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MODBUS Interface

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Platinum Modbus Interface

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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 family.

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 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			Zero = OFF, non-zero = ON
Byte, Char	1	--	LSB	N/A		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 is made thru the following 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.

Index		Mnemonic	Type	Description
512	0x0200	DEVICE_ID**	L	Device Identifier
514	0x0202	VERSION_NUMBER**	L	
516	0x0204	SYSTEM_STATUS	L	
518	0x0206	BOOT_LOADER_VERSION	L	
520	0x0208	HARDWARE_VERSION	L	
	0x0210	CURRENT_INPUT_VALUE	F	
	0x0212	REMOTE_SENSOR_VALUE	F	Internal Use Only
	0x0214	REMOTE_SETPOINT_VALUE	F	
	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_4_STATE	R	Flag indicating state of Output (0/1)
565	0x0235	OUTPUT_4_STATE	R	Flag indicating state of Output (0/1)
566	0x0236	OUTPUT_4_STATE	R	Flag indicating state of Output (0/1)
567	0x0237	OUTPUT_4_STATE	R	Flag indicating state of Output (0/1)
		Control Functions		
576	0x0240	RUN_MODE	R	Enumerated value – system running state
577	0x0241	FACTORY_RESET	R	Write 1 to force reset to factory defaults
578	0x0242	LATCH_RESET	R	Write 1 to reset latched alarms
579	0x0243	PID_AUTOTUNE_START	R	Write 1 to force Autotuning to start
580	0x0244	PID_AUTOTUNE_DONE	R	Internal use only
581	0x0245	DB_PROCESS_SCALE_ENABLE	R	Enables Scaling on Process values (LIVE/MANUAL)
		Display Functions		
584	0x0248	READING_DECIMAL_POSITION*	R	Enumerated value – number of dec. points
585	0x0249	DISPLAY_UNITS*	R	Enumerated value – units of measure
586	0x024a	DISPLAY_COLOR_NORMAL*	R	Enumerated value to set display color
587	0x024b	DISPLAY_BRIGHTNESS*	R	Enumerated value to set display brightness
588	0x024c	TIME_FORMAT*	R	Enumerated value to indicate time format
589	0x024d	DISPLAY_ALARM_CONTROL	R	
		User Calibration		
592	0x0250	TCAL_TYPE*	R	Enumerated value indicating type of TCAL
593	0x0251	SET_ICE_POINT	R	Write 1 to set ICE POINT offset
594	0x0252	SET_TCAL_1_POINT	R	Write 1 to set 1 point Cal. offset
595	0x0253	SET_TCAL_2_POINT_LOW	R	Write 1 to set 2 point Cal. LOW point
596	0x0254	SET_TCAL_2_POINT_HIGH	R	Write 1 to set 2 point Cal. HIGH point
600	0x0258	TCAL_ICE_POINT_OFFSET*	F	Stored ICE POINT offset
602	0x025a	TCAL_1_POINT_OFFSET*	F	Stored 1 point CAL offset
604	0x025c	TCAL_2_POINT_OFFSET*	F	Stored 2 point CAL offset
606	0x025e	TCAL_2_POINT_GAIN*	F	Stored 2 point CAL gain
		Ramp & Soak (Sequencer)		
608	0x0260	RAMP_SOAK_MODE*	R	Enumerated – Ramp and Soak mode
609	0x0261	RAMP_SOAK_PROFILE_SELECT*	R	Starting Profile for Ramp and Soak
610	0x0262	CURRENT_PROFILE	R	Use to select R&S profile to access
611	0x0263	CURRENT_SEGMENT	R	Use to select profile segment to access
		Ramp & Soak – Profile Specific		
612	0x0264	SEGMENTS_PER_PROFILE*	R	Number of segments in current profile

613	0x0265	SOAK_ACTION*	R	Enumerated – Soak Action
614	0x0266	SOAK_LINK*	R	Profile to link to after current profile
615	0x0267	TRACKING_TYPE*	R	Enumerated – R&S tracking type
		Ramp & Soak – Segment Specific		
616	0x0268	RAMP_EVENT*	R	RE.ON flag set for current segment
617	0x0269	SOAK_EVENT*	R	SE.ON flag set for current segment
618	0x026a	SOAK_PROCESS_VALUE*	F	Target SOAK setpoint for current segment
620	0x026c	RAMP_TIME*	L	Time (msec) to reach target SOAK setpoint
622	0x026e	SOAK_TIME*	L	Time (msec) to hold at SOAK setpoint
		Ramp & Soak - Running Status		
624	0x0270	CONTROL_SETPOINT	F	Setpoint used for PID/Control functions
626	0x0272	RAMP_SOAK_REMAINING_TIME	L	Ramp or Soak time remaining
628	0x0274	RAMP_SOAK_STATE	R	Enumerated – R&S flags
		Input Type/Configuration		
640	0x0280	CURRENT_INPUT_VALUE	F	Current Process value
642	0x0282	INPUT_SENSOR*	R	Enumerated sensor (input) type
643	0x0283	TC_TYPE*	R	Enumerated Thermocouple type
644	0x0284	RTD_WIRE*	R	Enumerated RTD wire type
645	0x0285	RTD_ACRV_OHM_TYPE*	R	Enumerated RTD Curve
646	0x0286	THERMISTOR_VALUE*	R	Enumerated Thermistor type
647	0x0287	PROCESS_RANGE*	R	Enumerated process input range
655	0x028f	READING_FILTER_CONSTANT*	R	Enumerated input filtering constant
		PID Parameters		
656	0x02a0	PID_ADAPTIVE_CONTROL_ENABLE*	R	Enumerated Toggle
657	0x02a1	PID_ACTION*	R	Enumerated PID control action
658	0x02a2	PID_AUTOTUNE_TIMEOUT*	L	Timeout (msec) for autotuning
660	0x02a4	PID_P_*	F	Proportional Gain value
662	0x02a6	PID_I_*	F	Integral Gain value
664	0x02a8	PID_D_*	F	Derivative Gain value
666	0x02aa	PID_PERCENT_LOW*	F	Minimum PID Control output value
668	0x02ac	PID_PERCENT_HIGH*	F	Maximum PID Control output value
670	0x02ae	PID_MAX_RATE*	F	PID maximum rate of change
672	0x02b0	PID_ STABILITY_TIMEOUT*	L	Autotune stability test timeout
674	0x02b2	PID_ STABILITY_RATE*	F	Autotune maximum rate of change stabilitytest
		Safety		

704	0x02c0	SAFETY_DELAYED_POWER_ON_RUN*	R	Write 1 to DISABLE auto RUN on power up
705	0x02c1	SAFETY_DELAYED_OPER_RUN*	R	Write 1 to DISABLE return to RUN in OPER
706	0x02c2	SAFETY_SETPOINT_LIMIT_LOW*	F	Minimum allowed setpoint value
708	0x02c4	SAFETY_SETPOINT_LIMIT_HIGH*	F	Maximum allowed setpoint value
710	0x02c6	LOOP_BREAK_ENABLE*	R	Enumerated Toggle
712	0x02c8	LOOP_BREAK_TIME*	L	Time (msec) for break test
714	0x02ca	OPEN_CIRCUIT_ENABLE*	R	Write 1 to enable open circuit test
		Password / Access Control		
720	0x02d0	PASSWORD_INIT_ENABLE*	R	Write 1 to enable INIT menu password
722	0x02d2	PASSWORD_INIT*	L	INIT menu password
724	0x02d4	PASSWORD_PROGRAM_ENABLE*	R	Write 1 to enable PROG menu password
726	0x02d6	PASSWORD_PROGRAM*	L	PROG menu password
		Setpoints		
736	0x02e0	SETPOINT_1_MODE*	R	Enumerated Setpoint 1 mode
738	0x02e2	SETPOINT_1*	F	Setpoint 1 value
740	0x02e8	SETPOINT_2_MODE*	R	Enumerated Setpoint 2 mode
742	0x02ea	ABSOLUTE_SETPOINT_2*	F	Setpoint 2 value (absolute mode)
744	0x02ec	DEVIATION_SETPOINT_2*	F	Setpoint 2 value (derivative mode)
		Process Input Range (Scaling)		
768	0x0300	DB_4_20_MANUAL_LIVE*	R	Enumerated Input Process mode
770	0x0302	DB_4_20_MANUAL_READING_1*	F	Manual Scale reading value 1
772	0x0304	DB_4_20_MANUAL_INPUT_1*	F	Manual Scale input value 1
774	0x0306	DB_4_20_MANUAL_READING_2*	F	Manual Scale reading value 2
776	0x0308	DB_4_20_MANUAL_INPUT_2*	F	Manual Scale input value 2
778	0x030a	DB_4_20_LIVE_READING_1*	F	Live Scale reading value 1
780	0x030c	DB_4_20_LIVE_INPUT_1*	F	Live Scale input value 1
782	0x030e	DB_4_20_LIVE_READING_2*	F	Live Scale reading value 2
784	0x0310	DB_4_20_LIVE_INPUT_2*	F	Live Scale input value 2
800	0x0320	DB_0_24_MANUAL_LIVE*	R	Enumerated Input Process mode
802	0x0322	DB_0_24_MANUAL_READING_1*	F	Manual Scale reading value 1
804	0x0324	DB_0_24_MANUAL_INPUT_1*	F	Manual Scale input value 1
806	0x0326	DB_0_24_MANUAL_READING_2*	F	Manual Scale reading value 2
808	0x0328	DB_0_24_MANUAL_INPUT_2*	F	Manual Scale input value 2
810	0x032a	DB_0_24_LIVE_READING_1*	F	Live Scale reading value 1
812	0x032c	DB_0_24_LIVE_INPUT_1*	F	Live Scale input value 1

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814	0x032e	DB_0_24_LIVE_READING_2*	F	Live Scale reading value 2
816	0x0330	DB_0_24_LIVE_INPUT_2*	F	Live Scale input value 2
832	0x0340	DB_10_MANUAL_LIVE*	R	Enumerated Input Process mode
834	0x0342	DB_10_MANUAL_READING_1*	F	Manual Scale reading value 1
836	0x0344	DB_10_MANUAL_INPUT_1*	F	Manual Scale input value 1
838	0x0346	DB_10_MANUAL_READING_2*	F	Manual Scale reading value 2
840	0x0348	DB_10_MANUAL_INPUT_2*	F	Manual Scale input value 2
842	0x034a	DB_10_LIVE_READING_1*	F	Live Scale reading value 1
844	0x034c	DB_10_LIVE_INPUT_1*	F	Live Scale input value 1
846	0x034e	DB_10_LIVE_READING_2*	F	Live Scale reading value 2
848	0x0350	DB_10_LIVE_INPUT_2*	F	Live Scale input value 2
864	0x0360	DB_1_MANUAL_LIVE*	R	Enumerated Input Process mode
866	0x0362	DB_1_MANUAL_READING_1*	F	Manual Scale reading value 1
868	0x0364	DB_1_MANUAL_INPUT_1*	F	Manual Scale input value 1
870	0x0366	DB_1_MANUAL_READING_2*	F	Manual Scale reading value 2
872	0x0368	DB_1_MANUAL_INPUT_2*	F	Manual Scale input value 2
874	0x036a	DB_1_LIVE_READING_1*	F	Live Scale reading value 1
876	0x036c	DB_1_LIVE_INPUT_1*	F	Live Scale input value 1
878	0x036e	DB_1_LIVE_READING_2*	F	Live Scale reading value 2
880	0x0370	DB_1_LIVE_INPUT_2*	F	Live Scale input value 2
896	0x0380	DB_POINT_1_MANUAL_LIVE*	R	Enumerated Input Process mode
898	0x0382	DB_POINT_1_MANUAL_READING_1*	F	Manual Scale reading value 1
890	0x0384	DB_POINT_1_MANUAL_INPUT_1*	F	Manual Scale input value 1
892	0x0386	DB_POINT_1_MANUAL_READING_2*	F	Manual Scale reading value 2
894	0x0388	DB_POINT_1_MANUAL_INPUT_2*	F	Manual Scale input value 2
896	0x038a	DB_POINT_1_LIVE_READING_1*	F	Live Scale reading value 1
898	0x038c	DB_POINT_1_LIVE_INPUT_1*	F	Live Scale input value 1
900	0x038e	DB_POINT_1_LIVE_READING_2*	F	Live Scale reading value 2
902	0x0390	DB_POINT_1_LIVE_INPUT_2*	F	Live Scale input value 2
		Auxiliary Input (Remote Setpoint)		
976	0x03d0	RSP_PROCESS_RANGE*	R	Enumerated Process Range
977	0x03d2	RSP_ENABLE*	R	Enumerated Toggle (sets SP 1 mode)
		Auxiliary Input Scaling		
984	0x03d8	RSP_4_20_SETPOINT_MIN*	F	Minimum Setpoint
986	0x03da	RSP_4_20_INPUT_MIN*	F	Minimum Input

988	0x03dc	RSP_4_20_SETPPOINT_MAX*	F	Maximum Setpoint
990	0x03de	RSP_4_20_INPUT_MAX*	F	Maximum Input
992	0x03e0	RSP_0_24_SETPOINT_MIN*	F	
994	0x03e2	RSP_0_24_INPUT_MIN*	F	
996	0x03e4	RSP_0_24_SETPOINT_MAX*	F	
998	0x03e6	RSP_0_24_INPUT_MAX*	F	
1000	0x03e8	RSP_0_10_SETPOINT_MIN*	F	
1002	0x03ea	RSP_0_10_INPUT_MIN*	F	
1004	0x03ec	RSP_0_10_SETPOINT_MAX*	F	
1006	0x03ee	RSP_0_10_INPUT_MAX*	F	
1008	0x03f0	RSP_0_1_SETPOINT_MIN*	F	
1010	0x03f2	RSP_0_1_INPUT_MIN*	F	
1012	0x03f4	RSP_0_1_SETPOINT_MAX*	F	
1014	0x03f6	RSP_0_1_INPUT_MAX*	F	
		Output Configuration		
1024	0x0400	OUTPUT_1_HW_TYPE	R	Enumerated Hardware Type – upper 4 bits provide the 'Instance' count
1025	0x0401	OUTPUT_1_MODE*	R	Enumerated Output Mode
1026	0x0402	OUTPUT_1_ON_OFF_ACTION*	R	Enumerated On-Off Action
1027	0x0403	OUTPUT_1_SETPOINT*	R	Output Setpoint selection
1028	0x0404	OUTPUT_1_PULSE_LENGTH*	F	Pulse Length (.1 sec increments)
1030	0x0406	OUTPUT_1_ON_OFF_DEADBAND*	F	Deadband
1032	0x0408	OUTPUT_1_OUTPUT_RANGE*	R	Enumerated Output Analog Range
1034	0x040a	OUTPUT_1_RETRAN_READING_1*	F	Retransmission Reading Low
1036	0x040c	OUTPUT_1_RETRAN_OUTPUT_1*	F	Output Level Low
1038	0x040e	OUTPUT_1_RETRAN_READING_2*	F	Retransmission Reading High
1040	0x0410	OUTPUT_1_RETRAN_OUTPUT_2*	F	Output Level High
1056	0x0420	OUTPUT_2_HW_TYPE	R	
1057	0x0421	OUTPUT_2_MODE*	R	
1058	0x0422	OUTPUT_2_ON_OFF_ACTION*	R	
1059	0x0423	OUTPUT_2_SETPOINT*	R	
1060	0x0424	OUTPUT_2_PULSE_LENGTH*	F	
1062	0x0426	OUTPUT_2_ON_OFF_DEADBAND*	F	
1064	0x0428	OUTPUT_2_OUTPUT_RANGE*	R	
1066	0x042a	OUTPUT_2_RETRAN_READING_1*	F	
1068	0x042c	OUTPUT_2_RETRAN_OUTPUT_1*	F	

1070	0x042e	OUTPUT_2_RETRAN_READING_2*	F	
1072	0x0430	OUTPUT_2_RETRAN_OUTPUT_2*	F	
1088	0x0440	OUTPUT_3_HW_TYPE	R	
1089	0x0441	OUTPUT_3_MODE*	R	
1090	0x0442	OUTPUT_3_ON_OFF_ACTION*	R	
1091	0x0443	OUTPUT_3_SETPOINT*	R	
1092	0x0444	OUTPUT_3_PULSE_LENGTH*	F	
1094	0x0446	OUTPUT_3_ON_OFF_DEADBAND*	F	
1096	0x0448	OUTPUT_3_OUTPUT_RANGE*	R	
1098	0x044a	OUTPUT_3_RETRAN_READING_1*	F	
1100	0x044c	OUTPUT_3_RETRAN_OUTPUT_1*	F	
1102	0x044e	OUTPUT_3_RETRAN_READING_2*	F	
1104	0x0450	OUTPUT_3_RETRAN_OUTPUT_2*	F	
1120	0x0460	OUTPUT_4_HW_TYPE	R	
1121	0x0461	OUTPUT_4_MODE*	R	
1122	0x0462	OUTPUT_4_ON_OFF_ACTION*	R	
1123	0x0463	OUTPUT_4_SETPOINT*	R	
1124	0x0464	OUTPUT_4_PULSE_LENGTH*	F	
1126	0x0466	OUTPUT_4_ON_OFF_DEADBAND*	F	
1128	0x0468	OUTPUT_4_OUTPUT_RANGE*	R	
1130	0x046a	OUTPUT_4_RETRAN_READING_1*	F	
1132	0x046c	OUTPUT_4_RETRAN_OUTPUT_1*	F	
1134	0x046e	OUTPUT_4_RETRAN_READING_2*	F	
1136	0x0470	OUTPUT_4_RETRAN_OUTPUT_28	F	
1152	0x0480	OUTPUT_5_HW_TYPE	R	
1153	0x0481	OUTPUT_5_MODE*	R	
1154	0x0482	OUTPUT_5_ON_OFF_ACTION*	R	
1155	0x0483	OUTPUT_5_SETPOINT*	R	
1156	0x0484	OUTPUT_5_PULSE_LENGTH*	F	
1158	0x0486	OUTPUT_5_ON_OFF_DEADBAND*	F	
1160	0x0488	OUTPUT_5_OUTPUT_RANGE*	R	
1162	0x048a	OUTPUT_5_RETRAN_READING_1*	F	
1164	0x048c	OUTPUT_5_RETRAN_OUTPUT_1*	F	
1165	0x048e	OUTPUT_5_RETRAN_READING_2*	F	

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1168	0x0490	OUTPUT_5_RETRAN_OUTPUT_28	F	
1184	0x04a0	OUTPUT_6_HW_TYPE	R	
1185	0x04a1	OUTPUT_6_MODE*	R	
1186	0x04a2	OUTPUT_6_ON_OFF_ACTION*	R	
1187	0x04a3	OUTPUT_6_SETPOINT*	R	
1188	0x04a4	OUTPUT_6_PULSE_LENGTH*	F	
1190	0x04a6	OUTPUT_6_ON_OFF_DEADBAND*	F	
1192	0x04a8	OUTPUT_6_OUTPUT_RANGE*	R	
1194	0x04aa	OUTPUT_6_RETRAN_READING_1*	F	
1196	0x04ac	OUTPUT_6_RETRAN_OUTPUT_1*	F	
1198	0x04ae	OUTPUT_6_RETRAN_READING_2*	F	
1200	0x04b0	OUTPUT_6_RETRAN_OUTPUT_28	F	
1216	0x04c0	OUTPUT_7_HW_TYPE	R	
1217	0x04c1	OUTPUT_7_MODE*	R	
1218	0x04c2	OUTPUT_7_ON_OFF_ACTION*	R	
1219	0x04c3	OUTPUT_7_SETPOINT*	R	
1220	0x04c4	OUTPUT_7_PULSE_LENGTH*	F	
1222	0x04c6	OUTPUT_7_ON_OFF_DEADBAND*	F	
1224	0x04c8	OUTPUT_7_OUTPUT_RANGE*	R	
1226	0x04ca	OUTPUT_7_RETRAN_READING_1*	F	
1228	0x04cc	OUTPUT_7_RETRAN_OUTPUT_1*	F	
1230	0x04ce	OUTPUT_7_RETRAN_READING_2*	F	
1232	0x04d0	OUTPUT_7_RETRAN_OUTPUT_28	F	
1248	0x04e0	OUTPUT_8_HW_TYPE	R	
1259	0x04e1	OUTPUT_8_MODE*	R	
1250	0x04e2	OUTPUT_8_ON_OFF_ACTION*	R	
1251	0x04e3	OUTPUT_8_SETPOINT*	R	
1252	0x04e4	OUTPUT_8_PULSE_LENGTH*	F	
1254	0x04e6	OUTPUT_8_ON_OFF_DEADBAND*	F	
1256	0x04e8	OUTPUT_8_OUTPUT_RANGE*	R	
1258	0x04ea	OUTPUT_8_RETRAN_READING_1*	F	
1260	0x04ec	OUTPUT_8_RETRAN_OUTPUT_1*	F	
1262	0x04ee	OUTPUT_8_RETRAN_READING_2*	F	

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1264	0x04f0	OUTPUT_8_RETRAN_OUTPUT_28	F	
		Alarm Configuration		
1280	0x0500	ALARM_STATE	R	Alarm state (Bit 0)
1281	0x0501	ALARM_1_TYPE*	R	Enumerated Alarm type
1282	0x0502	ALARM_1_MODE*	R	Enumerated Alarm Mode
1283	0x0503	ALARM_1_DISPLAY_COLOR*	R	Enumerated Alarm Color
1284	0x0504	ALARM_1_HIGH_HIGH_MODE*	R	Enumerated Toggle value
1285	0x0505	ALARM_1_LATCH_TYPE*	R	Enumerated Toggle value
1286	0x0506	ALARM_1_CONTACT_CLOSURE_TYPE*	R	Enumerated Contact closure type
1287	0x0507	ALARM_1_POWER_ON_STATE*	R	Enumerated Power on control
1288	0x0508	ABSOLUTE_ALARM_1_LOW*	F	Alarm Low value (Absolute mode)
1290	0x050a	ABSOLUTE_ALARM_1_HIGH*	F	Alarm High value (Absolute mode)
1292	0x050c	DEVIATION_ALARM_1_LOW*	F	Alarm Low offset (Deviation mode)
1294	0x050e	DEVIATION_ALARM_1_HIGH*	F	Alarm High offset (Deviation mode)
1296	0x0510	ALARM_1_HIGH_HIGH_OFFSET*	F	Alarm High-High offset
1298	0x0512	ALARM_1_ON_DELAY*	F	Alarm On Delay
1300	0x0514	ALARM_1_OFF_DELAY*	F	Alarm Off Delay
1312	0x0520	ALARM_STATE	R	
1313	0x0521	ALARM_2_TYPE*	R	
1314	0x0522	ALARM_2_MODE*	R	
1315	0x0523	ALARM_2_DISPLAY_COLOR*	R	
1316	0x0524	ALARM_2_HIGH_HIGH_MODE*	R	
1317	0x0525	ALARM_2_LATCH_TYPE*	R	
1318	0x0526	ALARM_2_CONTACT_CLOSURE_TYPE*	R	
1319	0x0527	ALARM_2_POWER_ON_STATE*	R	
1320	0x0528	ABSOLUTE_ALARM_2_LOW*	F	
1322	0x052a	ABSOLUTE_ALARM_2_HIGH*	F	
1324	0x052c	DEVIATION_ALARM_2_LOW*	F	
1326	0x052e	DEVIATION_ALARM_2_HIGH*	F	
1328	0x0530	ALARM_2_HIGH_HIGH_OFFSET*	F	
1330	0x0532	ALARM_2_ON_DELAY*	F	
1332	0x0534	ALARM_2_OFF_DELAY*	F	
		Excitation Voltage		
1472	0x05c0	EXCITATION_VOLTAGE*	R	Enumerated Excitation Voltage
		Annunciators		

1504	0x05e0	DB_ANNUNCIATOR_STATE	R	Enumerated Annunciator State
1505	0x05e1	DB_ANNUNCIATOR_1_MODE*	R	Enumerated Annunciator Mode
1508	0x05e4	DB_ANNUNCIATOR_STATE	R	Enumerated Annunciator State
1509	0x05e5	DB_ANNUNCIATOR_2_MODE*	R	Enumerated Annunciator Mode
		Data Comm - USB		
1536	0x0600	USB_PROTOCOL*	R	Enumerated Comm Mode
1537	0x0601	USB_RECOGNITION_CHARACTER*	R	Recognition character
1538	0x0602	USB_DATA_FLOW*	R	Enumerated Data Flow (Omega mode)
1539	0x0603	USB_ECHO_MODE*	R	Enumerated Toggle value
1540	0x0604	USB_CONTINUOUS_DATA_PERIOD*	F	Time interval in continuous mode (0.1 sec)
1542	0x0606	USB_DATA_FORMAT_STATUS*	R	Enumerated Toggle value
1543	0x0607	USB_DATA_FORMAT_READING*	R	Enumerated Toggle value
1544	0x0608	USB_DATA_FORMAT_PEAK*	R	Enumerated Toggle value
1545	0x0609	USB_DATA_FORMAT_VALLEY*	R	Enumerated Toggle value
1546	0x060a	USB_DATA_FORMAT_UNIT*	R	Enumerated Toggle value
1547	0x060b	USB_SEPARATION_CHAR*	R	Enumerated Separation character
1548	0x060c	USB_LINE_FEED*	R	Enumerated Toggle value
1549	0x060d	USB_DEVICE_ADDRESS*	R	Byte address (0..255)
1550	0x060e	USB_MODBUS_MODE*	R	Enumerated Modbus mode
1551	0x060f	USB_MODBUS_EOL*	R	2 character EOL character string (CR/LF)
		Data Comm - Ethernet		
1568	0x0620	ETH_PROTOCOL*	R	
1569	0x0621	ETH_RECOGNITION_CHARACTER*	R	
1570	0x0622	ETH_DATA_FLOW*	R	
1571	0x0623	ETH_ECHO_MODE*	R	
1572	0x0624	ETH_CONTINUOUS_DATA_PERIO*	F	
1574	0x0626	ETH_DATA_FORMAT_STATUS*	R	
1575	0x0627	ETH_DATA_FORMAT_READING*	R	
1576	0x0628	ETH_DATA_FORMAT_PEAK*	R	
1577	0x0629	ETH_DATA_FORMAT_VALLEY*	R	
1578	0x062a	ETH_DATA_FORMAT_UNIT*	R	
1579	0x062b	ETH_LINE_FEED*	R	
1580	0x062c	ETH_SEPARATION_CHAR*	R	
1581	0x062d	ETH_DEVICE_ADDRESS*	R	
1582	0x062e	ETH_MODBUS_MODE*	R	

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1583	0x062f	ETH_MODBUS_EOF*	R	
		Data Comm - Serial		
1600	0x0640	SERIAL_PROTOCOL*	R	
1601	0x0641	SERIAL_RECOGNITION_CHARAC*	R	
1602	0x0642	SERIAL_DATA_FLOW*	R	
1603	0x0643	SERIAL_ECHO_MODE*	R	
1604	0x0644	SERIAL_CONTINUOUS_DATA_PE*	F	
1606	0x0646	SERIAL_DATA_FORMAT_STATUS*	R	
1607	0x0647	SERIAL_DATA_FORMAT_READIN*	R	
1608	0x0648	SERIAL_DATA_FORMAT_PEAK*	R	
1609	0x0649	SERIAL_DATA_FORMAT_VALLEY*	R	
1610	0x064a	SERIAL_DATA_FORMAT_UNIT*	R	
1611	0x064b	SERIAL_LINE_FEED*	R	
1612	0x064c	SERIAL_SEPARATION_CHAR*	R	
1613	0x064d	SERIAL_DEVICE_ADDRESS*	R	
1614	0x064e	SERIAL_MODBUS_MODE*	R	
1615	0x064f	SERIAL_MODBUS_EOF*	R	
1616	0x0650	SERIAL_232_485*	R	Enumerated serial interface type
1617	0x0651	SERIAL_BAUD_RATE*	R	Enumerated baud rate value
1618	0x0652	SERIAL_PARITY*	R	Enumerated parity value
1619	0x0653	SERIAL_DATABITS*	R	Enumerated databits value
1620	0x0654	SERIAL_STOPBITS*	R	Enumerated stopbits value

3.1 Enumerated Values

The following define the Enumerated values.

3.1.1 Control/System Parameters

Toggle		
0	DISABLE	Feature or option is disabled
1	ENABLE	Feature or option is enabled

Control		

0	STOP	Control is stopped
1	START	Control is started
2	CANCEL	Control is cancelled
3	AUTO_ON	Control is immediated started
4	CONTINUOUS	Control is continuously (repeatedly) enabled

Control Action		
0	ACTION_REVERSE	Output active if P.V. < Setpoint
1	ACTION_DIRECT	Output active if P.V. > Setpoint

System State		
0	LOAD	File transfer in progress
1	IDLE	Idle, no control
2	INPUT_ADJUST	Adjusting input value
3	CONTROL_ADJUST	Adjusting output value
4	MODIFY	Modify parameter in OPER mode
5	WAIT	Waiting for RUN condition
6	RUN	System is running
7	STANDBY	Standby mode
8	STOP	Stopped mode
9	PAUSE	Paused mode
10	FAULT	Fault detected
11	SHUTDOWN	Shutdown condition detected
12	AUTOTUNE	Autotune in progress

3.1.2 Simulator Parameters

Simulation Mode

0	STOPPED	Simulator is stopped
1	PAUSED	Simulator is paused
2	TRIANGLE	Triangle output
3	SAW	Sawtooth output
4	INVERTED	Inverted Sawtooth output
5	PLANT	Simulated Plant

3.1.3 Display & Formatting

Time Format		
0	MINUTE_SECOND	MM.SS displayed
1	HOUR_MINUTE	HH.MM displayed
2	MILLISECONDS	S.MMM displayed

Decimal Point		
0	DECIMAL_POINT_NONE	Display as XXXX
1	DECIMAL_POINT_3	Display as XXX.X
2	DECIMAL_POINT_2	Display as XX.XX
3	DECIMAL_POINT_1	Display as X.XXX

Units		
0	UNIT_NONE	No units applied
1	UNIT_CELCIUS	Values converted to oC
2	UNIT_FARENHEIT	Values converted to oF

Color		
0	COLOR_OFF	No color
1	COLOR_GREEN	GREEN
2	COLOR_RED	RED

3	COLOR_AMBER	AMBER
4	COLOR_NO_CHANGE	Do not change color (internal use)

Brightness		
0	BRIGHTNESS_LOW	
1	BRIGHTNESS_MEDIUM	
2	BRIGHTNESS_HIGH	

3.1.4 Ramp and Soak Parameters

Ramp & Soak State (bit mapped)		
0x00	INACTIVE	Ramp & Soak is inactive
0x01	RAMPING	Ramp time and RE bit set
0x02	SOAKING	Soak time and SE bit set
0x04	RAMP_ACTIVE	Ramp time
0x08	SOAK_ACTIVE	Soak time
0x10	RAMP_SOAK_PAUSED	Ramp & Soak is in PAUSE condition
0x80	RAMP_SOAK_ERROR	Ramp & Soak error condition

Ramp & Soak Tracking		
0	FIXED_RAMP	Fixed RAMP time
1	FIXED_SOAK	Fixed SOAK time
2	FIXED_CYCLE	Fixed CYCLE time

Ramp & Soak Link Action		
0	STOP_PROCESS	Stop at end of profile
1	HOLD_PROCESS	Hold last SOAK level at end of profile
2	LINK_PROFILE	Link to Profile defined in LINK field

Ramp & Soak Control		
0	RAMP_SOAK_DISABLED	Disabled
1	RAMP_SOAK_ENABLED	Enabled by RUN button
2	RAMP_SOAK_REMOTE	Enabled by RUN button or Digital Input

3.1.5 Input Parameters

Sensor Type		
0	SENSOR_TC	Thermocouple
1	SENSOR_RTD	RTD
2	SENSOR_PROCESS	Process Input
3	SENSOR_THERMISTOR	Thermistor
4	SENSOR_REMOTE	Remote

Thermocouple Types			
0	J	6	R
1	K	7	S
2	T	8	B
3	E	9	C
4	N	10	<RESERVED>
5	<RESEREVED>	11	<RESERVED>

RTD ACRV OHM Types		
0	385_100	385 Curve, 100 ohms
1	385_500	385 Curve, 500 ohms
2	385_1000	385 Curve, 1000 ohms
3	392_100	392 Curve, 100 ohms

4	3916_100	3916Curve, 100 ohms

RTD Wire types		
0	2_WIRE	
1	3_WIRE	
2	4_WIRE	

Thermistor Type		
0	THERMISTOR_2_25_K	2.25 K
1	THERMISTOR_5_K	5K
2	THERMISTOR_10_K	10K

Process Input Types		
0	PROCESS_4_20	4 – 20 mA
1	PROCESS_0_24	0 – 24 mA
2	PROCESS_0_10	0 – 10 Vdc
3	PROCESS_0_1	0 – 1.0 Vdc
2	PROCESS_0_POINT_1	0 – 0.1 Vdc
5	PROCESS_PLUS_MINUS_1	+/– 10 Vdc
6	PROCESS_PLUS_MINUS_10	+/ – 1.0 Vdc
7	PROCESS_PLUS_MINUS_POINT_1	+/ – 0.1 Vdc

Process Live_Manual mode		
0	LIVE_MODE	
1	MANUAL_MODE	

Input Filtering

0	FILTER_CONSTANT_1	No filtering (1 X rate)
1	FILTER_CONSTANT_2	X 2 filtering
2	FILTER_CONSTANT_4	X 4 filtering
3	FILTER_CONSTANT_8	X 8 filtering
4	FILTER_CONSTANT_16	X 16 filtering
5	FILTER_CONSTANT_32	X 32 filtering
6	FILTER_CONSTANT_64	X 64 filtering
7	FILTER_CONSTANT_128	X 128 filtering

3.1.6 Setpoint Parameters

Setpoint Modes		
0	SETPOINT_ABSOLUTE	Setpoint value given as fixed constant
1	SETPOINT_DEVIATION	Setpoint value is deviation (+/-) Setpoint 1 value
2	SETPOINT_REMOTE	Setpoint 1 set by Remote Setpoint
3	SETPOINT_EXTERNAL	Setpoint value set externally
4	SETPOINT_RAMP_SOAK	Setpoint value set by Ramp & Soak process

3.1.7 Alarm Parameters

Alarm Mode		
0	ALARM_ABSOLUTE	Alarm setpoint is fixed constant
1	ALARM_DEVIATION_1	Alarm is offset from Setpoint 1
2	ALARM_DEVIATION_2	Alarm is offset from Setpoint 2

Alarm Type		
0	ALARM_DISABLED	Alarm not active
1	ALARM_ABOVE	Alarm triggered if PV > ALM.H
2	ALARM_BELOW	Alarm trigger if PV < ALM.L

| 3 | ALARM_HI_LO | Alarm trigger if PV > ALM.H or PV < ALM.L |
| 4 | ALARM_BAND | Alarm trigger if PV > ALM.L and PV < ALM.H |

Alarm Latch Control		
0	ALARM_UNLATCH	Alarm does not latch
1	ALARM_LATCH	Alarm state will be latched, clear by front panel
2	ALARM_LATCH_REMOTE	Alarm state will be latched, clear by digital input
3	ALARM_HI_LO	Alarm state latched, clear by front panel or input

3.1.8 Output Parameters

Output Types		
0x00	OUTPUT_NONE	No output available
0x01	OUTPUT_STR	Single Poll Relay
0x02	OUTPUT_SSR	SSR output
0x04	OUTPUT_DTR	Double Poll Relay
0x08	OUTPUT_DCP	DC Pulse output
0x10	OUTPUT_ANG	Analog Output
0x20	OUTPUT_IANG	Isolated Analog Output
0x40	OUTPUT_IDC	Isolated DC Pulse ouput

Output Polarity		
0	NORMALLY_OPEN	Contacts OPEN until activated
1	NORMALLY_CLOSED	Contacts CLOSED until activated

Output Type		
0	VOLTAGE	Voltage range
1	CURRENT	Current range

Output Mode		
0	OUTPUT_OFF	Output maintained in OFF state
1	OUTPUT_PID	Output control by PID control function
2	OUTPUT_ON_OFF	Output controlled by ON-OFF control function
3	OUTPUT_RETRANSMISSION	Output retransmits the scaled process variable
4	OUTPUT_ALARM_1	Output set by ALARM 1 state
5	OUTPUT_ALARM_2	Output set by ALARM 2 state
6	OUTPUT_RAMP_EVENT	Output set by Ramp & Soak RE.ON control bit
7	OUTPUT_SOAK_EVENT	Output set by Ramp & Soak SE.ON control bit

Output Process Range		
0	OUTPUT_0_10	0-10 Vdc
1	OUTPUT_0_5	0-5 Vdc
2	OUTPUT_0_20	0-20 mA
3	OUTPUT_4-20	4-20 mA
4	OUTPUT_0_24	0-24 mA

3.1.9 Annunciator Parameters

Annunciator Mode		
0	ANNUN_NONE	Disable Annunciator
1	ANNUN_ALARM_1	Annunciator activated by Alarm 1
2	ANNUN_ALARM_2	Annunciator activated by Alarm 2
3	ANNUN_OUTPUT_1	Annunciator activated by Output 1
4	ANNUN_OUTPUT_2	Annunciator activated by Output 2
5	ANNUN_OUTPUT_3	Annunciator activated by Output 3
6	ANNUN_OUTPUT_4	Annunciator activated by Output 4
6	ANNUN_RE_ON	Annunciator activated by RE.ON bit

8	ANNUN_SE_ON	Annunciator activated by SE.ON bit
9	ANNUN_RAMP_ACTIVE	Annunciator activated during any RAMP cycle
10	ANNUN_SOAK_ACTIVE	Annunciator activated during any SOAK cycle

3.1.10 Communication Parameters

Protocol		
0	PROTOCOL_OMEGA	Omega Protocol
1	PROTOCOL_MODBUS	Modbus Protocol

Data Flow (Omega Protocol)		
0	DATA_FLOW_COMMAND	Interactive command mode
1	DATA_FLOW_CONTINUOUS	Continuous mode

Separation Character (Omega Protocol)		
0	SEPARATION_SPACE	Use <space> character between records
1	SEPARATION_CR	Use <CR> between records

Modbus Protocol (Modbus Protocol)		
0	MODBUS_RTU	ASCII formatted records
1	MODBUS_ASCII	RTU formatted records
2	MODBUS_PDU	PDU formatted records

Serial Mode		
0	SERIAL_RS232	
1	SERIAL_RS485	

Serial Baud Rate		
0	BAUD_300	

1	BAUD_600	
2	BAUD_1200	
3	BAUD_2400	
4	BAUD_4800	
5	BAUD_9600	
6	BAUD_19200	
7	BAUD_38400	
8	BAUD_57600	
9	BAUD_115200	

Parity		
0	PARITY_NONE	
1	PARITY_ODD	
2	PARITY_EVEN	

Data Bits		
0	BITS_7	
1	BITS_8	

3.1.11 Excitation Parameters

Excitation		
0	EXCITATION_0_VOLTS	
1	EXCITATION_5_VOLTS	
2	EXCITATION_10_VOLTS	
3	EXCITATION_12_VOLTS	
4	EXCITATION_24_VOLTS	

3.1.12 Calibration Parameters

	Calibration Mode	
0	CAL_NONE	
1	CAL_1_POINT	
2	CAL_2_POINT	
3	CAL_ICE_POINT	

3.1.13 Input / Output Scaling

Scaling operations allow translating source (input) signals to scaled output signal using a linear translation defined by a SLOPE (or gain) and an OFFSET. As shown below, (X1,Y1) and (X2,Y2) define two points on a line that has a certain SLOPE and OFFSET. Knowing the SLOPE and OFFSET allows determining the OUTPUT value for any given INPUT value using the equation:

Output = Input X SLOPE + OFFSET, where

GAIN = (Y2 - Y1) / (X2 - X1)

OFFSET = Y1 - (GAIN * X1).
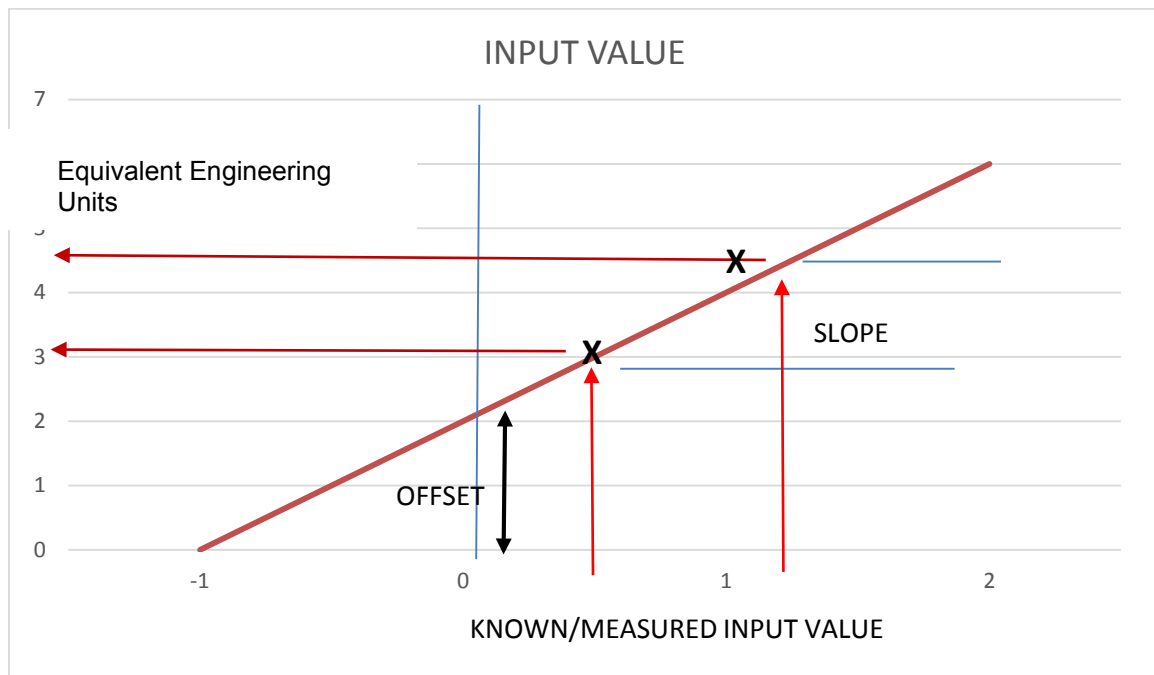
If (X2 - X1) == 0, the GAIN is set to 1 and the OFFSET is set to 0.

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **61 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **five (5) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

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RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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