REV	ACTION	DRAWN	CHECKED	APPROVED	DATE
AA	L4556	HEFTON	HEFTON	HOLLAND	97/07/10
AB	D4613	HEFTON	HEFTON	HOLLAND	97/07/25
AC	D20072	KASTNER	KASTNER	BUSHNELL	06/11/29

Totalflow Modbus Protocol for 6400 (5189) FCUs

PRODUCT LINE TOTALFLOW	DATE	ABB TOTALFLOW Products							
DESIGN R. EPPS	97/07	TITLE TOTALFLOW MODBUS PROTOCOL 6400 (5189) FCU MODBUS							
DRAWN HEFTON	97/07								
CHECKED HEFTON	97/07								
APPROVED G. HOLLAND	97/07	SCALE NONE	SIZE A	TYPE AI	DRAWING NO. 2017394	REV AC	SHEET 1	OF	23

I. Purpose

This paper describes Modbus communications protocol for Totalflow FCUs.

II. Modbus Description

The Modbus protocol is described in the document entitled "Gould Modbus Protocol Reference Guide" published January, 1985 by Gould Inc., Programmable Control Division, Andover, Massachusetts.

Modbus uses the master, slave communications concept. Slave devices speak only when spoken to by the master. Each slave is identified by an unsigned, one byte number ranging from 1 to 247 (inclusive). A slave must send a single response to a master's request for data.

Modbus messages may be one of two formats:

Modbus RTU message frame format:

Packet	CRC
N x 8 bits	16-bits

Packet: The packet field consists of the Modbus packet being sent or received. Packet format varies with the function being performed and the register group being accessed.

CRC: The error check field consists an 16 bit cyclic redundancy check calculated over the length of the packet field.

Modbus ASCII message frame format:

BOF	Packet	LRC	EOF	Ready
:	2 x Number of bytes in Modbus packet	8-bits	CR	LF

BOF: A colon (:) character is used to indicate beginning of frame.

Packet: The packet field consists of hexadecimal ASCII characters representing the Modbus packet being sent or received. The number of characters is twice the number of bytes in the Modbus packet because each packet byte is converted into two hexadecimal ASCII characters ('0'-'9','A'-'F'.)

LRC: The error check field consists an 8 bit longitudinal redundancy check calculated over the length of the packet field before it is converted to hexadecimal ASCII.

EOF/Ready: A carriage return and line feed are used to delineate end of frame.

Note: *Total message frame length can not exceed 256 bytes.*

III. Totalflow Modbus Implementation

Totalflow Modbus supports RTU or ASCII mode. Support has also been added for long integer, floating point, and archive record registers. Totalflow Modbus supports the following subset of the Gould Modbus defined functions:

Code	Function	Description
01	Read Boolean	Reads group of boolean registers
03	Read Registers	Reads group of 16/32 bit registers
05	Set Single Boolean	Set or clear a boolean register
06	Set Single Register	Set a 16/32 bit register to specified value
16	Set Multiple Register	Set multiple 16/32 bit registers
128-143	Exception Response	Used in FCU response packets to indicate errors in processing function codes 1-16.

Packet formats:

Read Query

Address	Function	Register	Quantity
8-bits	8-bits	16-bits	16-bits

Read Response

Address	Function	Byte Count	Data
8-bits	8-bits	8-bits	N x 8 bits

Set Query

Address	Function	Register	Data
8-bits	8-bits	16-bits	N x 8 bits

Set Response

Address	Function	Register	Data
8-bits	8-bits	16-bits	N x 8 bits

Set Multiple Query

Address	Function	Register	Quantity	Byte Count	Data
8-bits	8-bits	16-bits	16-bits	8-bits	N x 8 bits

Set Multiple Response

Address	Function	Register	Quantity
8-bits	8-bits	16-bits	16-bits

Exception Response

Address	Function	Code
8-bits	8-bits	8-bits

Address: The address field contains the slave address of the FCU intended to receive the packet. Each FCU must be assigned a unique address in the range of 1 to 247.

Function: The function code field contains a code which tells the FCU what to do or what data to send. The high order bit in this field may be set by the FCU in the response packet to indicate an error response.

Register: The register field contains the register number of the FCU data item to fetch or set. For read functions, this is the starting register number.

Code: The code field contains an error value for the exception response. Currently there are three values used; 1 indicates that the function code is unsupported, 2 indicates the register number requested is invalid, 3 indicates that too many data

values were requested and that the maximum packet size was exceeded. The maximum packet size for ASCII is 122 bytes and for RTU the maximum packet size is 250.

Quantity: The quantity field contains the number of consecutive registers to fetch or set. This field is not present in all packets (only read and set multiple queries).

Byte Count: The byte count field contains the number of bytes of data being transferred. This field is not present in all packets (only read response and set multiple query).

Data: The data field contains the actual data values being transferred. This field is not present in all packets. The size and format of the data values depend on the register group being accessed. The byte order of data items is high to low (MSB first, LSB last).

IV. Register Group Configuration

Registers are grouped by data type. The grouping is fixed, but the base (or starting) register number of each group is configurable. Default register group assignments:

Default Base	Type	Description
100	INTEGER	Register Configuration Group
1001	BOOLEAN	1 Bit Boolean Group
3001	INTEGER	16 Bit Integer Group
5001	LONG INTEGER	32 Bit Long Integer Group
7001	FLOATING POINT	32 Bit IEEE Floating Point Group
10001	RECORD	Daily Flow Archive Record Group
11001	RECORD	Log Period Flow Archive Record Group
12001	RECORD	Event Log Archive Record Group
0 (Disabled)	FLOATING POINT	Configurable Read-only Floating Point Group

Group configuration registers are read using function code 03 and set using function code 06 or 16. To disable a register group, set the base register to zero (0).

Register	Access	Description
100	Read/Write	Configuration Group Base Register Number
101	Read/Write	Boolean Register Group Base Register Number
102	Read/Write	Integer Register Group Base Register Number
103	Read/Write	Long Register Group Base Register Number
104	Read/Write	Floating Point Register Group Base Register Number
105	Read/Write	Daily Flow Archive Register Group Base Register Number
106	Read/Write	Log Period Archive Register Group Base Register Number
107	Read/Write	Event Log Archive Register Group Base Register Number
110	Read/Write	Configurable Register Group Base Register Number
111	Read/Write	Configurable Register 1
112	Read/Write	Configurable Register 2
113	Read/Write	Configurable Register 3
114	Read/Write	Configurable Register 4
115	Read/Write	Configurable Register 5
116	Read/Write	Configurable Register 6
117	Read/Write	Configurable Register 7
118	Read/Write	Configurable Register 8
119	Read/Write	Configurable Register 9
120	Read/Write	Configurable Register 10
121	Read/Write	Configurable Register 11
122	Read/Write	Configurable Register 12
123	Read/Write	Configurable Register 13
124	Read/Write	Configurable Register 14
125	Read/Write	Configurable Register 15
126	Read/Write	Configurable Register 16
127	Read/Write	Configurable Register 17
128	Read/Write	Configurable Register 18
129	Read/Write	Configurable Register 19
130	Read/Write	Configurable Register 20
131	Read/Write	Configurable Register 21
132	Read/Write	Configurable Register 22
133	Read/Write	Configurable Register 23
134	Read/Write	Configurable Register 24
135	Read/Write	Configurable Register 25
136	Read/Write	Configurable Register 26

Register	Access	Description
137	Read/Write	Configurable Register 27
138	Read/Write	Configurable Register 28
139	Read/Write	Configurable Register 29
140	Read/Write	Configurable Register 30
141	Read/Write	Configurable Register 31
142	Read/Write	Configurable Register 32
143	Read/Write	Configurable Register 33
144	Read/Write	Configurable Register 34
145	Read/Write	Configurable Register 35
146	Read/Write	Configurable Register 36
147	Read/Write	Configurable Register 37
148	Read/Write	Configurable Register 38
149	Read/Write	Configurable Register 39
150	Read/Write	Configurable Register 40
151	Read/Write	Configurable Register 41
152	Read/Write	Configurable Register 42
153	Read/Write	Configurable Register 43
154	Read/Write	Configurable Register 44
155	Read/Write	Configurable Register 45
156	Read/Write	Configurable Register 46
157	Read/Write	Configurable Register 47
158	Read/Write	Configurable Register 48
159	Read/Write	Configurable Register 49
160	Read/Write	Configurable Register 50
161	Read/Write	Configurable Register 51
162	Read/Write	Configurable Register 52
163	Read/Write	Configurable Register 53
164	Read/Write	Configurable Register 54
165	Read/Write	Configurable Register 55
166	Read/Write	Configurable Register 56
167	Read/Write	Configurable Register 57
168	Read/Write	Configurable Register 58
169	Read/Write	Configurable Register 59
170	Read/Write	Configurable Register 60
171	Read/Write	Configurable Register 61
172	Read/Write	Configurable Register 62

V. Configurable Register Group

Registers 110-172 can be used to configure a custom floating point register group as follows:

- Define the register group by writing the fixed register numbers of the data items to be included in this register group into registers 111-172. Any of the Boolean, Integer, Long Integer, or Floating Point registers may be specified. The data from boolean, integer, and long integer registers will be converted to floating point before they are inserted into the response packet.

- Enable the register group by writing a base register number into register 110. This will be the starting register number of the custom register group.

Example Custom Group Definition:

110 = 8001 (Starting register number of group)
111 = 0 (Null)
112 = 0 (Null)
113 = 7003 (Current AP)
114 = 7004 (Current DP)
115 = 7005 (Current TF)
116 = 7006 (Current Flow Rate)
117 = 7009 (Today's Accumulated Volume)
118 = 7022 (Previous Day's Volume)
119 = 7001 (Current Battery Voltage)
120 = 7002 (Current Charger Voltage)

Using the above group definition, a poll of registers 8001-8010 will return:

8001 = zero (0.0)
8002 = zero (0.0)
8003 = Current AP
8004 = Current DP
8005 = Current TF
8006 = Current Flow Rate
8007 = Today's Accumulated Volume
8008 = Previous Day's Volume
8009 = Current Battery Voltage
8010 = Current Charger Voltage

As shown in the example above, null (0) register entries are allowed. The response packet will be padded with zero (0.0) values for each null register polled. Attempts to write to null register entries will be ignored.

VI. Boolean Register Group

Boolean registers are read using function code 01 or set using function code 05. The base register number for this register group defaults to 1001 when the unit is cold started. It can be changed by setting register 101 to the desired starting register number of the group.

Register	Access	Description	Meter Type
1001	Read/Write	Use Sqrt /linear AP/DP avgs (1 = Sqrt)	Gas Orifice
1002	Read/Write	Use F(pb) (1985 Equation)	G.O. / Turbine
1003	Read/Write	Use F(tb) (1985 Equation)	G.O. / Turbine
1004	Read/Write	Use F(tf) (1985 Equation)	Gas Orifice
1005	Read/Write	Use F(g) (1985 Equation)	Gas Orifice
1006	Read/Write	Use F(a) (1985 Equation)	Gas Orifice
1007	Read/Write	Use F(r) (1985 Equation)	Gas Orifice
1008	Read/Write	Use Y (1985 Equation)	Gas Orifice
1009	Read/Write	Use F(w) (1985 Equation)	Gas Orifice
1010	Read/Write	Use F(pv) (1985 Equation)	Gas Orifice
1011	Read/Write	Use F(aux) (1985 Equation)	G.O. / Turbine
1012	Read/Write	Use F(b) (1985 Equation)	Gas Orifice
1013	Read/Write	Tap location (1985 Equation) (1 = Upstream)	Gas Orifice
1014	Read/Write	Orifice Type (0 = SS, 1 = Monel) (1985 Eq only)	Gas Orifice
1015	Read/Write	Use Y (1992 Equation)	Gas Orifice
1016	Read/Write	Use F(pv) (1992 Equation)	Gas Orifice
1017	Read/Write	Use F(w) (1992 Equation)	Gas Orifice
1018	Read/Write	Use F(aux) (1992 Equation)	Gas Orifice
1019	Read/Write	Tap location (1992 Equation)(1 = Upstream, 0 = Down)	Gas Orifice
1020	Read/Write	Use calc Cd / fixed Cd (1 = calc Cd) (1992 Equation)	Gas Orifice
1021	ReadOnly	Tap Type Support (1 = supported) (1985 Equation)	Gas Orifice

1022	Read/Write	Tap type (1 = pipe, 0 = flange) (1985 Equation)	Gas Orifice
1023	Read/Write	RTD installed	G.O. / Turbine
1024	Read/Write	Temperature in calcs (1 = Measured, 0 = Fixed)	G.O. / Turbine
1025	Write Only	Reset volume	Gas Orifice
1026	Write Only	Reset Log Period	Gas Orifice
1027	Read/Write	Trip contact on Low Charger alarm	G.O. / Turbine
1028	Read/Write	Trip contact on DP low alarm	Gas Orifice
1029	Read/Write	Trip contact on DP high alarm	Gas Orifice
1030	Read/Write	Trip contact on AP low alarm	G.O. / Turbine
1031	Read/Write	Trip contact on AP high alarm	G.O. / Turbine
1032	Read/Write	Trip contact on Remote Sense	G.O. / Turbine
1033	Read/Write	Trip contact on volume setpoint	G.O. / Turbine
1034	Read/Write	Aux Contact Auto Reset (1 = yes)	G.O. / Turbine
1035	Read/Write	Auxiliary Contact State (0/1)	Gas Orifice
1036	Read/Write	Hold Current Analog Inputs	Gas Orifice
1037	Read Only	Attached to stream (AIU support)	G.O. / Turbine
1038	Read Only	First analysis received (AIU support)	G.O. / Turbine
1039	Read/Write	Use Fixed Analysis on error (AIU support)	G.O. / Turbine
1040	Read/Write	Use Fixed Water Vapor Content	Gas Orifice
1041	Write Only	Wakeup FCU from low voltage induced sleep	Gas Orifice
1042	Read/Write	Use Fixed Test Mode AP, DP/PI, and RTD values.	Gas Orifice
1043	Read/Write	Use Measured AP	Turbine
1044	Read/Write	Use S (Fpv^2)	Turbine
1045	Read/Write	Trip contact on ACF low alarm	Turbine
1046	Read/Write	Trip contact on ACF high alarm	Turbine
1047	Read Only	Remote Sense Digital Input State(DI 1)	G.O. / Turbine
1048	Read Only	Digital Input 2 (DI 2, 6400 DBs Only)	G.O. / Turbine
1049	Read/Write	Digital Output 2 (DO 2, 6400 DBs Only)	G.O. / Turbine
1050	Read/Write	Trip contact (DO1) on Tf Low Alarm	G.O. / Turbine
1051	Read/Write	Trip contact (DO1) on Tf High Alarm	G.O./ Turbine
1052	Read/Write	Trip contact (DO1) on Flow Rate Low Alarm	G.O. / Turbine
1053	Read/Write	Trip contact (DO1) on Flow Rate High Alarm	G.O./ Turbine
1054	Read/Write	Trip contact (DO2) on Low Charger alarm	G.O. / Turbine
1055	Read/Write	Trip contact (DO2) on DP (or ACF) low alarm	Gas Orifice
1056	Read/Write	Trip contact (DO2) on DP (or ACf) high alarm	Gas Orifice
1057	Read/Write	Trip contact (DO2) on AP low alarm	G.O. / Turbine
1058	Read/Write	Trip contact (DO2) on AP high alarm	G.O. / Turbine
1059	Read/Write	Trip contact (DO2) on Remote Sense	G.O. / Turbine
1060	Read/Write	Trip contact (DO2) on volume setpoint	G.O. / Turbine
1061	Read/Write	Aux Contact (DO2) Auto Reset (1 = yes)	G.O. / Turbine
1062	Read/Write	Trip contact (DO2) on Tf Low Alarm	G.O. / Turbine
1063	Read/Write	Trip contact (DO2) on Tf High Alarm	G.O./ Turbine
1064	Read/Write	Trip contact (DO2) on Flow Rate Low Alarm	G.O. / Turbine
1065	Read/Write	Trip contact (DO2) on Flow Rate High Alarm	G.O./ Turbine

VII. Short Integer Register Group

Short integer registers are read using function code 03 and set using function code 06 or 16. The base register number for this register group defaults to 3001 when the unit is cold started. It can be changed by setting register 102 to the desired starting register number of the group.

Register	Access	Description	Meter Type
3001	Read Only	Primary element (1 = Turbine, 0 = Gas Orifice)	G.O. / Turbine

3002	Read Only	Primary element mask	G.O. / Turbine
3003	Read/Write	FCU volume calc. method (1 = 1985 eq., 2 = 1992 eq.)	G.O.
3004	Read Only	FCU volume calc method mask	G.O.
3005	Read Only	FCU calculation units	G.O. / Turbine
3006	Read Only	FCU calculation units mask	G.O. / Turbine
3007	Read/Write	Supercomp method (0 = NX19 Fixed, 1 = NX19 Auto, 2 = NX19 GCN, 3 = NX19 GCNM, 11 = AGA-8 Gross, 12 = AGA-8 Detail)	G.O. / Turbine
3008	Read Only	Supercomp method mask	G.O. / Turbine
3009	Read/Write	Contract Hour	G.O. / Turbine
3010	Read/Write	Volume calculation period in seconds (60, 120, 600, 1200, & 3600)	G.O. / Turbine
3011	Read/Write	Modbus Slave Address	G.O. / Turbine
3012	Read/Write	Remote Comm Baud (0=1200,1=2400,2=4800,3=9600)	G.O. / Turbine
3013	Read/Write	Remote Comm Data Bits (7 or 8)	G.O. / Turbine
3014	Read/Write	Remote Comm Parity (0 = None, 1 = Odd, 2 = Even)	G.O. / Turbine
3015	Read/Write	Remote Comm Stop Bits (1 or 2)	G.O. / Turbine
3016	Read/Write	Radio power up delay(milliseconds)	G.O. / Turbine
3017	Read/Write	Xmitter key delay(milliseconds)	G.O. / Turbine
3018	Read/Write	Xmitter unkey delay (milliseconds)	G.O. / Turbine
3019	Read/Write	Remote Comm Protocol (0 = Totalflow, 1 = Modbus)	G.O. / Turbine
3020	Read/Write	Remote Comm Link Establish Time (Totalflow Protocol)	G.O. / Turbine
3021	Read/Write	Maximum Number of Events	G.O. / Turbine
3022	Read/Write	Sequence Number of Last Event Logged	G.O. / Turbine
3023	Read/Write	Sequence Number of Last Event Read	G.O. / Turbine
3024	Read/Write	Sequence Number of Last Event Acknowledged	G.O. / Turbine
3025	Read/Write	Number of unacknowledged events	G.O. / Turbine
3026	Read/Write	Maximum Number of Log Period Records	G.O. / Turbine
3027	Read Only	Sequence Number of current Log Period Record	G.O. / Turbine
3028	Read/Write	Maximum Number of Day Period Records	G.O. / Turbine
3029	Read Only	Sequence Number of current Day Period Record	G.O. / Turbine
3030	Read Only	Sequence number of 1st Log Period Rec in current day	G.O. / Turbine
3031	Read/Write	Vol Period Counter	G.O. / Turbine
3032	Read/Write	FCU ID	G.O. / Turbine
3033	Read/Write	FCU ID (cont.)	G.O. / Turbine
3034	Read/Write	FCU ID (cont.)	G.O. / Turbine
3035	Read/Write	FCU ID (cont.)	G.O. / Turbine
3036	Read/Write	FCU ID (cont.)	G.O. / Turbine
3037	Read/Write	FCU Location	G.O. / Turbine
3038	Read/Write	FCU Location (cont.)	G.O. / Turbine
3039	Read/Write	FCU Location (cont.)	G.O. / Turbine
3040	Read/Write	FCU Location (cont.)	G.O. / Turbine
3041	Read/Write	FCU Location (cont.)	G.O. / Turbine
3042	Read/Write	FCU Location (cont.)	G.O. / Turbine
3043	Read/Write	FCU Location (cont.)	G.O. / Turbine
3044	Read/Write	FCU Location (cont.)	G.O. / Turbine
3045	Read/Write	FCU Location (cont.)	G.O. / Turbine
3046	Read/Write	FCU Location (cont.)	G.O. / Turbine
3047	Read/Write	FCU Location (cont.)	G.O. / Turbine
3048	Read/Write	FCU Location (cont.)	G.O. / Turbine
3049	Read/Write	Software Part Number	G.O. / Turbine
3050	Read/Write	Software Part Number (cont.)	G.O. / Turbine
3051	Read/Write	Software Part Number (cont.)	G.O. / Turbine
3052	Read/Write	Software Part Number (cont.)	G.O. / Turbine
3053	Read/Write	Software Part Number (cont.)	G.O. / Turbine
3054	Read/Write	Software Part Number (cont.)	G.O. / Turbine
3055	Read/Write	Software Part Name	G.O. / Turbine
3056	Read/Write	Software Part Name (cont.)	G.O. / Turbine

3057	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3058	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3059	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3060	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3061	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3062	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3063	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3064	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3065	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3066	Read/Write	Software Part Name (cont.)	G.O. / Turbine
3067	Read/Write	Software Revision	G.O. / Turbine
3068	Read/Write	Software Revision (cont.)	G.O. / Turbine
3069	Read Only	Flow Window Period In Seconds (1, 2, 5, 10, 15, 20, 30, & 60) (60 - 3600 in 60 sec. intervals)	Turbine
3070	Read/Write	Modbus Group Address	G.O. / Turbine
3071	Read/Write	Current Group Select	G.O. / Turbine
3072	Read/Write	Remote Port Listen Interval Timeout (Seconds)	G.O. / Turbine
3073	Read/Write	Local Port Listen Interval Timeout (Seconds)	G.O. / Turbine
3074	Read/Write	Aux Port Listen Interval Timeout (Seconds)	G.O. / Turbine
3075	Read/Write	Current Analog Input Number (0-6)	6400dbs Only

VIII. Long Integer Register Group

Long integer registers are read using function code 03 and set using function code 06 or 16. The base register number for this register group defaults to 5001 when the unit is cold started. It can be changed by setting register 103 to the desired starting register number of the group.

Register	Access	Description	Meter Type
5001 / 5001	Read/Write	Date / Time (Julian - # seconds since 00:00:00 1/1/70)	G.O. / Turbine
5002 / 5003	Read/Write	Volume Log period	G.O. / Turbine
5003 / 5005	Read Only	Log Period Counter	G.O. / Turbine
5004 /5007	Read Only	Log Period Start Date/Time	G.O. / Turbine
5005 / 5009	Read Only	Day Period Start Date/Time	G.O. / Turbine
5006 / 5011	Read Only	AIU Date/Time	G.O. / Turbine
5007 / 5013	Read Only	AIU Stream ID	G.O. / Turbine
5008 / 5015	Read/Write	Modbus Security Seed	G.O. / Turbine
5009 / 5017	Read Only	Extended Feature Flags	G.O. / Turbine
5010 / 5019	Read Only	Cold Start Date	G.O. / Turbine
5011 / 5021	Read Only	Total RAM size	G.O. / Turbine
5012 / 5023	Read Only	Total Banked RAM size	G.O. / Turbine
5013 / 5025	Read Only	Total Free Banked RAM	G.O. / Turbine
5014 / 5027	Read Only	Last calc Period Int. Range	G.O. / Turbine
5015 / 5029	Read Only	Last calc Period Int. Counts	G.O. / Turbine
5016 / 5031	Read Only	Last calc Period Alarms	G.O. / Turbine
5017 / 5033	Read/Write	PI 1 Accumulated Counts	G.O. / Turbine
5018 / 5035	Read/Write	PI 2 Accumulated Counts (6400DBs Only)	G.O. / Turbine
5019 / 5037	Read Only	PI 1 Current Counts (1 second reading)	G.O. / Turbine
5020 / 5039	Read Only	PI 2 Current Counts (1 second reading, 6400DBs)	G.O. / Turbine

VIIII. Floating Point Register Group

Floating point registers are read using function code 03 and set using function code 06 or 16. The base register number for this register group defaults to 7001 when the unit is cold started. It can be changed by setting register 104 to the desired starting register number of the group.

Register	Access	Description	Meter Type
7001 / 7001	Read Only	Current battery voltage	G.O. / Turbine
7002 / 7003	Read Only	Current charger voltage	G.O. / Turbine
7003 / 7005	Read Only	Current AP	G.O. / Turbine
7004 / 7007	Read Only	Current DP	Gas Orifice
7005 / 7009	Read Only	Current Temp	G.O. / Turbine
7006 / 7011	Read Only	Current flow rate (MCF/Hour)	G.O. / Turbine
7007 / 7013	Read Only	Current energy rate (MMBTU/Hour)	G.O. / Turbine
7008 / 7015	Read Only	Accumulated volume (MCF)	G.O. / Turbine
7009 / 7017	Read Only	Accumulated Volume since start of contract day (MCF)	G.O. / Turbine
7010 / 7019	Read Only	Previous Hour diff. pressure	Gas Orifice
7011 / 7021	Read Only	Previous Hour abs. pressure	G.O. / Turbine
7012 / 7023	Read Only	Previous Hour flowing temp	G.O. / Turbine
7013 / 7025	Read Only	Previous Hour extension	Gas Orifice
7014 / 7027	Read Only	Previous Hour volume (MCF)	G.O. / Turbine
7015 / 7029	Read Only	Previous Hour energy (MMBTU)	G.O. / Turbine
7016 / 7031	Read Only	Previous Hour Flow Time (MMMM.SS)	G.O. / Turbine
7017 / 7033	Read Only	Previous Hour Time (MMMM.SS)	G.O. / Turbine
7018 / 7035	Read Only	Previous Day diff. pressure	Gas Orifice
7019 / 7037	Read Only	Previous Day abs. pressure	G.O. / Turbine
7020 / 7039	Read Only	Previous Day flowing temp	G.O. / Turbine
7021 / 7041	Read Only	Previous Day Extension	Gas Orifice
7022 / 7043	Read Only	Previous Day volume (MCF)	G.O. / Turbine
7023 / 7045	Read Only	Previous Day energy (MMBTU)	G.O. / Turbine
7024 / 7047	Read Only	Previous Day Flow Time (MMMM.SS)	G.O. / Turbine
7025 / 7049	Read Only	Previous Day Time (MMMM.SS)	G.O. / Turbine
7026 / 7051	Read/Write	Fixed Analysis BTU	G.O. / Turbine
7027 / 7053	Read/Write	Fixed Analysis Gravity	G.O. / Turbine
7028 / 7055	Read/Write	Fixed Analysis CO2	G.O. / Turbine
7029 / 7057	Read/Write	Fixed Analysis N2	G.O. / Turbine
7030 / 7059	Read/Write	Fixed Analysis Methane	G.O. / Turbine
7031 / 7061	Read/Write	Fixed Analysis Ethane	G.O. / Turbine
7032 / 7063	Read/Write	Fixed Analysis Propane	G.O. / Turbine
7033 / 7065	Read/Write	Fixed Analysis IButane	G.O. / Turbine
7034 / 7067	Read/Write	Fixed Analysis NButane	G.O. / Turbine
7035 / 7069	Read/Write	Fixed Analysis IPentane	G.O. / Turbine
7036 / 7071	Read/Write	Fixed Analysis NPentane	G.O. / Turbine
7037 / 7073	Read/Write	Fixed Analysis NHexane	G.O. / Turbine
7038 / 7075	Read/Write	Fixed Analysis NHeptane	G.O. / Turbine
7039 / 7077	Read/Write	Fixed Analysis NOctane	G.O. / Turbine
7040 / 7079	Read/Write	Fixed Analysis NNonane	G.O. / Turbine
7041 / 7081	Read/Write	Fixed Analysis H2S	G.O. / Turbine
7042 / 7083	Read/Write	Fixed Analysis Hydrogen	G.O. / Turbine
7043 / 7085	Read/Write	Fixed Analysis Helium	G.O. / Turbine
7044 / 7087	Read/Write	Fixed Analysis Oxygen	G.O. / Turbine
7045 / 7089	Read/Write	Fixed Analysis Carbon Monoxide	G.O. / Turbine
7046 / 7091	Read/Write	Fixed Analysis Argon	G.O. / Turbine
7047 / 7093	Read/Write	Fixed Analysis NDecane	G.O. / Turbine
7048 / 7095	Read/Write	Fixed Analysis H2O	G.O. / Turbine
7049 / 7097	Read/Write	Fixed temperature	G.O. / Turbine
7050 / 7099	Read/Write	Temperature bias	G.O. / Turbine

7051 / 7101	Read/Write	Temperature base	G.O. / Turbine
7052 / 7103	Read/Write	Pressure base	G.O. / Turbine
7053 / 7105	Read/Write	Ratio of specific heats	G.O. / Turbine
7054 / 7107	Read/Write	Viscosity	G.O. / Turbine
7055 / 7109	Read/Write	Fixed F(b) (1985 Equation)	Gas Orifice
7056 / 7111	Read/Write	Fixed Cd (1992 Equation)	Gas Orifice
7057 / 7113	Read/Write	Fixed F(aux)	G.O. / Turbine
7058 / 7115	Read/Write	Fixed F(t) for NX19	G.O. / Turbine
7059 / 7117	Read/Write	Fixed F(p) for NX19	G.O. / Turbine
7060 / 7119	Read/Write	Zba - Z of air at base (1992 Equation)	Gas Orifice
7061 / 7121	Read/Write	Orifice diameter	Gas Orifice
7062 / 7123	Read/Write	Orifice plate coef. of expansion (1992 Equation)	Gas Orifice
7063 / 7125	Read/Write	Pipe diameter	Gas Orifice
7064 / 7127	Read/Write	Pipe coef. of expansion (1992 Equation)	Gas Orifice
7065 / 7129	Read/Write	Fixed barometric pressure	G.O. / Turbine
7066 / 7131	Read/Write	Fixed Water Vapor Content (LBS/MMSCF)	Gas Orifice
7067 / 7133	Read/Write	Water Content Bias (LBS/MMSCF)	Gas Orifice
7068 / 7135	Read Only	Last Calc Period diff. pressure	Gas Orifice
7069 / 7137	Read Only	Last Calc Period abs. pressure	G.O. / Turbine
7070 / 7139	Read Only	Last Calc Period flowing temp	G.O. / Turbine
7071 / 7141	Read Only	Last Calc Period volume (MCF)	G.O. / Turbine
7072 / 7143	Read Only	Last Calc Period Extension	Gas Orifice
7073 / 7145	Read Only	Last Calc Period C'	G.O. / Turbine
7074 / 7147	Read Only	Last Calc Period Y	Gas Orifice
7075 / 7149	Read Only	Last Calc Period F(pv)	Gas Orifice
7076 / 7151	Read Only	Last Calc Period F(w)	Gas Orifice
7077 / 7153	Read Only	Last Calc Period F(aux)	Gas Orifice
7078 / 7155	Read Only	Last Calc Period Qv	Gas Orifice
7079 / 7157	Read Only	Last Calc Period F(b)	Gas Orifice
7080 / 7159	Read Only	Last Calc Period F(r)	Gas Orifice
7081 / 7161	Read Only	Last Calc Period F(pb)	G.O. / Turbine
7082 / 7163	Read Only	Last Calc Period F(tb)	G.O. / Turbine
7083 / 7165	Read Only	Last Calc Period F(tf)	Gas Orifice
7084 / 7167	Read Only	Last Calc Period F(g)	Gas Orifice
7085 / 7169	Read Only	Last Calc Period F(a)	Gas Orifice
7086 / 7171	Read Only	Last Calc Period Fip	Gas Orifice
7087 / 7173	Read Only	Last Calc Period Ev	Gas Orifice
7088 / 7175	Read Only	Last Calc Period Orif Diameter	Gas Orifice
7089 / 7177	Read Only	Last Calc Period Pipe Diameter	Gas Orifice
7090 / 7179	Read Only	Last Calc Period Rhob	Gas Orifice
7091 / 7181	Read Only	Last Calc Period qm	Gas Orifice
7092 / 7183	Read Only	Last Calc Period Cd	Gas Orifice
7093 / 7185	Read Only	Last Calc Analysis BTU	G.O. / Turbine
7094 / 7187	Read Only	Last Calc Analysis Gravity	G.O. / Turbine
7095 / 7189	Read Only	Last Calc Analysis CO2	G.O. / Turbine
7096 / 7191	Read Only	Last Calc Analysis N2	G.O. / Turbine
7097 / 7193	Read Only	Last Calc Analysis Methane	G.O. / Turbine
7098 / 7195	Read Only	Last Calc Analysis Ethane	G.O. / Turbine
7099 / 7197	Read Only	Last Calc Analysis Propane	G.O. / Turbine
7100 / 7199	Read Only	Last Calc Analysis IButane	G.O. / Turbine
7101 / 7201	Read Only	Last Calc Analysis NButane	G.O. / Turbine
7102 / 7203	Read Only	Last Calc Analysis IPentane	G.O. / Turbine
7103 / 7205	Read Only	Last Calc Analysis NPentane	G.O. / Turbine
7104 / 7207	Read Only	Last Calc Analysis NHexane	G.O. / Turbine
7105 / 7209	Read Only	Last Calc Analysis NHeptane	G.O. / Turbine
7106 / 7211	Read Only	Last Calc Analysis NOctane	G.O. / Turbine
7107 / 7213	Read Only	Last Calc Analysis NNonane	G.O. / Turbine

7108 / 7215	Read Only	Last Calc Analysis H2S	G.O. / Turbine
7109 / 7217	Read Only	Last Calc Analysis Hydrogen	G.O. / Turbine
7110 / 7219	Read Only	Last Calc Analysis Helium	G.O. / Turbine
7111 / 7221	Read Only	Last Calc Analysis Oxygen	G.O. / Turbine
7112 / 7223	Read Only	Last Calc Analysis Carbon Monoxide	G.O. / Turbine
7113 / 7225	Read Only	Last Calc Analysis Argon	G.O. / Turbine
7114 / 7227	Read Only	Last Calc Analysis NDecane	G.O. / Turbine
7115 / 7229	Read Only	Last Calc Analysis H2O	G.O. / Turbine
7116 / 7231	Read/Write	DP Zero cutoff	Gas Orifice
7117 / 7233	Read/Write	DP low limit	Gas Orifice
7118 / 7235	Read/Write	DP hi limit	Gas Orifice
7119 / 7237	Read/Write	AP lo limit	G.O. / Turbine
7120 / 7239	Read/Write	AP hi limit	G.O. / Turbine
7121 / 7241	Read/Write	Tf low limit	G.O. / Turbine
7122 / 7243	Read/Write	Tf high limit	G.O. / Turbine
7123 / 7245	Read/Write	Flow Rate low limit	G.O. / Turbine
7124 / 7247	Read/Write	Flow Rate high limit	G.O. / Turbine
7125 / 7249	Read/Write	Volume Set Point for contact	G.O. / Turbine
7126 / 7251	Read Only	Accumulated Volume Rollover Setpoint	G.O. / Turbine
7127 / 7253	Read/Write	Places User Site Code in Event Log	G.O. / Turbine
7128 / 7255	Read Only	AP low calibration	G.O. / Turbine
7129 / 7257	Read Only	AP mid calibration	G.O. / Turbine
7130 / 7259	Read Only	AP high calibration	G.O. / Turbine
7131 / 7261	Read Only	DP lo calibration	Gas Orifice
7132 / 7263	Read Only	DP mid calibration	Gas Orifice
7133 / 7265	Read Only	DP high calibration	Gas Orifice
7134 / 7267	Read Only	Current Unfiltered Temp	G.O. / Turbine
7135 / 7269	Read Only	Current Unfiltered AP	G.O. / Turbine
7136 / 7271	Read Only	Current Unfiltered DP	Gas Orifice
7137 / 7273	Read Only	Current Pulse Count * Meter Factor	G.O. / Turbine
7138 / 7275	Read Only	Test Mode Fixed RTD Input Value	G.O. / Turbine
7139 / 7277	Read Only	Test Mode Fixed AP Input Value	G.O. / Turbine
7140 / 7279	Read Only	Test Mode Fixed DP/PI Input Value	G.O. / Turbine
7141 / 7281	Read Only	Previous Vol Period Pulse Count	Turbine
7142 / 7283	Read Only	Current Uncorrected Flow Rate	Turbine
7143 / 7285	Read Only	Uncorrected Accumulated Volume	Turbine
7144 / 7287	Read Only	Yesterday's Uncorrected Volume	Turbine
7145 / 7289	Read Only	Last Calc Period Uncorrected Volume	Turbine
7146 / 7291	Read Only	Last Calc Period S (Fpv^2)	Turbine
7147 / 7293	Read Only	Fixed AP	Turbine
7148 / 7295	Read Only	ACF high limit	Turbine
7149 / 7297	Read Only	ACF low limit	Turbine
7150 / 7299	Read Only	Meter Factor	Turbine
7151 / 7301	Read Only	Accumulated Energy	(G.O. / Turbine)
7152 / 7303	Read Only	Contract Day Accumulated Energy	(G.O. / Turbine)
7153 / 7305	Read Only	Prev Contract Day Accum Energy	(G.O. / Turbine)
7154 / 7307	Read Only	Prev Contract Day Accum Volume	(G.O. / Turbine)
7155 / 7309	Read Only	AI 1 scaled value	(G.O. / Turbine)
7156 / 7311	Read Only	AI 2 scaled value	(G.O. / Turbine)
7157 / 7313	Read Only	AI 1 ratio value	(G.O. / Turbine)
7158 / 7315	Read Only	AI 2 ratio value	(G.O. / Turbine)
7159 / 7317	Read/Write	PI 1 K factor	(G.O. / Turbine)
7160 / 7319	Read/Write	PI 2 K factor	(G.O. / Turbine)
7161 / 7321	Read Only	PI 1 Accum Conract Day Value	(G.O. / Turbine)
7162 / 7323	Read Only	PI 2 Accum Contract Day Value	(G.O. / Turbine)
7163 / 7325	Read Only	PI 1 Prev Contract Day Value	(G.O. / Turbine)
7164 / 7327	Read Only	PI 2 Prev Contract Day Value	(G.O. / Turbine)

7165 / 7329	Read Only	Current PI 1 Value	(G.O. / Turbine)
7166 / 7331	Read Only	Current PI 2 Value	(G.O. / Turbine)
7167 / 7333	Read/Write	Calibrate selected analog input	(G.O. / Turbine)
7168 / 7335	Read/Write	Selected analog input mid hi cal units	(G.O. / Turbine)
7169 / 7337	Read/Write	Selected analog input mid lo cal units	(G.O. / Turbine)
7170 / 7339	Read/Write	Selected analog input high cal units	(G.O. / Turbine)
7171 / 7341	Read/Write	Selected analog input mid cal units	(G.O. / Turbine)
7172 / 7343	Read/Write	Selected analog input low cal units	(G.O. / Turbine)
7173 / 7345	Read/Write	DO 2 volume setpoint	(G.O. / Turbine)
7174 / 7347	Read/Write	Custom poll register scale factor	(G.O. / Turbine)
7175 / 7349	Read/Write	Flow Rate MCF/Day	(G.O. / Turbine)

X. Log Period Flow Record Register Group

Totalflow Log Period flow records are read using Modbus function code 03. The byte order of the record is reversed in the response packet (MSB of last field first, LSB of first field last.) The base register number for the Log Period Flow Record register group defaults to 11001 when the unit is cold started. It can be changed by setting register 106 to the desired starting register number of the group. Register 11001 accesses the most recent log period record, register 11970 accesses the least recent log period record.

Gas Orifice Log Period Flow Record Format

Field	Size	Type	Description
Date/time	4	ULONG	Log Date/Time (# seconds since 00:00:00 1/1/70)
Sequence #	2	UINT	Log Period record sequence number
Average DP	4	FLOAT	Average differential pressure during flow
Average AP	4	FLOAT	Average static pressure during flow
Average TF	4	FLOAT	Average temperature
Extension	4	FLOAT	Accumulated Extension / 3600
Volume	4	FLOAT	Total volume for the day (MCF)
Energy	4	FLOAT	Total energy for the day
Flowtime	4	ULONG	Total flow seconds for the day
Period time	4	ULONG	Total seconds actually used in this log period
Alarms	3	24BITS	Period alarm summary (See alarm bit mapping)
Verification Code	1	UCHAR	8 Bit Proprietary Checksum

Turbine Log Period Flow Record Format

Field	Size	Type	Description
Date/time	4	ULONG	Log Date/Time (# seconds since 00:00:00 1/1/70)
Sequence #	2	UINT	Log Period record sequence number
Pulse Count	4	FLOAT	Total pulse count for the period
Average AP	4	FLOAT	Average static pressure during flow
Average TF	4	FLOAT	Average temperature
Uncorrected Volume	4	FLOAT	Total uncorrected volume for the day (MACF)
Volume	4	FLOAT	Total volume for the day (MCF)
Energy	4	FLOAT	Total energy for the day
Flowtime	4	ULONG	Total flow seconds for the day
Period time	4	ULONG	Total seconds actually used in this log period
Alarms	3	24BITS	Period alarm summary (See alarm bit mapping)
Verification Code	1	UCHAR	8 Bit Proprietary Checksum

XI. Daily Flow Record Register Group

Totalflow Daily flow records are read using Modbus function code 03. The byte order of the record is reversed in the response packet (MSB of last field first, LSB of first field last.) The base register number for the Daily Flow Record register group defaults to 10001 when the unit is cold started. It can be changed by setting register 105 to the desired starting register number of the group. Register 10001 accesses the most recent daily record, register 10050 accesses the least recent daily record.

Gas Orifice Daily Flow Record Format

Field	Size	Type	Description
Date/time	4	ULONG	Day Date/Time (# seconds since 00:00:00 1/1/70)
Sequence #	2	UINT	Daily record sequence number
Event Sequence #	2	UINT	Event sequence counter at start of day
Starting Log Seq#	2	UINT	1st Log Period record assigned to this day
Ending Log Seq#	2	UINT	Last Log Period record assigned to this day
Contract Hour	1	UCHAR	Start of gas day per contract
Extension	4	FLOAT	Accumulated Extension / 3600
Volume	4	FLOAT	Total volume for the day (MCF)
Energy	4	FLOAT	Total energy for the day
Flowtime	4	ULONG	Total flow seconds for the day
Backflow	4	ULONG	Total backflow seconds for the day
Period time	4	ULONG	Total seconds actually used in this log period
Alarms	3	24BITS	Daily alarm summary (See alarm bit mapping)
Average AP	4	FLOAT	Average static pressure during flow
Min AP	4	FLOAT	Minimum AP value observed during this period
Max AP	4	FLOAT	Maximum AP value observed during this period
% time AP high	4	FLOAT	AP percent of day above hi limit
% time AP low	4	FLOAT	AP percent of day below lo limit
Average DP	4	FLOAT	Average differential pressure during flow
Min DP	4	FLOAT	Minimum DP value observed during this period
Max DP	4	FLOAT	Maximum DP value observed during this period
% time DP high	4	FLOAT	DP percent of day above hi limit
% time DP low	4	FLOAT	DP percent of day below lo limit
Average TF	4	FLOAT	Average temperature
Min TF	4	FLOAT	Minimum Temp value observed during this period
Max TF	4	FLOAT	MaximumTemp value observed during this period
% time TF high	4	FLOAT	Tf percent of day above hi limit
% time TF low	4	FLOAT	Tf percent of day below low limit
Verification Code	1	UCHAR	8 Bit Proprietary Checksum

Turbine Daily Flow Record Format

Field	Size	Type	Description
Date/time	4	ULONG	Day Date/Time (# seconds since 00:00:00 1/1/70)
Sequence #	2	UINT	Daily record sequence number
Event Sequence #	2	UINT	Event sequence counter at start of day
Starting Log Seq#	2	UINT	1st Log Period record assigned to this day
Ending Log Seq#	2	UINT	Last Log Period record assigned to this day
Contract Hour	1	UCHAR	Start of gas day per contract
Uncorrected Volume	4	FLOAT	Total uncorrected volume for the day (MACF)
Volume	4	FLOAT	Total volume for the day (MCF)
Energy	4	FLOAT	Total energy for the day
Flowtime	4	ULONG	Total flow seconds for the day
Backflow	4	ULONG	Total backflow seconds for the day
Period time	4	ULONG	Total seconds actually used in this log period
Alarms	3	24BITS	Daily alarm summary (See alarm bit mapping)
Average AP	4	FLOAT	Average static pressure during flow
Min AP	4	FLOAT	Minimum AP value observed during this period
Max AP	4	FLOAT	Maximum AP value observed during this period
% time AP high	4	FLOAT	AP percent of day above hi limit
% time AP low	4	FLOAT	AP percent of day below lo limit
Pulse Count	4	FLOAT	Total pulse count for the day
Min Pulse Count	4	FLOAT	Minimum pulse count observed during this period
Max Pulse Count	4	FLOAT	Maximum pulse count observed during this period
% time ACF high	4	FLOAT	ACF percent of day above hi limit
% time ACF low	4	FLOAT	ACF percent of day below lo limit
Average TF	4	FLOAT	Average temperature
Min TF	4	FLOAT	Minimum Temp value observed during this period
Max TF	4	FLOAT	MaximumTemp value observed during this period
% time TF high	4	FLOAT	Tf percent of day above hi limit
% time TF low	4	FLOAT	Tf percent of day below low limit
Verification Code	1	UCHAR	8 Bit Proprietary Checksum

XII. Alarm bit mapping for Totalflow Daily and Log Period records

Bit	Description
0	AGA Calculation error
1	Methane gravity method f(pv) used
2	Alternate analysis used
3	Low lithium battery
4	Low charger
5	DP measurement error
6	AP measurement error
7	Temperature measurement error
8	Auxiliary contact #1 tripped
9	Remote sense #1 detected
10	Back flow detected
11	Zero flow detected
12	DP below low limit
13	DP over high limit
14	AP below low limit
15	AP over high limit
16	Auxiliary contact #2 tripped
17	Remote sense #2 detected
18	Tf below low limit
19	Tf above high limit

XIII. Event Log Record Register Group

Totalflow Event records are read using Modbus function code 03. The base register number for this register group defaults to 12001 when the unit is cold started. It can be changed by setting register 107 to the desired starting register number of the group. Register 12001 accesses the most recent event log record, register 12200 accesses the least recent event log record. The byte order of the record is reversed in the response packet (MSB of last field first, LSB of first field last.)

Field	Size	Type	Description
Date/time	4	ULONG	# of seconds since 00:00:00 1/1/70
Event flags	1	BITS	Event flags (such as day skip)
Event Sequence #	2	UINT	Sequence # of event
Event Code	2	UINT	Describes event type (Table 5.13)
Old Value	4	Depends on Code	Value changed from...
New Value	4	Depends on Code	Value changed to...
Verification Code	1	UCHAR	8 Bit Proprietary Checksum

Totalflow Event data types

Type	Old Value Format	New Value Format
1	Unsigned Integer	Unsigned Integer
2	Unsigned Char	Unsigned Char
3	BOOL	BOOL
4	IEEE Floating Point	N/A (Rollover)
5	IEEE Floating Point	IEEE Floating Point
8	Unsigned Long Integer	Unsigned Long Integer
9	2 Character String	2 Character String

Totalflow Event Codes

Event Code	Data Type	Description
1	8	New date and time
5	1	Contract day starting hour
8	8	AIU Stream ID
9	3	Use fixed analysis on error?
10	2	Reset volume
11	2	Wakeup from sleep
12	2	Go to sleep
13	2	Watchdog timeout
14	2	Accumulated volume rollover
15	2	Security code changed
16	3	Attached to AIU stream?
19	3	Is AP present?
20	3	RTD installed
21	3	Use fixed temperature
24	3	SS/Monel orifice plate
25	3	Use Fb
26	3	Use Fr
27	3	Use Y
28	3	Use Ftb
29	3	Use Fpb
30	3	Use Ftf
31	3	Use Fg
32	3	Use Fpv
33	3	Use Fa
34	3	Use contact on charger low
35	3	Contact on dp lo
36	3	Contact on dp hi

37	3	Contact on ap lo
38	3	Contact on ap hi
39	3	Contact on remote sense
40	3	Auto re-open
41	3	Contact on vol set point
42	3	Use Fw
43	3	Use Faux
44	3	Use Fpm (TURBINE_REV)
45	3	Use Ftm (TURBINE_REV)
46	3	Use s (TURBINE_REV)
47	3	Use Faux (TURBINE_REV)
49	5	fixed ap value (TURBINE_REV)
50	4	well log code (Site Code)
51	4	Accumulated volume reset
52	3	RTD installed (TURBINE)
53	3	Use rtd (TURBINE)
54	3	Auto start TEG (TURBINE)
55	3	Check security code(TURBINE)
56	3	Use fixed ap (TURBINE)
57	4	Accum ACF before reset (TRB)
58	4	Initial volume reset value(TRB)
59	2	Accum ACF rollover date (TRB)
60	5	Fb
61	5	Orifice diameter
62	5	Pipe diameter
63	5	Specific gravity
64	5	DP lo limit
65	5	DP hi limit
66	5	AP lo limit
67	5	AP hi limit
68	5	CO2 mole percent
69	5	N2 mole percent
70	5	AP lo calibration
71	5	AP mid calibration
72	5	AP hi calibration
73	5	DP lo calibration
74	5	DP mid calibration
75	5	DP hi calibration
76	5	DP zero cutoff
77	5	Temperature base
78	5	Pressure base
79	5	Fixed temperature
80	5	Temperature bias
81	5	Viscosity
82	5	Ratio of specific heats
83	5	Ft - gravity adjusted temp
84	5	Fp - gravity adjusted press
85	5	BTU/SCF
86	5	AP pressure marker
87	5	DP pressure marker
88	3	Contact on charger low (TRB)
89	3	Contact on acf low (TRB)
90	3	Contact on acf hi (TRB)
91	3	Contact on ap lo (TRB)
92	3	Contact on ap hi (TRB)
93	3	Contact on remote sense (TRB)
94	3	Contact auto re-open (TRB)

95	3	Contact on vol set point (TRB)
96	5	ACF Lo Limit (TURBINE)
97	5	ACF Hi Limit (TURBINE)
98	5	Flow period (TURBINE)
99	5	Faux (TURBINE)
100	5	Faux
101	5	K (TURBINE)
102	5	Initial analys. OK?
103	5	VCF K0
104	5	VCF K1
105	5	VCF K2
106	1	Liquid type
107	1	Calculation units type
108	1	Z method
111	1	AGA calculation type
112	5	Fixed cd
115	5	Zba
116	9	Software revision change
117	1	Volume calculation period
118	8	Volume log period
119	5	H2S content
120	5	H20 content
121	5	Helium content
122	5	Methane content
123	5	Ethane content
124	5	Propane content
125	5	N-Butane content
126	5	I-Butane content
127	5	N-Bentane content
128	5	I-Pentane content
129	5	N-Hexane content
130	5	N-Heptane content
131	5	N-Octane content
132	5	N-Nonane content
133	5	N-Decane content
134	5	Oxygen content
135	5	Carbon Monoxide content
136	5	Orif coef of expansion
137	5	Pipe coef of expansion
138	5	barometric pressure
142	1	Characteristic type
143	3	Calculated or Fixed Cd in vol calc
144	5	Fixed Argon mole percent
145	5	Fixed hydrogen mole percent
146	4	Accumulated volume rollover
147	4	Event log full (CANADIAN EVENT)
148	4	Event log collected (CANADIAN)
149	1	Password mode, operator change
150	3	Password mode, password enable
151	2	Password mode, password table
152	2	A/D converter could not be read
153	5	Ap mid lo calibration event
154	5	Ap mid hi calibration event
155	5	Dp mid lo calibration event
156	5	Dp mid hi calibration event
157	3	Use Faux
158	3	static pressure tap up/downstream

159	3	Use Y expansion factor
160	3	Use Fpv factor
161	3	Use Fw water vapor factor
162	5	Reset Log Period
164	3	Use Linear/Sqrt Averaging
165	3	Hold last read analog values (AP, DP, TF)
166	1	Maximum number of events log records
167	1	Maximum number of day period records
168	1	Maximum number of log period records
169	1	Size of local port communications buffer
170	1	Size of remote port communications buffer
171	8	Partition memory free space
172	3	Use fixed water content in wet gas calcs
173	5	Water content (LBS/MMSCF)
174	5	Water content bias

XIIII. Radio Power Duty Cycling and Group Operation.

Duty cycling the power to the radio can significantly decrease the solar panel and battery requirements of a remote installation. Totalflow Modbus uses group addressing to control radio duty cycling. Using Modbus group addresses also removes the standard Modbus limit of 247 slave addresses per communications channel.

Totalflow Modbus group addressing and radio duty cycling work as follows:

Writing a group number into the Modbus group address register (3070) invokes Modbus group addressing. The FCU will listen for its standard Modbus slave address (0-247) only when the Modbus group address register (3070) matches the current group select register (3071) set by a previous broadcast.

The duty cycle is specified by setting the link establishment register (3020) to the desired cycle time (seconds). The FCU will power the radio once each duty cycle and listen for broadcasts. A duty cycle time of zero (0) means that the radio is always powered (used for group addressing without duty cycling).

When the remote unit is duty cycling the radio, the host must broadcast function code 6 (single register write command) to the current group select register (3071) continuously for the duty cycle interval. This forces remote units with matching Modbus group address registers (3070) to keep it's radio powered up and listen for subsequent commands (addressed to the standard slave address) until the group address register (3070) no longer matches the current group select register (3071).

The group returns to duty cycling when the host broadcasts a different group select. The current group select register is also reset (to 0) upon expiration of the maximum listen time specified in the listen timeout register (3072).

For example, the following ASCII mode broadcast command would set the current group select register to 1. As mentioned above, this command must be repeated for the configured duty cycle.

Broadcast :

BOF	Address	Function	Register	Data	LRC	EOF	Ready
:	00	06	0B FF	00 01	??	CR	LF

The remote device does not respond to the broadcast. It powers the radio and listens for Modbus commands directed to it's standard Modbus slave address. When the host is finished polling this group, it switches to the next goup by broadcasting a new group select address. If the host does not intend to switch to a new group, it should disable the current group by broadcasting a group select of zero (0).

XV. Communications Setup

The Totalflow Portable Calibration and Collection Unit (PCCU) or Laptop PCCU emulation software should be used to configure the FCU communications port. The following items can be set from the PCCU remote communications setup menu:

- Listen cycle: 1 second, 2 second, 4 second (Totalflow protocol only) (rdc=0,1,2)
- Radio Powerup Delay (Milliseconds) (rkd=ms)
- Transmit Key Delay (Milliseconds) (rxkd=mx)
- Transmit Unkey Delay (Milliseconds) (rxud=ms)
- Protocol: Totalflow, Modbus RTU, Modbus ASCII (rpp=1,5)
- Modbus Slave Address: 1-247 (mba=sa)
- BaudRate: 1200, 2400, 4800, 9600 (rbr=0,1,2,3,4)
- Number of Data Bits: 7 or 8 (rdb=7,8)
- Parity: None, Even, or Odd (rpr=0,1,2)
- Number of Stop Bits: 1 or 2 (rsb=1,2)
- Interface Module: RS-232, RS-485 (rxi=12,28)
- 16/32 Bit long/float registers (rp16=0,1)
- 16 bit long/float register with word swap (rp16=2)