Precision Digital Modbus® Register Tables

This document describes how to communicate with the Trident Model PD765, Javelin T Model PD740, and Javelin D Model PD644 meters using the Modbus® RTU Serial Communication Protocol. The user should be familiar with Modbus serial communication and the meters. Refer to the meter instruction manuals and the serial communication adapters for setup and wiring instructions.

Register Overview

40001 – 40016: Process Value (PV), Max PV, Min PV in integer and floating point formats, with interspersed relay status for block reading, Initialize, Reset Max & Min display value, Alarm & Relay status, Relay acknowledge, Linear/Square Root selection, Remote Process scaling initiation.
40101 – 40113: Input selection, Decimal points, Adjust, Bypass, Cutoff, Filter, Lock, Baud, Parity, Modbus Address, and Byte-to-byte timeout, Display Intensity.
40201 – 40212: Remote Scaling for Process inputs.
40301 – 40310: Relays; Set & Reset points, Turn-on & Turn-off delays, Operating Mode.
40401 – 40412: 4-20 mA output; Mode, Filter, Sensor Break value, Overrange value, Underrange value, Maximum allowed, Minimum allowed, Display 1 value, Display 2 value, Output 1, Output 2, Data (mA), Data (bits)
49101 – 49116: Product ID, Firmware Version, and Manufacturing Serial Number.

Register [1]		Name	Access	Limits or Range [2]	Units	Data Type [3]	Function Code(s)	Comments
Number	Address (hex)							
40001	0 (0000)	Display value	Read Only	-1999 to +9999	User Defined	Integer	03, 04	Represents the display value without the decimal point. Decimal point setting in 40102.
40002	1 (0001)	Alarm and Relay status	Read both, Write Relays	1 = In Alarm 1 = relay energized	None	Bits	03, 06, 04	Read alarm status and energized/non-energized status of relays. Alarms are read only, so the upper byte is ignored for writes. Writing to a relay is only allowed when the relay is in the meter-disabled (Modbus accessible) mode. When writing, bits 2 through 15 are ignored. Alm = Alarm. Rly = Relay.
40003	2 (0002)	Maximum Display value	Read Write	-1999 to +9999	User defined	Integer	03, 06 04	Represents the Maximum display value, excluding the decimal point, since last power up or Max Value reset. Decimal point setting in 40102. Writing any value will reset the Maximum display value to the present display value.
40004	3 (0003)	Minimum Display value	Read Write	-1999 to +9999	User defined	Integer	03, 06 04	Represents the Minimum display value, excluding the decimal point, since last power up or Min Value reset. Decimal point setting in 40102. Writing any value will reset the Minimum display value to the present display value.
40005 – 40006	4 – 5 (0004–0005)	Display value	Read Only	-1999 to +9999	User defined	Floating point	03, 04	Represents the display value including the decimal point. Accessing 40005 or 40006 by itself will return 0xFFFF.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	Alm 2	Alm 1	0	0	0	0	0	0	Rly 2	Rly 1

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Register [1]		Name	Access	Limits or Range [2]	Units	Data Type [3]	Function Code(s)	Comments
Number	Address (hex)							
40007	6 (0006)	Alarm and Relay status	Read both, Write Relays	1 = In Alarm 1 = relay energized	None	Bits	03, 06, 04	Mirror of 40002.
40008 – 40009	7 – 8 (0007–0008)	Maximum Display value	Read Only	-1999 to +9999	User defined	Floating point	03, 04	Represents the Maximum display value, including the decimal point, since last power up or Max Value reset. Accessing 40008 or 40009 by itself will return 0xFFFF.
40010 – 40011	9 – 10 (0009–000A)	Minimum Display value	Read Only	-1999 to +9999	User Defined	Floating point	03, 04	Represents the Minimum display value, including the decimal point, since last power up or Min Value reset. Accessing 40010 or 40011 by itself will return 0xFFFF.
40012	11 (000B)	Linear/Square Root	Read Write	0xFF00 = Sq. rt 0x0000 = Linear	None	Bit	03, 06, 04	Determines process input function. Write 0x0000 for linear function. Write 0xFF00 for square root. Any other write value is ignored and has no effect.
40013	12 (000C)	Alarm Acknowledge	Write Only	Not applicable	None	Bits	06	Clear Relay *n* alarm condition. Set bit equal to 1 to acknowledge. Only has effect on relays programmed to allow manual acknowledging. Alm = Alarm; X = don't care. 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 X X X X X X Alm 2 Alm 1 X X X X X X X X
40014	13 (000D)	Initialize Meter	Write Only	0xFF00 to initialize.	None	Bit	06	Write 0xFF00 to reinitialize the meter. Writing any other data has no effect.
40015	14 (000E)	Remote Scale mA	Write Only	0xFF00 to execute remote scaling.	None	Bit	06	Used to remote scale the mA input. Writing any other data has no effect. *Caution! See Note 4, page 6.*
40016	15 (000F)	Remote Scale Volts	Write Only	0xFF00 to execute remote scaling.	None	Bit	06	Used to remote scale the Volts input. Writing any other data has no effect. *Caution! See Note 4, page 6.*
40101	100 (0064)	Input selection	Read Write	Not applicable	None	Word; bit flags	03, 06, 16, 04	See Table 1, page 7.
40102	101 (0065)	Active Decimal Point	Read Write	1, 2, 3, or 6	None	Integer	03, 06, 16, 04	6 = no decimal point. 1 to 3 = number of digits to right of dp. Mirror of bits 6-4 of 40101. Only process decimal points can be written. Writing a non-process dp returns 0xFFFF.
40103	102 (0066)	Current & Voltage decimal points	Read Write	0x00CV, where C & V = 1, 2, 3, or 6.	None	Word	03, 06, 16, 04	See table 2. If an out of range value is sent for either or both decimal points, no change is made for that value. Valid settings are none, 1, 2, and 3 decimal places.
40104	103 (0067)	Adjust	Read Write	-199 to +199	°C or °F	Integer	03, 06, 16, 04	Actually represents -19.9 to +19.9. Offset value is only applied to temperature inputs. If Adjust is greater than 11°C and the temperature units are switched to °F, it will be set to 19.9 (lower than -11, set to -19.9).

Register [1]		Name	Access	Limits or Range [2]	Units	Data Type [3]	Function Code(s)	Comments
Number	Address (hex)							
40105	104 (0068)	Bypass	Read Write	2 to 999	Percent of full scale or °F	Integer	03, 06, 16, 04	Actually represents 0.2 to 99.9. If the input steps greater than the bypass value, it will be displayed immediately, with no filtering occurring. The number represents percent of full-scale for process inputs and °F for temperature inputs. No effect if filter = 0.
40106	105 (0069)	Cutoff	Read Write	0 to 9999	User Defined	Integer	03, 06, 16, 04	Represents the cutoff value without the decimal point. Valid only for process inputs.
40107	106 (006A)	Filter	Read Write	0, 2 to 199	Unit-less	Integer	03, 06, 16, 04	Display filtering. 0 = no filtering. New = old + ((new - old)/Filter)
40108	107 (006B)	Lock	Read Write	0x0000 to 0x9999	None	Integer (Packed BCD)	03, 06, 16, 04	See Note 5, page 6.
40109	108 (006C)	Baud	Read Write	0 to 6	None	Integer	03, 06, 16, 04	0 = 300, 1 = 600, 2 = 1200, 3 = 2400, 4 = 4800, 5 = 9600, & 6 = 19200. Changes to this register are saved but don't take effect until next meter reset (Modbus command or power-up). Writing out of range data results in a baud rate of 2400.
40110	109 (006D)	Parity	Read Write	0 to 2	None	Word; bit flags	03, 06, 16, 04	0 = None, 1 = Odd, 2 = Even. Changes to this register are saved but don't take effect until next meter reset (Modbus command or power-up). Writing out of range data results in a parity setting of Even.
40111	110 (006E)	Byte-to-byte timeout	Read Write	0 to 2.54	Seconds	Integer	03, 06, 16, 04	This is the timeout between bytes of a Modbus frame. Note that a value less than the minimum value for the present baud rate cannot be saved. Minimums are: 300 baud = 0.06 secs, 600 = 0.03, 1200 = 0.02 and 0.01 for 2400 to 19200. Changes to this register are saved but don't take effect until next meter reset (Modbus command or power-up). Writing out of range data results in a timeout of 2.54 seconds.
40112	111 (006F)	Modbus Address	Read Write	1 to 247	None	Integer	03, 06, 16, 04	Changes to this register are saved but don't take effect until next meter reset (Modbus command or power-up). Writing out of range data results in an address of 247.
40113	112 (0070)	Display Intensity	Read Write	1 to 8	None	Integer	03, 06, 16, 04	8 is the brightest level. Writing out of range data results in level 2 brightness.
40201 40202	200 (00C8) 201 (00C9)	Display 1 & 2, mA	Read Write	-1999 to 9999	User Defined	Integer	03, 06, 16, 04	Used to remotely scale the mA input. This data represents the display value without a decimal point. *Caution! See Note 4, page 6.*
40203 – 40204 40205 – 40206	202 – 203 (00CA–00CB) 204 – 205 (00CC–00CD)	Input 1 & 2, mA	Read Write	-1999 to 2000	10's of µA (-19.99 to 20.00 mA)	Floating point	03, 06, 16, 04	Used to remotely scale the mA input. If data sent is out of range, default values of 400 and 2000, respectively, will be used instead. This data represents the input points in mA. For example: 400 ≡ 4.00 mA. *Caution! See Note 4, page 6.*

Register [1]		Name	Access	Limits or Range [2]	Units	Data Type [3]	Function Code(s)	Comments
Number	Address (hex)							
40207 40208	206 (00CE) 207 (00CF)	Display 1 & 2, Volts	Read Write	-1999 to 9999	User Defined	Integer	03, 06, 16, 04	Used to remotely scale the Volts input. If data sent is out of range, default values of 0 and 1000, respectively, will be used instead. This data represents the display value without a decimal point. *Caution! See Note 4, page 6.*
40209 – 40210 40211 – 40212	208 – 209 (00D0–00D1) 210 – 211 (00D2–00D3)	Input 1 & 2, Volts	Read Write	PD644: 0 to 3000 PD765: -999 to 1000	PD644: Tenths of Volts (000.0 to 300.0 V) PD765: 10's of mV (-9.99 to 10.00 V)	Floating point	03, 06, 16, 04	Used to remotely scale the Volts input. If data sent is out of range, default values of 0 and 1000, respectively, will be used instead. This data represents the input points in volts. For example: 1000 ≡ 10.00 V. *Caution! See Note 4, page 6.*
40301 To 40305	300 301 302 303 304 (012C to 0130)	Relay 1: Set point Reset point Turn-on delay Turn-off delay Mode	Read Write	-1999 to +9999 -1999 to +9999 0 to 199 0 to 199 Bits 4, 2, 1, 0	User Defined User Defined Seconds Seconds None	Integer Integer Integer Integer Word: bits	03, 06, 16, 04	Set and Reset points represent the display value without the decimal point. See Table 3, page 8, for operating modes and bit assignments.
40306 To 40310	305 306 307 308 309 (0131 to 0135)	Relay 2: Set point Reset point Turn-on delay Turn-off delay Mode	Read Write	-1999 to +9999 -1999 to +9999 0 to 199 0 to 199 Bits 4, 2, 1, 0	User Defined User Defined Seconds Seconds None	Integer Integer Integer Integer Word: bits	03, 06, 16, 04	Set and Reset points represent the display value without the decimal point. See Table 3, page 8, for operating modes and bit assignments.
40401	400 (0190)	4-20mA out – Mode	Read Write	0000 0000 y000 0yyy	None	Integer	03, 06, 16, 04	Selects output option and where the data source for the 4-20 mA output. See Table 4, page 9.
40402	401 (0191)	4-20mA out – Filter	Read Write	0, 2 to 19	None	Integer	03, 06, 16, 04	*This feature is not available through manual programming.* 4-20 mA filtering: 0 = no filtering. Writing out of range data results in a value of 0. New = old + ((new - old)/Filter)
40403	402 (0192)	4-20mA out – Sensor Break value	Read Write	0 to 2399	10's of µA	Integer	03, 06, 16, 04	Due to hardware variations, actual output range is designed to be at least 1.00 to 23.00 mA. Writing out of range data results in a value of 3.00 mA.
40404	403 (0193)	4-20mA out – Overrange value	Read Write	0 to 2399	10's of µA	Integer	03, 06, 16, 04	*This feature is not available through manual programming.* Due to hardware variations, actual output range is designed to be at least 1.00 to 23.00 mA. Writing out of range data results in a value of 21.00 mA.
40405	404 (0194)	4-20mA out – Underrange value	Read Write	0 to 2399	10's of µA	Integer	03, 06, 16, 04	*This feature is not available through manual programming.* Due to hardware variations, actual output range is designed to be at least 1.00 to 23.00 mA. Writing out of range data results in a value of 3.00 mA.

Register [1]		Name	Access	Limits or Range [2]	Units	Data Type [3]	Function Code(s)	Comments
Number	Address (hex)							
40406	405 (0195)	4-20mA out – Maximum value allowed	Read Write	0 to 2399	10's of µA	Integer	03, 06, 16, 04	*This feature is not available through manual programming.* Due to hardware variations, actual output range is designed to be at least 1.00 to 23.00 mA. Writing out of range data results in a value of 23.00 mA.
40407	406 (0196)	4-20mA out – Minimum value allowed	Read Write	0 to 2399	10's of µA	Integer	03, 06, 16, 04	*This feature is not available through manual programming.* Due to hardware variations, actual output range is designed to be at least 1.00 to 23.00 mA. Writing out of range data results in a value of 0.00 mA.
40408	407 (0197)	4-20mA out – Display Value 1	Read Write	-1999 to +9999	User Defined	Integer	03, 16, 04	4-20mA out scaling. Represents the display value without the decimal point.
40409	408 (0198)	4-20mA out – Display Value 2	Read Write	-1999 to +9999	User Defined	Integer	03, 16, 04	4-20mA out scaling. Represents the display value without the decimal point.
40410	409 (0199)	4-20mA out – Output 1	Read Write	0 to 2399	10's of µA	Integer	03, 06, 16, 04	4-20mA out scaling. Represents the mA output at Display 1 value without decimal point. Writing out of range data results in a value of 23.99 mA.
40411	410 (019A)	4-20mA out – Output 2	Read Write	0 to 2399	10's of µA	Integer	03, 06, 16, 04	4-20mA out scaling. Represents the mA output at Display 2 value without decimal point. Writing out of range data results in a value of 23.99 mA.
40412	411 (019B)	4-20mA out – Data in mA or Data in bits	Read Write	0 to 2399 or 0 to 65535	10's of µA (00.00 to 23.99 mA) or DAC bits	Integer	03, 06, 16, 04	If 4-20mA out mode is set to "Serial Comm., mA" (0x83) this register is in 10's of µA. Due to hardware variations, the actual output range is at least 1.00 to 23.00 mA. Writing out of range data results in a value of 23.99 mA. If 4-20mA out mode is set to "Serial Comm., bits" (0x84), this register is in DAC bits. See Table 4, page 9.
49101 To 49104	9100 – 9103 (238C – 238F)	Product Identifier	Read Only	Not applicable	None	ASCII characters	03, 04	8 characters indicating the product firmware number
49105 To 49108	9104 – 9107 (2390 – 2393)	Firmware Version	Read Only	Not applicable	None	ASCII characters	03, 04	8 characters indicating the firmware version number
49109 To 49116	9108 – 9115 (2394 – 239B)	Mfg. Serial Number	Read Only	Not applicable	None	ASCII characters	03, 04	16 (max) characters indicating the manufacturing serial number information.

Notes

Note 1. The Register numbers and addresses follow the Modbus format:
- 3xxxx are for Input Registers and are read-only.
- 4xxxx are for Holding Registers and are read/write.

Although there are no specific 3x Registers, all 4x Registers are mirrored into 3x register space, and are therefore capable of being read by Modbus function 04 (Read Input Registers). All data addresses in Modbus messages are referenced to zero (0), while Register addresses are referenced to one (1). For example, Register 40100 is sent in the Modbus message as 0x0063 (100-1 = 99 ≡ 63 hex). If two addresses are shown separated by a " – ", they form a register pair to make the parameter into a 4-byte (32 bit) value.

Note 2. Limits or Range: Writing a value that is outside the parameters range will force it to be limited to the closest value within the range. For example, if the range is -1.99 to +1.99 and the value sent is 3.21, the value used is 1.99. Likewise for the lower side of the range. Exceptions are noted in the comments.

Note 3. Data Types:
Data format is highest byte first.
Word = 16 bit
Integer = -32768 to 32767
Long = -2,147,483,648 to 2,147,483,647
Float = IEEE floating point format, 4 bytes
"Decimal point setting in 40102." These values represent the number without regard to the decimal point. The decimal point setting can be found in Holding Register 40102. For example, if the number 12.34 is displayed, a read of 40001 will return 1234 (0x04D2). Register 40102 will contain 2 (0x0002) to indicate a decimal point setting of two places to the right of the decimal point. Floating point versions of these numbers, with the decimal point included, are also available.

Examples (register values are shown in hexadecimal):

Process value displayed	Register 40001	Register 40102	Registers 40005 – 40006
1.234	04D2	0003	3F9D – F3B6
12.34	04D2	0002	4145 – 70A4
123.4	04D2	0001	42F6 – CCCD
-123.4	FB2E	0001	C2F6 – CCCD

Note 4. Remote scaling procedure:
a. Write the desired values for the display, Display 1 & 2.
b. Write the desired values for the input, Input 1 & 2, for mA or volts. Note that the values written to the PD765 are (mA * 100) or (volts * 100) because of the meter's input specifications (4 digit, 20.00 mA and 10.00 volt input ranges) and values written to the PD644 are (volts * 10) because of the meter's input specifications (4 digit, 300.0 volt input range).
c. Write to the remote scaling register for either mA or volts.
Warning!
The scaling process takes the input values in mA or volts and converts them to A/D counts. Therefore, do NOT execute a remote scaling register write without first writing the display and input registers. In a similar vein, don't write to the mA (volts) registers and then execute a remote scale command for the volts (mA) input.

Note 5. A read of the Lock register will return 0x0000 if the meter is unlocked, otherwise it will return 0xFFFF to indicate a locked meter. To unlock, the correct lock number must be written, which will then clear the lock number to 0x0000. If the wrong lock number is written, the reply will return 0xFFFF. If the correct lock number is written, the reply will be 0x0000. An unlocked meter can be locked by writing any non-zero value, but the value must be in BCD (i.e. only nybbles between 0 and 9. If a nybble between A and F is sent, no change to lock status will occur and the return value will be 0xFF00).

Note 6. Modbus® is a Registered Trademark of Schneider Automation Inc.

Tables

Table 1. Input configuration

Temperature sensor type and units are only used when temperature is input selected. Decimal point is automatically set for PD740 and for PD765, if temperature input is selected. Invalid selections will result in default settings (shown by the asterisks). Defaults are based on the input selected: for example, if RTD is selected, thermocouple type selection is not allowed and decimal point is forced to none.

Bit(s)	15	14, 13, 12	11, 10, 9, 8	7, 6, 5, 4, 3, 2, 1, 0
Function	°F or °C	Active decimal point setting	Temperature sensor type	Input selected

0	°C
1	°F

PD765	
0x1000	123.4
0x2000	12.34 *
0x3000	1.234
0x6000	1234
PD740	
0x000 *	

0x0000	J *
0x0100	K
0x0200	T
0x0300	T, 0.1°
0x0400	E
0x0500	100 Ω RTD * 0.00385 α
0x0600	100 Ω RTD 0.00392 α

PD765	
0x0000	Volts *
0x0011	mA
0x0022	RTD
0x0023	TC
PD740	
0x0022	RTD
0x0023	TC *

* Default settings for invalid selections

Table 2. Decimal Point Selections for PD644 and PD765

Decimal Point for PD644

Bit(s)	15 – 4	3 – 0
Function	0x000	Decimal Point

Decimal Point Selections for PD644 and PD765	
0x1	123.4
0x2	12.34
0x3	1.234
0x6	1234

Decimal Point for PD765

Bit(s)	15 – 8	7 – 4	3 – 0
Function	00000000	Decimal Point for mA	Decimal Point for Volts

The relationship between these decimal point settings and the one found in 40101 (and mirrored in 40102) is that the decimal point setting in 40101 is the active (presently displayed) decimal point, and the settings found in 40103 are the settings for the mA and Volts inputs. If the mA input is selected, the decimal point setting in bits 14 to 12 of 40101 will be the same as the one in bits 7 to 4 of 40103. If the voltage input is selected, the decimal point setting in bits 14 to 12 of 40101 will be the same as the one in bits 3 to 0 of 40103. If a temperature input is selected, the settings in 40103 may or may not be the same as the active setting (in 40101). There is no storage for the decimal point settings for the RTD or thermocouple inputs because these are fixed.

Table 3. Relay Configuration

Bit(s)	15 – 8	7 – 5	4	3	2 – 0
Function	00000000	000	Normal/ Fail-Safe	0	Operation

0	Normal
1	Fail-Safe

0	Automatic reset
1	Auto & Manual reset
2	Latching
3	Latching with Clear
4	Pump Alternation
5	Unused
6	Unused
7	Off (Disabled) (Modbus accessible)

Table 4. 4-20 mA Output Modes

Bit(s)	15 – 8	7	6 – 3	2 – 0
Function	00000000	Output Option	000 0	4-20 mA Data Source

PD644	
0	No 4-20 mA
1	4-20 mA installed

PD740 PD765	
0	Relays
1	4-20 mA

0	Display value	The data for the 4-20 mA output is the display (process) value.
1	Max Display value	The data for the 4-20 mA output is the Maximum display value.
2	Min Display value	The data for the 4-20 mA output is the Minimum display value.
3	Serial Comm., mA	The data for the 4-20 mA output is register 40412.
4	Serial Comm., bits	The data for the 4-20 mA output is register 40412.
5	Unused	
6	Unused	
7	Unused	

Table 5. Available Register Table

This table shows available registers versus firmware versions for various Precision Digital products.

PD765 Version 3.xxx	PD740 Version 1.xxx	PD644 Version 1.xxx
40001 to 40016	40001 to 40011	40001 to 40011
	40013 to 40014	40013 to 40014
40101 to 40113	40101	40102
	40104 to 40105	40105
	40107 to 40113	40107 to 40113
40201 to 40212		40207 to 40212
40301 to 40310	40301 to 40310	40301 to 40310
40401 to 40412	40401 to 40412	40401 to 40402
		40404 to 40412
49101 to 49116	49101 to 49116	49101 to 49116