**NEWFLOW LTD**

**George House**
**Derwent Road**
**Malton**
**UK**
**YO17 6YB**

# P572 Modbus Address Map Manual

| Rev | Date | Changes | Prepared | Checked | Authorized |
|---|---|---|---|---|---|
| 0 | 26 Nov 2019 | Original release | MOB | DGS | |
| 1 | | | | | |
| 2 | | | | | |
| | | | | | |
| | | | | | |

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# Introduction

## *Overview*

The NÅNO RTU2 can be used in either PIU (prover data acquisition mode) or as an RTU, with specific features for flow measurement and prover (Small Volume, Ball or Master Meter) including Dual Pulse pulse fidelity and Dual Chronometry.

## *Software description*

The NÅNO RTU2 supports Modbus RTU.

The currently supported Modbus functions are:-

| | |
|---|---|
| FN03/FN04 | Read Registers |
| FN08 | Diagnostics (note : only Subfunction 00 Return Query Data is supported) |
| FN16 | Preset Multiple Registers |

Writes to unused registers are simply ignored.

Reads from unused registers return 0x0000.

## *Turnaround Delay*

The typical turnaround delay is approximately 2.5ms.

# Modbus Maps

There are two separate Modbus maps in the RTU2, these are

1) The Scaled 32 Bit Integer Modbus Slave Map

2) Legacy Mixed Format Modbus Slave Map

Each of these may have advantages in specific applications, but the Scaled 32 Bit Integer Modbus Slave Map is in most cases the easiest to use, since unlike Floating point number, the scaled Integer values are human readable, and ALL data can be acquired in one Modbus Poll.

# Scaled 32 Bit Integer Modbus Slave Map

## *Tabular View*

| Modbus Address | Type | Description | ATT. | NV? | Range | Pre-Scaler Value |
|---|---|---|---|---|---|---|
| 2000 | Int32 | P513 Hardware Version | RO | n/a | 0 to 65535 | Not Scaled |
| 2002 | Int32 | P513 Software Version | RO | n/a | 0 to 65535 | Not Scaled |
| 2004 | Int32 | P517 Firmware Version | RO | n/a | 0 to 65535 | Not Scaled |
| 2006 | Int32 | Reserved | RO | n/a | | - |
| 2008 | Int32 | System Status (Bits: 0 - 7) | RO | n/a | 0 to 255 | Binary |
| 2010 | Int32 | Digital Inputs (Bits: 0 - 8) | RO | n/a | 0 to 511 | Binary |
| 2012 | Int32 | Prover Status (Bits: 0-2) | RO | n/a | 0 to 7 | Binary |
| 2014 | Int32 | Message Id (2 Hz) | RO | n/a | 0 to 4294967295 | Not Scaled |
| 2016 | Int32 | Reserved | RO | n/a | | - |
| 2018 | Int32 | Good / A pulse count | RO | n/a | 0 to 4294967295 | Not Scaled |
| 2020 | Int32 | Reserved | RO | n/a | | - |
| 2022 | Int32 | Bad / B pulse count | RO | n/a | 0 to 4294967295 | Not Scaled |
| 2024 | Int32 | Reserved | RO | n/a | | - |
| 2026 | Int32 | RAWIN pulse count | RO | n/a | 0 to 4294967295 | Not Scaled |
| 2028 | Int32 | Prover PULSEIN pulse count | RO | n/a | 0 to 4294967295 | Not Scaled |
| 2030 | Int32 | Prover PULSEIN SW1-2 (gated) | RO | n/a | 0 to 4294967295 | Not Scaled |
| 2032 | Int32 | Prover Time SW1-2 (gated) ( x100ns ) | RO | n/a | 0 to 4294967295 | Not Scaled |
| 2034 | Int32 | Prover Time P1-N1 (gated) (x100ns) | RO | n/a | 0 to 4294967295 | Not Scaled |
| 2036 | Int32 | Reserved | RO | n/a | | - |
| 2038 | Int32 | Good / A frequency (0 to 10kHz) | RO | n/a | 0 to 1,000,000,000 | Hz x 100,000 |
| 2040 | Int32 | Bad / B frequency (0 to 10kHz) | RO | n/a | 0 to 1,000,000,000 | Hz x 100,000 |
| 2042 | Int32 | RAWIN frequency (0 to 10kHz) | RO | n/a | 0 to 1,000,000,000 | Hz x 100,000 |
| 2044 | Int32 | Reserved | RO | n/a | | - |
| 2046 | Int32 | Density 1 period (50 to 5kHz) | RO | n/a | 0 to 2,000,000,000 | uS x 100,000 |
| 2048 | Int32 | Density 1 period (50 to 5kHz) | RO | n/a | 0 to 2,000,000,000 | uS x 100,000 |
| 2050 | Int32 | Reserved | RO | n/a | | - |
| 2052 | Int32 | Analog Input 1 (0 to 22mA) | RO | n/a | 0 to 2,500,000,000 | mA x 1,000,000 |
| 2054 | Int32 | Analog Input 2 (0 to 22mA) | RO | n/a | 0 to 2,500,000,000 | mA x 1,000,000 |
| 2056 | Int32 | Analog Input 3 (0 to 22mA) | RO | n/a | 0 to 2,500,000,000 | mA x 1,000,000 |
| 2058 | Int32 | Analog Input 4 (0 to 22mA) | RO | n/a | 0 to 2,500,000,000 | mA x 1,000,000 |
| 2060 | Int32 | Analog Input 5 (0 to 22mA) | RO | n/a | 0 to 2,500,000,000 | mA x 1,000,000 |
| 2062 | Int32 | PRT (60 to 212 Ohms) | RO | n/a | 0 to ???,000,000 | Ohm x 1,000,000 |
| 2064 | Int32 | Analog Channel Status | RO | n/a | 0 to 4095 | Binary |

| Modbus Address | Type | Description | ATT. | NV? | Range | Pre-Scaler Value |
|---|---|---|---|---|---|---|
| 2066 | Int32 | Reserved | RO | n/a | | - |
| 2068 | Int32 | DAC 1 (0 to 21mA) | R/W | No | 0-24,000 | mA x1000 |
| 2070 | Int32 | DAC 2 (0 to 21mA) | R/W | No | 0-24,000 | mA x1000 |
| 2072 | Int32 | Digital Outputs (Bits 0 – 6) | R/W | No | 0 to 127 | Binary |
| 2074 | Int32 | Pulse Output 1 bucket (0 to 65535) | R/W | No | 0 to 65535 | Not Scaled |
| 2076 | Int32 | Pulse Output 2 bucket (0 to 65535) | R/W | No | 0 to 65535 | Not Scaled |
| 2078 | Int32 | Prover Configuration (1=Run) | R/W | No | 0 or 1 | Binary |
| 2080 | Int32 | Reserved (Writes are ignored) | R/W | No | | - |
| 2082 | Int32 | Purge Pulse Output #1 (1=Reset) | R/W | No | 0 or 1 | Binary |
| 2084 | Int32 | Purge Pulse Output #2 (1=Reset) | R/W | No | 0 or 1 | Binary |
| 2086 | Int32 | System Configuration (Bits: 0 - 7 Pulses) | R/W | **YES** | 0 to 256 | Binary |
| 2088 | Int32 | System Configuration (Bits: 10 - 19 Analogs) | R/W | **YES** | 0 to 1023 | Binary |
| 2090 | Int32 | Pulse Output 1 width (1 to 2047mSec) | R/W | **YES** | 1 to 2047 | Not Scaled |
| 2092 | Int32 | Pulse Output 2 width (1 to 2047mSec) | R/W | **YES** | 1 to 2047 | Not Scaled |
| 2094 | Int32 | Prover OneShot Count (1mS debounce counts) | R/W | **YES** | 0 to 65535 | Not Scaled |
| 2096 | Int32 | RAWOUT Mode (Bits 0 - 2) | R/W | No | 0 to 7 | Binary |
| 2098 | Int32 | Prover Source Selection (0 - 2) | R/W | No | 0 to 7 | Binary |

## *Register Description*

All the registers in the scaled 32 Bit map are 32 bit integers in **3210** Byte Order

### Register 2000 (Read-Only) : P513 Hardware Version

The firmware in the P513 & P572 boards are split into three types. This register holds the Hardware version for the P513 firmware.

e.g. if the Hardware firmware was 12v01, this register would hold the decimal value 1201.

### Register 2002 (Read-Only) : P513 Software Version

The firmware in the P513 & P572 boards are split into three types. This register holds the Software version for the P513 firmware.

e.g. if the Software firmware was 0v22, this register would hold the decimal value 22 (to represent 0022).

### Register 2004 (Read-Only) : P572 Firmware Version

The firmware in the P513 & P572 boards are split into three types. This register holds the version for the P572 firmware.

e.g. if the firmware was 1v18, this register would hold the decimal value 118 (to represent 0118).

### Register 2006 (Read-Only) : Reserved

Reading any reserved register will result in a value of zero (00000000hex)

### Register 2008 (Read-Only) : System Status

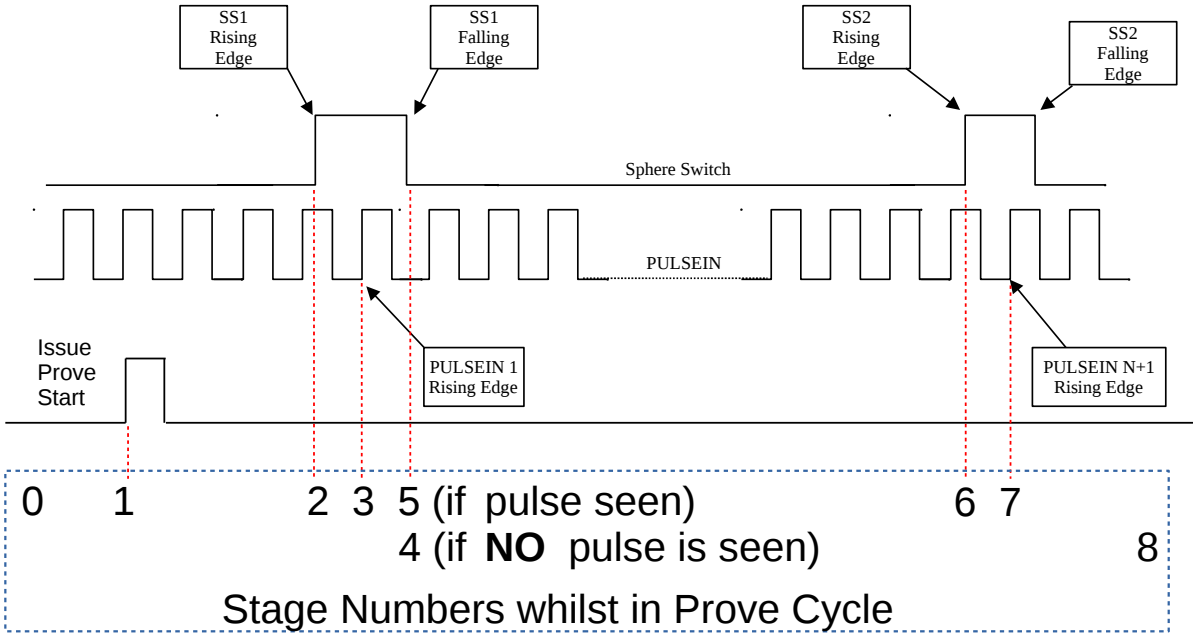
| Bit(s) | Function | Values |
|---|---|---|
| 0 | Comms status | 0 : No comms error<br>1 : Comms error |
| 1 | Pulse Out 1 Bucket Status | 0 : Bucket okay<br>1 : Last fill was rejected |
| 2 | Pulse Out 2 Bucket Status | 0 : Bucket okay<br>1 : Last fill was rejected |
| 3 | Dual Pulse Channel A Line Integrity | 0 : Line okay<br>1 : Line fail |
| 4 | Dual Pulse Channel B Line Integrity | 0 : Line okay<br>1 : Line fail |
| 5 | Good/A roll-over flag | 0 : No roll-over<br>1 : Roll-over occurred (self clears after 5 seconds) |
| 6 | Bad/B roll-over flag | 0 : No roll-over<br>1 : Roll-over occurred (self clears after 5 seconds) |
| 7 | RAWIN roll-over flag | 0 : No roll-over<br>1 : Roll-over occurred (self clears after 5 seconds) |
| 31:8 | [unused] | [unused] |

## Register 2010 (Read-Only) : Digital Inputs

| Bit(s) | Function | Values |
|---|---|---|
| 8:0 | Digital Input 9..1 | 0 : Digital Input Inactive<br>1 : Digital Input Active |
| 31:9 | [unused] | [unused] |

## Register 2012 (Read-Only) : Prover Status

| Bit(s) | Function | Values |
|---|---|---|
| 2:0 | Prover State | 0 : Waiting for Start<br>1 : Waiting for SS1 rising edge<br>2 : Got SS1 rising edge, waiting for subsequent PULSEIN rising edge<br>3 : Got SS1 rising edge and subsequent PULSEIN rising edge, waiting for SS1 falling edge<br>4 : Got SS1 falling edge, no PULSEIN rising edge since state 2.<br>5 : Got SS1 falling edge and PULSEIN rising edge, waiting for SS2<br>6 : Got SS2 rising edge and waiting for PULSEIN N+1 rising edge<br>7 : Done, got SS2 rising edge and PULSEIN N+1 rising edge. Waiting for Start<br>8 : Abort, waiting for Start |
| 31:3 | [unused] | [unused] |



## Register 2014 (Read-Only) : FPGA Message Count

Each data message from the P513 I/O board is marked with a unique sequential id value. The value is reset to zero when the unit is powered up (or reset), and increases with each data message. Since each data message is automatically generated every ½ second from the high accuracy clock, the id can be used to calculate time intervals.

**NOTE:** Rolls over at 4,294,967,295. ($2^{32}$-1)

## Register 2016 (Read-Only) : Reserved

Reading any reserved register will result in a value of zero (00000000hex)

## Register 2018 (Read-Only) : Good / A pulse count

Total number of pulses received on the Good / A channel.

If in Dual Pulse mode this will be populated with the Good pulse count. In Single Pulse mode, it will be Pulse Train A count

**NOTE:** Rolls over at 4,294,967,295. ($2^{32}$-1)

## Register 2020 (Read-Only) : Reserved

Reading any reserved register will result in a value of zero (00000000hex)

## Register 2022 (Read-Only) : Bad / B pulse count

Total number of pulses received on the Bad / B channel.

If in Dual Pulse mode this will be populated with the Bad pulse count. In Single Pulse mode, it will be Pulse Train B count

**NOTE:** Rolls over at 4,294,967,295. ($2^{32}$-1)

## Register 2024 (Read-Only) : Reserved

Reading any reserved register will result in a value of zero (00000000hex)

## Register 2026 (Read-Only) : RAWIN pulse count

Total number of pulses received on the RAWIN channel.

**NOTE:** Rolls over at 4,294,967,295. ($2^{32}$-1)

## Register 2028 (Read-Only) : Prover PULSEIN

Number of pulses received on the Prover PULSEIN channel.

The PULSEIN source can be selected via the System Config register (Register 50).

## Register 2030 (Read-Only) : Prover PULSEIN SW1-2 Count

Number of pulses received on the Prover PULSEIN channel occurring between Sphere Switch 1 Leading Edge and Sphere Switch 2 Leading Edge.

This register is reset to 0 when a prove sequence is initiated.

**NOTE:** Rolls over at 65535. ($2^{16}$-1)

## Register 2032 (Read-Only) : Prover Time SW1-2

Timer interval (in 100ns counts) between Sphere Switch 1 Leading Edge and Sphere Switch 2 Leading Edge. This register is reset to 0 when a prove sequence is initiated.

**NOTE:** Rolls over at 4,294,967,295. ($2^{32}$-1)

## Register 2034 (Read-Only) : Prover Time P1-N1

Timer interval (in 100ns counts) between PULSEIN 1 Leading Edge and PULSEIN N+1 Leading Edge

This register is reset to 0 when a prove sequence is initiated.

**NOTE:** Rolls over at 4,294,967,295. (232-1)

## Register 2036 (Read-Only) : Reserved

Reading any reserved register will result in a value of zero (00000000hex)

## Register 2038 (Read-Only) : Good / A frequency

Frequency of the Good / A input. Divide the value by 100,000 to get Hz.

If in Dual Pulse mode this will be populated with the Good pulse frequency. In Single Pulse mode, it will be Pulse Train A frequency.

## Register 2040 (Read-Only) : Bad / B frequency

Frequency of the Bad / B input. Divide the value by 100,000 to get Hz.

If in Dual Pulse mode this will be populated with the Bad pulse frequency. In Single Pulse mode, it will be Pulse Train B frequency.

## Register 2042 (Read-Only) : RAWIN frequency

Frequency of the RAWIN input. Divide the value by 100,000 to get Hz.

## Register 2044 (Read-Only) : Reserved

Reading any reserved register will result in a value of zero (00000000hex)

## Register 2046 (Read-Only) : Density 1 period

Period of the Density 1 input. Divide the value by 100,000 to get microseconds.

## Register 2048 (Read-Only) : Density 2 period

Period of the Density 2 input. Divide the value by 100,000 to get microseconds.

## Register 2050 (Read-Only) : Reserved

Reading any reserved register will result in a value of zero (00000000hex)

## Register 2052 (Read-Only) : Analogue Input 1

Value of Analogue Input 1. Value in nA (divide by a million to get milli-amps)

## Register 2054 (Read-Only) : Analogue Input 2

Value of Analogue Input 2. Value in nA (divide by a million to get milli-amps).

## Register 2056 (Read-Only) : Analogue Input 3

Value of Analogue Input 3. Value in nA (divide by a million to get milli-amps).

## Register 2058 (Read-Only) : Analogue Input 4

Value of Analogue Input 4. Value in nA (divide by a million to get milli-amps).

## Register 2060 (Read-Only) : Analogue Input 5/PRT2

Value of Analogue Input 5. This may be the 4-20 value in nA (divide by a million to get milli-amps) or if in PRT/ RTD Mode, the resistance in µΩ (divide by a million to get ohms)

## Register 2062 (Read-Only) : Analogue Input 6/PRT1

Value of Analogue Input 6. This may be the 4-20 Value in nA (divide by a million to get milli-amps) or if in PRT/ RTD Mode, the resistance in µΩ (divide by a million to get ohms)

## Register 2064 (Read-Only) : Analog Channel Status

| Bit(s) | Function | Values |
|---|---|---|
| 0 | Analog Input AnIn 01 | 0= No error, 1 =Analog channel comms failed |
| 1 | Analog Input AnIn 02 | 0= No error, 1 =Analog channel comms failed |
| 2 | Analog Input AnIn 03 | 0= No error, 1 =Analog channel comms failed |
| 3 | Analog Input AnIn 04 | 0= No error, 1 =Analog channel comms failed |
| 6:4 | Analog Input AnIn 05 | 000: No error<br>001: Analog channel comms failed<br>010: PRT/RTD Current Low<br>011: PRT/RTD Current high<br>100: PRT/RDT wiring reversed<br>101 & 110 are reserved |
| 9:7 | Analog Input AnIn 05 | As bits 6:4 |
| 31:10 | [unused] | [unused] |

## Register 2066 (Read-Only) : Reserved

Reading any reserved register will result in a value of zero (00000000hex)

## Register 2068 (Read/Write) : DAC 1

DAC 1 setting in µA. Divide by 1,000 to get milli-amps

On a power cycle, this register will hold a value of 0.

## Register 2070 (Read/Write) : DAC 2

DAC 2 setting in µA. Divide by 1,000 to get milli-amps

On a power cycle, this register will hold a value of 0.

## Register 2072 (Read/Write) : Digital Outputs

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 0 | Digital Output 1 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 1 | Digital Output 2 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 2 | Digital Output 3 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 3 | Digital Output 4 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 4 | Digital Output 5 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 5 | Digital Output 6 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 6 | Alarm relay | **0 : Relay inactive (Alarm Set)**<br>1 : Relay active (No Fault) |
| 31:7 | [unused] | [unused] |

## Register 2074 (Read/Write) : Pulse Output 1 bucket

Writing to this register adds counts to the Pulse Output 1 bucket. If the counts would overflow the bucket, then bit 1 in the System Status register will be set and no counts will be added.

Once the increment has been processed or on a power cycle, this register will hold a value of 0.

Note that the bucket can only contain a maximum of 65535 counts.

## Register 2076 (Read/Write) : Pulse Output 2 bucket

Writing to this register adds counts to the Pulse Output 2 bucket. If the counts would overflow the bucket, then bit 2 in the System Status register will be set and no counts will be added.

Once the increment has been processed or on a power cycle, this register will hold a value of 0.

Note that the bucket can only contain a maximum of 65535 counts.

## Register 2078 (Read/Write): Prover Configuration

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 0 | Prove Sequence Control | **0 : Do nothing/Idle**<br>1 : Initiate prove sequence |
| 31:1 | [unused] | [unused] |

Once the request has been processed or on a power cycle, this register will hold a value of 0.

## Register 2080 (Read-Only) : Reserved

Reading any reserved register will result in a value of zero (00000000hex).

## Register 2082 (Read/Write) : Purge Pulse Output #1

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 0 | Pulse Out 1 Bucket Purge<br>(note : always 0 on reset) | **0 : Do nothing**<br>1 : Purge |
| 31:1 | [unused] | [unused] |

Once the request has been processed or on a power cycle, this register will hold a value of 0.

## Register 2084 (Read/Write) : Purge Pulse Output #2

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 0 | Pulse Out 2 Bucket Purge<br>(note : always 0 on reset) | **0 : Do nothing**<br>1 : Purge |
| 31:1 | [unused] | [unused] |

Once the request has been processed or on a power cycle, this register will hold a value of 0.

## Register 2086 (Read/Write) : System Config (Non-Volatile)

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 1:0 | Sphere Switch Polarity | 00 : No change<br>**01 : Normal**<br>10 : Invert<br>11 : No Change |
| 3:2 | Pulse Out 1 Mode | 00 : No change<br>01 : Always '0'<br>10 : Always '1'<br>**11 : Pulse output** |
| 5:4 | Pulse Out 2 Mode | 00 : No change<br>01 : Always '0'<br>10 : Always '1'<br>**11 : Pulse output** |
| 7:6 | Dual Pulse Mode | 00 : No change<br>01 : Twin Single Streams (Level E)<br>10 : Dual Pulse (Level B)<br>**11 : Dual Pulse (Level A)** |
| 31:8 | [unused] | [unused] |

## Register 2088 (Read/Write) : System Config (Non-Volatile)

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 1:0 | ADC 1 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |
| 3:2 | ADC 2 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |
| 5:4 | ADC 3 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |
| 7:6 | ADC 4 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |
| 9:8 | ADC 5 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |

| | | |
|---|---|---|
| 11:10 | ADC 6 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |
| 13:12 | ADC 6 / RTD 1 Mode | 00 : No Change<br>**01 : Voltage/Current mode**<br>10 : RTD mode<br>11 : No Change |
| 15:14 | ADC 5 / RTD 2 Mode | 00 : No Change<br>**01 : Voltage/Current mode**<br>10 : RTD mode<br>11 : No Change |
| 31:16 | [unused] | [unused] |

## Register 2090 (Read/Write) : Pulse Output 1 period (Non-Volatile)

Writing to this register sets the pulse rate for Pulse Output 1. The value written here sets the on period for the output pulse train. The pulse output mark/space ratio is fixed at 50:50.

Default value is 250ms.

As an example, if this value is set to 1, it will switch on the output for 1ms, with 1ms off (as 50:50 duty cycle) so that the output frequency would be 500Hz.

Range 1 – 2047. (11 bit number)

## Register 2092 (Read/Write) : Pulse Output 2 period (Non-Volatile)

Writing to this register sets the pulse rate for Pulse Output 2. The value written here sets the on period for the output pulse train. The pulse output mark/space ratio is fixed at 50:50.

Default value is 250ms.

As an example, if this value is set to 1, it will switch on the output for 1ms, with 1ms off (as 50:50 duty cycle) so that the output frequency would be 500Hz.

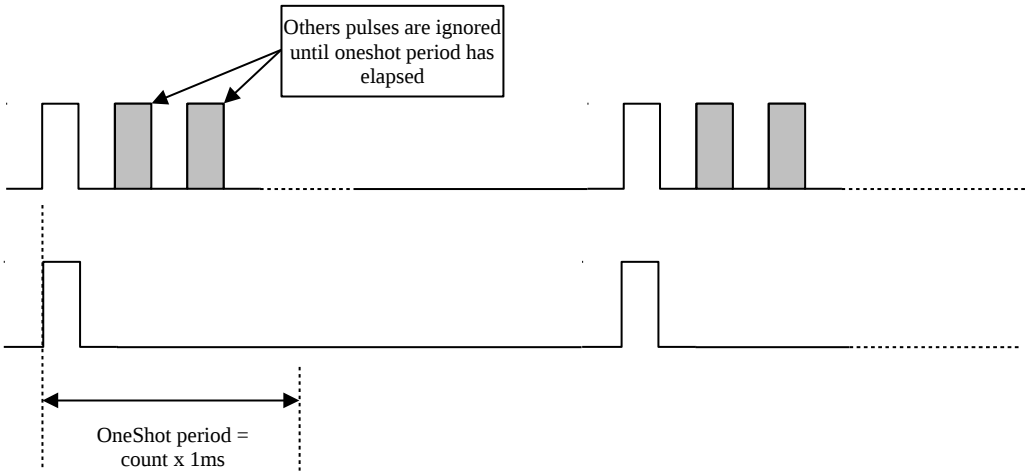
Range 1 – 2047. (11 bit number)

## Register 2094 (Read/Write) : Prover OneShot Count (Non-Volatile)

The Prover OneShot Count specifies the dead time after the first pulse, such that any pulses in the dead time are ignored.

Maximum valid value is 65535.

The period is measured in 1ms counts, and the default OneShot count is 300 (= 300ms).




## Register 2096 (Read/Write) : RAWOUT Mode

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 1:0 | RAWOUT Mode | 00 : No change<br>**01 : RAWOUT disabled**<br>10 : RAWOUT = Dual Pulse Channel A<br>11 : RAWOUT = Dual Pulse Channel B |
| 31:2 | [unused] | [unused] |

## Register 2098 (Read/Write) : Prover Source Selection

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 2:0 | Prover PULSEIN Source | **000 : RAWIN**<br>001 : Dual Pulse Good<br>010 : Dual Pulse Bad<br>011 : Dual Pulse Channel A<br>100 : Dual Pulse Channel B<br>101 : unused<br>110 : unused<br>111 : unused |
| 31:3 | [unused] | [unused] |

# Legacy Mixed Format Modbus Slave Map

## *Read-Only Registers*

| Address | Type | Function |
|---|---|---|
| 0 | Int32 | System Status |
| 2 | Int32 | Digital Inputs |
| 4 | Int32 | Message Id |
| 6 * | Int32 | Good / A pulse count |
| 8 * | Int32 | Bad / B pulse count |
| 10 | Int32 | RAWIN pulse count |
| 12 | Int32 | Prover Status |
| 14 | Int32 | Prover PULSEIN |
| 16 | Int32 | Prover PULSEIN SW1-2 |
| 18 | Int32 | Prover Time SW1-2 |
| 20 | Int32 | Prover Time P1-N1 |
| 22 | Int32 | P513 Hardware Version |
| 24 | Int32 | P513 Software Version |
| 26 | Int32 | P517 Firmware Version |
| 28 | Int32 | Reserved - Future |
| | | |
| 1000 * | Float32 | Good / A frequency |
| 1002 * | Float32 | Bad / B frequency |
| 1004 | Float32 | RAWIN frequency |
| 1006 | Float32 | Density 1 period |
| 1008 | Float32 | Density 2 period |
| 1010 ** | Float32 | Analogue Input 1 |
| 1012 ** | Float32 | Analogue Input 2 |
| 1014 ** | Float32 | Analogue Input 3 |
| 1016 ** | Float32 | Analogue Input 4 |
| 1018 ** | Float32 | Analogue Input 5 |
| 1020 ** | Float32 | PRT |

* - Function depends on the Mode Selected
** - Requires Optional Analogue Board fitted (P511)

**NOTE:** Int32 values are in Modbus **1032** byte order and
Float32 value are in Modbus **3210** byte order.

## Register 0 (Read-Only, Int32) : System Status

| Bit(s) | Function | Values |
|---|---|---|
| 0 | Comms status | 0 : No comms error<br>1 : Comms error |
| 1 | Pulse Out 1 Bucket Status | 0 : Bucket okay<br>1 : Last fill was rejected |
| 2 | Pulse Out 2 Bucket Status | 0 : Bucket okay<br>1 : Last fill was rejected |
| 3 | Dual Pulse Channel A Line Integrity | 0 : Line okay<br>1 : Line fail |
| 4 | Dual Pulse Channel B Line Integrity | 0 : Line okay<br>1 : Line fail |
| 5 | Good/A roll-over flag | 0 : No roll-over<br>1 : Roll-over occurred (self clears after 5 seconds) |
| 6 | Bad/B roll-over flag | 0 : No roll-over<br>1 : Roll-over occurred (self clears after 5 seconds) |
| 7 | RAWIN roll-over flag | 0 : No roll-over<br>1 : Roll-over occurred (self clears after 5 seconds) |
| 31:8 | [unused] | [unused] |

## Register 2 (Read-Only, Int32) : Digital Inputs

| Bit(s) | Function | Values |
|---|---|---|
| 8:0 | Digital Input 8..0 | 0 : Digital Input Inactive<br>1 : Digital Input Active |
| 31:9 | [unused] | [unused] |

## Register 4 (Read-Only, Int32) : Message Id

Id “time-stamp” marker. Each data message from the P513 I/O board is marked with a unique id value. The value is reset to zero when the unit is powered up (or reset), and increases with each data message. Since each data message is automatically generated every ½ second from the high accuracy clock, the id can be used to calculate time intervals.

Rolls over at 4,294,967,295. ($2^{32}$-1)

## Register 6 (Read-Only, Int32) : Good / A pulse count

Total number of pulses received on the Good / A channel.

If in Dual Pulse mode this will be populated with the Good pulse count. In Single Pulse mode, it will be Pulse Train A count

Rolls over at 4,294,967,295. ($2^{32}$-1)

## Register 8 (Read-Only, Int32) : Bad / B pulse count

| Format | Int32 |
|---|---|

Total number of pulses received on the Bad / B channel.

If in Dual Pulse mode this will be populated with the Bad pulse count. In Single Pulse mode, it will be Pulse Train B count

Rolls over at 4,294,967,295. ($2^{32}$-1)

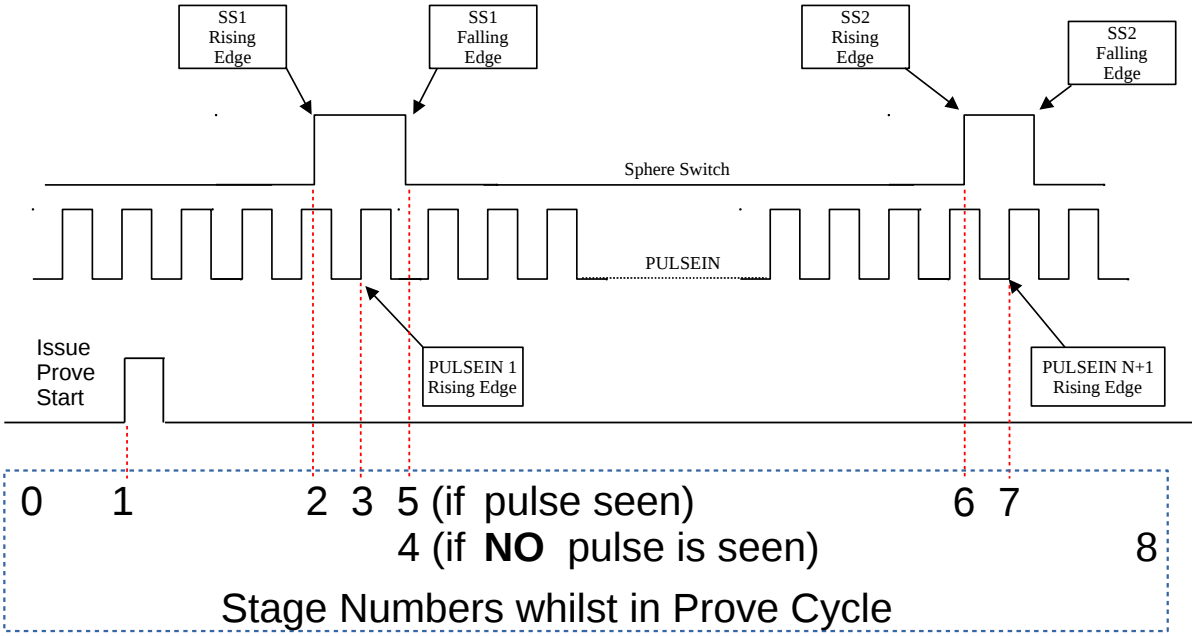
## Register 10 (Read-Only, Int32) : RAWIN pulse count

Total number of pulses received on the RAWIN channel.

Rolls over at 4,294,967,295. ($2^{32}$-1)

## Register 12 (Read-Only, Int32) : Prover Status

| Bit(s) | Function | Values |
|---|---|---|
| 2:0 | Prover State | 0 : Waiting for Start<br>1 : Waiting for SS1 rising edge<br>2 : Got SS1 rising edge, waiting for subsequent PULSEIN rising edge<br>3 : Got SS1 rising edge and subsequent PULSEIN rising edge, waiting for SS1 falling edge<br>4 : Got SS1 falling edge, waiting for PULSEIN rising edge<br>5 : Got SS1 falling edge and PULSEIN rising edge, waiting for SS2<br>6 : Got SS2 rising edge and PULSEIN rising edge<br>7 : Done, got SS2 rising edge and PULSEIN rising edge N+1. Waiting for Start<br>8 : Abort, waiting for Start |
| 31:3 | [unused] | [unused] |




## Register 14 (Read-Only, Int32) : Prover PULSEIN

Number of pulses received on the Prover PULSEIN channel.

The PULSEIN source can be selected via the System Config register (Register 50).

## Register 16 (Read-Only, Int32) : Prover PULSEIN SW1-2

Number of pulses received on the Prover PULSEIN channel occurring between Sphere Switch 1 (SS edge #1) and Sphere Switch 2 (SS edge #3).

This register is reset to 0 when a prove sequence is initiated.

Rolls over at 65535. ($2^{16}$-1)

## Register 18 (Read-Only, Int32) : Prover Time SW1-2

Timer interval (in 100ns counts) between Sphere Switch 1 (SS edge #1) and Sphere Switch 2 (SS edge #3).

This register is reset to 0 when a prove sequence is initiated.

Rolls over at 4,294,967,295. ($2^{32}$-1)

## Register 20 (Read-Only, Int32) : Prover Time P1-N1

Timer interval (in 100ns counts) between PULSEIN edge #1 and PULSEIN edge #2.

This register is reset to 0 when a prove sequence is initiated.

Rolls over at 4,294,967,295. ($2^{32}$-1)

## Register 22 (Read-Only, Int32) : P513 Hardware Version

The firmware in the P513 & P517 boards are split into three types. This register holds the Hardware version for the P513 firmware.

e.g. if the Hardware firmware was 12v1, this register would hold the decimal value 1201.

## Register 24 (Read-Only, Int32) : P513 Software Version

The firmware in the P513 & P517 boards are split into three types. This register holds the Software version for the P513 firmware.

e.g. if the Software firmware was 0v22, this register would hold the decimal value 22 (to represent 0022).

## Register 26 (Read-Only) : P517 Firmware Version

The firmware in the P513 & P517 boards are split into three types. This register holds the version for the P517 firmware.

e.g. if the firmware was 1v18, this register would hold the decimal value 118 (to represent 0118).

## Register 28 (Read-Only, Int32) : [Reserved]

Reserved for possible future use, reserved for Analogue Calibration date.

## Register 1000 (Read-Only, Float32) : Good / A frequency

Frequency of the Good / A input. Value in Hz.

If in Dual Pulse mode this will be populated with the Good pulse frequency. In Single Pulse mode, it will be Pulse Train A frequency.

## Register 1002 (Read-Only, Float32) : Bad / B frequency

Frequency of the Bad / B input. Value in Hz.

If in Dual Pulse mode this will be populated with the Bad pulse frequency. In Single Pulse mode, it will be Pulse Train B frequency.

## Register 1004 (Read-Only, Float32) : RAWIN frequency

Frequency of the RAWIN input. Value in Hz.

## Register 1006 (Read-Only, Float32) : Density 1 period

Period of the Density 1 input. Value in microseconds.

## Register 1008 (Read-Only, Float32) : Density 2 period

Period of the Density 2 input. Value in microseconds.

## Register 1010 (Read-Only, Float32) : Analogue Input 1

Value of Analogue Input 1. Value in mA.

## Register 1012 (Read-Only, Float32) : Analogue Input 2

Value of Analogue Input 2. Value in mA.

## Register 1014 (Read-Only, Float32) : Analogue Input 3

Value of Analogue Input 3. Value in mA.

## Register 1016 (Read-Only, Float32) : Analogue Input 4

Value of Analogue Input 4. Value in mA.

## Register 1018 (Read-Only, Float32) : Analogue Input 5/PRT2

Value of Analogue Input 5. Value in mA.

## Register 1020 (Read-Only, Float32) : Analogue Input 6/PRT1

Value of the PRT input. Value in ohms.

## *Read/Write Registers*

Unless otherwise stated, all Read/Write register values are lost on a reset. These registers will default to a zero value if no default is specified or the default value if specified. Non Volatile registers will retain their setting, these registers are highlighted below.

| **Address** | **Type** | **Function** |
|---|---|---|
| 50 * | Int32 | System Configuration |
| 52 | Int32 | Digital Outputs |
| 54 | Int32 | Pulse Output 1 bucket |
| 56 | Int32 | Pulse Output 2 bucket |
| 58 * | Int32 | Pulse Output 1 period |
| 60 * | Int32 | Pulse Output 2 period |
| | | |
| 62 | Int32 | Prover Configuration |
| 64 | Int32 | [unused] |
| 66 * | Int32 | Prover OneShot Count |
| 68 | Int32 | Purge Pulse Output #1 |
| 70 | Int32 | Purge Pulse Output #2 |
| 72 | Int32 | RAWOUT Mode |
| | | |
| 1050 ** | Float32 | DAC 1 |
| 1052 ** | Float32 | DAC 2 |

* - Non Volatile registers (retained on a power cycle)

** - Requires Optional Analogue Board fitted (P511)

**NOTE:** Int32 values are in Modbus 1032 byte order and Float32 value are in Modbus 3210 byte order.

## Register 50 (Read/Write, Int32) : System Config (Non-Volatile)

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 1:0 | Sphere Switch Polarity | 00 : No change<br>**01 : Normal**<br>10 : Invert<br>11 : No Change |
| 3:2 | Pulse Out 1 Mode | 00 : No change<br>01 : Always '0'<br>10 : Always '1'<br>**11 : Pulse output** |
| 5:4 | Pulse Out 2 Mode | 00 : No change<br>01 : Always '0'<br>10 : Always '1'<br>**11 : Pulse output** |
| 7:6 | Dual Pulse Mode | 00 : No change<br>01 : Twin Single Streams (Level E)<br>10 : Dual Pulse (Level B)<br>**11 : Dual Pulse (Level A)** |
| 9:8 | [unused] | [unused] |
| 11:10 | ADC 1 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |
| 13:12 | ADC 2 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |
| 15:14 | ADC 3 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |
| 17:16 | ADC 4 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |
| 19:18 | ADC 5 Mode | 00 : No Change<br>01 : Current mode<br>**10 : Voltage mode**<br>11 : No Change |
| 22:20 | Prover PULSEIN Source | **000 : RAWIN**<br>001 : Dual Pulse Good<br>010 : Dual Pulse Bad<br>011 : Dual Pulse Channel A<br>100 : Dual Pulse Channel B<br>101 : unused<br>110 : unused<br>111 : unused |
| 31:23 | [unused] | [unused] |

## Register 52 (Read/Write, Int32) : Digital Outputs

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 0 | Digital Output 1 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 1 | Digital Output 2 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 2 | Digital Output 3 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 3 | Digital Output 4 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 4 | Digital Output 5 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 5 | Digital Output 6 | **0 : Digital Output Inactive**<br>1 : Digital Output Active |
| 6 | Alarm relay | **0 : Relay inactive (Alarm Set)**<br>1 : Relay active (No Fault) |
| 31:7 | [unused] | [unused] |

## Register 54 (Read/Write, Int32) : Pulse Output 1 bucket

Writing to this register adds counts to the Pulse Output 1 bucket. If the counts would overflow the bucket, then bit 1 in the System Status register will be set and no counts will be added.

Once the increment has been processed or on a power cycle, this register will hold a value of 0.

Note that the bucket can only contain a maximum of 65535 counts.

## Register 56 (Read/Write, Int32) : Pulse Output 2 bucket

Writing to this register adds counts to the Pulse Output 2 bucket. If the counts would overflow the bucket, then bit 2 in the System Status register will be set and no counts will be added.

Once the increment has been processed or on a power cycle, this register will hold a value of 0.

Note that the bucket can only contain a maximum of 65535 counts.

## Register 58 (Read/Write, Int32) : Pulse Output 1 period (Non-Volatile)

Writing to this register sets the pulse rate for Pulse Output 1. The value written here sets the on period for the output pulse train. The pulse output mark/space ratio is fixed at 50:50.

Default value is 250ms.

As an example, if this value is set to 1, it will switch on the output for 1ms, with 1ms off (as 50:50 duty cycle) so that the output frequency would be 500Hz.

Range 1 – 2047. (11 bit number)

## Register 60 (Read/Write, Int32) : Pulse Output 2 period (Non-Volatile)

Writing to this register sets the pulse rate for Pulse Output 2. The value written here sets the on period for the output pulse train. The pulse output mark/space ratio is fixed at 50:50.

Default value is 250ms.

As an example, if this value is set to 1, it will switch on the output for 1ms, with 1ms off (as 50:50 duty cycle) so that the output frequency would be 500Hz.

Range 1 – 2047. (11 bit number)

## Register 62 (Read/Write, Int32): Prover Configuration

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 0 | Prove Sequence Control | **0 : Do nothing/Idle**<br>1 : Initiate prove sequence |
| 31:1 | [unused] | [unused] |

Once the request has been processed or on a power cycle, this register will hold a value of 0.

## Register 64 (Read/Write, Int32) : [Unused]

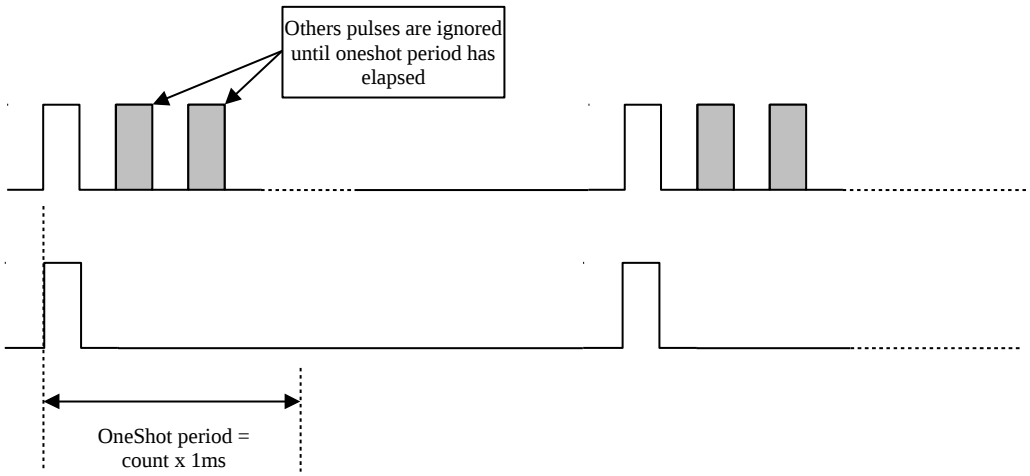
Any writes to this address will be ignored.

## Register 66 (Read/Write, Int32) : Prover OneShot Count (Non-Volatile)

The Prover OneShot Count specifies the dead time after the first pulse, such that any pulses in the dead time are ignored.

Maximum valid value is 65535.

The period is measured in 1ms counts, and the default OneShot count is 300 (= 300ms).




## Register 68 (Read/Write, Int32) : Purge Pulse Output #1

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 0 | Pulse Out 1 Bucket Purge<br>(note : always 0 on reset) | **0 : Do nothing**<br>1 : Purge |
| 31:1 | [unused] | [unused] |

Once the request has been processed or on a power cycle, this register will hold a value of 0.

## Register 70 (Read/Write, Int32) : Purge Pulse Output #2

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 0 | Pulse Out 2 Bucket Purge<br>(note : always 0 on reset) | **0 : Do nothing**<br>1 : Purge |
| 31:1 | [unused] | [unused] |

Once the request has been processed or on a power cycle, this register will hold a value of 0.

## Register 72 (Read/Write, Int32) : RAWOUT Mode

| **Bit(s)** | **Function** | **Values** (defaults are shown in **bold**) |
|---|---|---|
| 1:0 | RAWOUT Mode | 00 : No change<br>**01 : RAWOUT disabled**<br>10 : RAWOUT = Dual Pulse Channel A<br>11 : RAWOUT = Dual Pulse Channel B |
| 31:2 | [unused] | [unused] |

## Register 1050 (Read/Write, Float32) : DAC 1

DAC 1 setting in mA.

On a power cycle, this register will hold a value of 0.

## Register 1052 (Read/Write, Float32) : DAC 2

DAC 2 setting in mA.

On a power cycle, this register will hold a value of 0.

# Example Modbus Messages

## Poll for Good Pulse Count (Channel A) - INT32 (1032 Byte Order)

**NOTE:** This example is for the legacy Mixed Format Slave Map, the Scaled Integer version is in 3210 Byte Order

**Request:**

TX: 01 03 00 06 00 02 24 0A

where;

Slave Address = 01

Function Code = 03

Starting Address = 00 06 (Decimal 6)

Quantity of Registers = 00 02

Checksum = 24 0A

**Response:**

RX: 01 03 04 0A F7 00 21 88 01

where;

Slave Address = 01

Function Code = 03

Byte Count = 04

Data Register 6 Value = 0A F7 (LSB)

Data Register 7 Value = 00 21 (MSB)

Checksum = 88 01

Register 6 represents the lower 16 bits of the INT32, Register 7 represents the higher 16 bits of the INT32

The data string 0AF70021 decodes to a value of 00210AF7 (Decimal 2165495)

## Poll for Good Pulse Frequency (Channel A) - FLOAT32 (3210 Byte Order)

**Request:**

TX: 01 03 03 E8 00 02 44 7B

where;

Slave Address = 01

Function Code = 03

Starting Address = 03E8 (Decimal 1000)

Quantity of Registers = 00 02

Checksum = 44 7B

**Response:**

RX: 01 03 04 45 79 FE D6 FF 18

where;

Slave Address = 01

Function Code = 03

Byte Count = 04

Data Register 1000 Value = 45 79 (MSB)

Data Register 1001 Value = FE D6 (LSB)

Checksum = FF 18

Register 1000 represents the higher 16 bits of the FLOAT32, Register 1001 represents the lower 16 bits of the FLOAT32

The data string 4579FED6 decodes as 3999.927246 as a IEEE-754 value

## Poll to force Purge Pulse Out #1 - INT32 (1032 Byte Order)

**NOTE:** This example is for the legacy Mixed Format Slave Map, the Scaled Integer version is in 3210 Byte Order

**Request:**

TX: 01 10 00 44 00 02 04 00 01 00 00 A7 AC

where;

Slave Address = 01

Function Code = 10 (Decimal 16)

Starting Address = 00 44 (Decimal 68)

Quantity of Registers = 00 02

Byte Count 04

Data Register 68 Value = 00 01 (LSB)

Data Register 69 Value = 00 00 (MSB)

Checksum = A7 AC

**Response:**

RX: 01 10 00 44 00 02 01 DD

where;

Slave Address = 01

Function Code = 10 (Decimal 16)

Starting Address = 00 44 (Decimal 68)

Quantity of Registers = 00 02

Checksum = 01 DD

## Poll to set DAC Out #1 - FLOAT32 (3210 Byte Order)

**Request:**

TX: 01 10 04 1A 00 02 04 41 40 00 00 55 F4

where;

Slave Address = 01

Function Code = 10 (Decimal 16)

Starting Address = 041A (Decimal 1050)

Quantity of Registers = 00 02

Byte Count 04

Data Register 1050 Value =  41 40 (MSB)

Data Register 1051 Value =  00 00 (LSB)

Checksum = 55 F4

Register 1050 represents the higher 16 bits of the FLOAT32, Register 1051 represents the lower 16 bits of the FLOAT32

The data string 41400000 decodes as 12 as a IEEE-754 value

**Response:**

RX: 01 10 04 1A 00 02 61 3F

where;

Slave Address = 01

Function Code = 10 (Decimal 16)

Starting Address = 04 1A (Decimal 1050)

Quantity of Registers = 00 02

Checksum = 61 3F