the various limit parameters.

<u>Argument</u>	<u>Limit Parameter</u>
'0'	Sensor Break Value (Irrelevant for PD644)
'1'	Overrange Value
'2'	Underrange Value
'3'	Max Value Allowed
'4'	Min Value Allowed

*Note:*

*Only the Sensor Break Value can be accessed through the front panel menu.*

**44 4-20 mA Output – Input and Output Points***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'4'	'4'	'0' to '3'	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------------	---------------	---------------	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'4'	'4'	'0' to '3'	'+' '.'	'0'	'0'	X	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------------	------------	-----	-----	---	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'4'	'4'	'+' '.'	'0'	'0'	X	X	X	X	X	Check- sum	Check -sum	ETX (0x03)
---------------	-----	-----	------------	-----	-----	---	---	---	---	---	---------------	---------------	---------------

Read and write the value for 4-20 mA Input and Output points. The first argument specifies which point is to be accessed. The data field following it is 7 characters. Note that the values for DAC Outputs 1 and 2 actually represent 0.00 to +23.99 milliamps. The range for Display Values is –1999 to +9999. The decimal point in the write command is implied. The decimal point in the reply for the Display Values will reflect the presently selected decimal point, but is fixed (00XX.XX) for the DAC Output values. The following table shows the arguments for the various limit parameters.

<u>Argument</u>	<u>Point</u>	<u>Range</u>
'0'	Display Value 1	-1999 to +9999
'1'	Display Value 2	-1999 to +9999
'2'	DAC Output 1	00.00 to +23.99
'3'	DAC Output 2	00.00 to +23.99

**47 Cutoff Value***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'4'	'7'	'9'	'5'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'4'	'7'	'+' '.'	'0'	'0'	X	X	X	X	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------	-----	-----	---	---	---	---	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'4'	'7'	'+' '.'	'0'	'0'	X	X	X	X	X	Check- sum	Check -sum	ETX (0x03)
---------------	-----	-----	------------	-----	-----	---	---	---	---	---	---------------	---------------	---------------

Read and write the value for the display Cutoff. Range is from 0000 to 9999, ignoring the decimal point. 0000 will disable cutoff. Cutoff is valid only for process inputs (current and voltage). The reply data format is eight characters consisting of '+' followed by a number string. The number string is always seven characters, consisting of either six digits and a decimal point, or six digits with a leading zero if no decimal point is selected. Note that the write command does not include the decimal point regardless of the decimal point setting.

**48 Linear/Exponential Selection***Command: Read*

SOH (0x01)	Meter Address	Meter Address	'4'	'8'	'9'	'4'	ETX (0x03)
---------------	------------------	------------------	-----	-----	-----	-----	---------------

*Command: Write*

SOH (0x01)	Meter Address	Meter Address	'4'	'8'	'L' 'E'	Check -sum	Check -sum	ETX (0x03)
---------------	------------------	------------------	-----	-----	------------	---------------	---------------	---------------

*Reply: Write and Read*

STX (0x02)	'4'	'8'	'L' 'E'	Check -sum	Check -sum	ETX (0x03)
---------------	-----	-----	------------	---------------	---------------	---------------

Select Linear ('L') or Exponent ('E') display mode.

Linear:  $DisplayValue = (ADC\_count * Gain) + Offset,$

Exponent:  $DisplayValue = ((ADC\_count - Input\_low)^{0.5} * Gain) + Offset,$   
 where Input\_low, Gain, and Offset are user defined, either through scaling or external calibration.

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