

Modbus RTU with Teledyne Isco Syringe Pumps

Setup and Operation Instructions

Overview

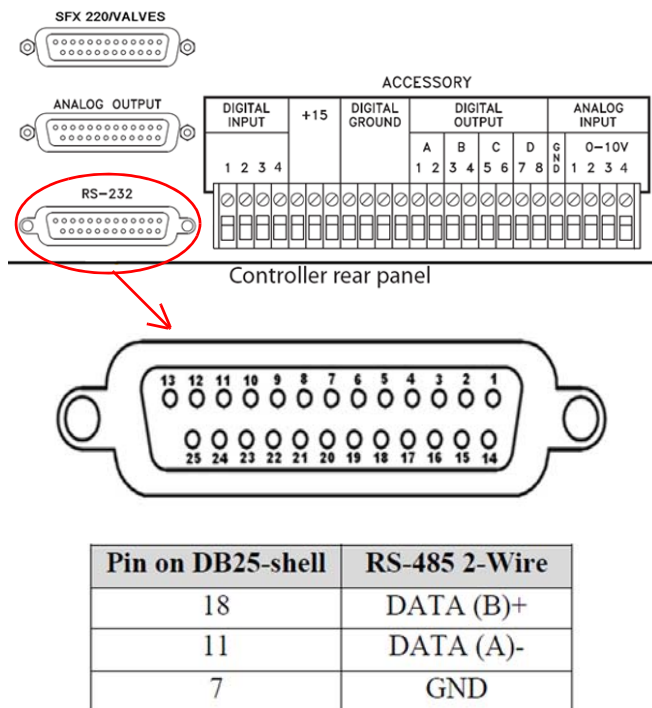
Modbus is a simple command/response mechanism to read from and write to specific memory locations called *registers*. A register is a holding place for a piece of digital information within the equipment. For more information on Modbus, please refer to the following documents which can be found on the www.modbus.org website: [Modbus Application Protocol Vol. 1¹](#) and [Modbus Over Serial Line Vol. 1²](#)

☑ Note

The RS-485 can only be used with the updated controller and the firmware revision must be 1.09 or later. See [TB28 D-Series Syringe Pump Controller Versions³](#) for more information.

This Modbus implementation uses the RTU protocol over a 2-wire RS-485 connection. The RS-485 connections are located on the DB25 connector labeled RS-232. We recommend connecting the ground reference wire as shown in Figure 1. The matching connection is a D-Subminiature 25-pin standard plug, such as an AMP part #747912-2 from an electronic parts supplier.

Figure 1: 485 Connection



Modbus Configuration Options

To access the Modbus configuration settings, press:

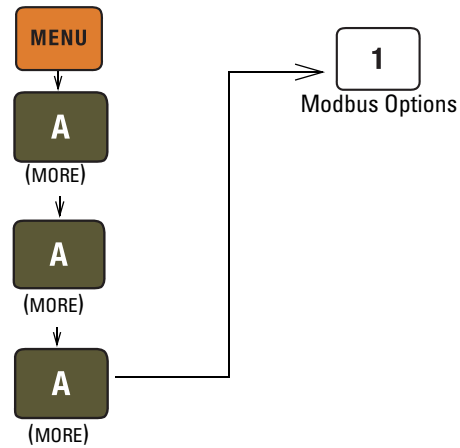


Table 1: Modbus Configuration Options

Item	Value	Description
Baud Rate	300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200	Communication Speed (Default 19200)
Slave ID	1-247	Device address (Default 1)
Parity	Even 1 Stop Bit, Odd 1 Stop Bit, None 1 Stop Bit, None 2 Stop Bit	Communication parameters (Default Even 1 Stop Bit)
Word Order	Big Endian, Little Endian	Word order for 32-bit integers and IEEE-754 floating point numbers. Big Endian: AB CD; Little Endian CD AB. (Default Big Endian)
Character Time	Min: Baud Rate dependent Max: 999ms	Time to transmit single character t1. Used to calculate inter frame and inter character space t1.5, t3.5 (50 m sec default)

Table 2: Supported Modbus Function Codes

Function Code	Description
01	Read Discrete Output Coils
03	Read Analog Output Holding Registers
05	Write Single Discrete Output Coil
15	Write Multiple Discrete Output Coils
16	Write Multiple Analog Output Holding Registers

Table 3: Exception Responses

Exception Code	Name	Description
01	Illegal Function	Function code received is not supported.
02	Illegal Data Address	Data address received is not an allowable address.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the addressed location. This may indicate a fault in the structure of the remainder of a complex request, such that the implied length is incorrect. Does NOT mean data value is outside the expectation of the controller.

Table 4: Coils

Register	Address	Type	Size	Description
00001	0	R/W	1 BIT	0: Stop Pump A 1: Run Pump A
00002	1	R/W	1 BIT	0: Stop Pump B 1: Run Pump B
00003	2	R/W	1 BIT	0: Stop Pump C 1: Run Pump C
00004	3	R/W	1 BIT	0: Stop Pump D 1: Run Pump D
00005	4	R/W	1 BIT	Link Run/Stop operation of multi-pump pair AB & multi-pump pair CD 0: Disable 1:Enable
00006	5	R/W	1 BIT	0: Stop Pump A if in Refill 1: Run Pump A in Refill
00007	6	R/W	1 BIT	0: Stop Pump B if in Refill 1: Run Pump B in Refill
00008	7	R/W	1 BIT	0: Stop Pump C if in Refill 1: Run Pump C in Refill
00009	8	R/W	1 BIT	0: Stop Pump D if in Refill 1: Run Pump D in Refill
00010	9	R/W	1 BIT	1: Pump A in Constant Pressure mode
00011	10	R/W	1 BIT	1: Pump B in Constant Pressure mode
00012	11	R/W	1 BIT	1: Pump C in Constant Pressure mode
00013	12	R/W	1 BIT	1: Pump D in Constant Pressure mode
00014	13	R/W	1 BIT	1: Pump A in Constant Flow mode
00015	14	R/W	1 BIT	1: Pump B in Constant Flow mode
00016	15	R/W	1 BIT	1: Pump C in Constant Flow mode
00017	16	R/W	1 BIT	1: Pump D in Constant Flow mode
00018	17	R/W	1 BIT	1: Pump A & Pump B in Independent mode
00019	18	R/W	1 BIT	1: Pump A & Pump B in Continuous Flow Constant Flow mode
00020	19	R/W	1 BIT	1: Pump A & Pump B in Continuous Flow Constant Pressure mode
00021	20	R/W	1 BIT	1: Pump A & Pump B in Modifier addition mode
00022	21	R/W	1 BIT	1: Pump A & Pump B & Pump C in Continuous Modifier addition mode
00023	22	R/W	1 BIT	1: Pump C & Pump D in Independent mode

Table 4: Coils

Register	Address	Type	Size	Description
00024	23	R/W	1 BIT	1: Pump C & Pump D in Continuous Flow Constant Flow mode
00025	24	R/W	1 BIT	1: Pump C & Pump D in Continuous Flow Constant Pressure mode
00026	25	R/W	1 BIT	0: Multi-pump pair AB in Delivery mode 1: Multi-pump pair AB in Receive mode
00027	26	R/W	1 BIT	0: Multi-pump pair AB in Low Press operation 1: Multi-pump pair AB in Normal Press operation
00028	27	R/W	1 BIT	0: Use Fast (coarser) pressure match control for multi-pump pair AB 1: Use Normal (finer) pressure match control for multi-pump pair AB
00029	28	R/W	1 BIT	0: Multi-pump pair CD in Delivery mode 1: Multi-pump pair CD in Receive mode
00030	29	R/W	1 BIT	0: Multi-pump pair CD in Low Press operation 1: Put multi-pump pair CD in Normal Press operation
00031	30	R/W	1 BIT	0: Use Fast (coarser) pressure match control for multi-pump pair CD 1: Use Normal (finer) pressure match control for multi-pump pair CD
00032	31	R/W	1 BIT	1: Activates the automatic rapid pressurization cycle (Constant Flow mode only) for Pump A
00033	32	R/W	1 BIT	1: Activates the automatic rapid pressurization cycle (Constant Flow mode only) for Pump B
00034	33	R/W	1 BIT	1: Activates the automatic rapid pressurization cycle (Constant Flow mode only) for Pump C
00035	34	R/W	1 BIT	1: Activates the automatic rapid pressurization cycle (Constant Flow mode only) for Pump D
00036	35	R	1 BIT	1: Pump A is Equilibrating
00037	36	R	1 BIT	1: Pump B is Equilibrating
00038	37	R	1 BIT	1: Pump C is Equilibrating
00039	38	R	1 BIT	1: Pump D is Equilibrating
00040	39	R	1 BIT	1: Pump A is in Hold (clock stopped)
00041	40	R	1 BIT	1: Pump B is in Hold (clock stopped)
00042	41	R	1 BIT	1: Pump C is in Hold (clock stopped)
00043	42	R	1 BIT	1: Pump D is in Hold (clock stopped)
00044	43	R	1 BIT	1: Pump A & Pump B in Concentration Gradient
00045	44	R	1 BIT	1: Pump A in Pressure Gradient
00046	45	R	1 BIT	1: Pump A in Flow Gradient
00047	46	R/W	1 BIT	1: Controller in Local Operation
00048	47	R/W	1 BIT	1: Controller in Remote Operation
00049	48	R/W	1 BIT	1: Controller in External Operation
00050	49	R/W	1 BIT	1: External Refill control enabled
00051	50	R/W	1 BIT	1: Zero pressure sensor offset for Pump A
00052	51	R/W	1 BIT	1: Zero pressure sensor offset for Pump B
00053	52	R/W	1 BIT	1: Zero pressure sensor offset for Pump C
00054	53	R/W	1 BIT	1: Zero pressure sensor offset for Pump D
00055	54	R/W	1 BIT	0: Pressure Integrator for Pump A OFF 1: Pressure Integrator for Pump A ON
00056	55	R/W	1 BIT	0: Pressure Integrator for Pump B OFF 1: Pressure Integrator for Pump B ON
00057	56	R/W	1 BIT	0: Pressure Integrator for Pump C OFF 1: Pressure Integrator for Pump C ON
00058	57	R/W	1 BIT	0: Pressure Integrator for Pump D OFF 1: Pressure Integrator for Pump D ON
00059	58	R/W	1 BIT	0: Pressure Deadband for Pump A OFF 1: Pressure Deadband for Pump A ON
00060	59	R/W	1 BIT	0: Pressure Deadband for Pump B OFF 1: Pressure Deadband for Pump B ON
00061	60	R/W	1 BIT	0: Pressure Deadband for Pump C OFF 1: Pressure Deadband for Pump C ON
00062	61	R/W	1 BIT	0: Pressure Deadband for Pump D OFF 1: Pressure Deadband for Pump D ON
00063	62	R/W	1 BIT	0: AUTO REFILL A OFF 1: AUTO REFILL A ON
00064	63	R/W	1 BIT	0: AUTO REFILL B OFF 1: AUTO REFILL B ON
00065	64	R/W	1 BIT	0: AUTO REFILL C OFF 1: AUTO REFILL C ON
00066	65	R/W	1 BIT	0: AUTO REFILL D OFF 1: AUTO REFILL D ON
00067	66	R/W	1 BIT	0: AUTO FILL A OFF 1: AUTO FILL A ON
00068	67	R/W	1 BIT	0: AUTO FILL B OFF 1: AUTO FILL B ON
00069	68	R/W	1 BIT	0: AUTO FILL C OFF 1: AUTO FILL C ON

Table 4: Coils

Register	Address	Type	Size	Description
00070	69	R/W	1 BIT	0: AUTO FILL D OFF 1: AUTO FILL D ON
00071	70	R/W	1 BIT	0: DIGITAL OUTPUT BIT 1 HIGH 1: DIGITAL OUTPUT BIT 1 LOW
00072	71	R/W	1 BIT	0: DIGITAL OUTPUT BIT 2 HIGH 1: DIGITAL OUTPUT BIT 2 LOW
00073	72	R/W	1 BIT	0: DIGITAL OUTPUT BIT 3 HIGH 1: DIGITAL OUTPUT BIT 3 LOW
00074	73	R/W	1 BIT	0: DIGITAL OUTPUT BIT 4 HIGH 1: DIGITAL OUTPUT BIT 4 LOW
00075	74	R/W	1 BIT	0: DIGITAL OUTPUT BIT 5 HIGH 1: DIGITAL OUTPUT BIT 5 LOW
00076	75	R/W	1 BIT	0: DIGITAL OUTPUT BIT 6 HIGH 1: DIGITAL OUTPUT BIT 6 LOW
00077	76	R/W	1 BIT	0: DIGITAL OUTPUT BIT 7 HIGH 1: DIGITAL OUTPUT BIT 7 LOW
00078	77	R/W	1 BIT	0: DIGITAL OUTPUT BIT 8 HIGH 1: DIGITAL OUTPUT BIT 8 LOW
00079	78	R/W	1 BIT	0: Disable Dispense Mode A 1: Enable Dispense Mode A Only configure if in Constant Flow Mode
00080	79	R/W	1 BIT	0: Disable Dispense Mode B 1: Enable Dispense Mode B Only configure if in Constant Flow Mode
00081	80	R/W	1 BIT	0: Disable Dispense Mode C 1: Enable Dispense Mode C Only configure if in Constant Flow Mode
00082	81	R/W	1 BIT	0: Disable Dispense Mode D 1: Enable Dispense Mode D Only configure if in Constant Flow Mode
00083	82	R/W	1 BIT	1: Reset total volume delivered by multi-pump pair AB
00084	83	R/W	1 BIT	1: Reset total volume delivered by multi-pump pair CD
00085	84	R/W	1 BIT	1: Pressure Units =ATM
00086	85	R/W	1 BIT	1: Pressure Units = BAR
00087	86	R/W	1 BIT	1: Pressure Units = kPa
00088	87	R/W	1 BIT	1: Pressure Units = PSI
00089	88	R/W	1 BIT	1: Flow Units = ml/min
00090	89	R/W	1 BIT	1: Flow Units = ml/hr
00091	90	R/W	1 BIT	1: Flow Units = ul/min
00092	91	R/W	1 BIT	1: Flow Units = ul/hr
00093	92	R/W	1 BIT	0: Overpressure Alarm OFF 1: Overpressure Alarm ON
00094	93	R/W	1 BIT	0: Overpressure Display OFF 1: Overpressure Display ON
00095	94	R/W	1 BIT	0: Overpressure Shutdown OFF 1: Overpressure Shutdown ON
00096	95	R/W	1 BIT	0: Underpressure Alarm OFF 1: Underpressure Alarm ON
00097	96	R/W	1 BIT	0: Underpressure Display OFF 1: Underpressure Display ON
00098	97	R/W	1 BIT	0: Underpressure Shutdown OFF 1: Underpressure Shutdown ON
00099	98	R/W	1 BIT	0: Overflow Alarm OFF 1: Overflow Alarm ON
00100	99	R/W	1 BIT	0: Overflow Display OFF 1: Overflow Display ON
00101	100	R/W	1 BIT	0: Overflow Shutdown OFF 1: Overflow Display ON
00102	101	R/W	1 BIT	0: Underflow Alarm OFF 1: Underflow Alarm ON
00103	102	R/W	1 BIT	0: Underflow Display OFF 1: Underflow Display ON
00104	103	R/W	1 BIT	0: Underflow Shutdown OFF 1: Underflow Shutdown ON
00105	103	R/W	1 BIT	0: Poor Fill Alarm A OFF 1: Poor Fill Alarm A ON
00106	105	R/W	1 BIT	0: Poor Fill Alarm B OFF 1: Poor Fill Alarm B ON
00107	106	R/W	1 BIT	0: Poor Fill Alarm C OFF 1: Poor Fill Alarm C ON
00108	107	R/W	1 BIT	0: Poor Fill Alarm D OFF 1: Poor Fill Alarm D ON
00109	108	R/W	1 BIT	1: Stop all motor and reset flow rate and pressure set-points to default.
00110	109	R	1 BIT	0: Transducer of Pump A not connected 1: Transducer of Pump A connected
00111	110	R	1 BIT	0: Pump A not at upper flag limit 1: Pump A at upper Flag Limit (Empty)
00112	111	R	1 BIT	0: Pump A not at lower flag limit 1: Pump A at lower flag limit (Full)
00113	112	R	1 BIT	1: Pump A is overpressure
00114	113	R	1 BIT	1: Pump A is underpressure
00115	114	R	1 BIT	1: Motor failure Pump A
00116	115	R	1 BIT	0: Transducer of Pump B not connected 1: Transducer of Pump B connected
00117	116	R	1 BIT	0: Pump B not at upper flag limit 1: Pump B at upper Flag Limit (Empty)

Table 4: Coils

Register	Address	Type	Size	Description
00118	117	R	1 BIT	0: Pump B not at lower flag limit 1: Pump B at lower flag limit (Full)
00119	118	R	1 BIT	1: Pump B is overpressure
00120	119	R	1 BIT	1: Pump B is underpressure
00121	120	R	1 BIT	1: Motor failure Pump B
00122	121	R	1 BIT	0: Transducer of Pump C not connected 1: Transducer of Pump C connected
00123	122	R	1 BIT	0: Pump C not at upper flag limit 1: Pump C at upper Flag Limit (Empty)
00124	123	R	1 BIT	0: Pump C not at lower flag limit 1: Pump C at lower flag limit (Full)
00125	124	R	1 BIT	1: Pump C is overpressure
00126	125	R	1 BIT	1: Pump C is underpressure
00127	126	R	1 BIT	1: Motor failure Pump C
00128	127	R	1 BIT	0: Transducer of Pump D not connected 1: Transducer of Pump D connected
00129	128	R	1 BIT	0: Pump D not at upper flag limit 1: Pump D at upper Flag Limit (Empty)
00130	129	R	1 BIT	0: Pump D not at lower flag limit 1: Pump D at lower flag limit (Full)
00131	130	R	1 BIT	1: Pump D is overpressure
00132	131	R	1 BIT	1: Pump D is underpressure
00133	132	R	1 BIT	1: Motor failure Pump D
00134	133	R	1 BIT	1: POOR FILL A ERROR
00135	134	R	1 BIT	1: POOR FILL B ERROR
00136	135	R	1 BIT	1: POOR FILL C ERROR
00137	136	R	1 BIT	1: POOR FILL D ERROR
00138	137	R	1 BIT	1: VALVE ERROR
00139	138	R	1 BIT	DIGITAL IN 1
00140	139	R	1 BIT	DIGITAL IN 2
00141	140	R	1 BIT	DIGITAL IN 3
00142	141	R	1 BIT	DIGITAL IN 4

Table 5: Holding Registers

Register	Address	Read/Write	Type	# Of Registers	Description	Units
40001	0	R/W	FLOAT	2	Pressure set-point for Pump A in Constant Pressure mode.	ATM; BAR; kPa; PSI See NOTE 1.
40003	2	R/W	FLOAT	2	Pressure set-point for Pump B in Constant Pressure mode.	ATM; BAR; kPa; PSI See NOTE 1.
40005	4	R/W	FLOAT	2	Pressure set-point for Pump C in Constant Pressure mode.	ATM; BAR; kPa; PSI See NOTE 1.
40007	6	R/W	FLOAT	2	Pressure set-point for Pump D in Constant Pressure mode.	ATM; BAR; kPa; PSI See NOTE 1.
40009	8	R/W	FLOAT	2	Pressure set-point for multi-pump pair AB in Continuous Flow Constant Pressure mode.	ATM; BAR; kPa; PSI See NOTE 1.
40011	10	R/W	FLOAT	2	Pressure set-point for multi-pump pair CD in Continuous Flow Constant Pressure mode.	ATM; BAR; kPa; PSI See NOTE 1.
40013	12	R/W	FLOAT	2	Flow rate set-point for Pump A in Constant Flow mode.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40015	14	R/W	FLOAT	2	Flow rate set-point for Pump B in Constant Flow mode.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40017	16	R/W	FLOAT	2	Flow rate set-point for Pump C in Constant Flow mode.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40019	18	R/W	FLOAT	2	Flow rate set-point for Pump D in Constant Flow mode.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40021	20	R/W	FLOAT	2	Flow rate set-point for multi-pump pair AB in Continuous Flow Constant Flow mode.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40023	22	R/W	FLOAT	2	Flow rate set-point for multi-pump pair CD in Continuous Flow Constant Flow mode.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40025	24	R/W	FLOAT	2	Refill flow rate for Pump A.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40027	26	R/W	FLOAT	2	Refill flow rate for Pump B.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40029	28	R/W	FLOAT	2	Refill flow rate for Pump C.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.

Table 5: Holding Registers

Register	Address	Read/Write	Type	# Of Registers	Description	Units
40031	30	R/W	FLOAT	2	Refill flow rate for Pump D.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40033	32	R/W	FLOAT	2	Maximum pressure set-point for Pump A.	ATM; BAR; kPa; PSI See NOTE 1.
40035	34	R/W	FLOAT	2	Maximum pressure set-point for Pump B.	ATM; BAR; kPa; PSI See NOTE 1.
40037	36	R/W	FLOAT	2	Maximum pressure set-point for Pump C.	ATM; BAR; kPa; PSI See NOTE 1.
40039	38	R/W	FLOAT	2	Maximum pressure set-point for Pump D.	ATM; BAR; kPa; PSI See NOTE 1.
40041	40	R/W	FLOAT	2	Minimum pressure set-point for Pump A.	ATM; BAR; kPa; PSI See NOTE 1.
40043	42	R/W	FLOAT	2	Minimum pressure set-point for Pump B.	ATM; BAR; kPa; PSI See NOTE 1.
40045	44	R/W	FLOAT	2	Minimum pressure set-point for Pump C.	ATM; BAR; kPa; PSI See NOTE 1.
40047	46	R/W	FLOAT	2	Minimum pressure set-point for Pump D.	ATM; BAR; kPa; PSI See NOTE 1.
40049	48	R/W	FLOAT	2	Maximum flow rate set-point for Pump A.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40051	50	R/W	FLOAT	2	Maximum flow rate set-point for Pump B.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40053	52	R/W	FLOAT	2	Maximum flow rate set-point for Pump C.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40055	54	R/W	FLOAT	2	Maximum flow rate set-point for Pump D.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40057	56	R/W	FLOAT	2	Minimum flow rate set-point for Pump A.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40059	58	R/W	FLOAT	2	Minimum flow rate set-point for Pump B.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40061	60	R/W	FLOAT	2	Minimum flow rate set-point for Pump C.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40063	62	R/W	FLOAT	2	Minimum flow rate set-point for Pump D.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40065	64	R/W	FLOAT	2	Maximum flow limit in Constant Pressure mode for Pump A.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40067	66	R/W	FLOAT	2	Maximum flow limit in Constant Pressure mode for Pump B.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40069	68	R/W	FLOAT	2	Maximum flow limit in Constant Pressure mode for Pump C.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40071	70	R/W	FLOAT	2	Maximum flow limit in Constant Pressure mode for Pump D.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40073	72	R	FLOAT	2	Actual pressure of Pump A.	ATM; BAR; kPa; PSI See NOTE 1.
40075	74	R	FLOAT	2	Actual flow rate of Pump A.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40077	76	R	FLOAT	2	Volume remaining in Pump A.	milliliters
40079	78	R	FLOAT	2	Actual pressure of Pump B.	ATM; BAR; kPa; PSI See NOTE 1.
40081	80	R	FLOAT	2	Actual flow rate of Pump B.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40083	82	R	FLOAT	2	Volume remaining in Pump B.	milliliters
40085	84	R	FLOAT	2	Actual pressure of Pump C.	ATM; BAR; kPa; PSI See NOTE 1.
40087	86	R	FLOAT	2	Actual flow rate of Pump C.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40089	88	R	FLOAT	2	Volume remaining in Pump C.	milliliters
40091	90	R	FLOAT	2	Actual pressure of Pump D.	ATM; BAR; kPa; PSI See NOTE 1.
40093	92	R	FLOAT	2	Actual flow rate of Pump D.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40095	94	R	FLOAT	2	Volume remaining in Pump D.	milliliters
40097	96	R	FLOAT	2	System flow rate of multi-pump pair AB.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40099	98	R	FLOAT	2	System pressure of multi-pump pair AB.	ATM; BAR; kPa; PSI See NOTE 1.
40101	100	R	FLOAT	2	Total volume delivered by multi-pump pair AB.	Liters
40103	102	R	FLOAT	2	System flow rate of multi-pump pair CD.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40105	104	R	FLOAT	2	System pressure of multi-pump pair CD.	ATM; BAR; kPa; PSI See NOTE 1.
40107	106	R	FLOAT	2	Total volume delivered by multi-pump pair CD.	Liters
40109	108	R	FLOAT	2	Analog voltage input on Analog Input 1 of the accessory connector.	Volts
40111	110	R	FLOAT	2	Analog voltage input on Analog Input 2 of the accessory connector.	Volts
40113	112	R	FLOAT	2	Analog voltage input on Analog Input 3 of the accessory connector.	Volts
40115	114	R	FLOAT	2	Analog voltage input on Analog Input 4 of the accessory connector.	Volts

Table 5: Holding Registers

Register	Address	Read/Write	Type	# Of Registers	Description	Units
40117	116	R/W	FLOAT	2	Volume at which Pump A will automatically switch to refill mode if AUTO REFILL A is ON .	milliliters
40119	118	R/W	FLOAT	2	Volume at which Pump B will automatically switch to refill mode if AUTO REFILL B is ON .	milliliters
40121	120	R/W	FLOAT	2	Volume at which Pump C will automatically switch to refill mode if AUTO REFILL C is ON .	milliliters
40123	122	R/W	FLOAT	2	Volume at which Pump D will automatically switch to refill mode if AUTO REFILL D is ON .	milliliters
40125	124	R/W	FLOAT	2	Volume that Pump A will be refill to if AUTO FILL TO A is ON.	milliliters
40127	126	R/W	FLOAT	2	Volume that Pump B will be refill to if AUTO FILL TO B is ON.	milliliters
40129	128	R/W	FLOAT	2	Volume that Pump C will be refill to if AUTO FILL TO C is ON.	milliliters
40131	130	R/W	FLOAT	2	Volume that Pump D will be refill to if AUTO FILL TO D is ON.	milliliters
40133	132	R/W	FLOAT	2	Percentage of total pump volume that the refilling pump of multi-pump pair AB will refill to.	%
40135	134	R/W	FLOAT	2	Percentage of total pump volume that the delivering pump of multi-pump pair AB will deliver to.	%
40137	136	R/W	FLOAT	2	Percentage of total pump volume that the refilling pump of multi-pump pair CD will refill to.	%
40139	138	R/W	FLOAT	2	Percentage of total pump volume that the delivering pump of multi-pump pair CD will deliver to.	%
40141	140	R/W	FLOAT	2	POOR FILL MARK A	% VALID ENTRIES:10,20,30,40,50,60,70,80,90
40143	142	R/W	FLOAT	2	POOR FILL MARK B	% VALID ENTRIES:10,20,30,40,50,60,70,80,90
40145	144	R/W	FLOAT	2	POOR FILL MARK C	% VALID ENTRIES:10,20,30,40,50,60,70,80,90
40147	146	R/W	FLOAT	2	POOR FILL MARK D	% VALID ENTRIES:10,20,30,40,50,60,70,80,90
40149	148	R/W	FLOAT	2	Volume being dispensed by Pump A in Dispense mode.	milliliters
40151	150	R/W	FLOAT	2	Volume being dispensed by Pump B in Dispense mode.	milliliters
40153	152	R/W	FLOAT	2	Volume being dispensed by Pump C in Dispense mode.	milliliters
40155	154	R/W	FLOAT	2	Volume being dispensed by Pump D in Dispense mode.	milliliters
40157	156	R/W	FLOAT	2	Full scale input range voltage for External mode.	Volts
40159	168	R/W	FLOAT	2	MIN MOD PRESS: Minimum modifier pump pressure	ATM; BAR; kPa; PSI See NOTE 1.
40161	160	R/W	FLOAT	2	Value of %B for Modifier addition mode.%C for Continuous Modifier addition mode.	%B FOR MODIFIER OR %C FOR CONTINUOUS MODIFIER
40201	200	R	FLOAT	2	Absolute maximum pressure for Pump A.	ATM; BAR; kPa; PSI See NOTE 1.
40203	202	R	FLOAT	2	Absolute maximum flow rate for Pump A.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40205	204	R	FLOAT	2	Absolute maximum refill rate for Pump A.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40207	206	R	FLOAT	2	Maximum volume for Pump A.	milliliters
40209	208	R	FLOAT	2	Absolute maximum pressure for Pump B.	ATM; BAR; kPa; PSI See NOTE 1.
40211	210	R	FLOAT	2	Absolute maximum flow rate for Pump B.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40213	212	R	FLOAT	2	Absolute maximum refill rate for Pump B.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40215	214	R	FLOAT	2	Maximum volume for Pump B.	milliliters
40217	216	R	FLOAT	2	Absolute maximum pressure for Pump C.	ATM; BAR; kPa; PSI See NOTE 1.
40219	218	R	FLOAT	2	Absolute maximum flow rate for Pump C.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40221	220	R	FLOAT	2	Absolute maximum refill rate for Pump C.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40223	222	R	FLOAT	2	Maximum volume for Pump C.	milliliters
40225	224	R	FLOAT	2	Absolute maximum pressure for Pump D.	ATM; BAR; kPa; PSI See NOTE 1.
40227	226	R	FLOAT	2	Absolute maximum flow rate for Pump D.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40229	228	R	FLOAT	2	Absolute maximum refill rate for Pump D.	ml/min; ml/hr; ul/min; ul/hr See NOTE 2.
40231	230	R	FLOAT	2	Maximum volume for Pump D.	milliliters

Table 5: Holding Registers

Register	Address	Read/ Write	Type	# Of Registers	Description	Units
40233	232	R	FLOAT	2	PUMP TYPE A	
40235	234	R	FLOAT	2	PUMP TYPE B	
40237	236	R	FLOAT	2	PUMP TYPE C	
40239	238	R	FLOAT	2	PUMP TYPE D	
40241	240	R	FLOAT	2	SOFTWARE MAJOR REV	
40243	242	R	FLOAT	2	SOFTWARE MINOR REV	
40245	244	R	FLOAT	2	SOFTWARE MICRO REV	

☑ Note

Pressure and flow rate based on user selected units.

References:

1. http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b.pdf
2. http://www.modbus.org/docs/Modbus_over_serial_line_V1_02.pdf
3. http://www.isco.com/WebProductFiles/Applications/105/Technical_Bulletins/TB28_Controller_Versions.pdf

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