sensia

Rockwell Automation + Schlumberger

CALDON® ULTRASONICS

LEFM® G3 Transmitter Modbus User Manual

Modbus Register Addresses and Parameters

Manual No. IB1504 Rev. 3

Sensia's Measurement Systems division is a manufacturer of high quality instrumentation and control products, selling direct from its Pittsburgh based factory to customers in the USA and through agents and representatives overseas. A complete range of support services is offered. For additional information or assistance on the application, operation or servicing of the LEFM 2xxCi or 3xxCi Modbus registers, write, call, or visit www.sensiaglobal.com.

Before performing maintenance procedures, system verification procedures, repair procedures, and troubleshooting procedures, personnel should receive general training from Sensia. Contact Sensia's Measurement Systems division for information on training programs.

TABLE OF CONTENTS

1 PURPOSE

This manual documents the parameters and Modbus addresses necessary for typical maintenance of the LEFM G3 transmitter. It includes the addresses and locations of typical setup configuration values and output data. It also defines the formats and ranges for these values.

If a user interface is all that is required, then please use the interface programs available from Cameron. It is always preferable to use Cameron provided software for changing transmitter settings.

The parameters defined include the following:

- Flow scaling and counts factor
- Analog interface parameters
- Modbus and display interface parameters

The transmitter will accept any value in a given field (provided it is the expected format and address, for example floating point or integer and not character). However, there are values that produce illogical inputs. Typically, the software bounds the inputs to prevent unacceptable inputs. Nevertheless, this document defines and recommends ranges for the inputs based on engineering analysis.

1.1 Related Documents

The LEFM G3 transmitters use the Modbus protocol for serial communication:

- Modicon Modbus Protocol Reference Guide (PI-MBUS-300 Rev. J) dated June 1996.

The following documents may also be useful:

- Cameron LEFM 2xxCi Installation and Operation Manual IB1402
- Cameron LEFM 380Ci Installation and Operation Manual IB1406

1.2 Intended Audience

The LEFM flowmeters can be customized following the information provided in this manual. This manual is intended to be used by plant site operators, site engineers, and supervisory personnel. This manual assumes the reader is familiar with the terminology typically used with Modbus.

1.3 Procedure for Changing Configuration Inputs (e.g., Holding Registers)

Note – Always read a register's value first in order to confirm its current value before it is changed.

1. Identify the parameter to be changed and the address of its Holding Register.
2. Read the contents of the Holding Register to confirm its as-found value.
3. Send Password to Register. (The password expires after ~5 minutes.) The password is typically controlled by the site manager. If the password cannot be determined, contact Cameron's Measurement System division to determine the as-shipped password.
4. Change the register using Modbus protocol.
5. Activate the Burn and Use Register.

1.4 Summary of Software for G3 Transmitter

The following table summarizes the available software for the G3 transmitter.

Table 1.1 G3 Software

Product	Model Transmitter	Software Versions (all revisions)
LEFM 2xxCi Series with G3 Transmitter	G3	9A-SW-000082
LEFM 3xxCi Series with G3 Transmitter	G3	9A-SW-000082

Last, the G3 transmitter has the adaptability of changing its Modbus registers. So accordingly, please request the Holding Register map for your transmitter.

2 USER SETUPS

The following sections define the addresses for the software setup variables used by typical users. All settings will need a password to be entered and the device will need to be use any holding register entries.

2.1 Display/Flow Settings

Table 2.1 Display Registers

Setup Variable	Variable Definition	G3 HR Address	Notes
Flow Rate Unit Selection	Integer	784	The flow display text is for display text only. Units conversion previously scales the flow. Value Selection 1 CFS 2 CFM 3 CMS 4 CFH 5 CMH 6 BPH
Totalizer Units Selection	Integer	785	The totalizer display text is for display text only. Units conversion previously scales the flow. Value Selection 1 Cubic Feet 2 Cubic Meters 3 Barrel
Counts Factor	Float	3048	Number of Counts per unit volume (units have already been converted by the units factor)

2.2 Operational Settings, Time Constants, and Cutoff Settings

Table 2.2 Operational Registers

Setup Variable	Variable Definition	HR Address	Notes
Low Flow Cutoff	Float	3064	Flow rates below this value (in absolute value) are clamped to 0 (display and pulses) and the flow meter's totalizers do not update.
Application Cycle Time	Float	18	Period (in seconds) that the Modbus registers are updated (typically 1 to 3 seconds).
Computed Flow Time Constant	Float	3258	Response time constant (seconds).

2.3 Analog Input/Output, and Process Inputs

Table 2.3 Status/Pulse Mode and Voltage Registers

Setup Variable	Variable Definition	HR Address	Notes
Pulser Mode	Integer	20022	Value Selection 0 A is Frequency (+/- flows), B is Quadrature 1 A is Frequency (+/- flows), B is Direction (+ indicates high, - indicates low) 2 A is Frequency (+ flows), B is Frequency (- flows)
Voltage for Pulse and Status – A	Integer	20026	Value Selection 0 5 volts Any other value 12 volts
Voltage for Pulse and Status – B	Integer	20028	Value Selection 0 5 volts Any other value 12 volts

2.3.1 Process Inputs

Table 2.4 Meter Body Temperature (MBT) Registers

Setup Variable	Variable Definition	HR Address	Notes
Default MBT	Float	2058	This register can be used to provide a constant value defined by the user.
Source for MBT	Integer	2050	Value Selection 0 Default MBT 1 A/I #1 2 A/I #2 3 A/I #3 5 RTD 6 Modbus Register
MBT Units	Integer	2052	Value Selection 0 deg F 1 deg C
Offset MBT	Float	2054	Sets an offset for the Meter Body Temperature when using an analog input.
Slope MBT	Float	2056	Sets the slope for the Meter Body Temperature when using an analog input.

Where:

$$\text{MBT} = \text{Offset} + \text{Slope} * \text{Analog Input(mA)}$$

Table 2.5 Fluid Temperature (FT) Registers

Setup Variable	Variable Definition	G3 HR Address	Notes
Default FT	Float	3070	This register can be used to provide a constant value defined by the user.
Source FT	Integer	2024	Value Selection 0 Default FT 1 A/I #1 2 A/I #2 3 A/I #3 5 Meter Body Temperature (MBT) 6 Modbus Register
FT Units	Integer	2016	Value Selection 0 def F 1 def C
Offset FT	Float	3230	Sets an offset for the Fluid Temperature when using an analog input.
Slope FT	Float	3232	Sets the slope for the Fluid Temperature when using an analog input.

Where:

$$\mathrm{FT} = \mathrm{Offset} + \mathrm{Slope} * \mathrm{Analog\ Input(mA)}$$

Table 2.6 Pressure Registers

Setup Variable	Variable Definition	G3 HR Address	Notes
Default Pressure	Float	3072	This register can be used to provide a constant value defined by the user.
Source Pressure	Integer	2026	Value Selection 0 Default pressure 1 A/I #1 2 A/I #2 3 A/I #3 6 Modbus Register
Pressure Units	Integer	2018	Value Selection 0 psig 1 kg/cm^2 2 bar 3 KPaG 4 MPaG
Offset Pressure	Float	3234	Sets an offset for the pressure when using an analog input.
Slope Pressure	Float	3236	Sets the slope for the pressure when using an analog input.

Where:

$$\mathrm{Pressure} = \mathrm{Offset} + \mathrm{Slope} * \mathrm{Analog\ Input(mA)}$$

Table 2.7 Density Registers

Setup Variable	Variable Definition	G3 HR Address	Notes
Default Density	Float	3074	This register can be used to provide a constant value defined by the user.
Source Density	Integer	2028	Value Selection 0 Default density 1 A/I #1 2 A/I #2 3 A/I #3 5 Internal Calculation (using acoustic measurements) 6 Modbus Register
Density Units	Integer	2020	Value Selection 0 g/cc 1 kg/m^3 2 API deg 3 lb/cf
Offset Density	Float	3238	Sets an offset for density when using an analog input.
Slope Density	Float	3240	Sets the slope for density when using an analog input.

Where:

$$\mathrm{FT} = \mathrm{Offset} + \mathrm{Slope} * \mathrm{Analog\ Input(mA)}$$

Table 2.8 Viscosity Registers

Setup Variable	Variable Definition	G3 HR Address	Notes
Default Viscosity	Float	3076	This register can be used to provide a constant value defined by the user.
Source Viscosity	Integer	2030	Value Selection 0 Default viscosity 1 A/I #1 2 A/I #2 3 A/I #3 5 Internal Calculation (using acoustic measurements) 6 Modbus Register
Viscosity Units			Always centistokes (cSt)
Offset Viscosity	Float	3240	Sets an offset for viscosity when using an analog input.
Slope Viscosity	Float	3242	Sets the slope for viscosity when using an analog input.

Where:

$$\mathrm{Viscosity} = \mathrm{Offset} + \mathrm{Slope} * \mathrm{Analog\ Input(mA)}$$

2.3.2 Process Outputs

Table 2.9 Analog Output 1 Registers

Setup Variable	Variable Definition	G3 HR Address	Notes
AO #1 Offset	Float	3262	Sets the offset for Analog Output 1.
AO #1 Slope	Float	3260	Sets the slope for Analog Output 1.
AO #1 Map	UINT	2032	Process value choices: Value Selection 0 Flow 2 Temperature 3 Pressure 4 Density 5 Viscosity

Table 2.10 Analog Output 2 Registers

Setup Variable	Variable Definition	G3 HR Address	Notes
AO #2 Offset	Float	3266	Sets the offset for Analog Output 2.
AO #2 Slope	Float	3264	Sets the slope for Analog Output 2.
AO #2 Map	Int	2034	Process value choices: Value Selection 0 Flow 2 Temperature 3 Pressure 4 Density 5 Viscosity

Where:

$$\text{Current} = \text{Offset} + \text{Slope} * \text{Analog Input(mA)}$$

Table 2.11 Status Bit Masks

Setup Variable	Variable Definition	G3 HR Address	Notes
Status Bit A	Integer	2012	This register indicates the status of the various Analog Outputs. The value corresponds to the bit map located in table below.
Status Bit B	Integer	2014	
Display/Modbus Mask	Integer	2042	

Table 2.12 Bit Map for Masking Alarms to be included in the Status Output

Bit	Alarm
0	Oscillator Alarm
1	VOS Alarm
2	Path Alert
3	Path Fail
4	CFG Modified
5	Flatness Ratio
6	Swirl
7	Plane Balance
8	Asymmetry Ratio
9	Meter Body Temperature Out of Range
10	Fluid Temperature Out of Range
11	Fluid Pressure Out of Range
12	Fluid Density Out of Range
13	Fluid Viscosity Out of Range
14	Platform Alarm
15	Future

2.4 Communications, Units, and Display

Table 2.13 Totalizer Limit

Setup Variable	Variable Definition	HR Address	Notes
Totalizer Wrap Around Value	Float	3052	Absolute value at which totalizers wrap around. For example, if this register were set to 1000.0, then the totalizer would wrap around back to 0 after 999.9.

2.4.1 Communication Ports

There are three total communication ports available on the G3 transmitter. The table below indicates the Holding Registers for each of the three communication ports.

Table 2.14 Serial Communication Configuration

Setup Variable	Variable Definition	HR Address			Notes
		COM 1	COM 2	COM 3	
Baud Rate	Integer	78	92	106	Allows the following various baud rates: 9600 19200 38400 57600
Modbus Address	Integer	88	102	116	Modbus Address (default as delivered is set to 1)

Note – Communications settings are indicated on the display on startup.

Table 2.15 Ethernet Communication Configuration

Setup Variable	Variable Definition	HR Address	Notes
DHCP Enabled	Integer	32	
IPV4_Part1	Integer	34	
IPV4_Part2	Integer	36	
IPV4_Part3	Integer	38	
IPV4_Part4	Integer	40	
Subnet_Part1	Integer	58	
Subnet_Part2	Integer	60	
Subnet_Part3	Integer	62	
Subnet_Part4	Integer	64	
Gateway IP_Part1	Integer	66	
Gateway IP _Part2	Integer	68	
Gateway IP _Part3	Integer	70	
Gateway IP _Part4	Integer	72	
CBM_Port	Integer	74	This is a custom port for CBM data transfer

2.5 Alarm Tests

Table 2.16 Alarm Limits

Setup Variable	Variable Definition	HR Address	Notes
Velocity of Sound Differential Limit	Float	21154	Defines the amount the VOS of different paths can differ prior to triggering an alarm.
Flatness Ratio Max Limit	Float	3214	Defines the maximum Flatness Ratio for the meter prior to triggering an alarm.
Flatness Ratio Min Limit	Float	3216	Defines the minimum Flatness Ratio for the meter prior to triggering an alarm.
Swirl Max Limit	Float	3218	Defines the maximum Swirl for the meter prior to triggering an alarm.
Swirl Min Limit	Float	3220	Defines the minimum Swirl for the meter prior to triggering an alarm.
Asymmetry Ratio Max Limit	Float	3222	Defines the maximum Asymmetry Ratio for the meter prior to triggering an alarm.
Asymmetry Ratio Min Limit	Float	3224	Defines the maximum Asymmetry Ratio for the meter prior to triggering an alarm.
Plane Balance Max Limit	Float	3226	Defines the maximum deviation between the Plane A and Plane B flow.
Plane Balance Min Limit	Float	3228	Defines the minimum deviation between the Plane A and Plane B flow.
Oscillator Test Threshold	Float	1218	Defines the maximum oscillator test threshold prior to triggering an alarm.
Gain Split Threshold	Float	1220	Defines the maximum split deviation threshold for Path Gains prior to triggering an alarm.
Gain Alarm Limit	Float	1222	Defines the maximum path gain value prior to triggering an alarm.

3 RESULT REGISTERS

The following tables define the addresses for the Modbus user outputs for all systems.

3.1 Status Data

Table 3.1 Path Status Registers

Setup Variable	Variable Definition	HR Address	IR Address	Notes
Path 1 State	INT	50006	190	Path state bit 0 - No signal (no zcd) bit 1 - Tup Deviation bit 2 - Tdown Deviation bit 3 - Delta T Deviation bit 5 - SNR Up Low bit 6 - SNR Down Low bit 7 - Delta T hit limit bit 8 - Instantaneous Vnorm test bit 9 - Gain split
Path 2 State	INT	50008	192	
Path 3 State	INT	50010	194	
Path 4 State	INT	50012	196	
Path 5 State	INT	50014	690	
Path 6 State	INT	50016	692	
Path 7 State	INT	50018	694	
Path 8 State	INT	50020	696	
Path 1 Status	INT	51150	74	Value Description 0 Valid 1 Pre-valid 2 Invalid 3 Gain Split 4 VOS Alarm 5 VOT (outlier test) Alarm
Path 2 Status	INT	51151	75	
Path 3 Status	INT	51152	76	
Path 4 Status	INT	51153	77	
Path 5 Status	INT	51154	574	
Path 6 Status	INT	51155	575	
Path 7 Status	INT	51156	576	
Path 8 Status	INT	51157	577	

Table 3.2 System & Meter Status Data Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
System Status	Integer	10010	72	N/A	Value Description 0 Normal 1 System Reset 2 Bad executable checksum 3 Bad configuration checksum 4 External trigger (if required) not received
Meter State Vector	Integer	10011	1101	N/A	Corresponds to the following bit values: Bit Description 0 Oscillator Alarm 1 VOS Alarm 2 Path Alert 3 Path Fail 4 CFG Modified 5 Flatness Ratio Alarm 6 Swirl Alarm 7 Plane Balance Alarm 8 Asymmetry Ratio Alarm 9 Meter Body Temp Out of Range 10 Fluid Temp Out of Range 11 Fluid Pressure Out of Range 12 Fluid Density Out of Range 13 Fluid Viscosity Out of Range 14 Platform Alarm 15 Future
Persistent Alarms (PA)	Integer	50002	404	N/A	Persistent alarms (PA); requires a user response to clear the alarm. Corresponds to the following bit values: Bit Description 0 Executable checksum failure 1 Config. checksum failure 2 Non-volatile Memory failure 3 Watchdog reset 4 Required external trigger failure 5 Oscillator alarm 6 Meter Body Temp failure 7 Path failure

Platform State	Integer	50004	40696	N/A	Corresponds to the following bit values: Bit Description 0 Normal 1 Path VOS Failure 2 MXR RTD Out of Range 3 A/I #1 Out of Range 4 A/I #2 Out of Range 5 A/I #3 Out of Range 6 System Time Out of Range

3.2 Path Acoustic Data

Table 3.3 Gain Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Path 1 Average Gain	Float	5100	212	dB	Average of the upstream and downstream Gain.
Path 2 Average Gain	Float	5102	214	dB	
Path 3 Average Gain	Float	5104	216	dB	
Path 4 Average Gain	Float	5106	218	dB	
Path 5 Average Gain	Float	5108	712	dB	
Path 6 Average Gain	Float	5110	714	dB	
Path 7 Average Gain	Float	5112	716	dB	
Path 8 Average Gain	Float	5114	718	dB	
Path 1 Average Gain	Float	7018	2018	dB	
Path 2 Average Gain	Float	7020	2020	dB	
Path 3 Average Gain	Float	7022	2022	dB	
Path 4 Average Gain	Float	7024	2024	dB	
Path 5 Average Gain	Float	7026	2026	dB	
Path 6 Average Gain	Float	7028	2028	dB	
Path 7 Average Gain	Float	7030	2030	dB	
Path 8 Average Gain	Float	7032	2032	dB	
Path 1 Up Gain	Float	5132	288	dB	Upstream Gain.
Path 2 Up Gain	Float	5134	290	dB	
Path 3 Up Gain	Float	5136	292	dB	
Path 4 Up Gain	Float	5138	294	dB	
Path 5 Up Gain	Float	5140	788	dB	
Path 6 Up Gain	Float	5142	790	dB	
Path 7 Up Gain	Float	5144	792	dB	
Path 8 Up Gain	Float	5146	794	dB	
Path 1 Down Gain	Float	5116	280	dB	Downstream Gain.
Path 2 Down Gain	Float	5118	282	dB	
Path 3 Down Gain	Float	5120	284	dB	
Path 4 Down Gain	Float	5122	286	dB	
Path 5 Down Gain	Float	5124	780	dB	
Path 6 Down Gain	Float	5126	782	dB	
Path 7 Down Gain	Float	5128	784	dB	
Path 8 Down Gain	Float	5130	786	dB	

Table 3.4 Signal-to-Noise Ratio Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Path 1 Average SNR	Integer	10059	24	N/A	Average of the upstream and downstream Signal-to-Noise ratio.
Path 2 Average SNR	Integer	10060	25	N/A	
Path 3 Average SNR	Integer	10061	26	N/A	
Path 4 Average SNR	Integer	10062	27	N/A	
Path 5 Average SNR	Integer	10063	524	N/A	
Path 6 Average SNR	Integer	10064	525	N/A	
Path 7 Average SNR	Integer	10065	526	N/A	
Path 8 Average SNR	Integer	10066	527	N/A	
Path 1 Average SNR	Integer	7034	2034	N/A	
Path 2 Average SNR	Integer	7035	2035	N/A	
Path 3 Average SNR	Integer	7036	2036	N/A	
Path 4 Average SNR	Integer	7037	2037	N/A	
Path 5 Average SNR	Integer	7038	2038	N/A	
Path 6 Average SNR	Integer	7039	2039	N/A	
Path 7 Average SNR	Integer	7040	2040	N/A	
Path 8 Average SNR	Integer	7041	2041	N/A	
Path 1 Up SNR	Integer	10075	204	N/A	Upstream Signal-to-Noise Ratio.
Path 2 Up SNR	Integer	10076	205	N/A	
Path 3 Up SNR	Integer	10077	206	N/A	
Path 4 Up SNR	Integer	10078	207	N/A	
Path 5 Up SNR	Integer	10079	704	N/A	
Path 6 Up SNR	Integer	10080	705	N/A	
Path 7 Up SNR	Integer	10081	706	N/A	
Path 8 Up SNR	Integer	10082	707	N/A	
Path 1 Down SNR	Integer	10067	200	N/A	Downstream Signal-to-Noise Ratio.
Path 2 Down SNR	Integer	10068	201	N/A	
Path 3 Down SNR	Integer	10069	202	N/A	
Path 4 Down SNR	Integer	10070	203	N/A	
Path 5 Down SNR	Integer	10071	700	N/A	
Path 6 Down SNR	Integer	10072	701	N/A	
Path 7 Down SNR	Integer	10073	702	N/A	
Path 8 Down SNR	Integer	10074	703	N/A	

Table 3.5 Path Performance Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Path 1 Performance	Integer	10051	16	%	Percent of data collected that is accepted due to signal to noise ratio, cross-correlation tests, or statistics. 100% indicated that 100% of the date is accepted.
Path 2 Performance	Integer	10052	17	%	
Path 3 Performance	Integer	10053	18	%	
Path 4 Performance	Integer	10054	19	%	
Path 5 Performance	Integer	10055	516	%	
Path 6 Performance	Integer	10056	517	%	
Path 7 Performance	Integer	10057	518	%	
Path 8 Performance	Integer	10058	519	%	

3.3 Fluid Property Data Registers

Table 3.6 Speed of Sound Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Path 1 VOS	Float	5052	40	m/s	Path Velocity of Sound.
Path 2 VOS	Float	5054	42	m/s	
Path 3 VOS	Float	5056	44	m/s	
Path 4 VOS	Float	5058	46	m/s	
Path 5 VOS	Float	5060	540	m/s	
Path 6 VOS	Float	5062	542	m/s	
Path 7 VOS	Float	5064	544	m/s	
Path 8 VOS	Float	5066	546	m/s	

3.4 Flow, Velocity, and Hydraulic Data Registers

Table 3.7 Plane Flow Data Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Flow A	Float	51100	2218	User Defined	Plane A Flow at standard conditions (if enabled)
Flow B	Float	51102	2220	User Defined	Plane B Flow at standard conditions (if enabled)
VNorm A	Float	51114	2214	N/A	Plane A Flow, normalized to average
VNorm B	Float	51116	2216	N/A	Plane B Flow, normalized to average
Average Velocity	Float	5010	2206	m/s	Average meter velocity, not expanded for temperature
Velocity A	Float	51094	2208	m/s	Plane A average velocity
Velocity B	Float	51096	2210	m/s	Plane B average velocity

Table 3.8 Path Velocity Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Path 1 Velocity	Float	5068	48	m/s	Path Velocity.
Path 2 Velocity	Float	5070	50	m/s	
Path 3 Velocity	Float	5072	52	m/s	
Path 4 Velocity	Float	5074	54	m/s	
Path 5 Velocity	Float	5076	548	m/s	
Path 6 Velocity	Float	5078	550	m/s	
Path 7 Velocity	Float	5080	552	m/s	
Path 8 Velocity	Float	5082	554	m/s	

Table 3.9 Path Normalized Velocity Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Path 1 VNorm	Float	5084	94	N/A	Normalized (to average) Path Velocity.
Path 2 VNorm	Float	5086	96	N/A	
Path 3 VNorm	Float	5088	98	N/A	
Path 4 VNorm	Float	5090	100	N/A	
Path 5 VNorm	Float	5092	594	N/A	
Path 6 VNorm	Float	5094	596	N/A	
Path 7 VNorm	Float	5096	598	N/A	
Path 8 VNorm	Float	5098	600	N/A	

Table 3.10 Hydraulic Data Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Flatness Ratio	Float	5014	274	N/A	Ratio of the long path velocities to the short path velocities: $\mathrm{FR} = \frac{V_1 + V_4 + V_5 + V_8}{V_2 + V_3 + V_6 + V_7}$
Plane Balance Ratio	Float	5020	402	N/A	Ratio of the Plane A velocity to the Plane B velocity: $\mathrm{PB} = \frac{V_A}{V_B}$
Asymmetry Ratio	Float	5018	400	N/A	Ratio of the average velocity of the top half of the pipe to the bottom half of the pipe: $\mathrm{AR} = \frac{V_1 + V_2 + V_5 + V_6}{V_3 + V_4 + V_7 + V_8}$
Swirl	Float	5016	276	N/A	Swirl rate of the velocity field.

3.5 Software Registers

Table 3.11 Software Data Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
APU Version Code	Integer	10012	73	N/A	Part number of the software
Executable Check Sum	Integer		20148	N/A	Executable Checksum
Major Software Revision	Integer	10014	329	N/A	Major revision of the software release.
Metrological Level Revision	Integer	10013	328	N/A	Metrological revision of the software release.
Minor Software Revision	Integer	10015	330	N/A	Minor revision of the software release.

Table 3.12 Timing Record Data Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Date	Integer	10006	315	N/A	
Hour	Integer	10007	314	N/A	
Minute	Integer	10008	313	N/A	
Month	Integer	10005	316	N/A	
Second	Integer	10009	312	N/A	
Year	Integer	10004	317	N/A	

3.6 Analog Input/Output Registers

Table 3.13 Analog Input Data Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Analog Input 1 Value	Float	5022	82	mA	Analog Input Value (mA)
Analog Input 2 Value	Float	5024	84	mA	
Analog Input 3 Value	Float	5026	86	mA	
Analog Input 1 Status	Float	10020	1220	N/A	Value Description
Analog Input 2 Status	Float	10021	1221	N/A	0 Normal
Analog Input 3 Status	Float	10022	1222	N/A	1 Out of Range Low 2 Out of Range High

Table 3.14 Analog Output Data Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Analog Output 1 Value	Float	51104	40042	mA	Analog Output Value (mA)
Analog Output 2 Value	Float	51106	40044	mA	

3.7 Fluid Characteristic Parameters

Table 3.15 Fluid Output Properties Data Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Density Standard	Float	51122	1122	User defined	Density converted to standard conditions.
Meter Body Temperature	Float	51000	78	User defined	
Fluid Temperature	Float	5002	150	User defined	
Fluid Pressure	Float	5008	80	User defined	
Fluid Density	Float	51006	90	User defined	
Fluid Viscosity	Float	51008	266	cSt	
Log(Reynolds Number)	Float	7016	132	N/A	Log10 of Reynolds number
Meter VOS	Float	5004	208	m/s	Average meter sound velocity

Table 3.16 Flow Data Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Measured Flow	Float	5000	38	User defined	Flow with conversion to standard conditions enabled.
Measured Flow Low Cutoff	Float	51110	2202	User defined	Flow with conversion to standard conditions enabled, but clamped to 0 if below the minimum
Gross Flow	Float	51108	2200	User defined	Flow in gross units
Gross Flow Low Cutoff	Float	51112	2204	User defined	Flow in gross units, but clamped to 0 if below the minimum flow cutoff.
Net Pressure Correction	Float	51118	1118		Pressure conversion factor to standard conditions
Net Temperature Correction	Float	51120	1120		Temperature conversion factor to standard conditions

Table 3.17 Totalizer and Meter Factor Data Registers

Setup Variable	Variable Definition	HR Address	IR Address	Units	Notes
Positive Totalizer High	Integer	10000	1112	N/A	High 32 bits of positive totalizer
Positive Totalizer Low	Integer	10001	1113	N/A	Low 32 bits of positive totalizer
Negative Totalizer High	Integer	10002	1116	N/A	High 32 bits of negative totalizer
Negative Totalizer Low	Integer	10003	1117	N/A	Low 32 bits of negative totalizer
Meter Factor Total	Float	5012	136	N/A	Total Meter Factor

4 HOLDING REGISTERS

Below is a list of all results stored in Holding Registers in sequential order.

HR	Tag Name
5000	BaseFlow
5002	FluidTemperature
5004	AvgVOS
5008	FluidPress
5010	Avg Velocity
5012	MF Total
5014	Flatness Ratio
5016	Swirl
5018	Asymmetry Ratio
5020	Plane Balance Ratio
5022	iopA 2D 1Ch 1CVal
5024	iopA 2D 1Ch 2CVal
5026	iopA 2D 1Ch 3CVal
5028	iopA 2D 1Ch 4CVal
5052	Path VOS 1
5054	Path VOS 2
5056	Path VOS 3
5058	Path VOS 4
5060	Path VOS 5
5062	Path VOS 6
5064	Path VOS 7
5066	Path VOS 8
5068	Velocity 1
5070	Velocity 2
5072	Velocity 3
5074	Velocity 4
5076	Velocity 5
5078	Velocity 6
5080	Velocity 7
5082	Velocity 8
5084	VNorm 1
5086	VNorm 2
5088	VNorm 3
5090	VNorm 4
5092	VNorm 5
5094	VNorm 6
5096	VNorm 7
5098	VNorm 8
5100	AvgPath Gain 1
5102	AvgPath Gain 2
5104	AvgPath Gain 3

HR	Tag Name
5106	AvgPath Gain 4
5108	AvgPath Gain 5
5110	AvgPath Gain 6
5112	AvgPath Gain 7
5114	AvgPath Gain 8
5116	GainUp 1
5118	GainUp 2
5120	GainUp 3
5122	GainUp 4
5124	GainUp 5
5126	GainUp 6
5128	GainUp 7
5130	GainUp 8
5132	GainDn 1
5134	GainDn 2
5136	GainDn 3
5138	GainDn 4
5140	GainDn 5
5142	GainDn 6
5144	GainDn 7
5146	GainDn 8
5148	TDown 1
5150	TDown 2
5152	TDown 3
5154	TDown 4
5156	TDown 5
5158	TDown 6
5160	TDown 7
5162	TDown 8
5164	TUp 1
5166	TUp 2
5168	TUp 3
5170	TUp 4
5172	TUp 5
5174	TUp 6
5176	TUp 7
5178	TUp 8
5180	DeltaT 1
5182	DeltaT 2
5184	DeltaT 3
5186	DeltaT 4

HR	Tag Name
5188	DeltaT 5
5190	DeltaT 6
5192	DeltaT 7
5194	DeltaT 8
5196	DtStd 1
5198	DtStd 2
5200	DtStd 3
5202	DtStd 4
5204	DtStd 5
5206	DtStd 6
5208	DtStd 7
5210	DtStd 8
7016	LogReyn
7018	Gain0
10000	Pos TotalizerHi
10001	Pos TotalizerLo
10002	Neg TotalizerHi
10003	Neg TotalizerLo
10004	RTCYear
10005	RTCMonth
10006	RTCDayOfWeek
10007	RTCHour
10008	RTCMinute
10009	RTCSecond
10010	SystemStatus
10011	MeterStateVector
10012	APUVersionCode
10013	MetroLevelRevision
10014	MajorSoftwareRev
10015	MinorSoftwareRev
10016	TruncExecChksum
10017	ConfigChecksum
10019	DipSwitch
10020	iopA 2D 1Ch 1Status
10051	Path Performance 1
10052	Path Performance 2
10053	Path Performance 3
10054	Path Performance 4
10055	Path Performance 5
10056	Path Performance 6
10057	Path Performance 7
10058	Path Performance 8
10059	Path SNRAvg 1
10060	Path SNRAvg 2

HR	Tag Name
10061	Path SNRAv
10062	Path SNRAvg 4
10063	Path SNRAvg 5
10064	Path SNRAvg 6
10065	Path SNRAvg 7
10066	Path SNRAvg 8
10067	Path SNRUp 1
10068	Path SNRUp 2
10069	Path SNRUp 3
10070	Path SNRUp 4
10071	Path SNRUp 5
10072	Path SNRUp 6
10073	Path SNRUp 7
10074	Path SNRUp 8
10075	Path SNRDn 1
10076	Path SNRDn 2
10077	Path SNRDn 3
10078	Path SNRDn 4
10079	Path SNRDn 5
10080	Path SNRDn 6
10081	Path SNRDn 7
10082	Path SNRDn 8
40017	ConfigModCtr

INPUT REGISTERS

Below are the results stored in Input Registers listed in sequential order.

Table 0.1 Input Registers

IR	Tag Name
0	TDown 1
2	TDown 2
4	TDown 3
6	TDown 4
8	DeltaT 1
10	DeltaT 2
12	DeltaT 3
14	DeltaT 4
16	Path Performance 1
17	Path Performance 2
18	Path Performance 3
19	Path Performance 4
24	Path SNRAvg 1
25	Path SNRAvg 2
26	Path SNRAv
27	Path SNRAvg 4
28	DtStd 1
30	DtStd 2
32	DtStd 3
34	DtStd 4
36	UsonicSamples
38	BaseFlow
40	Path VOS 1
42	Path VOS 2
44	Path VOS 3
46	Path VOS 4
48	Velocity 1
50	Velocity 2
52	Velocity 3
54	Velocity 4
72	SystemStatus
73	APUVersionCode
74	Path Status 1
75	Path Status 2
76	Path Status 3
77	Path Status 4
78	MeterBodyTemp
80	FluidPress

IR	Tag Name
82	iopA 2D 1Ch 1CVal
84	iopA 2D 1Ch 2CVal
86	iopA 2D 1Ch 3CVal
88	iopA 2D 1Ch 4CVal
94	VNorm 1
96	VNorm 2
98	VNorm 3
100	VNorm 4
132	LogReyn
132	Swirl MF
134	Swirl Adjustment
136	MF Total
148	TruncExecChksum
149	ConfigModCtr
150	FluidTemperature
162	ConfigChecksum
180	Refraction
182	Refract Correct
190	Path State 1
192	Path State 2
194	Path State 3
196	Path State 4
200	Path SNRUp 1
201	Path SNRUp 2
202	Path SNRUp 3
203	Path SNRUp 4
204	Path SNRDn 1
205	Path SNRDn 2
206	Path SNRDn 3
207	Path SNRDn 4
208	AvgVOS
210	iopA 2D 1Ch 1Status
212	AvgPath Gain 1
214	AvgPath Gain 2
216	AvgPath Gain 3
218	AvgPath Gain 4
274	Flatness Ratio
276	Swirl
280	GainUp 1

IR	Tag Name
282	GainUp 2
284	GainUp 3
286	GainUp 4
288	GainDn 1
290	GainDn 2
292	GainDn 3
294	GainDn 4
312	RTCSecond
313	RTCMinute
314	RTCHour
315	RTCDate
316	RTCMonth
317	RTCYear
318	DipSwitch
319	BootType
322	ThrottleVal
324	Estar Short
326	Estar Long
328	MetroLevelRevision
329	MajorSoftwareRev
330	MinorSoftwareRev
376	TUp 1
378	TUp 2
380	TUp 3
382	TUp 4
384	ThreshUp 1
386	ThreshUp 2
388	ThreshUp 3
390	ThreshUp 4
392	ThreshDn 1
394	ThreshDn 2
396	ThreshDn 3
398	ThreshDn 4
400	Asymmetry Ratio
402	Plane Balance Ratio
404	PA Alarms
500	TDown 5
502	TDown 6
504	TDown 7
506	TDown 8
508	DeltaT 5
510	DeltaT 6
512	DeltaT 7
514	DeltaT 8

IR	Tag Name
516	Path Performance 5
517	Path Performance 6
518	Path Performance 7
519	Path Performance 8
524	Path SNRAvg 5
525	Path SNRAvg 6
526	Path SNRAvg 7
527	Path SNRAvg 8
528	DtStd 5
530	DtStd 6
532	DtStd 7
534	DtStd 8
540	Path VOS 5
542	Path VOS 6
544	Path VOS 7
546	Path VOS 8
548	Velocity 5
550	Velocity 6
552	Velocity 7
554	Velocity 8
574	Path Status 5
575	Path Status 6
576	Path Status 7
577	Path Status 8
594	VNorm 5
596	VNorm 6
598	VNorm 7
600	VNorm 8
690	Path State 5
692	Path State 6
694	Path State 7
696	Path State 8
700	Path SNRUp 5
701	Path SNRUp 6
702	Path SNRUp 7
703	Path SNRUp 8
704	Path SNRDn 5
705	Path SNRDn 6
706	Path SNRDn 7
707	Path SNRDn 8
712	AvgPath Gain 5
714	AvgPath Gain 6
716	AvgPath Gain 7
718	AvgPath Gain 8

IR	Tag Name
780	GainUp 5
782	GainUp 6
784	GainUp 7
786	GainUp 8
788	GainDn 5
790	GainDn 6
792	GainDn 7
794	GainDn 8
876	TUp 5
878	TUp 6
880	TUp 7
882	TUp 8
884	ThreshUp 5
886	ThreshUp 6
888	ThreshUp 7
890	ThreshUp 8
892	ThreshDn 5
894	ThreshDn 6
896	ThreshDn 7
898	ThreshDn 8
1101	MeterStateVector
1112	Pos TotalizerHi
1113	Pos TotalizerLo
1116	Neg TotalizerHi
1117	Neg TotalizerLo
1118	Net CPL
1120	Net CTL
1122	Density Std
1300	VOSchk 1
1302	VOSchk 2
1304	VOSchk 3
1306	VOSchk 4
1308	VOSchk 5
1310	VOSchk 6
1312	VOSchk 7
1314	VOSchk 8
1316	VOSchk 9
1318	VOSchk 10
1320	VOSchk 11
1322	VOSchk 12
1324	VOSchk 13
1326	VOSchk 14
1328	VOSchk 15
1330	VOSchk 16

IR	Tag Name
2004	Clamp Flow
2006	Temperature
2008	Pressure
2012	Meter VOS
2014	Meter Viscosity
2018	Gain 1
2020	Gain 2
2022	Gain 3
2024	Gain 4
2026	Gain 5
2028	Gain 6
2030	Gain 7
2032	Gain 8
2034	SNR 1
2035	SNR 2
2036	SNR 3
2037	SNR 4
2038	SNR 5
2039	SNR 6
2040	SNR 7
2041	SNR 8
2042	Status 1
2043	Status 2
2044	Status 3
2045	Status 4
2046	Status 5
2047	Status 6
2048	Status 7
2049	Status 8
2050	Alarms
2216	Plane B VNorm
2218	Plane A Flow
2220	Plane B Flow
20000	PrevResetSrc
20002	CurrResetSrc
20148	FullExecChksum
40042	iopDAC 1Out
40044	iopDAC 2Out
40696	PlatformState

Sensia LLC
200 Westlake Park Blvd
Houston, TX 77079
+1-866-773-6742
sensiaglobal.com

Rockwell Automation + Schlumberger