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1 Introduction

1.1 Purpose

The following document defines the Modbus protocol support and register mapping used by the Platinum product allowing interfacing to the DasyLab Modbus interface software.

The Modbus interface is available on all communication channels and support is provided for MODBUS/ASCII, MODBUS/RTU and MODBUS/TCP/IP transactions.

1.2 Definition of Terms and Acronyms

I2C	2 wire serial interface
Base Device	Device connected to slave device
Smart Input	Device supporting 1 or more Input sensors
Smart Output	Device supporting 1 or more Output Elements
Sensor Element	One of the physical sensing elements on a Smart Output
AC	Alternating Current
DC	Direct Current
CS	Chip Select
ADC	Analog to Digital Converter
DAC	Digital to Analog Converter
RS485	Electrical signals used for serial communications
RS232	Electrical signals used for serial communications
CSV	Comma Separated Values
COTS	Commercially-Off-The-Shelf
ESD	Electo Static Discharge
FW	Firmware
HW	Hardware
I/O	Input/Output
LED	Light Emitting Diode
Hexadecimal	Values expressed using base 16 (2^4)

1.3 Applicable Documents

Doc. #	Name / Description	Rev. #
	Platinum Modbus Interface Reference	1.0
	Platinum Load and Save File Format	0.0.1
	Platinum Ramp and Soak Processing	0.0.1
	MODBUS APPLICATION PROTOCOL SPECIFICATION	V1.1b3
	Device Serialization and Version Information	Rev 0.1
	Omega Engineering Coding Standard	Rev 1.2.0

2 Modbus Interface

The Modbus interface is fully described in MODBUS APPLICATION PROTOCOL SPECIFICATION (V1.1b3).

The Modbus specification allows accessing to up 65535 internal 'holding' registers using register READ, register WRITE and WRITE MULTIPLE commands. Each Modbus holding register is defined as a 16 bit entity structured as BIG ENDIAN values (most significant byte always presented first).

The Platinum Modbus interface provides access to the internal database of the Platinum product family by internally mapping Modbus holding registers to specific database items.

Modbus is structured using a MASTER-SLAVE topology, in which there is one MASTER device and up to 255 slave devices. All transactions are initiated by the MASTER device.

Modbus slave devices are individually accessed using a one byte SLAVE address. The MASTER device initiates a transaction by sending a request packet to a specific slave. The SLAVE device processes the transaction and returns either response packet indicating success or failure.

Address 0 is reserved as a 'broadcast' address, in which all slave devices will accept and process the transaction but will not send a response.

2.1 Modbus Functions

The Platinum Modbus interface supports the following Modbus FUNCTION requests.

Function Code	Mnemonic	Description
0x03	Read Holding Register	Reads one or more consecutive 16 bit holding registers
0x06	Write Single Register	Writes a specific 16 bit holding register
0x07	Read Exception status	Reads structured status information
0x08	Diagnostic	Read/Write diagnostic information
0x10	Write Multiple Registers	Write one or more consecutive 16 bit holding registers
0x0b	Get Comm events	Read communication event counters

2.2 Data Formats

Modbus holding registers are represented as 16 bit entities. The following encoding is used for extended data items. Note that 'byte 0' will be the first byte received/transmitted.

For data types that can be represented in 16 bit (Boolean, byte, char, int16 and uint16) a single register is used.

For data types that require 32 bits two consecutive registers are used. The lower number register will represent the most significant data. The 2nd register represents the leas significant data.

2.2.1 Multiple Register Reads

When reading a dual register entity the lower order register should be used as the requested 'holdiing register', with a request for a minimum of 2 registers. Internally the entire entity is read and data is then built into a response packet.

The access can be split into 2 consecutive single register reads. When the lower (base) register is accessed the entire 32 bit entity is read and the two most significant bytes are returned. The following single register read must specify the next consecutive register address. The two least significant bytes of the internally buffered data used in the response.

Attempts to access the two least significant bytes without first reading the two most significant bytes will result in an error response.

2.2.2 Multiple Register Writes

When writing a dual register entity the lower order register should be used as the requested 'holdiing register', with a request for minimum of 2 registers. The write data is internally buffered and transferred to the database entry as a 32 bit value.

The access can be split into 2 consecutive single register writes. When the lower (base) register is written the 16 bit entity is internally buffered BUT NO DATA TRANSFER IS MADE TO THE DATABASE. The following single register write must specify the next consecutive register address. The two least significant bytes of the write request are combined with the previous write data and the entire 32 bit entity is written to the database.

Attempts to write the two least significant bytes without first writing the two most significant bytes will result in an error response.

Data Types	Number of Registers	Byte				Description
		0	1	2	3	
Boolean	1	--	LSB	N/A		Zero = OFF, non-zero = ON
Byte, Char	1	--	LSB			Entity contained in LSB of register, Byte 0 ignored.
Int16, uint16	1	MSB	LSB			Entity contained in MSB/LSB of register.
		0	1	2	3	(dual register data)
Int32, uint32	2	MSB	B-1	B-2	LSB	Requires 2 consecutive registers, MSB transferred first
float	2	Sign+ Exp	Mantisa MSB	B-1	Mantisa LSB	IEEE formatted value contained in 2 consecutive register

2.2.3 Request Packet Sizes

Multiple consecutive registers may be accessed in a single transaction.

The Platinum Modbus interface imposes a maximum of 64 bytes for the total transaction. Allowing for the required framing, addressing and integrity checks results in the following data size restrictions using the READ and WRITE MULTIPLE functions.

Format	Protocol Overhead	Maximum Read data	Maximum Write data
ASCII	16	12 Registers	12 Registers
RTU	8	23 Registers	23 Registers
TCP/IP	8	23 Registers	23 Registers

2.2.4 Modbus USB Support

The Modbus specification supports RS232 and RS485 serial data. For ASCII formatted packets a USB virtual comm channel provides full support since the framing information is specified by unique characters (SOF = ':', EOF = CR/LF).

For RTU formatted packets the Modbus requires specific inter-frame character timing to determine the framing of each transaction. This information is not available using a generic virtual comm channel across USB, which will typically collect 'serial' data into 64 byte packets for transmission, as determined by the USB end-point buffer size. The USB Modbus RTU interface relies on the USB channel collecting data into 64 byte packets.

3 Platinum Modbus Register Assignments

All accesses to the Platinum database information are made through the Modbus registers.

Mnemonic entries marked with '*' are identical to those used by the Platinum LOAD and SAVE file formats.

Mnemonic entries marked with '**' are identical to those used by the Platinum LOAD and SAVE file formats but are referenced in LOAD and FILE data are made using meta characters (%).

Data types are:

R – single 16 bit register (may be Boolean, byte, char, int16 or uint16 data)

L – dual (32 bit) register (may be int32 or uint32 data)

F – IEEE Floating point value

All data is transferred using BIG ENDIAN formatting, where the most significant byte is transmitted first.

3.1 DasyLab Platinum Modbus Registers

The following is an abbreviated list of the more common registers within a Platinum controller. Refer to the Platinum Modbus Interface document for a complete list.

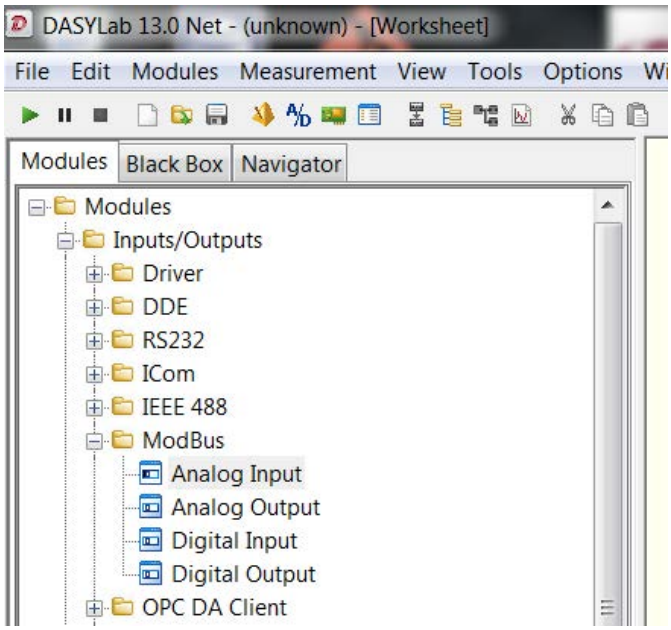
Index		Mnemonic	Type	Description
512	0x0200	DEVICE_ID**	L	Device Identifier
514	0x0202	VERSION_NUMBER**	L	Device Version number (Hex Value)
516	0x0204	SYSTEM_STATUS	L	Enumerated Status value
528	0x0210	CURRENT_INPUT_VALUE	F	Measured process input value
532	0x0214	REMOTE_SETPOINT_VALUE	F	Measured auxiliary input value
542	0x021e	INPUT_DIGITAL	R	State of digital input pin
544	0x0220	CURRENT_SETPOINT_1	F	Current value of Setpoint 1
546	0x0222	CURRENT_SETPOINT_2	F	Current value of Setpoint 2
548	0x0224	CONTROL_SETPOINT	F	Setpoint used in PID calculations
550	0x0226	PEAK_VALUE	F	Maximum Value processed
552	0x0228	VALLEY_VALUE	F	Minimum Value processed
554	0x022a	PID_OUTPUT	F	PID Output level (0..100%)
556	0x022c	CURRENT_INPUT_VALID	R	Flag indicating process value is valid
557	0x022d	ALARM_STATE	R	
558	0x022e	RAMP_SOAK_STATE	R	Enumerated value - R&S state
560	0x0230	OUTPUT_1_STATE	R	Flag indicating state of Output (0/1)
561	0x0231	OUTPUT_2_STATE	R	Flag indicating state of Output (0/1)
562	0x0232	OUTPUT_3_STATE	R	Flag indicating state of Output (0/1)
563	0x0233	OUTPUT_4_STATE	R	Flag indicating state of Output (0/1)

564	0x0234	OUTPUT_5_STATE	R	Flag indicating state of Output (0/1)
565	0x0235	OUTPUT_6_STATE	R	Flag indicating state of Output (0/1)
566	0x0236	OUTPUT_7_STATE	R	Flag indicating state of Output (0/1)
567	0x0237	OUTPUT_8_STATE	R	Flag indicating state of Output (0/1)
	Control Functions			
576	0x0240	RUN_MODE	R	Enumerated value – system running state
578	0x0242	LATCH_RESET	R	Write 1 to reset latched alarms
	Alarm Configuration			
1280	0x0500	ALARM_1_STATE	R	Alarm state (Bit 0)
1312	0x0520	ALARM_2_STATE	R	
	Excitation Voltage			
1472	0x05c0	EXCITATION_VOLTAGE*	R	Enumerated Excitation Voltage
	Annunciators			
1504	0x05e0	DB_ANNUNCIATOR_1_STATE	R	Enumerated Annunciator State
1508	0x05e4	DB_ANNUNCIATOR_2_STATE	R	Enumerated Annunciator State

3.2 DasyLab Platinum Modbus Register Access

The following specifications have been verified with DasyLab version 13. Refer to DasyLab specific documentation for further details.

The DasyLab software package allows the integration of Modbus compatible equipment through the Modbus Input/Output Module. All Platinum registers are treated as Analog INPUT or Analog OUTPUT values. Use Modbus Analog Input module to request data from Platinum and use Modbus Analog Output module to send data to Platinum.



DasyLab supports Modbus RTU (serial) and Modbus TCP/IP (Ethernet). The Platinum controller supports Modbus RTU on the USB interface, the RS232/RS485 interface (if installed) and Modbus TCP/IP on the Ethernet interface (if installed). For the serial channel and USB connections the correct COM channel must be selected and for serial channels the appropriate INTERFACE parameters must be chosen. The Platinum unit must have its corresponding COM parameters set accordingly.

If using serial interface, DASYLab assumes the function of the master which sends commands to the measurement devices or slaves. If using TCP/IP interface, DASYLab assumes the function of the client which requests data from the server.

3.3 Example

3.3.1 Serial interface

In the example shown, the Platinum controller has been connected using a USB cable and appears as 'Virtual COM Port' 256 within the Windows environment. For USB connections the serial interface parameters are ignored. The Platinum /INIT/COMM/USB/PROT (front panel access menu) has been set to MODBUS/RTU.

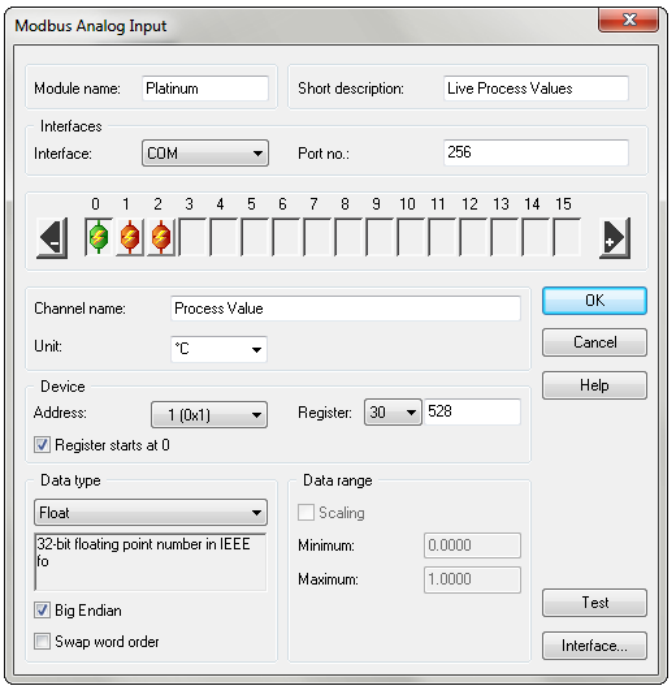
The Register Starts at 0 option should be checked. The '30' Pull Down option may be ignored. All values are accessed using BIG ENDIAN format and the 'swap word order' option should remain unchecked.

When a Modbus Input/Output module is placed it is necessary to link the associated values with the correct Platinum Modbus registers. DasyLab requires that register values are entered as decimal values.

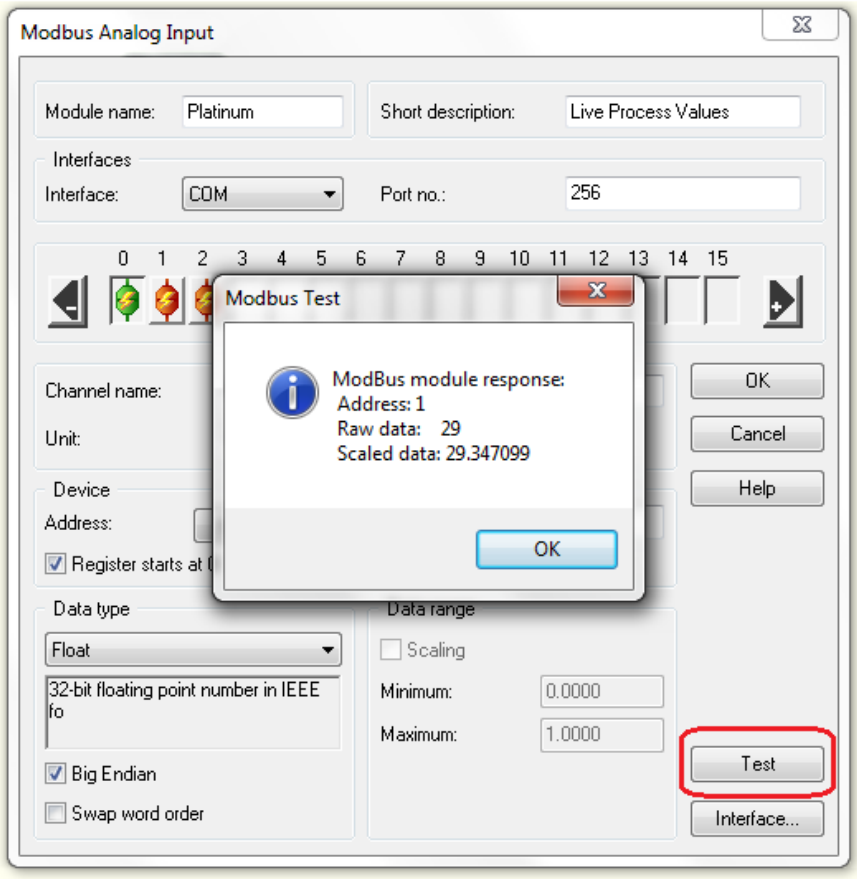
The following example shows how Modbus Analog Input module can be configured.

On Analog Input Channel 0, the channel is named as Process Value with Celsius temperature unit. The register index is 528 (Register starts at 0) and the Register data type is Float (32 bit). The Device Address is 0x01.

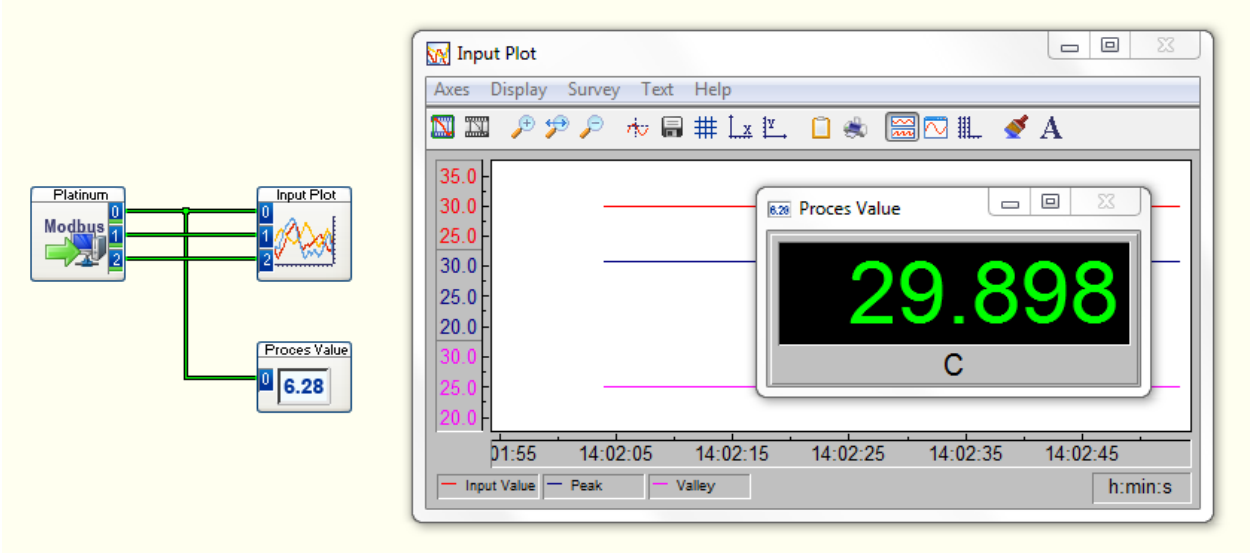
On Analog Input Channel 1 and 2 (not shown), Peak Value and Valley Value are configured with the matching Register index and Data type that can be found in Platinum Series User Manual - Modbus Interface document.



To quickly test communication to Platinum controller with Modbus Analog Input module, click on “Test” and the data returned from the device is displayed in “Scaled data” as shown in the screenshot below.

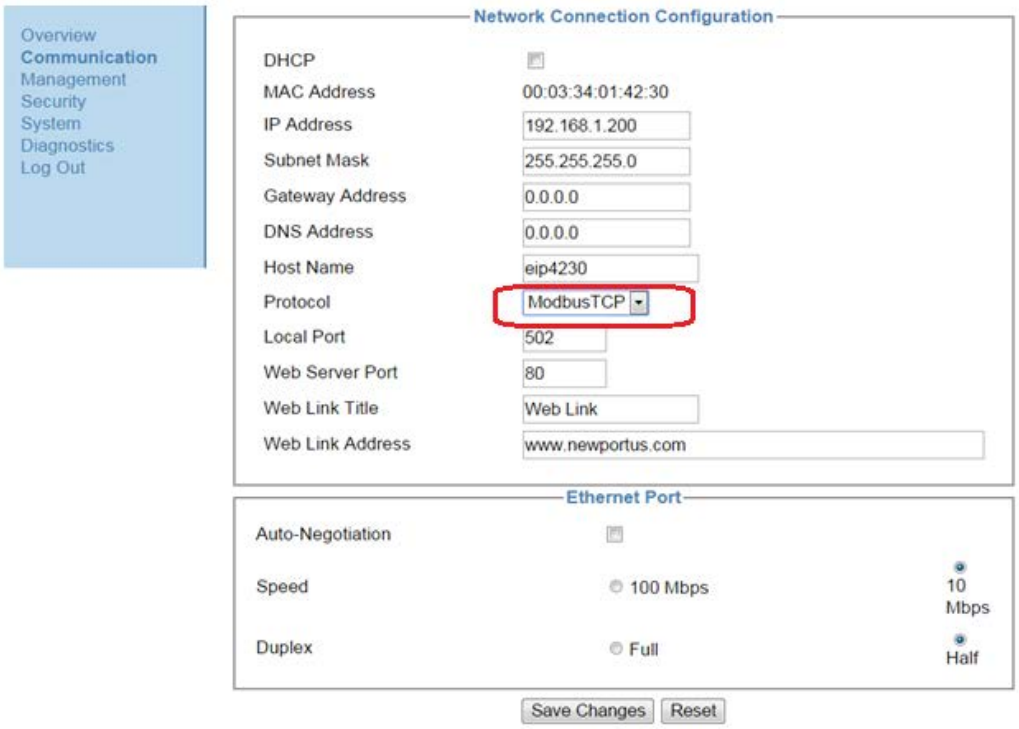


Once the Modbus Analog Input module is configured, it can then be connected to Display modules such as Digital display or Chart Recorder module which can be found in Display category.



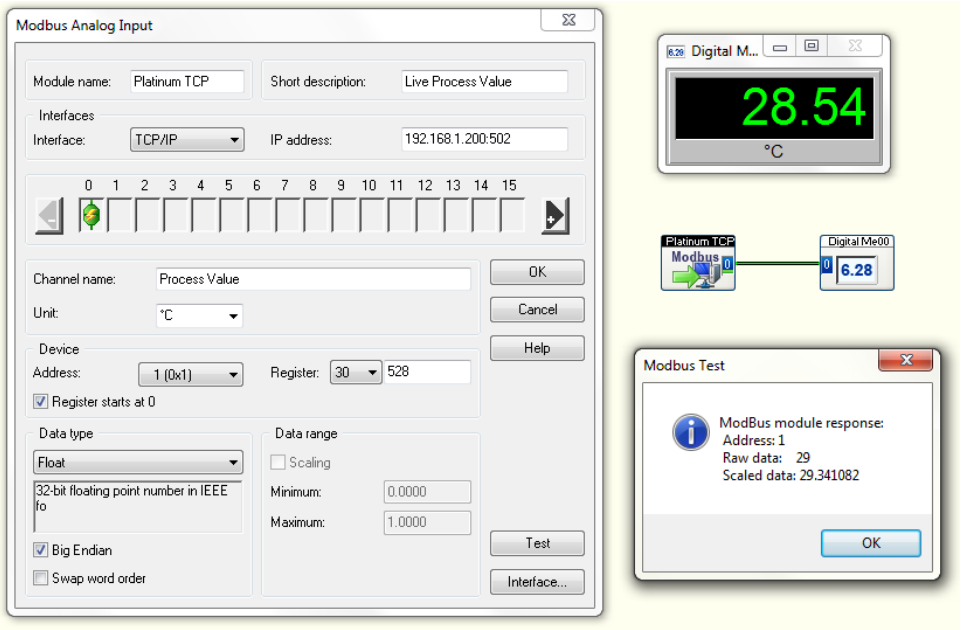
3.3.2 TCP/IP Interface

In this example, Modbus communication to Platinum is through TCP/IP interface. The TCP communication protocol needs to be changed to ModbusTCP. This setting can be found on Communication page/Network Connection Configuration section. The default device IP address of Platinum's TCP/IP interface is 192.168.1.200 and the default Modbus Local Port is 502.



Platinum Ethernet communication protocol also needs to be changed to Modbus/RTU. This setting is accessible through the front panel menu /INIT/COMM/ETHN/PROT.

The setup procedure for DasyLab Modbus over TCP/TIP is similar to DasyLab Modbus Serial. The following screenshot illustrates a typical configuration.



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