User Manual

MODBUS Communication For

XVG/eXVG Gas Fuel Metering Valves

SD-6021 Rev 1

September 2008

PREFACE

The purpose of this manual is to enable users to:

- Understand the basics of XVG/eXVG Modbus communications via standard definitions, interfaces, and protocols.
- Setup Modbus communication with a network of one or more XVG/eXVGs.

It is expected that the user have sufficient knowledge of serial communication and Modbus protocol. This manual only mentions the relevant information regarding XVG/eXVG and Modbus, but every attempt has been made to provide sufficient information for establishing communication with an XVG/eXVG using Modbus protocol. For detailed information about Modbus protocol, see www.modbus.org.

The following precautions must be considered when writing your own Modbus application for XVG/eXVG operations:

- **Adhere to the tables of registers provided and their allowable data ranges.**
- **Do not attempt to write to any register if you are not sure of the consequence.**
- **Do not write to registers that are for options your XVG/eXVG does not have.**

Failure to do so can result in erratic control and/or damage to equipment. Care must also be taken that the process cannot cause damage to property or injury to personnel if the wrong commands are sent due to operator error or equipment malfunction.

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1   Serial Communication

The primary interface used for XVG/eXVG is serial communication, which is the exchange of data one-bit-at-a time, sequentially, on a single data line or channel. XVG/eXVG can communicate either in PECC (a propriety standard protocol) or Modbus protocol via the serial interface.

2   Baud Rate

Baud rate is the speed at which a data line changes its state or the number of times per second the line changes state. If two serial devices are connected together via direct cables, then baud rate and bit-per-second are the same. XVG/eXVG Modbus communication supports baud rates of 9600, 19200, 38400, and 57600.

3   Parity bit

A parity bit is optionally transmitted along with data to help detect data corruption that may occur during transmission. There are three parity modes available: Odd, Even, or None. XVG/eXVG Modbus communication default parity setting is Even.

4   Start and Stop Bits

The start bit informs the receiving device that a character is coming; a stop bit indicates that a character is completed. The start bit is always 0 and stop bit is always 1. Per Modbus protocol requirements, XVG/eXVG Modbus communication employs 1 stop bit in Even or Odd parity mode, and 2 stop bits in None parity mode.

5   Electrical Interface Standards

XVG/eXVG serial communication uses either RS232 for one-to-one connection or RS485 for a multi-drop capable network.

-   RS232 interface uses three wires: transmit, receive, and common (ground) line. A -3 to -12V signal indicates a 1, a +3 to +12V signal indicates a 0. Communication is one-to-one, and full-duplex capable. Distance is limited to 50 feet.

-   RS485 interface uses two wires: T+/R+ and T-/R-. The RS485 receiver compares the voltage difference between both lines instead of the absolute voltage level on a signal line. Communication is half-duplex and up to 32 devices can be connected to a multi-drop network up. Distance is limited to 4000 feet.

Follow RS232 and RS485 standards for wiring and biasing of the communication bus.

6 XVG/eXVG Modbus Communication Default Settings

The default settings for XVG/eXVG Modbus communication are as follows:

- Baud Rate: 19200
- Parity Mode: Even
- Number of Start Bits: 1
- Number of Stop Bits: 1
- Device Address: 1

7 Protocol

Modbus devices communicate using a master/slave technique, in which only one device (the master) can initiate transactions. The other device (the slave) responds by supplying the requested data to the master or by taking the action requested. The master can address individual slaves or can initiate a broadcast message to all slaves. Slaves will only return a message to requests that are specifically addressed to them. However, all slaves will perform the action requested by a broadcast message, but responses are not returned.

XVG/eXVG Modbus conforms to standard Modbus protocol and support Modbus Remote Terminal Unit (RTU) mode (ASCII mode is not supported). With RS485, it is possible to have multiple host masters and XVG/eXVG units on the same network. However, the following protocol requirements must be observed:

- Only one host master can send a request message at a time.
- Each XVG/eXVG unit on the same network must have a unique address.

7.1 General Modbus Frame

Modbus protocol establishes the format for the master request message by placing into it the device address, a function code defining the requested action, any data to be sent, and an error–checking field. See Table 1 for a general Modbus frame which is followed from left to right.

DEVICE ADDRESS	FUNCTION CODE	DATA	ERROR-CHECK

Table 1: General Modbus Frame

7.2   Modbus Transactions

The slave's response message is also constructed using Modbus protocol. It contains fields confirming the action taken, any data to be returned, and an error–checking field.

If an error occurred in receipt of the message, or if the slave is unable to perform the requested action, the slave will construct an error message and send it as its response.

Request	**FUNCTION CODE + REQUEST DATA**
Response, no error	**FUNCTION CODE + RESPONSE DATA**
Response, with error	**EXCEPTION FUNCTION CODE + REQUEST DATA** where **EXCEPTION FUNCTION CODE = (FUNCTION CODE + 0x80)**

Table 2: Modbus Transactions

7.3   Modbus Register Types

Each Modbus register in the XVG/eXVG is identified by its 4-digit number address. With XVG/eXVG, the term "register" refers to both Modbus Holding Registers (read-write) and Modbus Input registers (read-only). The types of XVG/eXVG Modbus registers are listed in Table 3.

Register Type	Size	Data Type	Address Range	Description
U16	16 bit	Integer	3000-3999	Unsigned 16-bit integers ranging from 0 to 65535.
U32	16 bit	Integer	5000-6999	Use in pairs to store unsigned 32-bit integers ranging from 0 to 4294967295.
Float	16 bit	Floating-point	7000-7999	Use in pairs to store 32-bit floating-points values in single-precision IEEE 754 format.
ASCII	16 bit	8-bit ASCII	3000-3999	One or more consecutive registers. Each register stores two 8-bit ASCII characters (16 bits total).

Table 3: Modbus Transactions

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7.4 Modbus Functions

The following Modbus functions are supported by the XVG/eXVG:

- Read Registers (0x03)
- Write Single Register (0x06)
- Write Multiple Registers (0x10)
- Diagnostics (0x08) Query Data sub-function (0x00)

The master can address individual slaves, or can initiate a broadcast message (using device address 0) to all slaves. Slaves perform the actions requested by the broadcast messages but will not return a response. Per Modbus protocol, only Write Single Register (0x06) and Write Multiple Registers (0x10) support broadcast message.

7.4.1 Read Registers (0x03)

Request message:

SLAVE ADDRESS + FUNCTION CODE + STARTING ADDRESS + QUANTITY OF REGISTERS + CRC

Request	Length	Valid Value
Slave Address	1 Byte	0 to 247
Function code	1 Byte	0x03
Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity of Registers	2 Bytes	1 to 125 (0x7D)
CRC	2 Bytes	0x0000 to 0xFFFF

Table 4: Modbus Function 03 – Request Message

Response message:

SLAVE ADDRESS + FUNCTION CODE + BYTES COUNT + REGISTERS VALUES + CRC

Response	Length	Valid Value
Slave Address	1 Byte	0 to 247
Function code	1 Byte	0x03
Byte count	1 Byte	2xN
Registers Values	2xN Bytes	value
CRC	2 Bytes	0x0000 to 0xFFFF
*N = Quantity of Registers		

Table 5: Modbus Function 03 - Response Message

Example: Request to read holding registers 108 - 110	
Request	**Response**
01 03 00 6B 00 03 74 17	**01 03 06 02 2B 00 00 00 64 05 7A**
Slave Address 01	Slave Address 01
Function 03	Function 03
Starting Address Hi 00	Byte Count 06
Starting Address Lo 6B	Register Value Hi (108) 02
Number of Registers Hi 00	Register Value Lo (108) 2B
Number of Registers Lo 03	Register Value Hi (109) 00
CRC 7417	Register Value Lo (109) 00
	Register Value Hi (110) 00
	Register Value Lo (110) 64
	CRC 057A

Table 6: Modbus Function 03 - Example

7.4.2   Write Single Register (0x06)

Request message:

SLAVE ADDRESS + FUNCTION CODE + REGISTER ADDRESS + REGISTER VALUE + CRC

Request	**Length**	**Valid Value**
Slave Address	1 Byte	0 to 247
Function code	1 Byte	0x06
Register Address	2 Bytes	0x0000 to 0xFFFF
Register Value	2 Bytes	0x0000 to 0xFFFF
CRC	2 Bytes	0x0000 to 0xFFFF

Table 7: Modbus Function 06 - Request Message

Response message:

SLAVE ADDRESS + FUNCTION CODE + REGISTER ADDRESS + REGISTER VALUE + CRC

Response	**Length**	**Valid Value**
Slave Address	1 Byte	0 to 247
Function code	1 Byte	0x06
Register Address	2 Bytes	0x0000 to 0xFFFF
Register Value	2 Bytes	0x0000 to 0xFFFF
CRC	2 Bytes	0x0000 to 0xFFFF

Table 8: Modbus Function 06 - Response Message

Example: Request to write 0x03 to register 2.	
Request	**Response**
01 06 00 01 00 03 98 0B	**01 06 00 01 00 03 98 0B**
Function 06	Function 06
Register Address Hi 00	Register Address Hi 00
Register Address Lo 01	Register Address Lo 01
Register Value Hi 00	Register Value Hi 00
Register Value Lo 03	Register Value Lo 03
CRC 98 0B	CRC 98 0B

Table 9: Modbus Function 06 – Example

7.4.3 Write Multiple Registers (0x10)

Request message:

SLAVE ADDRESS + FUNCTION CODE + STARTING ADDRESS + QUANTITY OF REGISTERS + BYTES COUNT + REGISTERS VALUES + CRC

Request	Length	Valid Value
Slave Address	1 Byte	0 to 247
Function code	1 Byte	0x10
Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity of Registers	2 Bytes	1 to 123 (0x7B)
Bytes count	1 Byte	2xN
Registers Values	2xN Bytes	value
CRC	2 Bytes	0x0000 to 0xFFFF
*N = Quantity of Registers		

Table 10: Modbus Function 16 - Request Message

Response message:

SLAVE ADDRESS + FUNCTION CODE + STARTING ADDRESS + QUANTITY OF REGISTERS + CRC

Response	Length	Valid Value
Slave Address	1 Byte	0 to 247
Function code	1 Byte	0x10
Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity of Registers	2 Bytes	1 to 123 (0x7B)
CRC	2 Bytes	0x0000 to 0xFFFF

Table 11: Modbus Function 16 - Response Message

Example: Write 0x0A and 0x0102 to two registers, starting at register 2.	
Request	**Response**
01 10 00 01 00 02 04 00 0A 01 02 92 30	**01 10 00 01 00 02 10 08**
Function 10	Function 10

Starting Address Hi 00	Starting Address Hi 00
Starting Address Lo 01	Starting Address Lo 01
Quantity of Registers Hi 00	Quantity of Registers Hi 00
Quantity of Registers Lo 02	Quantity of Registers Lo 02
Byte Count 04	CRC 1008
Registers Value Hi 00	
Registers Value Lo 0A	
Registers Value Hi 01	
Registers Value Lo 02	
CRC 9230	

Table 12: Modbus Function 16 – Example

7.4.4   Diagnostics (0x08) (Loopback)

Request & Response message:

SLAVE ADDRESS + FUNCTION CODE + SUB-FUNCTION CODE + DATA + CRC

Request		
	Length	**Valid Value**
Slave Address	1 Byte	0 to 247
Function code	1 Byte	0x08
Sub-function	2 Bytes	0x00
Data	Any	value
CRC		0x0000 to 0xFFFF

Table 13: Modbus Function 08 - Request & Response Message

An exact copy of the diagnostic query message is sent back as a response.

8   Connections

The XVG/eXVG can communicate via RS-232 or RS-485, one interface or the other.
To communicate with an XVG/eXVG that was built with RS-485 interface circuit, you
may need to use RS232-to-RS485 converter.
The connection from the PC or PLC's serial port to the XVG/eXVG can be made as
follows:

8.1 RS-232 Connection (for XVG/eXVG with RS-232 interface)

PC COM Port (DB9M Connector)		XVG/eXVG Terminal Block		Wire Color (If XVG/eXVG is supplied with optional harness)
Signal	Pin #	Signal	Pin #	
SERIAL RX	2	SERIAL TX	39	WHT/ORN/BLU
SERIAL TX	3	SERIAL RX	40	WHT/ORN/YEL
SERIAL RTN	5	SERIAL RTN	41	WHT/ORN/GRN

Table 14: RS-232 Interface Connection

8.2 RS-485 Connection (for XVG/eXVG with RS-485 interface)

PC COM Port Through RS232-RS485 Converter	XVG/eXVG Terminal Block		Wire Color (If XVG/eXVG is supplied with optional harness)
Pin #	Signal	Pin #	
TD(B)+	TXD-485A (SERIAL TX)	39	WHT/ORN/BLU
TD(A)-	RXD-485B (SERIAL RX)	40	WHT/ORN/YEL
GND (Optional)	SERIAL RTN	41	WHT/ORN/GRN

Table 15: RS-485 Interface Connection

9 XVG/eXVG Modbus Parameters

9.1 Setup Parameters

Set up parameters are write-able parameters used to setup and control all XVG/eXVG operations. The following notes applied to all parameters:

- Register Number: This is the Modbus address of the register in the XVG/eXVG.
- All registers are readable.
- RO: Read-only. The register is read-only.
- W0: Open access for writing by any user.
- W1: A Customer or Factory level password must be entered before writing is allowed.
- W2: A password must be entered and IDM_SETUPCONNECT (register no. 3005) set to 1 before writing is allowed.
- W3: A factory level password must be entered before writing is allowed.
- W4: A factory level password must be entered and IDM_SETUPCONNECT set to 1 before writing is allowed.

9.1.1 General Setup Parameters

Register Number	XVG/eXVG Parameter Name	Write Access	Description	Type	Default Value
3500	IDM_MODE	W2	Operating Mode: 0=Stroke, 1=Flow Measurement, 2=Flow Control, 3=Flow Limiting	U16	0
3501	IDM_PROTOCOL	W2	Bit15=Don't care, Bit14 = inter-character timeout enable for Modbus, other bits reserved	U16	0
3502	IDM_DEMANDSRC	W4	Demand Source, not used	U16	0
3503	IDM_DIGCMDEN	W4	Digital Command Enable: Bit0, 0=Analog, 1=Digital, other bits reserved	U16	0
3504	IDM_SOLMAXAMPS	W4	XView functional flag: 1= XView will allow parameter download to valve regardless of demand signal, 2=XView will not download if Demand>3% (2 is for Solar OEM units)	U16	1
3505	IDM_CURVOLTCFG	W4	Current/Voltage Select: Bit0-Bit5=AI0-AI5, Bit8-Bit10=AO0-AO2, 0=Current, 1=Voltage	U16	63
3506	IDM_DEMANDOFFST	W4	Demand Offset: ADC counts, range 0-956	U16	683
3507	IDM_POSINTTBLEN	W4	Position Interpolation Table Enable: 0=Disable, 1=Enable	U16	0
3508	IDM_LVDTPHASE	W4	LVDT phase: Range 0-32	U16	8
3509	IDM_AOPOLARITY	W4	Analog Output Polarity: Bit0-Bit2=AO0-AO2, 0=Positive, 1=Negative	U16	0
3510	IDM_MINDEMAND	W4	=700 if IDM_MODE = 0, 1 or 2, =600 if IDM_MODE = 3, Range 600-4000, default represents 4.1mA	U16	700
3511	IDM_VERSION	W4	Valve Type Identifier: 2=Flow Limiting Mode (Enabled At Factory). 1=Non Flow Limiting	U16	1
3512	IDM_CONFIGNO	W4	Configuration Number: Range 0-65535	U16	102
3513	IDM_VOLTRANGE	W4	I/O Volt Range, Bit format same as IDM_CURVOLTCFG, 0=0-5V, 1=1-5V/4-20mA	U16	1
3514	IDM_FLTTM3VOLT3	W4	3.3V fault persist time: x20mS, range 0-32767	U16	3
3515	IDM_FLTTMINPRES	W4	Input pressure fault persist time: x20mS, range 0-32767	U16	5
3516	IDM_FLTTMOUTPRES	W4	Output pressure fault persist time: x20mS, range 0-32767	U16	5
3517	IDM_FLTTMLVDT	W4	LVDT fault persist time: x20mS, range 0-32767	U16	2
3518	IDM_FLTTMTRACK	W4	Tracking fault persist time: x20mS, range 0-32767	U16	50
3519	IDM_FLTTMGASTEMP	W4	Gas Temp fault persist time: x20mS, range 0-32767	U16	50
3520	IDM_FLTTMOVRPRES	W4	Overpressure fault persist time: x20mS, range 0-32767	U16	5

Register Number	XVG/eXVG Parameter Name	Write Access	Description	Type	Default Value
3521	IDM_FLOWCTRLEN	W4	Flow Control Enable: 0=Baseline (Stroke Mode) Valve, 1=FM / FC / FL valve	U16	1
3522	IDM_FLTTMCURRENT	W4	Current fault persist time: x20mS, range 0-32767	U16	32767
3523	IDM_FLTTMTMPSHUT	W4	Over temperature shutdown fault persist time: x20mS, range 0-32767	U16	500
3524	IDM_SOLIMAX	W4	Solenoid Current Limit: range 1-4095	U16	3500
3525	IDM_AO0CFG	W2	Analog Output Zero Configuration: 0=Disabled 1=Position Feedback (0-MaxStroke) 2=Measured Flow (0-Flow Range) 3=Corrected Output Pressure (0-500 PSIA) 4=Input Pressure (0-500 PSIA) 5=Output Pressure (0-500 PSIA) 6=Gas Temperature (-40 to 150 Deg. C) 7=Test mode to write directly to AO with ADC gain/offset via IDM_AOUTx	U16	1
3526	IDM_AO1CFG	W2	Same as IDM_AO0CFG	U16	0
3527	IDM_AO2CFG	W2	Same as IDM_AO0CFG	U16	0
3528	IDM_SELFCALENABLE	W4	Auto Zero Calibration Enable: 0=Disabled, 1=Enabled	U16	0
3529	IDM_DPENABLE	W4	Differential Pressure Measurement Enable (3 PSIA and higher): 0=show actual flow on all pressures except reverse flow conditions. 1=pressure differential less than 3.0 PSIA will report 0 PPH flow.	U16	1
3530	IDM_FLTTMPOS15V	W4	Positive 15V source fault persist time: x20mS, range 0-32767	U16	3
3531	IDM_FLTTMNEG15V	W4	Negative 15V source fault persist time: x20mS, range 0-32767	U16	3
3532	IDM_FLTTMTEMPAMB	W4	Ambient/electronics fault persist time: x20mS, range 0-32767	U16	50
3533	IDM_FLOWCALCURVE	W4	Flow Calibration Curve, range 0 to 100	U16	0
3534	IDM_ELECTINTRFC	W4	Electrical interface configuration number, range 0 to 3	U16	0
3535	IDM_FLANGEACC	W4	Flange accessory configuration number, range 0 to 3	U16	0
3536	IDM_LVDTEXSCALE	W4	LVDT excitation output scale factor. Re-tune if IDM_LVDTPHASE not a multiple of 4. Units of %. Range: 0 to 200	U16	100
3537	IDM_OCT	W4	Motor over-current threshold for AdvDiag over-current event counter. Range: 0-4095	U16	3850
3538	IDM_CLTHRESH	W4	Communication lost fault threshold time, units of seconds. Fault disabled if = 0. Range: 0 to 500	U16	0
3539	IDM_DJSUMDB	W4	Demand jitter accumulator dead-band, units of demand counts. Range: 0 to 200	U16	4
3540	IDM_SLAVEADDR	W2	Modbus slave (node) address. Range: 1 to 247	U16	1

Register Number	XVG/eXVG Parameter Name	Write Access	Description	Type	Default Value
3541	IDM_PARITY	W2	Modbus parity: 0 = None, 1 = Odd, 2 = Even	U16	0
3542	IDM_RXMSGTMOUT	W2	Modbus receive message timeout: 0 = auto-scale to 3.5 character times for current baud rate. Other values: n * 0.1ms timeout. Range: 0 to 1000.	U16	0
3543	IDM_MODELNO[0]	W4	Model Number: null terminated string, 16 bytes max. Each register contains one ASCII representation of one character string. Model number has maximum 16 characters.	ASCII	X
3544	IDM_MODELNO[1]	W4			V
3545	IDM_MODELNO[2]	W4			G
3546	IDM_MODELNO[3]	W4			
3547	IDM_MODELNO[4]	W4			
3548	IDM_MODELNO[5]	W4			
3549	IDM_MODELNO[6]	W4			
3550	IDM_MODELNO[7]	W4			
3551	IDM_MODELNO[8]	W4			
3552	IDM_MODELNO[9]	W4			
3553	IDM_MODELNO[10]	W4			
3554	IDM_MODELNO[11]	W4			
3555	IDM_MODELNO[12]	W4			
3556	IDM_MODELNO[13]	W4			
3557	IDM_MODELNO[14]	W4			
3558	IDM_MODELNO[15]	W4			
3559	IDM_PARTNO[0]	W4	Part Number: null terminated string, 16 bytes max. Each register contains one ASCII representation of one character string. Part number has maximum 16 characters.	ASCII	1
3560	IDM_PARTNO[1]	W4			2
3561	IDM_PARTNO[2]	W4			3
3562	IDM_PARTNO[3]	W4			4
3563	IDM_PARTNO[4]	W4			5
3564	IDM_PARTNO[5]	W4			
3565	IDM_PARTNO[6]	W4			
3566	IDM_PARTNO[7]	W4			
3567	IDM_PARTNO[8]	W4			
3568	IDM_PARTNO[9]	W4			
3569	IDM_PARTNO[10]	W4			
3570	IDM_PARTNO[11]	W4			
3571	IDM_PARTNO[12]	W4			
3572	IDM_PARTNO[13]	W4			
3573	IDM_PARTNO[14]	W4			
3574	IDM_PARTNO[15]	W4			
5500 5501	IDM_BAUD_RATE	W2	Baud Rate: 9600, 19200, 38400 or 57600	U32	19200
5502 5503	IDM_ANINPUTHYS	W4	4-20mA Input Hysteresis: ADC Count range 0 – 273	U32	0
5504 5505	IDM_DATE	W4	Date: range 0-0xFFFFFF, format MMDDYY in BCD	U32	666
5506 5507	IDM_SERIALNO	W4	Serial Number: range 1-0x7FFFFFFF	U32	24680

Register Number	XVG/eXVG Parameter Name	Write Access	Description	Type	Default Value
5508 5509	IDM_SETUPCHECK	W4	Setup parameter checksum	U32	12345
5510 5511	IDM_SHUTDNFLTS	W4	Faults to Shutdown on, same as IDM_FAULTFLAGS	U32	0
5512 5513	IDM_FAULTOUTCFGL	W4	Fault output configuration bit-field, to configure which fault codes will show on digital output channel 0. Same bits as IDM_FAULTFLAGSL	U32	0
5514 5515	IDM_TAT	W4	Thermal age threshold for Electronics Age Warning fault, units of seconds. Fault disabled if = 0. Range: 0 to 4 billion	U32	0
5516 5517	IDM_TITHRESH	W4	Total inches traveled warning fault threshold, units of inches. Fault disabled if = 0. Range: 0 to 4 billion	U32	0
7500 7501	IDM_LVDTGAIN	W4	LVDT Gain: range 0.1 – 3.0	Float	1
7502 7503	IDM_LVDTOFFSET	W4	LVDT Offset: range -200 – 200	Float	0
7504 7505	IDM_ADCAGAIN	W4	ADC A Gain: range 0.1 – 3.0, obsolete	Float	1
7506 7507	IDM_ADCAOFFSET	W4	ADC A Offset: range -200 – 200, obsolete	Float	0
7508 7509	IDM_OUTPUTGAIN	W4	4-20mA Feedback Gain, Obsolete	Float	1
7510 7511	IDM_ADCBGAIN	W4	ADC B Gain: range 0.1 – 3.0, obsolete	Float	1
7512 7513	IDM_ADCBOFFSET	W4	ADC B Offset: range -200 – 200, obsolete	Float	0
7514 7515	IDM_DMD420GAIN	W4	4-20mA Demand Input Gain: (Obsolete)	Float	1.016
7516 7517	IDM_DMD420OFF	W4	4-20mA Demand Input Offset: (Obsolete)	Float	0
7518 7519	IDM_CONSTR	W0	R Gas Constant: must be non-zero, default is Air	Float	53.34
7520 7521	IDM_CONSTK	W0	K Gas Constant: must be non-zero, default is Air	Float	1.4
7522 7523	IDM_CONSTGC	W2	Gc Gas Constant: must be non-zero, default is Air	Float	32.2
7524 7525	IDM_CONSTZ	W2	Z Gas Constant: must be non-zero, default is Air	Float	1
7526 7527	IDM_FLOWOFFSET	W4	Measured Flow Offset: range -1400 to 1400	Float	0
7528 7529	IDM_SUPPRESOFF	W4	Supply Pressure Offset: (obsolete)	Float	0
7530 7531	IDM_TEMPOFF	W4	Gas Temp Sensor Offset: range -39.2 to 39.2 Deg F	Float	0
7532 7533	IDM_SONSUBHYS	W4	Subsonic/Subsonic Hysteresis. Range -0.1 – 0.1	Float	0.03
7534 7535	IDM_DELTAPRESOFF	W4	Not used	Float	0
7536 7537	IDM_FLOWRANGE	W2	Flow Measurement and Control Max Limit: range 1.0 – 20000.0 PPH	Float	1600
7538 7539	IDM_MAXSTROKE	W2	Maximum Stroke: range 0.005 – 0.275 in	Float	0.25
7540 7541	IDM_MAXVELOCITY	W4	Maximum Velocity: range 0.0 – 0.01	Float	0.000625
7542 7543	IDM_KP	W4	Position Control Proportional Constant: must be non-zero	Float	0.038
7574 7545	IDM_KI	W4	Position Control Integral Constant: range 0.0 to 0.0156	Float	0.001
7576 7547	IDM_INPRESGAIN	W4	Input Pressure Sensor Gain: range 1 – 2	Float	1

Register Number	XVG/eXVG Parameter Name	Write Access	Description	Type	Default Value
7578 7579	IDM_INPRESOFF	W4	Input Pressure Sensor Offset: range -10 – 10 PSIA	Float	0
7580 7581	IDM_OUTPRESGAIN	W4	Output Pressure Sensor Gain: range 1 – 2	Float	1
7582 7583	IDM_OUTPRESOFF	W4	Output Pressure Sensor Offset: range -10 – 10 PSIA	Float	0
7584 7585	IDM_TEMPSENSEGAIN	W4	Gas Temp Sensor Gain: range 0.1 – 3.0	Float	1
7586 7587	IDM_TEMPSENSEOFF	W4	Gas Temp Sensor Offset: -20 – 20 Deg F	Float	0
7588 7589	IDM_VOLTS3GAIN3	W4	3.3V Supply ADC Channel Gain: range 0.95 – 1.05	Float	1
7590 7591	IDM_VOLTS3OFF3	W4	3.3V Supply ADC Channel Offset: range -80 – 80 Counts	Float	0
7592 7593	IDM_CURSENSEGAIN	W4	Current Sense Gain: range 0.95 – 1.05	Float	1
7594 7595	IDM_CURSENSEOFF	W4	Current Sense Offset: range -80 – 80 counts	Float	0
7596 7597	IDM_OUTPUTOFF	W4	Feedback Output Offset: (Obsolete)	Float	0
7598 7599	IDM_TEMPCOMPFCT	W4	Temp Compensation Factor: range -1 – 1	Float	0.000033
7600 7601	IDM_MINIPFLOWCTRL	W4	Minimum Input Pressure to Enable Flow Control Operation: range 5-450 PSIA	Float	20
7602 7603	IDM_AUTOZEROTOL	W4	Auto Zero Tolerance: must be non-zero, 0.030 max	Float	0.005
7604 7605	IDM_DMDVOLTGAIN	W4	Demand voltage gain, obsolete	Float	1
7606 7607	IDM_DMDVOLTOFF	W4	Demand voltage offset, obsolete	Float	0
7608 7609	IDM_AI0CURGAIN	W4	AI0 Current Gain: range 0.99 – 1.09	Float	1
7610 7611	IDM_AI0CUROFF	W4	AI0 Current Offset: range -(122.6 to 146.6)	Float	0
7612 7613	IDM_AI1CURGAIN	W4	AI1 Current Gain: range same as AI0	Float	1
7614 7615	IDM_AI1CUROFF	W4	AI1 Current Offset: range same as AI0	Float	0
7616 7617	IDM_AI2CURGAIN	W4	AI2 Current Gain: range same as AI0	Float	1
7618 7619	IDM_AI2CUROFF	W4	AI2 Current Offset: range same as AI0	Float	0
7620 7621	IDM_AI3CURGAIN	W4	AI3 Current Gain: range same as AI0	Float	1
7622 7623	IDM_AI3CUROFF	W4	AI3 Current Offset: range same as AI0	Float	0
7624 7625	IDM_AI4CURGAIN	W4	AI4 Current Gain: range same as AI0	Float	1
7626 7627	IDM_AI4CUROFF	W4	AI4 Current Offset: range same as AI0	Float	0
7628 7629	IDM_AI5CURGAIN	W4	AI5 Current Gain: range same as AI0	Float	1
7630 7631	IDM_AI5CUROFF	W4	AI5 Current Offset: range same as AI0	Float	0
7632 7633	IDM_OUTPCORX3	W4	Outlet pressure correction coefficient 3	Float	10000
7634 7635	IDM_OUTPCORX2	W4	Outlet pressure correction coefficient 2	Float	-6800
7636 7637	IDM_OUTPCORX1	W4	Outlet pressure correction coefficient 1	Float	1500
7638 7639	IDM_OUTPCORDIV	W4	Outlet pressure correction divisor	Float	8000
7640 7641	IDM_ADCINPRESGAIN	W4	Input Pressure Gain: range 0.97 – 1.03	Float	1
7642 7643	IDM_ADCINPRESOFF	W4	Input Pressure Offset: range -(122.6 to 146.6)	Float	0
7644 7645	IDM_ADCOUTPRESGAIN	W4	Output Pressure Gain: range 0.97 – 1.03	Float	1
7646 7647	IDM_ADCOUTPRESOFF	W4	Output Pressure Offset: range -(122.6 to 146.6)	Float	0
7648 7649	IDM_AO0CURGAIN	W4	AO0 Current Gain: range 0.72 – 0.80	Float	1

Register Number	XVG/eXVG Parameter Name	Write Access	Description	Type	Default Value
7650 7651	IDM_AO0CUROFF	W4	AO0 Current Offset: range -4 to 4 counts	Float	0
7652 7653	IDM_AO0VOLTGAIN	W4	AO0 Voltage Gain: range 0.72 – 0.80	Float	1
7654 7655	IDM_AO0VOLTOFF	W4	AO0 Voltage Offset: range -4 to 4 counts	Float	0
7656 7657	IDM_AO1CURGAIN	W4	AO1 Current Gain: range 0.72 – 0.80	Float	1
7658 7659	IDM_AO1CUROFF	W4	AO1 Current Offset: range -4 to 4 counts	Float	0
7660 7661	IDM_AO1VOLTGAIN	W4	AO1 Voltage Gain: range 0.72 – 0.80	Float	1
7662 7663	IDM_AO1VOLTOFF	W4	AO1 Voltage Offset: range -4 to 4 counts	Float	0
7664 7665	IDM_AO2CURGAIN	W4	AO2 Current Gain: range 0.72 – 0.80	Float	1
7666 7667	IDM_AO2CUROFF	W4	AO2 Current Offset: range -4 to 4 counts	Float	0
7668 7669	IDM_AO2VOLTGAIN	W4	AO2 Voltage Gain: range 0.72 – 0.80	Float	1
7670 7671	IDM_AO2VOLTOFF	W4	AO2 Voltage Offset: range -4 to 4 counts	Float	0
7672 7673	IDM_AI0VOLTGAIN	W4	AI0 Voltage Gain: range 1.03 – 1.05	Float	1
7674 7675	IDM_AI0VOLTOFF	W4	AI0 Voltage Offset: range -(122.6 to 146.6)	Float	0
7676 7677	IDM_AI1VOLTGAIN	W4	AI1 Voltage Gain: range 1.03 – 1.05	Float	1
7678 7679	IDM_AI1VOLTOFF	W4	AI1 Voltage Offset: range -(122.6 to 146.6)	Float	0
7680 7681	IDM_AI2VOLTGAIN	W4	AI2 Voltage Gain: range 1.03 – 1.05	Float	1
7682 7683	IDM_AI2VOLTOFF	W4	AI2 Voltage Offset: range -(122.6 to 146.6)	Float	0
7684 7685	IDM_AI3VOLTGAIN	W4	AI3 Voltage Gain: range 1.03 – 1.05	Float	1
7686 7687	IDM_AI3VOLTOFF	W4	AI3 Voltage Offset: range -(122.6 to 146.6)	Float	0
7688 7689	IDM_AI4VOLTGAIN	W4	AI4 Voltage Gain: range 1.03 – 1.05	Float	1
7690 7691	IDM_AI4VOLTOFF	W4	AI4 Voltage Offset: range -(122.6 to 146.6)	Float	0
7692 7693	IDM_AI5VOLTGAIN	W4	AI5 Voltage Gain: range 1.03 – 1.05	Float	1
7694 7695	IDM_AI5VOLTOFF	W4	AI5 Voltage Offset: range -(122.6 to 146.6)	Float	0
7696 7697	IDM_OVERPRESLIM	W4	Overpressure Limit, range 200 to 600PSIA	Float	450
7698 7699	IDM_MAXINTERR	W4	Maximum integral position control contribution, units of velocity. Range 0.0 to 1.999	Float	0.000013
7700 7701	IDM_TR	W4	Thermal aging reference temperature, units of deg C. Range: 0.0 to 150.0	Float	60.0
7702 7703	IDM_TITDB	W4	Total inches traveled accumulator dead-band, units of inches. Range: 0.0 to 0.005	Float	0.0005
7704 7705	IDM_INPRESCOEF2	W4	Second order inlet pressure sensor correction coefficient. Range: -1.0 to 1.0	Float	0.0
7706 7707	IDM_OUTPRESCOEF2	W4	Second order inlet pressure sensor correction coefficient. Range: -1.0 to 1.0	Float	0.0

Table 16: General Setup Parameters

9.1.2 Position Interpolation Parameters

The XVG/eXVG Fuel Metering Valve can be configured to operate with a non-linear stroke profile by adjusting the values in this table. The Position Interpolation Table is a 43-point table, which maps a specific position to a linear demand position point. The first 30 points in the table are spaced at 0.1mA intervals and the remaining points are spaced at 1.0mA intervals.

The position interpolation feature is enabled / disabled via the IDM_POSINTTBLEN setup parameter. The valve will ignore this data in this table and assume a linear stroke profile when IDM_POSINTTBLEN is disabled. Valid Parameter Interpolation Table values are in the range of 683.0-3413.0, values are in fixed point IQ8 format (count value multiplied by 2^8).

Register Number	XVG/eXVG Parameter Name	Write Access	Corresponding Demand	Type	Pre-Cal Default
5600 5601	IDM_POSTBL0	W2	Counts: 700.0625, 4.1mA Demand	U32	179216
5602 5603	IDM_POSTBL1	W2	Counts: 717.1250, 4.2mA Demand	U32	183584
5604 5605	IDM_POSTBL2	W2	Counts: 734.1250, 4.3mA Demand	U32	187952
5606 5607	IDM_POSTBL3	W2	Counts: 751.2500, 4.4mA Demand	U32	192320
5608 5609	IDM_POSTBL4	W2	Counts: 768.3125, 4.5mA Demand	U32	196688
5610 5611	IDM_POSTBL5	W2	Counts: 785.3750, 4.6mA Demand	U32	201056
5612 5613	IDM_POSTBL6	W2	Counts: 802.4375, 4.7mA Demand	U32	205424
5614 5615	IDM_POSTBL7	W2	Counts: 819.5000, 4.8mA Demand	U32	209792
5616 5617	IDM_POSTBL8	W2	Counts: 836.5625, 4.9mA Demand	U32	214160
5618 5619	IDM_POSTBL9	W2	Counts: 853.6250, 5.0mA Demand	U32	218528
5620 5621	IDM_POSTBL10	W2	Counts: 870.6875, 5.1mA Demand	U32	222896
5622 5623	IDM_POSTBL11	W2	Counts: 887.7500, 5.2mA Demand	U32	227264
5624 5625	IDM_POSTBL12	W2	Counts: 904.8125, 5.3mA Demand	U32	231632
5626 5627	IDM_POSTBL13	W2	Counts: 921.8750, 5.4mA Demand	U32	236000
5628 5629	IDM_POSTBL14	W2	Counts: 938.9375, 5.5mA Demand	U32	240368
5630 5631	IDM_POSTBL15	W2	Counts: 956.0000, 5.6mA Demand	U32	244736
5632 5633	IDM_POSTBL16	W2	Counts: 973.0625, 5.7mA Demand	U32	249104
5634 5635	IDM_POSTBL17	W2	Counts: 990.0125, 5.8mA Demand	U32	253443
5636 5637	IDM_POSTBL18	W2	Counts: 1007.1875, 5.9mA Demand	U32	257840
5638 5639	IDM_POSTBL19	W2	Counts: 1024.2500, 6.0mA Demand	U32	262208
5640 5641	IDM_POSTBL20	W2	Counts: 1041.3125, 6.1mA Demand	U32	266576
5642 5643	IDM_POSTBL21	W2	Counts: 1058.3750, 6.2mA Demand	U32	270944
5644 5645	IDM_POSTBL22	W2	Counts: 1075.4375, 6.3mA Demand	U32	275312
5646 5647	IDM_POSTBL23	W2	Counts: 1092.5000, 6.4mA Demand	U32	279680
5648 5649	IDM_POSTBL24	W2	Counts: 1109.5625, 6.5mA Demand	U32	284048
5650 5651	IDM_POSTBL25	W2	Counts: 1126.6250, 6.6mA Demand	U32	288416
5652 5653	IDM_POSTBL26	W2	Counts: 1143.6875, 6.7mA Demand	U32	292784
5654 5655	IDM_POSTBL27	W2	Counts: 1160.7500, 6.8mA Demand	U32	297152
5656 5657	IDM_POSTBL28	W2	Counts: 1177.8125, 6.9mA Demand	U32	301520
5658 5659	IDM_POSTBL29	W2	Counts: 1194.8750, 7.0mA Demand	U32	305888
5660 5661	IDM_POSTBL30	W2	Counts: 1365.5000, 8.0mA Demand	U32	349568
5662 5663	IDM_POSTBL31	W2	Counts: 1536.1250, 9.0mA Demand	U32	393248
5664 5665	IDM_POSTBL32	W2	Counts: 1706.7500, 10.0mA Demand	U32	436928
5666 5667	IDM_POSTBL33	W2	Counts: 1877.3750, 11.0mA Demand	U32	480608
5668 5669	IDM_POSTBL34	W2	Counts: 2048.0000, 12.0mA Demand	U32	524288

Register Number	XVG/eXVG Parameter Name	Write Access	Corresponding Demand	Type	Pre-Cal Default
5670 5671	IDM_POSTBL35	W2	Counts: 2218.6250, 13.0mA Demand	U32	567968
5672 5673	IDM_POSTBL36	W2	Counts: 2389.2500, 14.0mA Demand	U32	611648
5674 5675	IDM_POSTBL37	W2	Counts: 2559.8750, 15.0mA Demand	U32	655328
5676 5677	IDM_POSTBL38	W2	Counts: 2730.5000, 16.0mA Demand	U32	699008
5678 5679	IDM_POSTBL39	W2	Counts: 2901.1250, 17.0mA Demand	U32	742688
5680 5681	IDM_POSTBL40	W2	Counts: 3071.7500, 18.0mA Demand	U32	786368
5682 5683	IDM_POSTBL41	W2	Counts: 3242.3750, 19.0mA Demand	U32	830048
5684 5685	IDM_POSTBL42	W2	Counts: 3413.0000, 20.0mA Demand	U32	873728

Table 17: Position Interpolation Table Parameters

9.1.3 Stroke Position Parameters

For XVG/eXVG low measurement and flow control accuracy improvement, the CdA values are calculated based not only stroke position (using stroke- CdA interpolation table) but also on pressure ratio condition.
The following Stroke Position Table lists default values of fifteen stroke positions that will be used in CdA values calculation.   Table values are (stroke value$*2^{24}$).

Register Number	XVG/eXVG Parameter Name	Write Access	Corresponding Stroke	Type	Default Value
5900 5901	IDM_STROKETBL0	W4	0.005	U32	83886
5902 5903	IDM_STROKETBL1	W4	0.01	U32	167772
5904 5905	IDM_STROKETBL2	W4	0.015	U32	251658
5906 5907	IDM_STROKETBL3	W4	0.03	U32	503316
5908 5909	IDM_STROKETBL4	W4	0.045	U32	754975
5910 5911	IDM_STROKETBL5	W4	0.0625	U32	1048576
5912 5913	IDM_STROKETBL6	W4	0.078125	U32	1310720
5914 5915	IDM_STROKETBL7	W4	0.09	U32	2097152
5916 5917	IDM_STROKETBL8	W4	0.1	U32	2621440
5918 5919	IDM_STROKETBL9	W4	0.125	U32	2936013
5920 5921	IDM_STROKETBL10	W4	0.15625	U32	3355443
5922 5923	IDM_STROKETBL11	W4	0.175	U32	3774874
5924 5925	IDM_STROKETBL12	W4	0.2	U32	4194304
5926 5927	IDM_STROKETBL13	W4	0.225	U32	4194472
5928 5929	IDM_STROKETBL14	W4	0.25	U32	4194640

Table 18: Stroke Position Table Parameters

9.1.4 Pressure Ratio Parameters

These pressure ratio values are used in calculation of CdA values based on stroke and pressure ratio conditions. Table values are (pressure ratio value$*2^{24}$).

Register Number	XVG/eXVG Parameter Name	Write Access	Corresponding Pressure Ratio	Type	Default Value
5950 5951	IDM_PRTBL0	W4	0.1	U32	1677722
5952 5953	IDM_PRTBL1	W4	0.2	U32	3355443
5954 5955	IDM_PRTBL2	W4	0.3	U32	5033165
5956 5957	IDM_PRTBL3	W4	0.4	U32	6710886
5958 5959	IDM_PRTBL4	W4	0.5	U32	8388608
5960 5961	IDM_PRTBL5	W4	0.6	U32	10066330
5962 5963	IDM_PRTBL6	W4	0.7	U32	11744051
5964 5965	IDM_PRTBL7	W4	0.8	U32	13421773
5966 5967	IDM_PRTBL8	W4	0.9	U32	15099494
5968 5969	IDM_PRTBL9	W4	0.95	U32	15938355

Table 19: Pressure Ratio Table Parameters

9.1.5 CdA-Pressure Ratio Parameters

Table values are (CdA value multiplied by 2^{24}).

Register Number	XVG/eXVG Parameter Name	Write Access	Corresponding CdA value	Type	Default Value
6000 6001	IDM_CDATBLPR0S0	W4	0.01868701	U32	313516
6002 6003	IDM_CDATBLPR0S1	W4	0.035560012	U32	596598
6004 6005	IDM_CDATBLPR0S2	W4	0.05250603	U32	880905
6006 6007	IDM_CDATBLPR0S3	W4	0.102663994	U32	1722416
6008 6009	IDM_CDATBLPR0S4	W4	0.150811017	U32	2530189
6010 6011	IDM_CDATBLPR0S5	W4	0.199957013	U32	3354722
6012 6013	IDM_CDATBLPR0S6	W4	0.250204027	U32	4197727
6014 6015	IDM_CDATBLPR0S7	W4	0.317152977	U32	5320944
6016 6017	IDM_CDATBLPR0S8	W4	0.360710025	U32	6051710
6018 6019	IDM_CDATBLPR0S9	W4	0.371964991	U32	6240537
6020 6021	IDM_CDATBLPR0S10	W4	0.464591026	U32	7794544
6022 6023	IDM_CDATBLPR0S11	W4	0.522693992	U32	8769350
6024 6025	IDM_CDATBLPR0S12	W4	0.555297971	U32	9316354
6026 6027	IDM_CDATBLPR0S13	W4	0.62797302	U32	10535639
6028 6029	IDM_CDATBLPR0S14	W4	0.710866988	U32	11926369
6030 6031	IDM_CDATBLPR1S0	W4	0.018432021	U32	309238
6032 6033	IDM_CDATBLPR1S1	W4	0.035153985	U32	589786
6034 6035	IDM_CDATBLPR1S2	W4	0.051853001	U32	869949
6036 6037	IDM_CDATBLPR1S3	W4	0.100916982	U32	1693106
6038 6039	IDM_CDATBLPR1S4	W4	0.147484004	U32	2474371
6040 6041	IDM_CDATBLPR1S5	W4	0.199957013	U32	3354722
6042 6043	IDM_CDATBLPR1S6	W4	0.250204027	U32	4197727
6044 6045	IDM_CDATBLPR1S7	W4	0.301599979	U32	5060008
6046 6047	IDM_CDATBLPR1S8	W4	0.341509998	U32	5729587
6048 6049	IDM_CDATBLPR1S9	W4	0.371964991	U32	6240537

Register Number	XVG/eXVG Parameter Name	Write Access	Corresponding CdA value	Type	Default Value
6050 6051	IDM_CDATBLPR1S10	W4	0.464591026	U32	7794544
6052 6053	IDM_CDATBLPR1S11	W4	0.522693992	U32	8769350
6054 6055	IDM_CDATBLPR1S12	W4	0.555297971	U32	9316354
6056 6057	IDM_CDATBLPR1S13	W4	0.62797302	U32	10535639
6058 6059	IDM_CDATBLPR1S14	W4	0.710866988	U32	11926369
6060 6061	IDM_CDATBLPR2S0	W4	0.018271983	U32	306553
6062 6063	IDM_CDATBLPR2S1	W4	0.034884989	U32	585273
6064 6065	IDM_CDATBLPR2S2	W4	0.051634014	U32	866275
6066 6067	IDM_CDATBLPR2S3	W4	0.099170029	U32	1663797
6068 6069	IDM_CDATBLPR2S4	W4	0.144158006	U32	2418570
6070 6071	IDM_CDATBLPR2S5	W4	0.196815014	U32	3302008
6072 6073	IDM_CDATBLPR2S6	W4	0.244836986	U32	4107683
6074 6075	IDM_CDATBLPR2S7	W4	0.284681976	U32	4776171
6076 6077	IDM_CDATBLPR2S8	W4	0.324190021	U32	5439006
6078 6079	IDM_CDATBLPR2S9	W4	0.371964991	U32	6240537
6080 6081	IDM_CDATBLPR2S10	W4	0.464591026	U32	7794544
6082 6083	IDM_CDATBLPR2S11	W4	0.522693992	U32	8769350
6084 6085	IDM_CDATBLPR2S12	W4	0.555297971	U32	9316354
6086 6087	IDM_CDATBLPR2S13	W4	0.62797302	U32	10535639
6088 6089	IDM_CDATBLPR2S14	W4	0.710866988	U32	11926369
6090 6091	IDM_CDATBLPR3S0	W4	0.018070996	U32	303181
6092 6093	IDM_CDATBLPR3S1	W4	0.034645021	U32	581247
6094 6095	IDM_CDATBLPR3S2	W4	0.051371992	U32	861879
6096 6097	IDM_CDATBLPR3S3	W4	0.095315993	U32	1599137
6098 6099	IDM_CDATBLPR3S4	W4	0.140272021	U32	2353374
6100 6101	IDM_CDATBLPR3S5	W4	0.193674028	U32	3249311
6102 6103	IDM_CDATBLPR3S6	W4	0.239470005	U32	4017640
6104 6105	IDM_CDATBLPR3S7	W4	0.27858299	U32	4673847
6106 6107	IDM_CDATBLPR3S8	W4	0.307435989	U32	5157920
6108 6109	IDM_CDATBLPR3S9	W4	0.371964991	U32	6240537
6110 6111	IDM_CDATBLPR3S10	W4	0.464591026	U32	7794544
6112 6113	IDM_CDATBLPR3S11	W4	0.522693992	U32	8769350
6114 6115	IDM_CDATBLPR3S12	W4	0.555297971	U32	9316354
6116 6117	IDM_CDATBLPR3S13	W4	0.62797302	U32	10535639
6118 6119	IDM_CDATBLPR3S14	W4	0.710866988	U32	11926369
6120 6121	IDM_CDATBLPR4S0	W4	0.017931998	U32	300849
6122 6123	IDM_CDATBLPR4S1	W4	0.034437001	U32	577757
6124 6125	IDM_CDATBLPR4S2	W4	0.050974011	U32	855202
6126 6127	IDM_CDATBLPR4S3	W4	0.091620028	U32	1537129
6128 6129	IDM_CDATBLPR4S4	W4	0.13389802	U32	2246436
6130 6131	IDM_CDATBLPR4S5	W4	0.184538007	U32	3096034
6132 6133	IDM_CDATBLPR4S6	W4	0.229842007	U32	3856109
6134 6135	IDM_CDATBLPR4S7	W4	0.265470028	U32	4453848
6136 6137	IDM_CDATBLPR4S8	W4	0.29658699	U32	4975904
6138 6139	IDM_CDATBLPR4S9	W4	0.354771018	U32	5952070
6140 6141	IDM_CDATBLPR4S10	W4	0.442640007	U32	7426267
6142 6143	IDM_CDATBLPR4S11	W4	0.499430001	U32	8379045

Register Number	XVG/eXVG Parameter Name	Write Access	Corresponding CdA value	Type	Default Value
6144 6145	IDM_CDATBLPR4S12	W4	0.555297971	U32	9316354
6146 6147	IDM_CDATBLPR4S13	W4	0.62797302	U32	10535639
6148 6149	IDM_CDATBLPR4S14	W4	0.710866988	U32	11926369
6150 6151	IDM_CDATBLPR5S0	W4	0.017970979	U32	301503
6152 6153	IDM_CDATBLPR5S1	W4	0.034645975	U32	581263
6154 6155	IDM_CDATBLPR5S2	W4	0.048334002	U32	810910
6156 6157	IDM_CDATBLPR5S3	W4	0.086969018	U32	1459098
6158 6159	IDM_CDATBLPR5S4	W4	0.12787497	U32	2145386
6160 6161	IDM_CDATBLPR5S5	W4	0.176279008	U32	2957471
6162 6163	IDM_CDATBLPR5S6	W4	0.216894984	U32	3638894
6164 6165	IDM_CDATBLPR5S7	W4	0.252413988	U32	4234804
6166 6167	IDM_CDATBLPR5S8	W4	0.284949005	U32	4780651
6168 6169	IDM_CDATBLPR5S9	W4	0.337576985	U32	5663602
6170 6171	IDM_CDATBLPR5S10	W4	0.420688987	U32	7057990
6172 6173	IDM_CDATBLPR5S11	W4	0.47616601	U32	7988740
6174 6175	IDM_CDATBLPR5S12	W4	0.531268001	U32	8913198
6176 6177	IDM_CDATBLPR5S13	W4	0.604695022	U32	10145099
6178 6179	IDM_CDATBLPR5S14	W4	0.680217028	U32	11412148
6180 6181	IDM_CDATBLPR6S0	W4	0.018097997	U32	303634
6182 6183	IDM_CDATBLPR6S1	W4	0.034564972	U32	579904
6184 6185	IDM_CDATBLPR6S2	W4	0.046747983	U32	784301
6186 6187	IDM_CDATBLPR6S3	W4	0.082584977	U32	1385546
6188 6189	IDM_CDATBLPR6S4	W4	0.123016	U32	2063866
6190 6191	IDM_CDATBLPR6S5	W4	0.167436004	U32	2809110
6192 6193	IDM_CDATBLPR6S6	W4	0.209510028	U32	3514995
6194 6195	IDM_CDATBLPR6S7	W4	0.24348098	U32	4084933
6196 6197	IDM_CDATBLPR6S8	W4	0.273561001	U32	4589592
6198 6199	IDM_CDATBLPR6S9	W4	0.324248016	U32	5439979
6200 6201	IDM_CDATBLPR6S10	W4	0.399429977	U32	6701323
6202 6203	IDM_CDATBLPR6S11	W4	0.452902019	U32	7598435
6204 6205	IDM_CDATBLPR6S12	W4	0.507237971	U32	8510041
6206 6207	IDM_CDATBLPR6S13	W4	0.581417024	U32	9754559
6208 6209	IDM_CDATBLPR6S14	W4	0.649567008	U32	10897926
6210 6211	IDM_CDATBLPR7S0	W4	0.018015981	U32	302258
6212 6213	IDM_CDATBLPR7S1	W4	0.034865975	U32	584954
6214 6215	IDM_CDATBLPR7S2	W4	0.045041025	U32	755663
6216 6217	IDM_CDATBLPR7S3	W4	0.079456985	U32	1333067
6218 6219	IDM_CDATBLPR7S4	W4	0.117030978	U32	1963454
6220 6221	IDM_CDATBLPR7S5	W4	0.160700023	U32	2696099
6222 6223	IDM_CDATBLPR7S6	W4	0.200019002	U32	3355762
6224 6225	IDM_CDATBLPR7S7	W4	0.237761021	U32	3988968
6226 6227	IDM_CDATBLPR7S8	W4	0.264689982	U32	4440761
6228 6229	IDM_CDATBLPR7S9	W4	0.310918987	U32	5216355
6230 6231	IDM_CDATBLPR7S10	W4	0.386830986	U32	6489947
6232 6233	IDM_CDATBLPR7S11	W4	0.436703026	U32	7326661
6234 6235	IDM_CDATBLPR7S12	W4	0.492919981	U32	8269825
6236 6237	IDM_CDATBLPR7S13	W4	0.557698011	U32	9356620

Register Number	XVG/eXVG Parameter Name	Write Access	Corresponding CdA value	Type	Default Value
6238 6239	IDM_CDATBLPR7S14	W4	0.618915975	U32	10383687
6240 6241	IDM_CDATBLPR8S0	W4	0.017536998	U32	294222
6242 6243	IDM_CDATBLPR8S1	W4	0.034340978	U32	576146
6244 6245	IDM_CDATBLPR8S2	W4	0.045249999	U32	759169
6246 6247	IDM_CDATBLPR8S3	W4	0.075426996	U32	1265455
6248 6249	IDM_CDATBLPR8S4	W4	0.11294198	U32	1894852
6250 6251	IDM_CDATBLPR8S5	W4	0.154013991	U32	2583926
6252 6253	IDM_CDATBLPR8S6	W4	0.191594005	U32	3214414
6254 6255	IDM_CDATBLPR8S7	W4	0.233344972	U32	3914879
6256 6257	IDM_CDATBLPR8S8	W4	0.258821011	U32	4342296
6258 6259	IDM_CDATBLPR8S9	W4	0.302787006	U32	5079923
6260 6261	IDM_CDATBLPR8S10	W4	0.367821991	U32	6171029
6262 6263	IDM_CDATBLPR8S11	W4	0.415814996	U32	6976218
6264 6265	IDM_CDATBLPR8S12	W4	0.473388016	U32	7942133
6266 6267	IDM_CDATBLPR8S13	W4	0.527272999	U32	8846173
6268 6269	IDM_CDATBLPR8S14	W4	0.584348023	U32	9803733
6270 6271	IDM_CDATBLPR9S0	W4	0.017027974	U32	285682
6272 6273	IDM_CDATBLPR9S1	W4	0.033367991	U32	559822
6274 6275	IDM_CDATBLPR9S2	W4	0.043686986	U32	732946
6276 6267	IDM_CDATBLPR9S3	W4	0.073494017	U32	1233025
6278 6269	IDM_CDATBLPR9S4	W4	0.107271016	U32	1799709
6280 6281	IDM_CDATBLPR9S5	W4	0.150669992	U32	2527823
6282 6283	IDM_CDATBLPR9S6	W4	0.183247983	U32	3074391
6284 6285	IDM_CDATBLPR9S7	W4	0.231404006	U32	3882315
6286 6287	IDM_CDATBLPR9S8	W4	0.25821501	U32	4332129
6288 6289	IDM_CDATBLPR9S9	W4	0.281709015	U32	4726293
6290 6291	IDM_CDATBLPR9S10	W4	0.344421983	U32	5778442
6292 6293	IDM_CDATBLPR9S11	W4	0.391855001	U32	6574236
6294 6295	IDM_CDATBLPR9S12	W4	0.445888996	U32	7480776
6296 6297	IDM_CDATBLPR9S13	W4	0.501824021	U32	8419210
6298 6299	IDM_CDATBLPR9S14	W4	0.544903994	U32	9141972

Table 20: CdA-Pressure Ratio Table Parameters

9.1.6 Flow Limiting Mode Parameters

The following table is used to define the Flow Limiting Mode schedule. The 5-point Flow Limiting Mode Table defines the minimum and maximum flow limits by interpolation for a particular backpressure.

Valid Flow Limiting Mode Table Backpressure values are in the range 0.0 - 498.0, 32 bit floating point format. Valid Flow Limiting Mode Table Minimum Flow values are in the range 0.0 - 20000.0, 32 bit floating point format. Valid Flow Limiting Mode Table Maximum Flow values are in the range 0.0 - 20000.0, 32 bit floating point format.

Register Number	XVG/eXVG Parameter Name	Write Access	Description	Type	Default Value
7544 7545	IDM_BACKPRES0	W2	Backpressure 0	Float	14.7
7546 7547	IDM_BACKPRES1	W2	Backpressure 1	Float	64.7
7548 7549	IDM_BACKPRES2	W2	Backpressure 2	Float	114.7
7550 7551	IDM_BACKPRES3	W2	Backpressure 3	Float	164.7
7552 7553	IDM_BACKPRES4	W2	Backpressure 4	Float	214.7
7554 7555	IDM_MINFLOWLIM0	W2	Minimum Flow 0	Float	0
7556 7557	IDM_MINFLOWLIM1	W2	Minimum Flow 1	Float	200
7558 7559	IDM_MINFLOWLIM2	W2	Minimum Flow 2	Float	500
7560 7561	IDM_MINFLOWLIM3	W2	Minimum Flow 3	Float	750
7562 7563	IDM_MINFLOWLIM4	W2	Minimum Flow 4	Float	1000
7564 7565	IDM_MAXFLOWLIM0	W2	Maximum Flow 0	Float	500
7566 7567	IDM_MAXFLOWLIM1	W2	Maximum Flow 1	Float	1500
7568 7569	IDM_MAXFLOWLIM2	W2	Maximum Flow 2	Float	3000
7570 7571	IDM_MAXFLOWLIM3	W2	Maximum Flow 3	Float	4500
7572 7573	IDM_MAXFLOWLIM4	W2	Maximum Flow 4	Float	6000

Table 21: Flow Limiting Mode Table Parameters

9.2   Real Time Parameters

Real time parameters are status parameters that show the operation status of the XVG/eXVG. Most of the real time parameters are read-only.

Register Number	XVG/eXVG Parameters Name	Write Access	Description	Type
3000	IDM_DIGDEMAND	W0	Valve Demand in Digital Command Mode, range 683-3413 counts	U16
3001	IDM_DIGSTATUS	RO	Valve Feedback in Digital Command Mode, range 683-3413 counts	U16
3002	IDM_STATE	RO	Valve State: 0=Setup, 1=Run, 2=Shutdown, 3=Calibration	U16
3003	IDM_SETUPVALID	RO	Setup Checksum Valid: 0=No, 1=Yes	U16
3004	IDM_FLOWCOND	RO	Flow Condition: 0=Sonic, 1=Subsonic, 2=Reverse Flow	U16
3005	IDM_SETUPCONNECT	RO	Setup Mode: 1=Set Valve in Setup State, 2=Exit Setup and Reset CPU	U16
3006	IDM_MEASFLOWCTS	RO	Measured Flow Counts, Range 0 – 4095	U16
3007	IDM_MEASFLOW3413	RO	Measured Flow Counts, Range 683 – 3413	U16
3008	IDM_RUNTMSECS	RO	Seconds elapsed since power on	U16
3009	IDM_RUNTMMINS	RO	Minutes elapsed since power on	U16
3010	IDM_SOLDUTYCYC	RO	Solenoid Duty Cycle, not used	U16
3011	IDM_UPDATEPID	RO	Not used	U16
3012	IDM_ADCCALADC	RO	ADC A 0.22V ref calibration counts 0 – 4095	U16
3013	IDM_ADC3VOLTS3	RO	3.3V Supply counts, range 0 – 4095	U16

Register Number	XVG/eXVG Parameters Name	Write Access	Description	Type
3014	IDM_ADCINPRES	RO	Input Pressure counts, range 0-4095	U16
3015	IDM_ADCAI0	RO	Analog Input 0 (demand), range 0-3413	U16
3016	IDM_ADCOUTPRES	RO	Output Pressure counts, range 0-4095	U16
3017	IDM_ADCAI1	RO	Analog Input 1 counts, range 0 – 4095	U16
3018	IDM_ADCDELTAPRES	RO	Not used	U16
3019	IDM_ADCAI2	RO	Analog Input 2 counts, range 0 – 4095	U16
3020	IDM_ADCGASTEMP	RO	Gas Temperature counts	U16
3021	IDM_ADCAI3	RO	Analog Input 3 counts, range 0 – 4095	U16
3022	IDM_ADCSOLTEMP	RO	Solenoid temp counts, not used	U16
3023	IDM_ADCAI4	RO	Analog Input 4 counts, range 0 – 4095	U16
3024	IDM_ADCMOTORCUR	RO	Motor Current counts, range 0 - 4095	U16
3025	IDM_ADCAI5	RO	Analog Input 5 counts, range 0 – 4095	U16
3026	IDM_FFAULTFLGS	RO	Fault Report Variable, not used	U16
3027	IDM_FVERSION	RO	Fault Report Variable, not used	U16
3028	IDM_FRUNTMMINS	RO	Fault Log, Run Time Minutes of fault log	U16
3029	IDM_FRUNTMSECS	RO	Fault Log, Run Time Seconds of fault log	U16
3030	IDM_SETUPERROR	RO	Setup Validation Error Code, 0 = No Errors	U16
3031	IDM_TESTFLAGS	W3	Test Flags (SW debug use only)	U16
3032	IDM_FMODE	RO	Fault Report Variable, not used	U16
3033	IDM_CALFLAGS	W1	Calibration Flags: Bit0=Set Valve in Calibration State. The following bits active only in cal state: Bit1=Enable Feedback Override, Bit2=Set Solenoid Duty Cycle Out to 50% Bit3=Read ADC A raw cal voltage into IDM_ADCACALADC Bit4=Read ADC B raw cal voltage into IDM_ADCBCALADC Bit5=Write parameters to EEPROM Bit6=Reset IDM_TOTALHRS to 0 if parameter IDM_DATE = 666	U16
3034	IDM_CALAOUT0	W3	Analog Output 0 DAC Value, counts 0-4095	U16
3035	IDM_ADCBCALADC	RO	ADC B 2.5V Ref Calibration counts 0-4095	U16
3036	IDM_AOUT1	W3	Analog Output 1 DAC Value, counts 0-4095	U16
3037	IDM_AOUT2	W3	Analog Output 2 DAC Value, counts 0-4095	U16
3038	IDM_FIRMWAREVER	RO	Firmware Version	U16
3039	IDM_AOUT0	RO	AO0 DAC Value, counts 0-4095	U16
3040	IDM_DIN0	RO	DI0 Value: (reserved for external Run/Stop) Bit0-Bit3=DI0-DI3 – only used if valve enters CAL_STATE	U16
3041	IDM_DOUT0	W3	Digital Output 0 Value: (reserved for Fault Output) Bit0-Bit5=O0-O3, 485TXENA, 485TXENB – only valid if valve enters CAL_STATE, otherwise for SW test	U16

Register Number	XVG/eXVG Parameters Name	Write Access	Description	Type
3042	IDM_DOUT1	W3	Digital Output 1 Value, Current/Voltage: Bit0-Bit5=AI0-AI5, Bit8-Bit10=AO0-AO2 (1=Voltage, 0=Current) – only valid if valve enters CAL_STATE, otherwise for SW test	U16
3043	IDM_FRECORDNO	W0	Fault Log Record No, selects fault log record, 0-7	U16
3044	IDM_FFAULTCODE	RO	Fault Log, Fault Code of fault log record	U16
3045	IDM_FRECORDS	RO	Fault Log, Number of faults in fault log record	U16
3046	IDM_ADCA0	RO	ADC Channel A0 reading in counts	U16
3047	IDM_ADCA1	RO	ADC Channel A1 reading in counts	U16
3048	IDM_ADCA2	RO	ADC Channel A2 reading in counts	U16
3049	IDM_ADCA3	RO	ADC Channel A3 reading in counts	U16
3050	IDM_ADCA4	RO	ADC Channel A4 reading in counts	U16
3051	IDM_ADCA5	RO	ADC Channel A5 reading in counts	U16
3052	IDM_ADCA6	RO	ADC Channel A6 reading in counts	U16
3053	IDM_ADCA7	RO	ADC Channel A7 reading in counts	U16
3054	IDM_ADCB0	RO	ADC Channel B0 reading in counts	U16
3055	IDM_ADCB1	RO	ADC Channel B1 reading in counts	U16
3056	IDM_ADCB2	RO	ADC Channel B2 reading in counts	U16
3057	IDM_ADCB3	RO	ADC Channel B3 reading in counts	U16
3058	IDM_ADCB4	RO	ADC Channel B4 reading in counts	U16
3059	IDM_ADCB5	RO	ADC Channel B5 reading in counts	U16
3060	IDM_ADCB6	RO	ADC Channel B6 reading in counts	U16
3061	IDM_ADCB7	RO	ADC Channel B7 reading in counts	U16
3062	IDM_ADCA0GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3063	IDM_ADCA1GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3064	IDM_ADCA2GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3065	IDM_ADCA3GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3066	IDM_ADCA4GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3067	IDM_ADCA5GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3068	IDM_ADCA6GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3069	IDM_ADCA7GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3070	IDM_ADCB0GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3071	IDM_ADCB1GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3072	IDM_ADCB2GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16

Register Number	XVG/eXVG Parameters Name	Write Access	Description	Type
3073	IDM_ADCB3GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3074	IDM_ADCB4GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3075	IDM_ADCB5GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3076	IDM_ADCB6GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3077	IDM_ADCB7GAINOFF	RO	Analog input w/Auto ADC gain/off applied, cnts 0-4095	U16
3078	IDM_ADCB5A	RO	Muxed analog input for ADCAI3, counts 0-4095	U16
3079	IDM_ADCB5B	RO	Muxed analog input for ADCAI4, counts 0-4095	U16
3080	IDM_ADCB5C	RO	Muxed analog input for ADCAI5, counts 0-4095	U16
3081	IDM_ADCCALLOW	RO	ADC A 0.22V ref calibration counts 0 – 4095	U16
3082	IDM_ADCCALHI	RO	ADC B 2.5V Ref Calibration counts 0 – 4095	U16
3083	IDM_SOLDUTY	RO	Solenoid duty cycle, # of times on/1000 updates, for debug	U16
3084	IDM_LOOPCNT	RO	Main task loop cycles per 125ms, for debug	U16
3085	IDM_BUFINDEX1	W0	Advanced diagnostics histogram bucket index and ADC channel index	U16
3086	IDM_BUFINDEX2	W0	ADC buffer index	U16
3087	IDM_ADCBUFVAL	RO	ADC input buffer array value, for test. ADCBUFVAL[BUFINDEX1][BUFINDEX2]	U16
3088	IDM_DEMANDSTATUS	RO	Demand before position interpolation, value range: 683 to 3413	U16
3089	IDM_AOUT0PWMCTS	RO	Analog output 0 PWM value: 0 to 4095	U16
3090	IDM_AOUT1PWMCTS	RO	Analog output 1 PWM value: 0 to 4095	U16
3091	IDM_AOUT2PWMCTS	RO	Analog output 2 PWM value: 0 to 4095	U16
3092	IDM_FADCCALHI	RO	Fault Log, ADCCALHI at time of fault	U16
3093	IDM_FADCCALLOW	RO	Fault Log, ADCCALLOW at time of fault	U16
3094	IDM_TESTCTRL	W0	Use to trigger EEPROM tasks (sets bits in ETFLAGS). Fully functional using PECC protocol. Using Modbus, only fault read task allowed. See ETFLAGS for bits.	U16
3095	IDM_ETFLAGS	RO	Test parameter for viewing scheduled EEPROM tasks: b0=fault save, b1=fault reset, b2=fault read, b3=AdvDiag save, b4=EEPROM reset (use w/b3)	U16
3096	IDM_FLTBUF	RO	Buffer number of next fault record to be saved: 0 to 16 (16 = buffer 0)	U16
3097	IDM_CLSEC	RO	Lost communication seconds counter	U16
3098	IDM_LVDTCOUNT	RO	ADC count from LVDT	U16

Register Number	XVG/eXVG Parameters Name	Write Access	Description	Type
3099	IDM_TESTSTR[0]	W0	Test string, used for Modbus write access password. IDM_TESTSTR is an ASCII string array with maximum of 16 elements. The string start at register 3099 and a Null (0) character is required to end the string. Example: To enter PASSWORD, write: 80 to register 3099 65 to register 3100 83 to register 3101 83 to register 3102 87 to register 3103 79 to register 3104 82 to register 3105 68 to register 3106 0 to register 3107	ASCII
3100	IDM_TESTSTR[1]			
3101	IDM_TESTSTR[2]			
3102	IDM_TESTSTR[3]			
3103	IDM_TESTSTR[4]			
3104	IDM_TESTSTR[5]			
3105	IDM_TESTSTR[6]			
3106	IDM_TESTSTR[7]			
3107	IDM_TESTSTR[8]			
3108	IDM_TESTSTR[9]			
3109	IDM_TESTSTR[10]			
3110	IDM_TESTSTR[11]			
3111	IDM_TESTSTR[12]			
3112	IDM_TESTSTR[13]			
3113	IDM_TESTSTR[14]			
3114	IDM_TESTSTR[15]			
3115	IDM_AO0CHCFG	W2	Analog output channel 0 electrical configuration selector. Can be used to automatically set output configuration. Sets parameters when value assigned in setup state. (Parameter is not stored in EEPROM.) Returns configuration code when read is commanded. 0 = 4to20mA, 1 = 0to5V, 2 = 1to5V, 3 = 0to-5V. When reading, an invalid setup returns "99". An invalid write returns SETUPERROR = 9001.	U16
3116	IDM_AO1CHCFG	W2	Analog output channel 1 electrical configuration selector. Can be used to automatically set output configuration. Sets parameters when value assigned in setup state. (Parameter is not stored in EEPROM.) Returns configuration code when read is commanded. 0 = 4to20mA, 1 = 0to5V, 2 = 1to5V, 3 = 0to-5V. When reading, an invalid setup returns "99". An invalid write returns SETUPERROR = 9002.	U16
3117	IDM_AI0CHCFG	W2	Analog input channel 0 electrical configuration selector. Can be used to automatically set input configuration. Sets parameters when value assigned in setup state. (Parameter is not stored in EEPROM.) Returns configuration code when read is commanded. 0 = 4to20mA, 1 = 0to5V, 2 = 1to5V. When reading, an invalid setup returns "99". An invalid write returns SETUPERROR = 9003.	U16
5000 5001	IDM_POSMANSTPT	RO	Not used, SW test parameter	U32
5002 5003	IDM_CURMANSTPT	RO	Not used, SW test parameter	U32
5004 5055	IDM_VALVEDMD	RO	Position Demand, counts 683-3413	U32
5006 5007	IDM_VALVESTATUS	RO	Position Status, counts 683-3413	U32
5008 5009	IDM_FVALVEDMD	RO	Fault Report Variable, not used	U32
5010 5011	IDM_FVALVESTATUS	RO	Fault Report Variable, not used	U32
5012 5013	IDM_FDATE	RO	Fault Report Variable, not used	U32

Register Number	XVG/eXVG Parameters Name	Write Access	Description	Type
5014 5015	IDM_LVDTSCALEFCT	RO	Obsolete	U32
5016 5017	IDM_RUNTMHRS	RO	Run Time Hours since last power on	U32
5018 5019	IDM_FLOCTLPOSOUT	RO	Calculated flow control position demand, 683-3413	U32
5020 5021	IDM_TOTALHRS	RO	Total Running Hours	U32
5022 5023	IDM_TOTHRSIG	RO	Total Running Hours Cleared Signature	U32
5024 5025	IDM_FLOWLIMPOS	RO	Flow Limiting Pos Demand Output, 0-3413	U32
5026 5027	IDM_FTOTALHRS	RO	Fault Log, Total Hours of fault log record	U32
5028 5029	IDM_FRUNTMHRS	RO	Fault Log, Run Time Hours of fault log	U32
5030 5031	IDM_ADCSTATFLGS	RO	Bit field to indicate analog input over-range Bit0 = AdcA0 Bit1 = AdcB0 Bit0 = AdcA1 Bit1 = AdcB1 Bit0 = AdcA2 Bit1 = AdcB2 Bit0 = AdcA3 Bit1 = AdcB3 Bit0 = AdcA4 Bit1 = AdcB4 Bit0 = AdcA5 Bit1 = AdcB5 Bit0 = AdcA6 Bit1 = AdcB6	U32
5032 5033	IDM_FAULTLATCHL	W3	Latched Faults, format same as IDM_FAULTFLAGSL, cleared at power on	U32
5034 5035	IDM_FAULTFLAGSL	RO	Active Faults: Bit0=3.3V, Bit1=Tracking, Bit2=GasTemp Range, Bit4=Input Pressure, Bit5=Output Pressure, Bit6=LVDT, Bit7=Setup, Bit8=Flow Setup Bit10=Overpressure, Bit11=GasTemp shutdown, Bit12=+15V supply, Bit13=Neg15V supply, Bit14=Amb Temp, Bit15=Watchdog, Bit16=Advanced diagnostics, Bit 17=Communication	U32
5036 5037	IDM_TRS	RO	Total seconds of operation (valve open)	U32
5038 5039	IDM_OCC	RO	Over-current count, number of sample events with motor current > IDM_OCT	U32
5040 5041	IDM_MMG	RO	Modbus messages good, total valid messages received.	U32
5042 5043	IDM_MMI	RO	Modbus messages invalid, total invalid messages received (invalid data or request command)	U32
5044 5045	IDM_MMB	RO	Modbus messages bad, total messages received with bad CRC.	U32
5046 5047	IDM_TA	RO	Thermal age, estimated electronics age with temperature factor, in seconds.	U32
5048 5049	IDM_PRS	RO	Histogram array parameter for PressureRatio, seconds	U32
5050 5051	IDM_GTS	RO	Histogram array parameter for GasTemp, seconds	U32
5052 5053	IDM_TAS	RO	Histogram array parameter for electronics temperature, seconds	U32
5054 5055	IDM_IPS	RO	Histogram array parameter for InletPressure, seconds	U32

Register Number	XVG/eXVG Parameters Name	Write Access	Description	Type
5056 5057	IDM_OPS	RO	Histogram array parameter for OutletPressure, seconds	U32
5058 5059	IDM_FS	RO	Histogram array parameter for flow measurement, seconds	U32
5060 5061	IDM_MCS	RO	Histogram array parameter for MotorCurrent, seconds	U32
5062 5063	IDM_DJS	RO	Histogram array parameter for demand jitter, seconds (command change accumulation/sec)	U32
7000 7001	IDM_POSININCHES	RO	Valve Position in inches	Float
7002 7003	IDM_INPUTPRES	W3	Input Pressure, PSIA	Float
7004 7005	IDM_OUTPUTPRES	W3	Output Pressure, PSIA	Float
7006 7007	IDM_OUTPCORRECT	RO	Output Pressure Corrected, PSIA	Float
7008 7009	IDM_MEASFLOW	RO	Measured Flow, PPH	Float
7010 7011	IDM_CDAOUT	RO	CdA specified by demand	Float
7012 7013	IDM_MEASUREDCDA	RO	Measured CdA, calculated from measured position	Float
7014 7015	IDM_GASTEMP	W3	Gas Temperature, degrees F (includes TEMPOFF)	Float
7016 7017	IDM_VOLTS3PT3	RO	3.3V supply voltage, Volts	Float
7018 7019	IDM_PRESSRATIO	RO	Pressure Ratio	Float
7020 7021	IDM_DMDININCHES	RO	Position Demand in inches	Float
7022 7023	IDM_FLOWLIMDMD	RO	Flow Limiting Demand Output	Float
7024 7025	IDM_MINFLOWLIM	RO	Calculated Min Flow Limit	Float
7026 7027	IDM_MAXFLOWLIM	RO	Calculated Max Flow Limit	Float
7028 7029	IDM_FLOWLIMRNG	RO	Calculated Flow Limiting Range	Float
7030 7031	IDM_FLOWRNGSCALR	RO	Flow Range Scaler, Max Flow / Max Counts	Float
7032 7033	IDM_SOLTEMP	RO	Solenoid Temperature, not used	Float
7034 7035	IDM_EQCONSTA	RO	Flow equation constant A	Float
7036 7037	IDM_EQCONSTB	RO	Flow equation constant B	Float
7038 7039	IDM_EQCONSTC	RO	Flow equation constant C	Float
7040 7041	IDM_EQCONSTD	RO	Flow equation constant D	Float
7042 7043	IDM_EQCONSTE	RO	Flow equation constant E	Float
7044 7045	IDM_EQCONSTF	RO	Flow equation constant F	Float
7046 7047	IDM_LVDTAPLUSB	RO	LVDT A+B signal	Float
7048 7049	IDM_LVDTAMINUSB	RO	LVDT A-B signal	Float
7050 7051	IDM_FVOLTS3PT3	RO	Fault Log, Volts3pt3 at time of fault	Float
7052 7053	IDM_FSOLTEMP	RO	Fault report variable, not used	Float
7054 7055	IDM_FINPUTPRES	RO	Fault Log, InputPres at time of fault	Float
7056 7057	IDM_FOUTPUTPRES	RO	Fault Log, OutputPres at time of fault	Float
7058 7059	IDM_FGASTEMP	RO	Fault Log, GasTemp at time of fault	Float
7060 7061	IDM_FFLOWRANGE	RO	Fault report variable, not used	Float
7062 7063	IDM_FMEASFLOW	RO	Fault Log, MeasFlow at time of fault	Float
7064 7065	IDM_FFAULTDATA	RO	Fault Log, Fault Data at time of fault	Float
7066 7067	IDM_FPOSININCHES	RO	Fault Log, PosInInches at time of fault	Float
7068 7069	IDM_FTEMPAMB	RO	Fault Log, TempAmb at time of fault	Float
7070 7071	IDM_FVOLTSPOS15	RO	Fault Log, VoltsPos15 at time of fault	Float

Register Number	XVG/eXVG Parameters Name	Write Access	Description	Type
7072 7073	IDM_FVOLTSNEG15	RO	Fault Log, VoltsNeg15 at time of fault	Float
7074 7075	IDM_TEMPAMB	W3	Approx. ambient temp. of electronics cavity, deg C	Float
7076 7077	IDM_AUTOADCAGAIN	RO	AUTO ADC A gain, range 0.95 to 1.05	Float
7078 7079	IDM_AUTOADCBGAIN	RO	AUTO ADC B gain, range 0.95 to 1.05	Float
7080 7081	IDM_AUTOADCAOFF	RO	AUTO ADC A offset, range -80 to 80 counts	Float
7082 7083	IDM_AUTOADCBOFF	RO	AUTO ADC B offset, range -80 to 80 counts	Float
7084 7085	IDM_VOLTSPOS15	RO	+15V supply voltage, Volts	Float
7086 7087	IDM_VOLTSNEG15	RO	-15V supply voltage, Volts	Float
7088 7089	IDM_XMEAS	RO	Same as PosInInches	Float
7090 7091	IDM_XCMD	RO	Commanded position, inches	Float
7092 7093	IDM_XERR	RO	Position error, inches	Float
7094 7095	IDM_INTXERR	RO	Position control integral command, velocity (in/0.0001sec)	Float
7096 7097	IDM_VCMD	RO	Velocity command (in/0.0001sec)	Float
7098 7099	IDM_ICMD	RO	Motor current command, counts	Float
7100 7101	IDM_VMEAS	RO	Measured velocity (in/0.0001sec)	Float
7102 7103	IDM_GASTEMPC	RO	Gas temperature in Celsius (includes TempOff), used for LVDT position compensation & analog output	Float
7104 7105	IDM_MOTORCUR	RO	Motor current, approximation in Amps	Float
7106 7107	IDM_TIT	RO	Total inches traveled	Float
7108 7109	IDM_DJSUM	RO	Total demand jitter, volts	Float
7110 7111	IDM_SLR	RO	Seal life remaining, % (based on IDM_TITHRESH)	Float
7112 7113	IDM_APLUSBV	RO	LVDT A+B voltage measurement	Float
7114 7115	IDM_AMINUSBV	RO	LVDT A-B voltage measurement	Float

Table 22: Real Time Status Parameters

10   Write Modbus Application

Software packages that support Modbus protocol could be used to write Modbus application for the XVG/eXVG. The necessary Modbus functions are Read Registers, Write Single Register, and Write Multiple Registers.

- All XVG/eXVG Modbus parameters are readable using Read Register function.
- Write to the writeable registers can be accomplished with Write functions and appropriate password.

User Responsibility

By using the Modbus read and write functions, it is possible to access all of the XVG/eXVG parameters, features, and functions. The following precautions must be considered when writing your own Modbus application:

- Only one host master can send request message at a time.
- Each XVG/eXVG unit on the same network must have a unique address.
- Adhere to the tables of registers provided and their allowable data range.
- Do not attempt to write to any register if you are not sure of the consequence.
- Do not write to registers that are for options your XVG/eXVG does not have.

Failure to do so can result in erratic control and/or damage to equipment. Care must also be taken that the process cannot cause damage to property or injury to personnel if the wrong commands are sent due to operator error or equipment malfunction.

Handling Communication Errors

- Reading from or writing to a register that does not exist or is currently disabled will result in a "time-out response", or in other words, the XVG/eXVG will not reply with a message.
- Messages with the wrong format, timing, or CRC are ignored.
- Writing to a read-only register, writing with out-of-range data, or writing with improper permission will result in response error messages.
- It is the user's responsibility to handle the error appropriately and determine whether to resend the message or halt the operation.

Following are a few sample procedures for XVG/eXVG Modbus application:

10.1 Real-Time Status & Parameters Upload Procedure

Following are examples of the real time parameters that can be read at anytime.

Register Number	XVG/eXVG Parameter Name	Description	Type
7000	IDM_POSININCHES	Valve Position in inches	Float
7002	IDM_INPUTPRES	Input Pressure, PSIA	Float
7004	IDM_OUTPUTPRES	Output Pressure, PSIA	Float
7008	IDM_MEASFLOW	Measured Flow, PPH	Float
7014	IDM_GASTEMP	Gas Temperature, degrees F (includes TEMPOFF)	Float
7016	IDM_VOLTS3PT3	3.3V supply voltage, Volts	Float
7018	IDM_PRESSRATIO	Pressure Ratio	Float
7020	IDM_DMDININCHES	Position Demand in inches	Float
7074	IDM_TEMPAMB	Approx. ambient temp. of electronics cavity, deg C	Float
7084	IDM_VOLTSPOS15	+15V supply voltage, Volts	Float
7086	IDM_VOLTSNEG15	-15V supply voltage, Volts	Float
7104	IDM_MOTORCUR	Motor current, approximation in Amps	Float
7106	IDM_TIT	Total inches traveled	Float

Table 23: Parameters Upload for Status

All XVG/eXVG parameters can be uploaded using Modbus Read Registers function then convert the results into appropriate number representation for display and monitoring. Model number and part number need to be converted into ASCII character string. All registers are readable, choose whichever parameters are of interest and read them.

10.2 Accessing Fault Records Procedure

The following parameters will be used to retrieve the XVG/eXVG fault records. There are a maximum of 16 records available in the valve. The first eight are permanent records, the other records are updated on a first-in first-out basis. When there were 16 fault records in the valve, the oldest non-permanent record will be deleted when a new fault record is created.

Register Number	XVG/eXVG Parameter Name	Description	Type	Write Access
3028	IDM_FRUNTMMINS	Fault Log, Run Time Minutes of fault log	U16	RO
3029	IDM_FRUNTMSECS	Fault Log, Run Time Seconds of fault log	U16	RO
3043	IDM_FRECORDNO	Fault Log Record No, selects fault log record, 0-16	U16	W0
3044	IDM_FFAULTCODE	Fault Log, Fault Code of fault log record	U16	RO
3045	IDM_FRECORDS	Fault Log, Number of faults in fault log record	U16	RO
3094	IDM_TESTCTRL	Use to trigger EEPROM tasks (sets bits in ETFLAGS). Fully functional using PECC protocol. Using Modbus, only fault read task allowed. See ETFLAGS for bits.	U16	W0
5026	IDM_FTOTALHRS	Fault Log, Total Hours of fault log record	U32	RO
5028	IDM_FRUNTMHRS	Fault Log, Run Time Hours of fault log	U32	RO
7050	IDM_FVOLTS3PT3	Fault Log, Volts3pt3 at time of fault	Float	RO
7052	IDM_FSOLTEMP	Fault report variable, not used	Float	RO
7054	IDM_FINPUTPRES	Fault Log, InputPres at time of fault	Float	RO
7056	IDM_FOUTPUTPRES	Fault Log, OutputPres at time of fault	Float	RO
7058	IDM_FGASTEMP	Fault Log, GasTemp at time of fault	Float	RO
7060	IDM_FFLOWRANGE	Fault report variable, not used	Float	RO
7062	IDM_FMEASFLOW	Fault Log, MeasFlow at time of fault	Float	RO
7064	IDM_FFAULTDATA	Fault Log, Fault Data at time of fault	Float	RO
7066	IDM_FPOSININCHES	Fault Log, PosInInches at time of fault	Float	RO
7068	IDM_FTEMPAMB	Fault Log, TempAmb at time of fault	Float	RO
7070	IDM_FVOLTSPOS15	Fault Log, VoltsPos15 at time of fault	Float	RO
7072	IDM_FVOLTSNEG15	Fault Log, VoltsNeg15 at time of fault	Float	RO

Table 24: Fault Records Parameters

Perform the following steps to retrieve the fault records:

1. Read register 3045, IDM_RECORDS, to get the current number of fault records available in the XVG/eXVG. The records are named 0, 1, 2, .. , n-1. Maximum n = 16.
2. To retrieve first record, record 0, write 0 to register 3043, IDM_FRECORDNO.
3. Write 4 to register 3094, IDM_TESTCTRL.
4. Read registers 3028, 3029, 3044, 5026, 5028, 7050-7072 to complete record 0.
5. Repeat steps 2, 3, 4, and 5, to retrieve record 1, 2, .., n-1.

10.3 Change Gas Constant R and K Procedure

Register Number	XVG/eXVG Parameter Name	Description	Type	Write Access
3005	IDM_SETUPCONNECT	Setup Mode: 1=Set Valve in Setup State, 2=Exit Setup and Reset CPU	U16	W1
3033	IDM_CALFLAGS	Calibration Flags	U16	W1
3099	IDM_TESTSTR	Test string, used for Modbus write access password.	U16	W0
7008	IDM_MEASFLOW	Measured Flow, PPH	Float	Read
7518	IDM_CONSTR	R Gas Constant: must be non-zero, default is Air, 53.34	Float	W0
7520	IDM_CONSTK	K Gas Constant: must be non-zero, default is Air, 1.4	Float	W0

Table 25: Parameters for Gas Constant R and K

Perform the following steps to change gas constant R and K in real-time.

1. Read registers 7518, 7520, and 7008, to get the R, K, and corresponding measured flow values. Take note of the R and K values for reference. The only way to restore the default values without a valve close and reset (engine shutdown) is to write those values into the valve again.
2. Write registers 7518 and/or 7520 with appropriate new values.
3. Read register 7008 to get new measured flow value.
4. Read the registers that are of interest to your application.
5. If desired, save the new R and K value to the valve. Note that the following SAVE or RESET procedure will CLOSE and RESET the valve.

SAVE Parameters routine:

- Write a password to register 3099.
- Write 1 to register 3033. Wait 100 milliseconds.
- Write 32 to register 3033. Wait 100 milliseconds.
- Write 1 to register 3005. Wait 100 milliseconds.

- Write 2 to register 3005. Valve will close and reset.

6. To restore the previous R and K values, write the value of R to register 7518 and the value of K to 7520. In case the old values are forgotten and the new values have not been saved to the valve, reset the valve by turning power off then on to restore R and K. The following steps will also reset the valve; care must be taken, valve will close and reset.

RESET valve routine:

- Write a password to register 3099.
- Write 1 to register 3005. Wait 100 milliseconds.
- Write 2 to register 3005. Valve will close and reset.

10.4 Download Parameters

All setup parameters, tables 15-20, can be written when you have the appropriate password. New parameters can be downloaded to the XVG/eXVG as follows:

- Setup proper write-access level for the parameters.
- Write the new values to the registers.
- Perform Save Parameters routine.

10.5 Re-Assign Device Address Procedure

Register Number	XVG/eXVG Parameter Name	Description	Type	Write Access
3005	IDM_SETUPCONNECT	Setup Mode: 1=Set Valve in Setup State, 2=Exit Setup and Reset CPU	U16	W1
3033	IDM_CALFLAGS	Calibration Flags	U16	W1
3099	IDM_TESTSTR	Test string, used for Modbus write access password.	U16	W0
3540	IDM_SLAVEADDR	Modbus slave address. Range: 1 to 247	U16	W2

Table 26: Parameters Used to Assign Device Address

XVG/eXVG default Modbus address is 1. In case the Modbus address is forgotten, a new address can be assigned by using broadcast messages. Perform the following steps; send all messages with device address 0:

1. Make a one-to-one connection between the Modbus master and the XVG/eXVG; no other Modbus device is present on the network.
2. Write a password to register 3099.
3. Write 1 to register 3005.
4. Write the new device address to register 3540.
5. Write 1 to register 3033. Wait 100 milliseconds.

6. Write 32 to register 3033. Wait 100 milliseconds.
7. Write 1 to register 3005. Wait 100 milliseconds.
8. Write 2 to register 3005. Valve will close, reset and assume new address.