



Modbus Register Map – PCE Instruments

Version 22 - 8/30/2017

This document describes the Modbus registers that are used to communicate with PCE Instruments particle counters, using the PCE Instruments register map. These registers are applicable to units with RS485/232 serial and TCP/IP interfaces.

Protocol options

| Description | Options | Default |
|-------------------|-----------------------------------|------------|
| Transmission Mode | Modbus RTU, ASCII, TCP | Modbus RTU |
| Bus Type | RS-232, RS-485 (half-duplex) | RS-232 |
| Baud Rates | 9600, 19200, 38400, 57600, 115200 | 19200 |
| Parity | None, Even, Odd | Even |
| Modbus Address | 0-247 (0=Broadcast) | 247 |

Register Data Representations

| Data Type | Description | Byte Order |
|-----------|---|---|
| I16, U16 | Signed and Unsigned 16 bit Integers | Big-Endian |
| I32, U32 | Signed and Unsigned 32 bit Integers | Big-Endian within each register Little-Endian across registers |
| String | Double-Byte characters zero terminated | First character in high byte of lowest address |
| Float | IEEE-754 Single Precision (32-bit) | Big-Endian within each register Little-Endian across registers |
| Date | ISO-8601 YYYY-MM-DD | See String data type |
| Time | ISO-8601 hh:mm:ss 24-hour notation, local time | See String data type |

Register Access Codes

| Code | Description |
|------|---------------------------------|
| R | Read Access |
| W | Write Access |
| RW | Read and Write Access |
| PR | Protected Read Access |
| PW | Protected Write Access |
| PRW | Protected Read and Write Access |

To access protected registers the admin password must be written to register xx.
Certain access codes can be combined. For example, an access code of R+PW requires a password to write but may be read without a password.

References

Modbus: <http://www.modbus.org/>
ISO-8601: http://en.wikipedia.org/wiki/ISO_8601
IEEE-754 http://en.wikipedia.org/wiki/IEEE_floating_point

System Information

| Description | Address | # of Registers | Data Type | Access | Notes |
|----------------------|---------|----------------|-----------|--------|--|
| Register Map Version | 0 | 1 | U16 | R | |
| Manufacture ID | 1 | 30 | String | R | Particles Plus Inc. |
| System Model Number | 31 | 11 | String | R | |
| System Serial Number | 42 | 13 | String | R | |
| Reserved | 55 | 11 | | | |
| GUI Model | 66 | 11 | String | R | |
| GUI Serial Number | 77 | 17 | String | R | |
| GUI HW Rev | 94 | 11 | String | R | |
| GUI FW Rev | 105 | 11 | String | R | |
| COM Model | 116 | 11 | String | R | |
| COM Serial Number | 127 | 17 | String | R | |
| COM HW Rev | 144 | 11 | String | R | |
| COM FW Rev | 155 | 11 | String | R | |
| PWR Model | 166 | 11 | String | R | |
| PWR Serial Number | 177 | 17 | String | R | |
| PWR HW Rev | 194 | 11 | String | R | |
| PWR FW Rev | 205 | 11 | String | R | |
| BAT Model | 216 | 11 | String | R | |
| BAT Serial Number | 227 | 17 | String | R | |
| BAT HW Rev | 244 | 11 | String | R | |
| BAT FW Rev | 255 | 11 | String | R | |
| PMP Model | 266 | 11 | String | R | |
| PMP Serial Number | 277 | 17 | String | R | |
| PMP HW Rev | 294 | 11 | String | R | |
| PMP FW Rev | 305 | 11 | String | R | |
| DET Model | 316 | 11 | String | R | |
| DET Serial Number | 327 | 17 | String | R | |
| DET HW Rev | 344 | 11 | String | R | |
| DET FW Rev | 355 | 11 | String | R | |
| LSR Model | 366 | 11 | String | R | |
| LSR Serial Number | 377 | 17 | String | R | |
| LSR HW Rev | 394 | 11 | String | R | |
| LSR FW Rev | 405 | 11 | String | R | |
| EXT Device Count | 416 | 1 | U16 | R | Number of External Devices |
| EXT Device Select | 417 | 1 | U16 | RW | Select External Device to Read |
| EXT Device Model | 418 | 11 | String | R | There may be zero or more External Devices attached to the system. Use EXT Device Select Register to access. |
| EXT Serial Number | 429 | 17 | String | R | |
| EXT HW Rev | 446 | 11 | String | R | |
| EXT FW Rev | 457 | 11 | String | R | |

Configuration

| Description | Address | # of Registers | Data Type | Access | Notes |
|----------------------------------|---------|----------------|-----------|--------|---|
| Admin Password | 1000 | 16 | String | W | Enter this password to access protected registers |
| Current Date | 1016 | 11 | Date | R+PW | System Date |
| Current Time | 1027 | 9 | Time | R+PW | System Time |
| Number of Channels | 1036 | 1 | U16 | R | Maximum # of active channels |
| Minimum Channel Size | 1037 | 2 | Float | R | Smallest channel size in microns |
| Maximum Channel Size | 1039 | 2 | Float | R | Largest channel size in microns |
| Options | 1041 | 1 | U16 | R | TBD |
| Reserved | 1042 | 158 | | | |
| Calibration Date | 1200 | 11 | Date | R | |
| Calibration Due Date | 1211 | 11 | Date | R | |
| Language | | 2 | | R+PW | 0 = Not Set 1 = Chinese Simplified 2 = Chinese Traditional 3 = English 4 = French 5 = German 6 = Italian 7 = Japanese 8 = Korean 9 = Spanish |
| Pump Start Time Use Default | | | | | |
| Pump Start Time in Delay | | | | | |
| Pump Start Time in Hold | | | | | |
| Store Partial Samples | | | | | |
| Alarm Acknowledge | | | | | |
| Enable Annotations | | | | | |
| Temperature Alarm Enable | | | | | |
| Temperature Alarm Low Threshold | | | | | |
| Temperature Alarm High Threshold | | | | | |
| RH Alarm Enable | | | | | |
| RH Alarm Low Threshold | | | | | |
| RH Alarm High Threshold | | | | | |
| Automatic Printing | | | | | |
| Automatic Print on | | | | | 0 = Sample 1 = Alarm |
| Print Model Name | | | | | |
| Print Serial Number | | | | | |
| Print Last Calibration | | | | | |
| Print Separator | | | | | |
| Print Averages | | | | | |

Communication

| Description | Address | # of Registers | Data Type | Access | Notes |
|------------------------|---------|----------------|-----------|--------|---|
| Modbus Address | 2000 | 1 | U16 | R+PW | 1 – 247 |
| Modbus Configuration | 2001 | 24 | String | R+PW | Format: mmmmm,ttt,bbbbbb,pppp Where (case insensitive): m = Mode t = Type of bus b = Baud Rate p = Parity Example: ASCII,485,9600,None Refer to Protocol Options |
| Modbus TCP Port | | 1 | U16 | R+PW | |
| Modbus TCP Config Port | | 1 | U16 | R+PW | |
| TCP/IP Interface | 2100 | 1 | U16 | R | 0 = None 1 = Ethernet 2 = Wi-Fi |
| Ethernet DHCP Enable | 2101 | 1 | U16 | R | 0= disabled, 1= enabled |
| Ethernet MAC Address | 2102 | 18 | String | R | Format: xx-xx-xx-xx-xx-xx xx = byte in hex format |
| | 2120 | 6 | | | Reserved (for 64 bit MAC) |
| Ethernet IP Address | 2126 | 16 | String | R | Format: 999.999.999.999 |
| Ethernet Subnet Mask | 2142 | 16 | String | R | Format: 999.999.999.999 |
| Ethernet Gateway | 2158 | 16 | String | R | Format: 999.999.999.999 |
| Wi-Fi DHCP Enable | 2201 | 1 | U16 | R | 0= disabled, 1= enabled |
| Wi-Fi MAC Address | 2202 | 18 | String | R | Format: xx-xx-xx-xx-xx-xx xx = byte in hex format |
| | 2220 | 6 | | | Reserved (for 64 bit MAC) |
| Wi-Fi IP Address | 2226 | 16 | String | R | Format: 999.999.999.999 |
| Wi-Fi Subnet Mask | 2242 | 16 | String | R | Format: 999.999.999.999 |
| Wi-Fi Gateway | 2258 | 16 | String | R | Format: 999.999.999.999 |
| Wi-Fi SSID | 2274 | 34 | String | R | SSID string (setup through IMS) |
| | | | | | |
| | | | | | |

Diagnostics

| Description | Addresses | # of Registers | Data Type | Access | Notes |
|------------------------------------|-----------|----------------|-----------|--------|---|
| Battery Level | 3000 | 1 | U16 | R | Percentage of remaining battery charge (0-100) |
| Battery Estimated Idle Minutes | 3001 | 1 | U16 | R | Estimated number of minutes the instrument can run while Idle (Stopped) |
| Battery Estimated Sampling Minutes | 3002 | 1 | U16 | R | Estimated number of minutes the instrument can run while sampling |
| Battery Remaining Life | 3003 | 1 | U16 | R | Percentage of remaining battery life (0-100) |
| On Ac Power | 3004 | 1 | U16 | R | 0 = Running on battery 1 = Running on AC power |

Calibration

| Description | Address | # of Registers | Data Type | Access | Notes |
|-------------|---------|----------------|-----------|--------|-------|
| | 4000 | | | | |
| | | | | | |

Sampling Setup and Control

| Description | Address | # of Registers | Data Type | Access | Notes |
|---------------------|---------|----------------|-----------|-----------------|--|
| Start/Stop Sampling | 5000 | 1 | U16 | RW | Write: 0 = Stop Sampling 1 = Start Sampling Read: Sampling State 0 = Stopped 1 = Delay 2 = Counting 3 = Hold |
| Device Status | 5001 | 1 | U16 | R | One bit for each status 0x0001 Flow Error 0x0002 Laser Error 0x0004 Time of day clock not running 0x0008 Internal Data Error Note: Flow Error and Laser Error will be true when not counting. |
| Cycle Count | 5002 | 1 | U16 | RW ¹ | Number of sample periods (1-9999) 0 = Continuous Sampling |
| Delay Time | 5003 | 2 | U32 | RW ¹ | Seconds, 0 – 359999 (99h, 59m, 59s) |
| Sample Time | 5005 | 2 | U32 | RW ¹ | Seconds, 0 – 359999 |
| Hold Time | 5007 | 2 | U32 | RW ¹ | Seconds, 0 – 359999 |
| Sample Mode | 5009 | 2 | U16 | RW ¹ | 0 = Automatic 1 = Manual 2 = RT Meter |
| Alarm On | 5011 | 2 | | | 0 = Alarm on Differential Counts 1 = Alarm on Differential Counts / ft ³ 2 = Alarm on Differential Counts / m ³ 3 = Alarm on µg/m ³ 4 = Alarm on Sum Counts 5 = Alarm on Sum Counts / ft ³ 6 = Alarm on Sum Counts / m ³ 7 = Alarm on PM |
| Mass Mode | 5013 | 1 | | RW | 0 = Disable Mass Mode 1 = Enable Mass Mode |
| Use Recipes | 5014 | 1 | U16 | RW ² | 0 = Disabled. Do not use recipes 1 = Enabled. Use Recipes |
| Recipe Index | 5015 | 1 | U16 | R | Only applicable when Use Recipes is enabled |
| Recipe Name | 5016 | 16 | String | R | Only applicable when Use Recipes is enabled |
| Location Index | 5032 | 1 | U16 | R | |

¹ These items may only be written when the Use Recipes register is set to disabled.

² This version of the Modbus interface does not provide support for selecting or modifying recipes.

Channel Setup – To Access Channel n refer to the register address formula found in the next section

| Description | Base Address | # of Registers | Data Type | Access | Notes |
|------------------|--------------|----------------|-----------|--------|------------------------------------|
| Channel Enable | 6000 | 100 | U16 | RW | Channel enabled? 0=No, 1=Yes |
| Channel Size | 6100 | 200 | Float | RW | Channel size in microns |
| Alarm Enable | 6300 | 100 | U16 | RW | Channel alarm enabled? 0=No, 1=Yes |
| Alarm Threshold | 6400 | 200 | U32 | RW | Channel alarm threshold value |
| Density Factor | 6600 | 200 | Float | RW | Channel density factor |
| Refractive Index | 6800 | 200 | Float | RW | Channel refractive index |

Data Record Selection

| Description | Address | # of Registers | Data Type | Access | Notes |
|-----------------------|---------|----------------|-----------|--------|--|
| Record Count | 8000 | 2 | U32 | R | # of records stored |
| Record Number to Read | 8002 | 2 | I32 | RW | Record number to access 0 = Read current data 1 – n = Read record n where n is ≤ to Record Count -1 = Read last record |
| Clear All Records | 8004 | 1 | U16 | PW | Writing a value 0x9559 to this register will erase all records! |

To read data that is currently being displayed on the instrument write zero to Record Number (Address 8002) then read the data starting at register 9000. To read the channel data for the selected record use the following formula:

$$\text{Register Address} = \text{Base Address} + ((\text{Channel } n - 1) * \frac{\# \text{ of Registers}}{100})$$

For example, to read differential counts from record #7, channel #5:

1. Set the record number register at address 8002/8003 to 7
2. Read 2 registers (data type float) from address 10308.

Note: When reading current data (Register 8002 = 0). Writing a 0 to register 8002 prompts the system to take a snapshot of the current data values. Thereafter, reads to the data registers (9000+) use the data captured during that snapshot. That data remains in those registers until the next snapshot is prompted by writing another 0 to register 8002.

Data Record – Select Record Using Record Number

| Description | Address | # of Registers | Data Type | Access | Notes |
|--------------------|---------|----------------|-----------|--------|--|
| Record Number | 9000 | 2 | I32 | R | -1 = No data 0 = Current data 1 – n = Data record # |
| Date | 9002 | 11 | Date | R | Date data was recorded |
| Time | 9013 | 9 | Time | R | Time data was recorded |
| Location | 9022 | 21 | String | R | Location where data was taken |
| Annotation | 9043 | 31 | String | R | Data annotation |
| Sample Duration | 9074 | 2 | Float | R | Seconds |
| Sample Flow Rate | 9076 | 2 | Float | R | CFM |
| Sample Status Bits | 9078 | 1 | U16 | R | Bit Mask (one bit for each status) 0x0001 -> Laser Ok 0x0002 -> Flow Ok 0x0004 -> Temperature Ok 0x0008 -> Relative Humidity Ok 0x0010 -> CO ₂ Ok 0x0020 -> TVOC Ok 0x0040 -> Barometric Pressure Ok 0x0080 -> Timestamp is invalid |
| Temperature | 9079 | 1 | U16 | R | Temperature LSB 0.1°C If temperature = 999 No device If temperature = 998 Sensor Error Otherwise temperature at beginning of sample or if a temperature alarm occurred during the sample then the temperature when the alarm was detected. |
| RH | 9080 | 1 | U16 | R | Relative Humidity, LSB 1% If RH = 0 No device If RH = 1 Sensor Error Otherwise same logic as temperature |
| BP | 9081 | 2 | Float | R | Absolute Barometric Pressure LSB 1 kPa If BP = 0 Sensor Error |
| CO ₂ | 9083 | 1 | U16 | | CO ₂ , LSB 1 ppm If CO ₂ = 65535 No Device If CO ₂ = 65534 Sensor over range <div style="text-align: right;">> 2000ppm</div> If CO ₂ = 65533 Sensor Over range <div style="text-align: right;">> 5000ppm</div> |
| TVOC | 9084 | 1 | U16 | | Total Volatile Organic Compound LSB 1 ppb If TVOC = 65535 No Device If TVOC = 65534 Sensor Error |
| Sample TPM | 9085 | 2 | Float | R | Total Particle Mass in µg/m³ |

Channel Data – Select Record Using Record Number
Channel Data is offset from base address

| Description | Base Address | # of Registers | Data Type | Access | Notes |
|-------------------------------------|--------------|----------------|-----------|--------|--|
| Alarm Flag | 10000 | 100 | U16 | R | 0 = Data did not exceed alarm threshold 1 = Data exceeded alarm threshold |
| Channel Size | 10100 | 200 | Float | R | µm |
| Differential Counts | 10300 | 200 | Float | R | Count of Particles measured in this channel |
| Differential Counts/ft ³ | 10500 | 200 | Float | R | Particles per cubic foot |
| Differential Counts/m ³ | 10700 | 200 | Float | R | Particles per cubic meter |
| Differential Mass | 10900 | 200 | Float | R | Particle Mass in µg per cubic meter (µg/m ³) |
| Sum Counts | 11100 | 200 | Float | R | Sum of Particle counts in this and larger channels |
| Sum Counts / ft ³ | 11300 | 200 | Float | R | Sum count per cubic foot |
| Sum Counts / m ³ | 11500 | 200 | Float | R | Sum count per cubic meter |
| PM | 11700 | 200 | Float | R | Sum Particle Mass in smaller channels |

Revision History

| | | | |
|------------|----|-----|--|
| 10/11/2014 | 1 | mrh | Initial Draft |
| 10/27/2014 | 2 | mrh | Added register to select sample count units |
| 10/30/2014 | 3 | DP | Added unit fields for all data, sampled, buffered and logged Clarified status fields for above data (bit fields for any errors) |
| 12/03/2014 | 4 | mrh | Rewrite to fit better with PPI data structures. Reserve space for 100 channels. |
| 12/05/2014 | 5 | DP | Reviewed document and added comments |
| 12/16/2014 | 6 | mrh | Sent out for internal review. |
| 12/23/2014 | 8 | mrh | Added a register and Renumbered Data Record Addresses. Implemented more registers. |
| 12/29/2014 | 9 | mrh | Added notes to temp/RH regarding display of errors. |
| 2/9/2015 | 10 | mrh | Added Co2 and VOC |
| 4/3/2015 | 11 | mrh | Added Battery Status Registers |
| 4/25/2015 | 12 | mrh | Added Co2 and VOC status bits to recorded records. |
| 5/3/2015 | 13 | mrh | Modified definition of register #8002 to include a code that will read the last recorded record. |
| 5/4/2015 | 14 | mrh | Modified definition of register #9083 CO2 range errors. |
| 5/12/2015 | 15 | mrh | Fixed sample register address calculation. Changed code for reading last recorder data record from 65535 to -1. |
| 7/1/2015 | 16 | mrh | Check register 5000 from write only to RW. |
| 7/19/2015 | 17 | mrh | - Changed Register 5001 from Sampling State to device status. - Added comment to register 6000 indicating that disabling a channel on effects the displayed data. - Added time stamp invalid status to recorded data sample status bits. |
| 3/22/2016 | 18 | Dkp | Added registers 2101-2274+ Communications parameters, they are currently only implemented as read-only Changed document name (so we can have other map documents for competitive counters) |
| 3/23/2016 | 19 | Dkp | Added registers 6000-6800+ Channel settings management |
| 4/13/2016 | 20 | Dkp | Added note that register 8002 needs to be written w/ 0 to refresh data values. |
| 4/28/2016 | 21 | Dkp | Added clear samples register 8004 |
| 8/30/2017 | 22 | Dkp | Changed document format (cosmetic only) |