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AA	L12040	NORFLEET	SHORT	HOLLAND	01/12/21
AB		NORFLEET			03/02/14
AC	D14351	NORFLEET	JOHNSON	BUSHNELL	03/03/03
AD		NORFLEET			

APPLICATION INFORMATION FOR
TOTALFLOW MODBUS PROTOCOL
AND
PRINTER / CONSOLE FOR BTU-XMTR

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PRODUCT LINE TOTALFLOW®	LEVEL 3	 TOTALFLOW PRODUCTS							
DESIGN NORFLEET	DATE 01/12/21	APPLICATION INFORMATION AI – MODBUS AND PRINTER CONSOLE MODBUS							
DRAWN NORFLEET	01/12/21								
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APPROVED HOLLAND		SCALE NONE	SIZE A	TYPE AI	DRAWING NO. 2100666	REV AD	SHEET 1	OF 64	64

I. Purpose

This paper describes the Modbus communications protocol for Totalflow Model 8000 BTU Transmitters.

II. Modbus Description

The Modbus protocol is described in the document entitled "Modicon Modbus Protocol Reference Guide" produced by AEG Schneider Automation, Part Number PI-MBUS-300 Rev. G, 1994.

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.

The BTU Transmitter supports the ASCII message frame format and the RTU message frame format.

Modbus ASCII message frame format:

Clear	BOF	Packet	LRC	EOF	Ready
0xff	:	2 x Number of bytes in Modbus packet	8-bits	CR	LF

Clear:	This character is an extension used by Totalflow to assist in clearing the communications link of noise and to help certain hardware devices to be able to receive BOF without errors. The Clear Byte can be disabled if required.
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. The LRC is calculated by adding together successive 8-bit bytes of the message, discarding any carries, and then two's complementing the result.
EOF/Ready:	A carriage return and line feed are used to delineate end of frame.

The communications parameters for the ASCII format are fixed at 7 data bits, even parity and 1 stop bits.

Modbus RTU Message Frame Format:

BOF	Packet	CRC	EOF
T1-T2-T3-T4	Number of bytes in Modbus packet	16-bits	T1-T2-T3-T4

BOF:	Represents 3.5 character times of silence with a minimum of 20 milliseconds.
Packet:	The packet field consists of hexadecimal binary characters representing the Modbus packet being sent or received.
CRC:	The error check field consists a 16-bit cyclical redundancy check calculated over the length of the packet field before it is converted to hexadecimal ASCII. The CRC is calculated according to the procedure outlined in the
EOF/Ready:	Represents 3.5 character times of silence with a minimum of 20 milliseconds.

Note: The design of the BTU Transmitter does not allow strict compliance with the timing requirements of the RTU protocol. RTU Protocol might not work with some hardware. In this case, use ASCII.

The communications parameters for the RTU format are fixed at 8 data bits, no parity and 1-stop bits.

Note: Total message frame length cannot exceed 256 bytes.

III. Communications Setup

The following items can be set from the Printer/Console mode:

- Modbus Slave Address: 1-247
- BaudRate: 1200, 2400, 4800, 9600, 19200

IV. Totalflow BTU Transmitter Modbus Implementation

Totalflow Modbus supports the following subset of the Gould (Modicon) Modbus defined functions:

Code	Function	Description
03	Read Registers	Reads group of registers
06	Set Single Register	Sets a single register (Prom Rev AG2015644-005 or above and all 2100528 and 2100986 part numbers)
08	Diagnostics	Return Query Data – subfunction 00 only.
16	Set Multiple Registers	Set multiple registers Byte count greater than 128 may cause transmitter failure.

Broadcast commands are not supported.

Packet formats:

Read Registers

Address	Function	Register	Quantity (N)
8-bits	8-bits (0x03)	16-bits	16-bits

Read Registers Response by BTU Transmitter

Address	Function	Byte Count	Data
8-bits	8-bits (0x03)	8-bits	N registers

Set Multiple Registers

Address	Function	Register	Quantity	Byte Count	Data
8-bits	8-bits (0x10)	16-bits	16-bits	8-bits	N registers

Set Multiple Registers Response by BTU Transmitter

Address	Function	Register	Quantity (N)
8-bits	8-bits (0x10)	16-bits	16-bits

Set Single Register

Address	Function	Register	Data
8-bits	8-bits (0x06)	16-bits	16-bits

Set Single Register Response by BTU Transmitter

Address	Function	Register	Data
8-bits	8-bits (0x06)	16-bits	16-bits

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

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

Register: The register field contains the starting register number of the transmitter data item to fetch or set.

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 registers).

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). The word order when transmitting 32 bit data items can be modified with the xxPFLG command.

V. Register Group Configuration

Registers are grouped by data type. The grouping is fixed. The register group assignments are:

Base	Type	Description
3001	INTEGER	16 Bit Integer Group
5001	LONG INTEGER	32 Bit Long Integer Group
7001	FLOATING POINT	32 Bit IEEE Floating Point Group

The long integer and floating point registers can be accessed in two ways. Thirty-two (32) bit access is used to interface to the Analyzer Interface Unit (AIU) or to Daniels Modbus compatible equipment. Sixteen (16) bit access is used to interface with equipment compatible with Modicon Modbus or word swapped Modbus. These capabilities are accessed through the xxPFLG command. Cycle, Hourly, Daily or Monthly data is also available by writing xxPFLG. Stream #4 is not directly available in 16 bit modes.

VI. Short Integer Register Group

Register	Access	Description
3001	Read Only	Component Table #1 Component Index #1 (C3)
3002	Read Only	Component Table #1 Component Index #2 (IC4)
3003	Read Only	Component Table #1 Component Index #3 (NC4)
3004	Read Only	Component Table #1 Component Index #4 (Neo C5)
3005	Read Only	Component Table #1 Component Index #5 (IC5)
3006	Read Only	Component Table #1 Component Index #6 (NC5)
3007	Read Only	Component Table #1 Component Index #7 (C6+)
3008	Read Only	Component Table #1 Component Index #8 (N2)
3009	Read Only	Component Table #1 Component Index #9 (C1)
3010	Read Only	Component Table #1 Component Index #10 (CO2)
3011	Read Only	Component Table #1 Component Index #11 (C4+)
3012	Read Only	Component Table #1 Component Index #12 (C9)
3013	Read Only	Component Table #1 Component Index #13 (C2)
3014	Read Only	Component Table #1 Component Index #14 (C6)
3015	Read Only	Component Table #1 Component Index #15 (C7)
3016	Read Only	Component Table #1 Component Index #16 (C8)
3017	Read Only	Component Table #2 Component Index #1
3018	Read Only	Component Table #2 Component Index #2
3019	Read Only	Component Table #2 Component Index #3
3020	Read Only	Component Table #2 Component Index #4
3021	Read Only	Component Table #2 Component Index #5
3022	Read Only	Component Table #2 Component Index #6
3023	Read Only	Component Table #2 Component Index #7
3024	Read Only	Component Table #2 Component Index #8
3025	Read Only	Component Table #2 Component Index #9
3026	Read Only	Component Table #2 Component Index #10
3027	Read Only	Component Table #2 Component Index #11
3028	Read Only	Component Table #2 Component Index #12
3029	Read Only	Component Table #2 Component Index #13
3030	Read Only	Component Table #2 Component Index #14
3031	Read Only	Component Table #2 Component Index #15
3032	Read Only	Component Table #2 Component Index #16

NOTE: Unless 255 is retrieved as a component index code, add 100 to get the true component index code. Then use the true component index code to find out the component represented in each area (Mole %, GPM, 24 hour average, etc.).

Register	Access	Description
3033	Read Only	Analysis Time (in 1/30ths of 1 second)
3034	Read/Write	Current Stream
3035	Read Only	Mask of streams associated with Component Table 41 (Bit 2 ⁽ⁿ⁻¹⁾ implies stream n included)
3036	Read/Write	Current Month (1-12)
3037	Read/Write	Current Day (1-31)
3038	Read/Write	Current Year (0-99)
3039	Read/Write	Current Hour (0-24)
3040	Read/Write	Current Minutes (0-59)
3041	Read Only	Cycle Start Time Month (1-12)
3042	Read Only	Cycle Start Time Day (1-31)
3043	Read Only	Cycle Start Time Year (0-99)
3044	Read Only	Cycle Start Time Hour (0-24)
3045	Read Only	Cycle Start Time Minutes (0-59)
3046	Read/Write	Bit Flags Transmitter
3047	Read/Write	Bit Flags Transmitter
3048	Read Only	Bit Flags Stream #1 Low
3049	Read Only	Bit Flags Stream #1 High
3050	Read Only	Bit Flags Stream #2 Low
3051	Read Only	Bit Flags Stream #2 High
3052	Read Only	Bit Flags Stream #3 Low
3053	Read Only	Bit Flags Stream #3 High
3054	Read Only	Bit Flags Stream #4 Low
3055	Read Only	Bit Flags Stream #4 High
3056	Read Only	Bit Flags Stream #5 Low - Unused
3057	Read Only	Bit Flags Stream #5 High - Unused
3058	Read/Write	New Data Flag (Set upon completion of calculations)
3059	Read Only	Cal/Analysis Flag (Set = 1 if analysis data, 0 if calculation data(Not Used))

NOTE: Component indices in registers 3001 through 3032 above correspond to the component code minus 100.

Methane - Component Code 100 Component = Index 0

Carbon Dioxide - Component Code 117 Component = Index 17

Unused component table entries contain Component Index = 255.

VII. Totalflow Short Integer Extended Registers Group

This register group is provided as an extension to the standard register set to allow further control over the BTU transmitter over a MODBUS communications link. Refer to the Printer/Console Document for more information on the values that each of these commands can have.

As an example, assume that the BTU Transmitter needs to be put into hold mode and later back into run mode. Referring to the Printer/Console document under NSTATE (which refers to CSTATE), the code to put the Transmitter into Hold mode is 01 and the Run code is 02. So the MODBUS master should be programmed to set register 3061 to 01 to enter hold mode and 02 to get running again.

These registers are defined in PROM revisions of AH.1 (Not AH) and greater and all 2100528 and 2100986 part numbers.

Register	Access	Description	Printer/Console Command
3060	Read Only	Read the Current State	CSTATE
3061	Read/Write	Set the Next State	NSTATE
3062	Read/Write	Auto Calibration During Startup	ACAL
3063	Read/Write	Auto Peak Detection During Startup	APEAK
3064	Read/Write	Auto Run after Startup	ASTART
3065	Read/Write	Number of Calibration Cycles	CALCYC
3066	Read/Write	Number of Calibration Cycles to Average	CALAVG

Register	Access	Description	Printer/Console Command
3067	Read/Write	Low Carrier Mode	LOWCAR
3068	Read/Write	Low Power Mode	LOWPOW
3069	Read/Write	Pre-Purge Selection	PP
3070	Read Only	Normal Status	DIOS
3071	Read Only	Fault Status	DIOS
3072	Read Only	Carrier Bottle Low (DI)	DIOS
3073	Read Only	Calibration Bottle Low (DI)	DIOS
3074	Write Only	Manually Update Response Factors	MAN
3075	Read/Write	Auto Update Response Factors Selection	AUTO
3076	Read/Write	Disable Stream Switching	DISSEL
3077	Read Only	Transmitter Current Warning	04CWARN
3078	Read Only	Transmitter Current Fault	04CFAULT
3079	Read Only	Transmitter Initial Warning	04IWARN
3080	Read Only	Transmitter Initial Fault	04IFFAULT
3081	Read Only	Stream #1 Current Warning	00CWARN
3082	Read Only	Stream #2 Current Warning	01CWARN
3083	Read Only	Stream #3 Current Warning	02CWARN
3084	Read Only	Stream #4 Current Warning	03CWARN
3085	Read Only	Stream #1 Current Fault	00CFAULT
3086	Read Only	Stream #2 Current Fault	01CFAULT
3087	Read Only	Stream #3 Current Fault	02CFAULT
3088	Read Only	Stream #4 Current Fault	03CFAULT
3089	Read Only	Stream #1 Initial Warning	00IWARN
3090	Read Only	Stream #2 Initial Warning	01IWARN
3091	Read Only	Stream #3 Initial Warning	02IWARN
3092	Read Only	Stream #4 Initial Warning	03IWARN
3093	Read Only	Stream #1 Initial Fault	00IFFAULT
3094	Read Only	Stream #2 Initial Fault	01IFFAULT
3095	Read Only	Stream #3 Initial Fault	02IFFAULT
3096	Read Only	Stream #4 Initial Fault	03IFFAULT
3097	Read/Write	Stream #1 Skip Flag	00SKIP
3098	Read/Write	Stream #2 Skip Flag	01SKIP
3099	Read/Write	Stream #3 Skip Flag	02SKIP
3100	Read/Write	Stream #4 Skip Flag	03SKIP
3101	Read/Write	Port #1 Report Flags	02PFLG
3102	Read/Write	Port #2 Report Flags	03PFLG
3103	Read/Write	Port #3 Report Flags	04PFLG
3104	Read/Write	Port #4 Report Flags	05PFLG
3105	Read/Write	Modbus C6+ Component Index Mode	C6IDX

VIII. Long Integer Register Group

Register (32)	Register (16)	Access	Description
5001	5001	Read/Write	Cycle Time (in 1/30ths of 1 second)
5002	5003	Read Only	Calibration Cycle Time (in 1/30ths of 1 second)
5003	5005	Read Only	Detector 0 Value
5004	5007	Read Only	Detector 1 Value

IX. Floating Point Register Group - Current Stream

Register (32)	Register (16)	Access	Description
7001	7001	Read Only	Mole % - Component #1
7002	7003	Read Only	Mole % - Component #2
7003	7005	Read Only	Mole % - Component #3
7004	7007	Read Only	Mole % - Component #4

Register (32)	Register (16)	Access	Description
7005	7009	Read Only	Mole % - Component #5
7006	7011	Read Only	Mole % - Component #6
7007	7013	Read Only	Mole % - Component #7
7008	7015	Read Only	Mole % - Component #8
7009	7017	Read Only	Mole % - Component #9
7010	7019	Read Only	Mole % - Component #10
7011	7021	Read Only	Mole % - Component #11
7012	7023	Read Only	Mole % - Component #12
7013	7025	Read Only	Mole % - Component #13
7014	7027	Read Only	Mole % - Component #14
7015	7029	Read Only	Mole % - Component #15
7016	7031	Read Only	Mole % - Component #16
7017	7033	Read Only	GPM - Component #1
7018	7035	Read Only	GPM - Component #2
7019	7037	Read Only	GPM - Component #3
7020	7039	Read Only	GPM - Component #4
7021	7041	Read Only	GPM - Component #5
7022	7043	Read Only	GPM - Component #6
7023	7045	Read Only	GPM - Component #7
7024	7047	Read Only	GPM - Component #8
7025	7049	Read Only	GPM - Component #9
7026	7051	Read Only	GPM - Component #10
7027	7053	Read Only	GPM - Component #11
7028	7055	Read Only	GPM - Component #12
7029	7057	Read Only	GPM - Component #13
7030	7059	Read Only	GPM - Component #14
7031	7061	Read Only	GPM - Component #15
7032	7063	Read Only	GPM - Component #16
7033	7065	Read Only	BTU - Dry
7034	7067	Read Only	BTU - Saturated
7035	7069	Read Only	Specific Gravity
7036	7071	Read Only	Compressibility
7037	7073	Read Only	WOBBE Index
7038	7075	Read Only	Total UN-normalized mole
7039	7077	Read Only	Total GPM
7040	7079	Read Only	Ratio #1 - Unused
7041	7081	Read Only	Ratio #2 - Unused
7042	7083	Read Only	Ratio #3 - Unused
7043	7085	Read Only	Ratio #4 - Unused
7044	7087	Read Only	Ratio #5 - Unused
7045	7089	Read Only	Rolling Average #1 - Unused
7046	7091	Read Only	Rolling Average #2 - Unused
7047	7093	Read Only	Rolling Average #3 - Unused
7048	7095	Read Only	Rolling Average #4 - Unused
7049	7097	Read Only	Rolling Average #5 - Unused
7050	7099	Read Only	Rolling Average #6 - Unused
7051	7101	Read Only	Rolling Average #7 - Unused
7052	7103	Read Only	Rolling Average #8 - Unused
7053	7105	Read Only	Rolling Average #9 - Unused
7054	7107	Read Only	Rolling Average #10 - Unused
7055	7109	Read Only	24 Hour Average for Component #1
7056	7111	Read Only	24 Hour Average for Component #2
7057	7113	Read Only	24 Hour Average for Component #3
7058	7115	Read Only	24 Hour Average for Component #4
7059	7117	Read Only	24 Hour Average for Component #5
7060	7119	Read Only	24 Hour Average for Component #6
7061	7121	Read Only	24 Hour Average for Component #7
7062	7123	Read Only	24 Hour Average for Component #8

Register (32)	Register (16)	Access	Description
7063	7125	Read Only	24 Hour Average for Component #9
7064	7127	Read Only	24 Hour Average for Component #10
7065	7129	Read Only	24 Hour Average for Component #11
7066	7131	Read Only	24 Hour Average for Component #12
7067	7133	Read Only	24 Hour Average for Component #13
7068	7135	Read Only	24 Hour Average for Component #14
7069	7137	Read Only	24 Hour Average for Component #15
7070	7139	Read Only	Previous 24 Hour Average for Component #1
7071	7141	Read Only	Previous 24 Hour Average for Component #2
7072	7143	Read Only	Previous 24 Hour Average for Component #3
7073	7145	Read Only	Previous 24 Hour Average for Component #4
7074	7147	Read Only	Previous 24 Hour Average for Component #5
7075	7149	Read Only	Previous 24 Hour Average for Component #6
7076	7151	Read Only	Previous 24 Hour Average for Component #7
7077	7153	Read Only	Previous 24 Hour Average for Component #8
7078	7155	Read Only	Previous 24 Hour Average for Component #9
7079	7157	Read Only	Previous 24 Hour Average for Component #10
7080	7159	Read Only	Previous 24 Hour Average for Component #11
7081	7161	Read Only	Previous 24 Hour Average for Component #12
7082	7163	Read Only	Previous 24 Hour Average for Component #13
7083	7165	Read Only	Previous 24 Hour Average for Component #14
7084	7167	Read Only	Previous 24 Hour Average for Component #15
7085	7169	Read Only	Normal Density
7086	7171	Read Only	Water – If Available
7087	7173	Read Only	Hydrogen Sulfide – If Available
7088	7175	Read Only	(Inferior) WOBBE
7089	7177	Read Only	Previous 24 Hour Average for C9
7090	7179	Read Only	Previous 24 Hour Average for Real CV
7091	7181	Read Only	Previous 24 Hour Average for Wet CV
7092	7183	Read Only	Previous 24 Hour Average for Real Specific Gravity
7093	7185	Read Only	Previous 24 Hour Average for Compressibility
7094	7187	Read Only	Previous 24 Hour Average for WOBBE
7095	7189	Read Only	Previous 24 Hour Average for Un-normalized Total
7096	7191	Read Only	Previous 24 Hour Average for GPM
7097	7193	Read Only	Previous 24 Hour Average for Normal Density
7098	7195	Read Only	Previous 24 Hour Average for (Inferior) WOBBE
7099	7197	Read Only	Methane Number
7100	7199	Read Only	Previous 24 Hour Average for Methane Number

X. Floating Point Register Group - Transmitter

Register (32)	Register (16)	Access	Description
7200	N/A	Read Only	Ground Reference
7201	7401	Read Only	Power
7202	7403	Read Only	Mandrel Temp
7203	7405	Read Only	Regulator Pressure
7204	7407	Read Only	Auxiliary Pressure
7205	7409	Read Only	Analog Input #6 - Spare
7206	7411	Read Only	Ambient Temp
7207	7413	Read Only	Voltage Reference
7209	7417	Read/Write	Calibration Standard - Component #1 – Not Indexed
7210	7419	Read/Write	Calibration Standard - Component #2 – Not Indexed
7211	7421	Read/Write	Calibration Standard - Component #3 – Not Indexed
7212	7423	Read/Write	Calibration Standard - Component #4 – Not Indexed
7213	7425	Read/Write	Calibration Standard - Component #5 – Not Indexed
7214	7427	Read/Write	Calibration Standard - Component #6 – Not Indexed

Register (32)	Register (16)	Access	Description
7215	7429	Read/Write	Calibration Standard - Component #7 – Not Indexed
7216	7431	Read/Write	Calibration Standard - Component #8 – Not Indexed
7217	7433	Read/Write	Calibration Standard - Component #9 – Not Indexed
7218	7435	Read/Write	Calibration Standard - Component #10 – Not Indexed
7219	7437	Read/Write	Calibration Standard - Component #11 – Not Indexed
7220	7439	Read/Write	Calibration Standard - Component #12 – Not Indexed
7221	7441	Read/Write	Calibration Standard - Component #13 – Not Indexed
7222	7443	Read Only	Calibration Standard - Component #14 – Not Used
7223	7445	Read Only	Calibration Standard - Component #15 – Not Used
7224	7447	Read Only	Calibration Standard - Component #16 – Not Used
7225	7449	Read Only	Response Factor - Component #1
7226	7451	Read Only	Response Factor - Component #2
7227	7453	Read Only	Response Factor - Component #3
7228	7455	Read Only	Response Factor - Component #4
7229	7457	Read Only	Response Factor - Component #5
7230	7459	Read Only	Response Factor - Component #6
7231	7461	Read Only	Response Factor - Component #7
7232	7463	Read Only	Response Factor - Component #8
7233	7465	Read Only	Response Factor - Component #9
7234	7467	Read Only	Response Factor - Component #10
7235	7469	Read Only	Response Factor - Component #11
7236	7471	Read Only	Response Factor - Component #12
7237	7473	Read Only	Response Factor - Component #13
7238	7475	Read Only	Response Factor - Component #14
7239	7477	Read Only	Response Factor - Component #15
7240	7479	Read Only	Response Factor - Component #16

XI. Floating Point Register Group - Stream #1

Register (32)	Register (16)	Access	Description
7400	N/A	Read Only	Registers 7400-7599 are for stream #1
7401	7801	Read Only	Mole % - Component #1
7402	7803	Read Only	Mole % - Component #2
7403	7805	Read Only	Mole % - Component #3
7404	7807	Read Only	Mole % - Component #4
7405	7809	Read Only	Mole % - Component #5
7406	7811	Read Only	Mole % - Component #6
7407	7813	Read Only	Mole % - Component #7
7408	7815	Read Only	Mole % - Component #8
7409	7817	Read Only	Mole % - Component #9
7410	7819	Read Only	Mole % - Component #10
7411	7821	Read Only	Mole % - Component #11
7412	7823	Read Only	Mole % - Component #12
7413	7825	Read Only	Mole % - Component #13
7414	7827	Read Only	Mole % - Component #14
7415	7829	Read Only	Mole % - Component #15
7416	7831	Read Only	Mole % - Component #16
7417	7833	Read Only	GPM - Component #1
7418	7835	Read Only	GPM - Component #2
7419	7837	Read Only	GPM - Component #3
7420	7839	Read Only	GPM - Component #4
7421	7841	Read Only	GPM - Component #5
7422	7843	Read Only	GPM - Component #6
7423	7845	Read Only	GPM - Component #7
7424	7847	Read Only	GPM - Component #8
7425	7849	Read Only	GPM - Component #9
7426	7851	Read Only	GPM - Component #10

Register (32)	Register (16)	Access	Description
7427	7853	Read Only	GPM - Component #11
7428	7855	Read Only	GPM - Component #12
7429	7857	Read Only	GPM - Component #13
7430	7859	Read Only	GPM - Component #14
7431	7861	Read Only	GPM - Component #15
7432	7863	Read Only	GPM - Component #16
7433	7865	Read Only	BTU - Dry
7434	7867	Read Only	BTU - Saturated
7435	7869	Read Only	Specific Gravity
7436	7871	Read Only	Compressibility
7437	7873	Read Only	WOBBE Index
7438	7875	Read Only	Total UN-normalized mole
7439	7877	Read Only	Total GPM
7440	7879	Read Only	Ratio #1 - Unused
7441	7881	Read Only	Ratio #2 - Unused
7442	7883	Read Only	Ratio #3 - Unused
7443	7885	Read Only	Ratio #4 - Unused
7444	7887	Read Only	Ratio #5 - Unused
7445	7889	Read Only	Rolling Average #1 - Unused
7446	7891	Read Only	Rolling Average #2 - Unused
7447	7893	Read Only	Rolling Average #3 - Unused
7448	7895	Read Only	Rolling Average #4 - Unused
7449	7897	Read Only	Rolling Average #5 - Unused
7450	7899	Read Only	Rolling Average #6 - Unused
7451	7901	Read Only	Rolling Average #7 - Unused
7452	7903	Read Only	Rolling Average #8 - Unused
7453	7905	Read Only	Rolling Average #9 - Unused
7454	7907	Read Only	Rolling Average #10 - Unused
7455	7909	Read Only	24 Hour Average for Component #1
7456	7911	Read Only	24 Hour Average for Component #2
7457	7913	Read Only	24 Hour Average for Component #3
7458	7915	Read Only	24 Hour Average for Component #4
7459	7917	Read Only	24 Hour Average for Component #5
7460	7919	Read Only	24 Hour Average for Component #6
7461	7921	Read Only	24 Hour Average for Component #7
7462	7923	Read Only	24 Hour Average for Component #8
7463	7925	Read Only	24 Hour Average for Component #9
7464	7927	Read Only	24 Hour Average for Component #10
7465	7929	Read Only	24 Hour Average for Component #11
7466	7931	Read Only	24 Hour Average for Component #12
7467	7933	Read Only	24 Hour Average for Component #13
7468	7935	Read Only	24 Hour Average for Component #14
7469	7937	Read Only	24 Hour Average for Component #15
7470	7939	Read Only	Previous 24 Hour Average for Component #1
7471	7941	Read Only	Previous 24 Hour Average for Component #2
7472	7943	Read Only	Previous 24 Hour Average for Component #3
7473	7945	Read Only	Previous 24 Hour Average for Component #4
7474	7947	Read Only	Previous 24 Hour Average for Component #5
7475	7949	Read Only	Previous 24 Hour Average for Component #6
7476	7951	Read Only	Previous 24 Hour Average for Component #7
7477	7953	Read Only	Previous 24 Hour Average for Component #8
7478	7955	Read Only	Previous 24 Hour Average for Component #9
7479	7957	Read Only	Previous 24 Hour Average for Component #10
7480	7959	Read Only	Previous 24 Hour Average for Component #11
7481	7961	Read Only	Previous 24 Hour Average for Component #12
7482	7963	Read Only	Previous 24 Hour Average for Component #13
7483	7965	Read Only	Previous 24 Hour Average for Component #14
7484	7967	Read Only	Previous 24 Hour Average for Component #15

Register (32)	Register (16)	Access	Description
7485	7969	Read Only	Normal Density
7486	7971	Read Only	Water – If Available
7487	7973	Read Only	Hydrogen Sulfide – If Available
7488	7975	Read Only	(Inferior) WOBBE
7489	7977	Read Only	Previous 24 Hour Average for C9
7490	7979	Read Only	Previous 24 Hour Average for Real CV
7491	7981	Read Only	Previous 24 Hour Average for Wet CV
7492	7983	Read Only	Previous 24 Hour Average for Real Specific Gravity
7493	7985	Read Only	Previous 24 Hour Average for Compressibility
7494	7987	Read Only	Previous 24 Hour Average for WOBBE
7495	7189	Read Only	Previous 24 Hour Average for Un-normalized Total
7496	7991	Read Only	Previous 24 Hour Average for GPM
7497	7993	Read Only	Previous 24 Hour Average for Normal Density
7498	7995	Read Only	Previous 24 Hour Average for (Inferior) WOBBE
7499	7997	Read Only	Methane Number
7500	7999	Read Only	Previous 24 Hour Average for Methane Number

XII. Floating Point Register Group - Stream #2

Register (32)	Register (16)	Access	Description
7600	N/A	Read Only	Registers 7600-7799 are for stream #2
7601	8201	Read Only	Mole % - Component #1
7602	8203	Read Only	Mole % - Component #2
7603	8205	Read Only	Mole % - Component #3
7604	8207	Read Only	Mole % - Component #4
7605	8209	Read Only	Mole % - Component #5
7606	8211	Read Only	Mole % - Component #6
7607	8213	Read Only	Mole % - Component #7
7608	8215	Read Only	Mole % - Component #8
7609	8217	Read Only	Mole % - Component #9
7610	8219	Read Only	Mole % - Component #10
7611	8221	Read Only	Mole % - Component #11
7612	8223	Read Only	Mole % - Component #12
7613	8225	Read Only	Mole % - Component #13
7614	8227	Read Only	Mole % - Component #14
7615	8229	Read Only	Mole % - Component #15
7616	8231	Read Only	Mole % - Component #16
7617	8233	Read Only	GPM - Component #1
7618	8235	Read Only	GPM - Component #2
7619	8237	Read Only	GPM - Component #3
7620	8239	Read Only	GPM - Component #4
7621	8241	Read Only	GPM - Component #5
7622	8243	Read Only	GPM - Component #6
7623	8245	Read Only	GPM - Component #7
7624	8247	Read Only	GPM - Component #8
7625	8249	Read Only	GPM - Component #9
7626	8251	Read Only	GPM - Component #10
7627	8253	Read Only	GPM - Component #11
7628	8255	Read Only	GPM - Component #12
7629	8257	Read Only	GPM - Component #13
7630	8259	Read Only	GPM - Component #14
7631	8261	Read Only	GPM - Component #15
7632	8263	Read Only	GPM - Component #16
7633	8265	Read Only	BTU - Dry
7634	8267	Read Only	BTU - Saturated
7635	8269	Read Only	Specific Gravity
7636	8271	Read Only	Compressibility

Register (32)	Register (16)	Access	Description
7637	8273	Read Only	WOBBE Index
7638	8275	Read Only	Total UN-normalized mole
7639	8277	Read Only	Total GPM
7640	8279	Read Only	Ratio #1 - Unused
7641	8281	Read Only	Ratio #2 - Unused
7642	8283	Read Only	Ratio #3 - Unused
7643	8285	Read Only	Ratio #4 - Unused
7644	8287	Read Only	Ratio #5 - Unused
7645	8289	Read Only	Rolling Average #1 - Unused
7646	8291	Read Only	Rolling Average #2 - Unused
7647	8293	Read Only	Rolling Average #3 - Unused
7648	8295	Read Only	Rolling Average #4 - Unused
7649	8297	Read Only	Rolling Average #5 - Unused
7650	8299	Read Only	Rolling Average #6 - Unused
7651	8301	Read Only	Rolling Average #7 - Unused
7652	8303	Read Only	Rolling Average #8 - Unused
7653	8305	Read Only	Rolling Average #9 - Unused
7654	8307	Read Only	Rolling Average #10 - Unused
7655	8309	Read Only	24 Hour Average for Component #1
7656	8311	Read Only	24 Hour Average for Component #2
7657	8313	Read Only	24 Hour Average for Component #3
7658	8315	Read Only	24 Hour Average for Component #4
7659	8317	Read Only	24 Hour Average for Component #5
7660	8319	Read Only	24 Hour Average for Component #6
7661	8321	Read Only	24 Hour Average for Component #7
7662	8323	Read Only	24 Hour Average for Component #8
7663	8325	Read Only	24 Hour Average for Component #9
7664	8327	Read Only	24 Hour Average for Component #10
7665	8329	Read Only	24 Hour Average for Component #11
7666	8331	Read Only	24 Hour Average for Component #12
7667	8333	Read Only	24 Hour Average for Component #13
7668	8335	Read Only	24 Hour Average for Component #14
7669	8337	Read Only	24 Hour Average for Component #15
7670	8339	Read Only	Previous 24 Hour Average for Component #1
7671	8341	Read Only	Previous 24 Hour Average for Component #2
7672	8343	Read Only	Previous 24 Hour Average for Component #3
7673	8345	Read Only	Previous 24 Hour Average for Component #4
7674	8347	Read Only	Previous 24 Hour Average for Component #5
7675	8349	Read Only	Previous 24 Hour Average for Component #6
7676	8351	Read Only	Previous 24 Hour Average for Component #7
7677	8353	Read Only	Previous 24 Hour Average for Component #8
7678	8355	Read Only	Previous 24 Hour Average for Component #9
7679	8357	Read Only	Previous 24 Hour Average for Component #10
7680	8359	Read Only	Previous 24 Hour Average for Component #11
7681	8361	Read Only	Previous 24 Hour Average for Component #12
7682	8363	Read Only	Previous 24 Hour Average for Component #13
7683	8365	Read Only	Previous 24 Hour Average for Component #14
7684	8367	Read Only	Previous 24 Hour Average for Component #15
7685	8369	Read Only	Normal Density
7686	8371	Read Only	Water – If Available
7687	8373	Read Only	Hydrogen Sulfide – If Available
7688	8375	Read Only	(Inferior) WOBBE
7689	8377	Read Only	Previous 24 Hour Average for C9
7690	8379	Read Only	Previous 24 Hour Average for Real CV
7691	8381	Read Only	Previous 24 Hour Average for Wet CV
7692	8383	Read Only	Previous 24 Hour Average for Real Specific Gravity
7693	8385	Read Only	Previous 24 Hour Average for Compressibility

Register (32)	Register (16)	Access	Description
7694	8387	Read Only	Previous 24 Hour Average for WOBBE
7695	8389	Read Only	Previous 24 Hour Average for Un-normalized Total
7696	8391	Read Only	Previous 24 Hour Average for GPM
7697	8393	Read Only	Previous 24 Hour Average for Normal Density
7698	8395	Read Only	Previous 24 Hour Average for (Inferior) WOBBE
7699	8397	Read Only	Methane Number
7700	8399	Read Only	Previous 24 Hour Average for Methane Number

XIII. Floating Point Register Group - Stream #3

Register (32)	Register (16)	Access	Description
7800	N/A	Read Only	Registers 7800-7999 are for stream #3
7801	8601	Read Only	Mole % - Component #1
7802	8603	Read Only	Mole % - Component #2
7803	8605	Read Only	Mole % - Component #3
7804	8607	Read Only	Mole % - Component #4
7805	8609	Read Only	Mole % - Component #5
7806	8611	Read Only	Mole % - Component #6
7807	8613	Read Only	Mole % - Component #7
7808	8615	Read Only	Mole % - Component #8
7809	8617	Read Only	Mole % - Component #9
7810	8619	Read Only	Mole % - Component #10
7811	8621	Read Only	Mole % - Component #11
7812	8623	Read Only	Mole % - Component #12
7813	8625	Read Only	Mole % - Component #13
7814	8627	Read Only	Mole % - Component #14
7815	8629	Read Only	Mole % - Component #15
7816	8631	Read Only	Mole % - Component #16
7817	8633	Read Only	GPM - Component #1
7818	8635	Read Only	GPM - Component #2
7819	8637	Read Only	GPM - Component #3
7820	8639	Read Only	GPM - Component #4
7821	8641	Read Only	GPM - Component #5
7822	8643	Read Only	GPM - Component #6
7823	8645	Read Only	GPM - Component #7
7824	8647	Read Only	GPM - Component #8
7825	8649	Read Only	GPM - Component #9
7826	8651	Read Only	GPM - Component #10
7827	8653	Read Only	GPM - Component #11
7828	8655	Read Only	GPM - Component #12
7829	8657	Read Only	GPM - Component #13
7830	8659	Read Only	GPM - Component #14
7831	8661	Read Only	GPM - Component #15
7832	8663	Read Only	GPM - Component #16
7833	8665	Read Only	BTU - Dry
7834	8667	Read Only	BTU - Saturated
7835	8669	Read Only	Specific Gravity
7836	8671	Read Only	Compressibility
7837	8673	Read Only	WOBBE Index
7838	8675	Read Only	Total UN-normalized mole
7839	8677	Read Only	Total GPM
7840	8679	Read Only	Ratio #1 - Unused
7841	8681	Read Only	Ratio #2 - Unused
7842	8683	Read Only	Ratio #3 - Unused
7843	8685	Read Only	Ratio #4 - Unused
7844	8687	Read Only	Ratio #5 - Unused
7845	8689	Read Only	Rolling Average #1 - Unused
7846	8691	Read Only	Rolling Average #2 - Unused

Register (32)	Register (16)	Access	Description
7847	8693	Read Only	Rolling Average #3 - Unused
7848	8695	Read Only	Rolling Average #4 - Unused
7849	8697	Read Only	Rolling Average #5 - Unused
7850	8699	Read Only	Rolling Average #6 - Unused
7851	8701	Read Only	Rolling Average #7 - Unused
7852	8703	Read Only	Rolling Average #8 - Unused
7853	8705	Read Only	Rolling Average #9 - Unused
7854	8707	Read Only	Rolling Average #10 - Unused
7855	8709	Read Only	24 Hour Average for Component #1
7856	8711	Read Only	24 Hour Average for Component #2
7857	8713	Read Only	24 Hour Average for Component #3
7858	8715	Read Only	24 Hour Average for Component #4
7859	8717	Read Only	24 Hour Average for Component #5
7860	8719	Read Only	24 Hour Average for Component #6
7861	8721	Read Only	24 Hour Average for Component #7
7862	8723	Read Only	24 Hour Average for Component #8
7863	8725	Read Only	24 Hour Average for Component #9
7864	8727	Read Only	24 Hour Average for Component #10
7865	8729	Read Only	24 Hour Average for Component #11
7866	8731	Read Only	24 Hour Average for Component #12
7867	8733	Read Only	24 Hour Average for Component #13
7868	8735	Read Only	24 Hour Average for Component #14
7869	8737	Read Only	24 Hour Average for Component #15
7870	8739	Read Only	Previous 24 Hour Average for Component #1
7871	8741	Read Only	Previous 24 Hour Average for Component #2
7872	8743	Read Only	Previous 24 Hour Average for Component #3
7873	8745	Read Only	Previous 24 Hour Average for Component #4
7874	8747	Read Only	Previous 24 Hour Average for Component #5
7875	8749	Read Only	Previous 24 Hour Average for Component #6
7876	8751	Read Only	Previous 24 Hour Average for Component #7
7877	8753	Read Only	Previous 24 Hour Average for Component #8
7878	8755	Read Only	Previous 24 Hour Average for Component #9
7879	8757	Read Only	Previous 24 Hour Average for Component #10
7880	8759	Read Only	Previous 24 Hour Average for Component #11
7881	8761	Read Only	Previous 24 Hour Average for Component #12
7882	8763	Read Only	Previous 24 Hour Average for Component #13
7883	8765	Read Only	Previous 24 Hour Average for Component #14
7884	8767	Read Only	Previous 24 Hour Average for Component #15
7885	8769	Read Only	Normal Density
7886	8771	Read Only	Water – If Available
7887	8773	Read Only	Hydrogen Sulfide – If Available
7888	8775	Read Only	(Inferior) WOBBE
7889	8777	Read Only	Previous 24 Hour Average for C9
7890	8779	Read Only	Previous 24 Hour Average for Real CV
7891	8781	Read Only	Previous 24 Hour Average for Wet CV
7892	8783	Read Only	Previous 24 Hour Average for Real Specific Gravity
7893	8785	Read Only	Previous 24 Hour Average for Compressibility
7894	8787	Read Only	Previous 24 Hour Average for WOBBE
7895	8789	Read Only	Previous 24 Hour Average for Un-normalized Total
7896	8791	Read Only	Previous 24 Hour Average for GPM
7897	8793	Read Only	Previous 24 Hour Average for Normal Density
7898	8795	Read Only	Previous 24 Hour Average for (Inferior) WOBBE
7899	8797	Read Only	Methane Number
7900	8799	Read Only	Previous 24 Hour Average for Methane Number

XIV. Floating Point Register Group - Stream #4

Register (32)	Register (16)	Access	Description
8000	N/A	Read Only	Registers 8000-8199 are for stream #4
8001	N/A	Read Only	Mole % - Component #1
8002	N/A	Read Only	Mole % - Component #2
8003	N/A	Read Only	Mole % - Component #3
8004	N/A	Read Only	Mole % - Component #4
8005	N/A	Read Only	Mole % - Component #5
8006	N/A	Read Only	Mole % - Component #6
8007	N/A	Read Only	Mole % - Component #7
8008	N/A	Read Only	Mole % - Component #8
8009	N/A	Read Only	Mole % - Component #9
8010	N/A	Read Only	Mole % - Component #10
8011	N/A	Read Only	Mole % - Component #11
8012	N/A	Read Only	Mole % - Component #12
8013	N/A	Read Only	Mole % - Component #13
8014	N/A	Read Only	Mole % - Component #14
8015	N/A	Read Only	Mole % - Component #15
8016	N/A	Read Only	Mole % - Component #16
8017	N/A	Read Only	GPM - Component #1
8018	N/A	Read Only	GPM - Component #2
8019	N/A	Read Only	GPM - Component #3
8020	N/A	Read Only	GPM - Component #4
8021	N/A	Read Only	GPM - Component #5
8022	N/A	Read Only	GPM - Component #6
8023	N/A	Read Only	GPM - Component #7
8024	N/A	Read Only	GPM - Component #8
8025	N/A	Read Only	GPM - Component #9
8026	N/A	Read Only	GPM - Component #10
8027	N/A	Read Only	GPM - Component #11
8028	N/A	Read Only	GPM - Component #12
8029	N/A	Read Only	GPM - Component #13
8030	N/A	Read Only	GPM - Component #14
8031	N/A	Read Only	GPM - Component #15
8032	N/A	Read Only	GPM - Component #16
8033	N/A	Read Only	BTU - Dry
8034	N/A	Read Only	BTU - Saturated
8035	N/A	Read Only	Specific Gravity
8036	N/A	Read Only	Compressibility
8037	N/A	Read Only	WOBBE Index
8038	N/A	Read Only	Total UN-normalized mole
8039	N/A	Read Only	Total GPM
8040	N/A	Read Only	Ratio #1 - Unused
8041	N/A	Read Only	Ratio #2 - Unused
8042	N/A	Read Only	Ratio #3 - Unused
8043	N/A	Read Only	Ratio #4 - Unused
8044	N/A	Read Only	Ratio #5 - Unused
8045	N/A	Read Only	Rolling Average #1 - Unused
8046	N/A	Read Only	Rolling Average #2 - Unused
8047	N/A	Read Only	Rolling Average #3 - Unused
8048	N/A	Read Only	Rolling Average #4 - Unused
8049	N/A	Read Only	Rolling Average #5 - Unused
8050	N/A	Read Only	Rolling Average #6 - Unused
8051	N/A	Read Only	Rolling Average #7 - Unused
8052	N/A	Read Only	Rolling Average #8 - Unused
8053	N/A	Read Only	Rolling Average #9 - Unused
8054	N/A	Read Only	Rolling Average #10 - Unused
8055	N/A	Read Only	24 Hour Average for Component #1
8056	N/A	Read Only	24 Hour Average for Component #2

Register (32)	Register (16)	Access	Description
8057	N/A	Read Only	24 Hour Average for Component #3
8058	N/A	Read Only	24 Hour Average for Component #4
8059	N/A	Read Only	24 Hour Average for Component #5
8060	N/A	Read Only	24 Hour Average for Component #6
8061	N/A	Read Only	24 Hour Average for Component #7
8062	N/A	Read Only	24 Hour Average for Component #8
8063	N/A	Read Only	24 Hour Average for Component #9
8064	N/A	Read Only	24 Hour Average for Component #10
8065	N/A	Read Only	24 Hour Average for Component #11
8066	N/A	Read Only	24 Hour Average for Component #12
8067	N/A	Read Only	24 Hour Average for Component #13
8068	N/A	Read Only	24 Hour Average for Component #14
8069	N/A	Read Only	24 Hour Average for Component #15
8070	N/A	Read Only	Previous 24 Hour Average for Component #1
8071	N/A	Read Only	Previous 24 Hour Average for Component #2
8072	N/A	Read Only	Previous 24 Hour Average for Component #3
8073	N/A	Read Only	Previous 24 Hour Average for Component #4
8074	N/A	Read Only	Previous 24 Hour Average for Component #5
8075	N/A	Read Only	Previous 24 Hour Average for Component #6
8076	N/A	Read Only	Previous 24 Hour Average for Component #7
8077	N/A	Read Only	Previous 24 Hour Average for Component #8
8078	N/A	Read Only	Previous 24 Hour Average for Component #9
8079	N/A	Read Only	Previous 24 Hour Average for Component #10
8080	N/A	Read Only	Previous 24 Hour Average for Component #11
8081	N/A	Read Only	Previous 24 Hour Average for Component #12
8082	N/A	Read Only	Previous 24 Hour Average for Component #13
8083	N/A	Read Only	Previous 24 Hour Average for Component #14
8084	N/A	Read Only	Previous 24 Hour Average for Component #15
8085	N/A	Read Only	Normal Density
8086	N/A	Read Only	Water – If Available
8087	N/A	Read Only	Hydrogen Sulfide – If Available
8088	N/A	Read Only	(Inferior) WOBBE
8089	N/A	Read Only	Previous 24 Hour Average for C9
8090	N/A	Read Only	Previous 24 Hour Average for Real CV
8091	N/A	Read Only	Previous 24 Hour Average for Wet CV
8092	N/A	Read Only	Previous 24 Hour Average for Real Specific Gravity
8093	N/A	Read Only	Previous 24 Hour Average for Compressibility
8094	N/A	Read Only	Previous 24 Hour Average for WOBBE
8095	N/A	Read Only	Previous 24 Hour Average for Un-normalized Total
8096	N/A	Read Only	Previous 24 Hour Average for GPM
8097	N/A	Read Only	Previous 24 Hour Average for Normal Density
8098	N/A	Read Only	Previous 24 Hour Average for (Inferior) WOBBE
8099	N/A	Read Only	Methane Number
8100	N/A	Read Only	Previous 24 Hour Average for Methane Number

XV. COMPONENT DATA TABLES

These tables are used in conjunction with registers 3001 through 3032 above to determine the mapping of components to component #'s. These tables and their constants are examples only and might not match the latest standards.

COMPONENT CODE	COMPONENT NAME	BTU-DRY	GPM FACTOR	\sqrt{bi}	SP. GR. IDEAL	MOLECULAR WEIGHT
100	METHANE	1012.0	0.0000	0.01160	0.5539	16.04
101	ETHANE	1773.7	0.2673	0.02390	1.0382	30.07
102	PROPANE	2522.1	0.2751	0.03440	1.5225	44.10
103	I-BUTKNE	3260.5	0.3270	0.04580	2.0068	58.12
104	N-BUTANE	3270.1	0.3151	0.04780	2.0068	58.12
105	IPENTANE	4011.1	0.3659	0.05810	2.4911	72.15
106	NPENTANE	4016.2	0.3622	0.06310	2.4911	72.15
107	NEO C5	3993.8	0.3830	0.05774**	2.4911	72.15
108	C 6 + (47,35,17)	5288.8	0.4462	0.09100	3.3127	95.96
109	C 6 + (50,50,0)	5141.2	0.4362	0.08730	3.2174	93.19
110	C 6 + (50,25,25)	5328.2	0.4488	0.09210	3.3383	96.70
***111	C 6 + (57,28,14)	5194.6	0.4398	0.08900	3.2521	94.19
*112	HYDROGEN	324.9	0.0000		0.0696	2.02
*113	HELIUM	0.0	0.0000	-.00452++	0.1382	4.00
*114	NITROGEN	0.0	0.0000	0.00440	0.2672	28.01
*115	C 0	321.3	0.0000	0.00530	0.9671	28.01
*116	OXYGEN	0.0	0.0000	0.00730	1.1048	32.00
*117	C 0 2	0.0	0.0000	0.01970	1.3195	44.01
118	N 2 0	0.0	0.0000	0.00000	0.0000	44.02
119	N 0 2	0.0	0.0000	0.00000	0.0000	46.00
120	Octane (was N 0)	6248.9		0.11370	3.9441	118.17
121	ETHYLEN	1603.4	0.0000	0.02054**	0.9686	28.05
122	ACTYLEN	1476.2	0.0000	0.02259**	0.8990	26.04
123	PROPENE	2339.1	0.2554	0.03258**	1.4529	42.08
124	PROPDIE	2254.2	0.0000	0.03195**	1.4110	40.07
125	PROPYNE	2246.2	0.0000	0.03195**	1.4110	40.07
*126	AIR	0.0	0.0000	0.00522**	1.0000	28.96
127	I-BUTENS	30a8.9	0.2960	0.04600**	1.9372	56.11
128	BUTENE-1	3087.8	0.2956	0.04488**	1.2372	56.11
129	C4-1	3078.4	0.2958	0.04548**	1.9372	56.11
130	T-C4=2	3075.3	0.2914	0.04796**	1.9372	36.11
131	C-C4=2	3000.2	0.2835	0.04803**	1.9372	56.11
132	BTITENES	3078.0	0.2944	0.04674**	1.9372	56.11
133	BUTANES	3265.3	0.3111	0.04652**	2.0068	58.12
134	1,3-C4@	2887.7	0.2732	0.04980**	1.8676	54.09
135	1,2-C4==	2946.8	0.2604	0.04593**	1.8676	54.09
136	ETHYL OX	1459.4	0.0000	0.00000	1.4900	44.CS
137	PENTEN-1	3835.7	0.3441	0.05534**	2.4215	70.14
138	MTHMERC	0.0	0.0000	0.00000	0.0000	49.10
139	HEXANE	4767.0	0.4111	0.08020	2.9754	86.18
*140	H 2 S	638.6	0.1367	0.0253	1.1767	34.09
141	C S 2	1267.0	0.0000	0.00000	2.629	76.14
142	c 0 s	0.0	0.0000	0.00000	0.0000	60.08
143	S 0 2	0.0	0.1453	0.00000	2.2117	64.06
*144	WATER	30.4	0.0571	0.06230	0.6220	16.02
145	HEPTANE	5515.4	0.4613	0.09440	3.4596	100.21
*146	ARGON	0.0	0.0000	0.00710	1.3793	39.95
147	C 3 +	2522.1	0.2751	0.0344	1.5225	44.10
148	C 4 +	3270.1	0.3151	0.04780	2.0068	58.12
149	C 5 +	4019.2	0.3622	0.06310	2.4911	72.15

+Special equation is used for H2 in accordance with GPA 2172 ++GPA Pseudo \sqrt{bi} He <1%.

*AGA Non-hydrocarbons

**Derived using GPA compressibility data

***The transmitter uses this code since no method was available to get more detailed split information in a compatible manner. For total analysis calculate Decane+ = C6+(111) - Hexane(139) - Heptane(145) - Octane(120) - Nonane(161)

NOTE: The values in this table are examples only. Refer to the latest GPA, ISO or AGA publications for exact values.

XVI. OTHER COMPONENT CODES

The following component codes are provided for completeness and to serve as a reference to use with other Totalflow Products such as the Analyzer Interface Unit. The transmitter uses component code 161 as no other method of gaining access to Nonane was available.

COMPONENT CODE	COMPONENT NAME	BTU-DRY	GPM FACTOR	\sqrt{bi}	SP. GR. IDEAL	MOLECULAR WEIGHT
150	METHANE	1012.3	0.0000	0.01160	0.3539	16.04
151	ETHANE	1773.7	0.2675	0.02390	1.0382	30.07
152	PROPANE	2521.9	0.2756	0.03440	1.5226	44.10
153	I-BUTANE	3259.4	0.3271	0.04580	2.0068	59.12
154	N-BUTANE	3269.8	0.3153	0.104780	2.0068	58.12
155	NEO C5	3993.8	0.3830	0.05774	2.4912	72.15
156	IPENTANE	4010.2	0.3659	0.05910	2.4912	72.15
157	NPENTANE	4018.2	0.3622	0.06310	2.4912	72.15
158	C 6 +	5288.7	0.4463	0.09100	3.3132	95.97
159	NITROGEN	0.0	0.0000	0.00440	0.9672	26.01
160	C O 2	0.0	0.0000	0.01970	1.5196	44.01
161	NONANE	6996.5		0.13310	4.4284	128.258

COMPONENT CODE	COMPONENT NAME
162	BTU-DRY
163	BTU-SAT
164	S.G.
165	z
166	WOBBE
167	TOTURRML
183	24 Hour Average for Component #1
184	24 Hour Average for Component #2
185	24 Hour Average for Component #3
186	24 Hour Average for Component #4
187	24 Hour Average for Component #5
188	24 Hour Average for Component #6
189	24 Hour Average for Component #7
190	24 Hour Average for Component #8
191	24 Hour Average for Component #9
192	24 Hour Average for Component #10
193	24 Hour Average for Component #11
194	24 Hour Average for Component #12
195	24 Hour Average for Component #13
196	24 Hour Average for Component #14
197	24 Hour Average for Component #15
198	Previous 24 Hour Average for Component #1
199	Previous 24 Hour Average for Component #2
200	Previous 24 Hour Average for Component #3
201	Previous 24 Hour Average for Component #4
202	Previous 24 Hour Average for Component #5
203	Previous 24 Hour Average for Component #6
204	Previous 24 Hour Average for Component #7
205	Previous 24 Hour Average for Component #8
206	Previous 24 Hour Average for Component #9
207	Previous 24 Hour Average for Component #10
208	Previous 24 Hour Average for Component #11
209	Previous 24 Hour Average for Component #12
210	Previous 24 Hour Average for Component #13
211	Previous 24 Hour Average for Component #14
212	Previous 24 Hour Average for Component #15
213	TOTALGPM

XVII. Bit Flags Registers 3046 through 3055

INDEX \ Bit Pos.	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Bit Weight	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1
3046	XMTR FAIL														
3047														RF % DEV	POWER FAIL
3048	Stream #1 Comp #15 LOW	Comp #14 LOW	Comp #13 LOW	Comp #12 LOW	Comp #11 LOW	Comp #10 LOW	Comp #9 LOW	Comp #8 LOW	Comp #7 LOW	Comp #6 LOW	Comp #5 LOW	Comp #4 LOW	Comp #3 LOW	Comp #2 LOW	Stream #1 Comp #1 LOW
3049	Stream #1 Comp #15 HIGH	Comp #14 HIGH	Comp #13 HIGH	Comp #12 HIGH	Comp #11 HIGH	Comp #10 HIGH	Comp #9 HIGH	Comp #8 HIGH	Comp #7 HIGH	Comp #6 HIGH	Comp #5 HIGH	Comp #4 HIGH	Comp #3 HIGH	Comp #2 HIGH	Stream #1 Comp #1 HIGH
3050	Stream #2 Comp #15 LOW	Comp #14 LOW	Comp #13 LOW	Comp #12 LOW	Comp #11 LOW	Comp #10 LOW	Comp #9 LOW	Comp #8 LOW	Comp #7 LOW	Comp #6 LOW	Comp #5 LOW	Comp #4 LOW	Comp #3 LOW	Comp #2 LOW	Stream #2 Comp #1 LOW
3051	Stream #2 Comp #15 HIGH	Comp #14 HIGH	Comp #13 HIGH	Comp #12 HIGH	Comp #11 HIGH	Comp #10 HIGH	Comp #9 HIGH	Comp #8 HIGH	Comp #7 HIGH	Comp #6 HIGH	Comp #5 HIGH	Comp #4 HIGH	Comp #3 HIGH	Comp #2 HIGH	Stream #2 Comp #1 HIGH
3052	Stream #3 Comp #15 LOW	Comp #14 LOW	Comp #13 LOW	Comp #12 LOW	Comp #11 LOW	Comp #10 LOW	Comp #9 LOW	Comp #8 LOW	Comp #7 LOW	Comp #6 LOW	Comp #5 LOW	Comp #4 LOW	Comp #3 LOW	Comp #2 LOW	Stream #3 Comp #1 LOW
3053	Stream #3 Comp #15 HIGH	Comp #14 HIGH	Comp #13 HIGH	Comp #12 HIGH	Comp #11 HIGH	Comp #10 HIGH	Comp #9 HIGH	Comp #8 HIGH	Comp #7 HIGH	Comp #6 HIGH	Comp #5 HIGH	Comp #4 HIGH	Comp #3 HIGH	Comp #2 HIGH	Stream #3 Comp #1 HIGH
3054	Stream #4 Comp #15 LOW	Comp #14 LOW	Comp #13 LOW	Comp #12 LOW	Comp #11 LOW	Comp #10 LOW	Comp #9 LOW	Comp #8 LOW	Comp #7 LOW	Comp #6 LOW	Comp #5 LOW	Comp #4 LOW	Comp #3 LOW	Comp #2 LOW	Stream #4 Comp #1 LOW
3055	Stream #4 Comp #15 HIGH	Comp #14 HIGH	Comp #13 HIGH	Comp #12 HIGH	Comp #11 HIGH	Comp #10 HIGH	Comp #9 HIGH	Comp #8 HIGH	Comp #7 HIGH	Comp #6 HIGH	Comp #5 HIGH	Comp #4 HIGH	Comp #3 HIGH	Comp #2 HIGH	Stream #4 Comp #1 HIGH

As an example, if on Stream #1 a Low alarm was signaled on components #2(4), #5(32) and #10(1024), then add together the weights of those bits to get the value returned as 4+32+1024=1060.

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BTU Transmitter Printer/Console Commands

Introduction

This document describes the commands that are available through the printer/console port on the BTU Transmitter.

Set/Retrieve/Command Protocol

The protocol used is a very simple command response protocol. An example of setting a variable in the Transmitter can be illustrated with the OK command. The format is OK <CR>. The transmitter will respond with the requested data if allowed by the security codes. In this case the response would be Y <CR> <LF>. To set a variable, give the proper command followed by an equal sign, and then the data. An illustration of this is the CODE command. The format is CODE= xxxx <CR>. Some commands that set fixed format data through Port D do not require the ending <CR>. The transmitter responds with: <CR><LF>. If an invalid command is given or access is not allowed, either the data is not returned or the variable is not set. An error setting a variable may also be indicated by not having both the <CR> and the <LF> returned. Some commands are prefaced with xx. These commands are for array type access to the variables in question. All array values start at 00.

Totalflow Connect Commands

These commands are always responded to regardless of security codes in effect or the position of security code override switches. These have been around forever and are always supported by Totalflow products.

OK - Access Allowed

The OK command is used to find out if any access is granted. OK will respond with N if no access is allowed. The response will be Y if some or all access is allowed.

CODE - Get Access

The CODE command is used to gain access to the transmitter. The format is CODE=XXXX where XXXX is the desired security code for the type of access desired, r/o or r/w.

Totalflow Security Commands

The following relate to Totalflow product security. Most of these have been around forever and are supported by most Totalflow products.

SC - Set Level 2 Security Code

This command sets the security code for level 2 or r/w access. The format is SC=XXXX. In printer/console mode, these commands normally have an equals sign (=) as part of the command to set a parameter.

sc - Set Level 1 Security Code

This command sets the security code for level 1 or r/o access. The format is sc=XXXX. In printer/console mode, these commands typically are those that are allowed to be set with an equals sign (=), but are read from the transmitter by pressing the enter key instead of the equals.

Sc - Set Operate Level Security Code

This command sets the security code for operation access. The format is Sc=XXXX. In printer/console mode, these commands typically are those that do not allow an equals sign to set a parameter. See the OP command for examples of which commands may be used with this security level.

OP – Set Operation Level Security Bits

This command is used in conjunction with the Sc command to set which operating commands to apply to the operation level security code. The default is 0x0026 (hex) which enables hold, run and calibration to be performed at the operation security level. If a bit is not set, then r/w access must be granted to allow operation of that command.

Bit	State	Explanation
00	Other	Applies to operation commands not provided for specifically (i.e. this applies to xxSAMPSTR, xxSELSTRM and xxBALDR).
01	Hold	Allows operator to enter hold mode.
02	Run	Allows operator to enter run mode.
03	Single Cycle	Allows operator to run a single cycle.
04	Abort	Allows operator to abort a calibration or startup sequence.
05	Calibrate	Allows operator to initiate a calibration.
06	Startup	Allows operator to initiate a startup sequence with peak detect and calibration if enabled.
07	Manual Update	Allows operator to manually update response factors after calibration.

Totalflow System Commands

The following are Totalflow System Commands. Most of these have been around forever and are supported by most Totalflow products.

dSL - Dump/Retrieve Station List

The dSL command uploads or downloads a data structure to support several Flow Computers connected in a station configuration. Normally, an AIU would be configured with the Station List so that analysis data could be downloaded to some or all Flow Computers in the list. This command is not currently implemented. This command will eventually be required to support local bus.

Td - Time and Date

This command sets or retrieves the Time and Date from the Transmitter. The format to set is Td=mm/dd/yy hh:mm. Retrieving the time and date returns a string in the same format.

Id - Analyzer Id Command

This command sets the 10 character Id that is used to access the Transmitter from the remote protocol. This command or function is generally available only through the local protocol.

L - Location Command

This command sets the 24 character Location factor. This can be used to further describe where the transmitter is or its function in a system.

Rev - Read Revision Information

This command reads the software revision codes. The format returned is: XXYYYYYYY-ZZZ where XX is the two-character software revision, YYYYYYY is the software part number, and ZZZ is the prom version code.

AN - Analyzer Number

This command sets the analyzer number. This is used in communications with an AIU. The format is XX. The analyzer number is primarily used in MODBUS communications. The actual address is one more than what this command is set to.

Transmitter Mode Commands

The following commands are used to set the operating mode of the transmitter. Depending on what is happening at the time, there may be a delay in the transmitter actually switching to the selected mode. These commands and their functionality are subject to change.

RUN - Run Command

This command tells the transmitter to begin running analysis cycles. This will continue until told to do otherwise at intervals specified by the CTIME and CUNITS commands. The RUN command is not accepted when the transmitter is in START.

START - Start Command

This command causes the transmitter to begin running cycles. The exact sequence of events is very dependent upon any prior activity. Generally speaking, the transmitter will stabilize, run self-test 1 & 2, find peaks (APEAK), calibrate (ACAL, AUTO, CALBLEND), and run (ASTART).

HOLD - Hold Command

This command tells the analyzer to stop running analysis cycles when the current cycle is complete.

ABORT - Abort Command

This command tells the analyzer to abort a calibration or startup sequence.

CYCLE - Run Single Cycle Command

This command tells the analyzer to run one cycle. The CYCLE command is not accepted when the transmitter is in START.

CAL - Calibrate Command

This command tells the analyzer to run a calibration sequence. The number of cycles run is specified with the CALCYC command and the number of cycles used in determining the response factors is specified with the CALAVG command. At the end of the calibrate sequence, the response factors will be automatically updated if the AUTO flag is set.

If this command is used when the analyzer is in run mode, a calibration sequence will be initiated as soon as possible. The analyzer returns to the run mode when calibration is complete. The CAL command is not accepted when the transmitter is in START.

CSTATE - Current State

This command returns the current running state of the analyzer.

Code	State	Explanation
01	Hold	Does not run cycles
02	Run	Continuously runs cycles as configured
03	Single Cycle	Runs one cycle, then goes to hold state
04	Abort	Ends Calibration or Startup in progress
05	Calibrate	Sets response factors
06	Startup	Runs diagnostics, Sets peak timing

NSTATE - Next State

This command returns the next expected running state of the analyzer. The code has the same interpretation as in the CSTATE command.

Component Commands

The following commands are used to read component concentrations and set up component parameters. Components are identified by index number. The transmitter directly measures real components. Carbon components are calculated as a percentage of the C6+ real component. The real components and the carbon-split components have their own sequence as follows.

Real Component Indexes

In each case the real components have the following ordering.

Real Component Index	Real Component Description
00	C3
01	IC4
02	NC4
03	Neo-C5
04	IC5
05	NC5
06	C6+
07	N2
08	C1
09	CO2
10	C4+
11	C3'
12	C2

Carbon Split Component Indexes

In each case the carbon components have the following ordering.

Carbon Component Index	Carbon Component Description
00	C6
01	C7
02	C8
03	C9
04	C10+

xxHILIMyy - Concentration High Limit

This command sets the concentration high limit for stream xx, component yy. This is expressed as a fraction, e.g. 100%=1. A concentration high warning is generated if the concentration is above this value with the concentration low limit being below the high limit. A concentration range warning is generated if the concentration is above this value and the concentration is below the low limit with the concentration hi limit being above the low limit.

xxLOWLIMyy - Concentration Low Limit

This command sets the concentration low limit for stream xx, component yy. This is expressed as a fraction, that is 100%=1. A concentration low warning is generated if the concentration is below this value with the concentration hi limit being above the low limit. A concentration range warning is generated if the concentration is below this value and the concentration is above the high limit with the concentration hi limit being below the low limit.

The two commands, xxHILIMyy and xxLOWLIMyy, work together as follows:

High/Low Mode

	High Limit Warning
High Limit > Low Limit	
	No Warning
Low Limit < High Limit	
	Low Limit Warning

Range Mode

	No Warning
Low Limit > High Limit	
	Range Warning
High Limit < Low Limit	
	No Warning

xxCONCyy - Read Measured Concentration

This command reads the measured concentration for stream xx component yy. The returned concentration is expressed as a fraction, e.g. 100%=1.

xxCByy - Read Measured Carbon Split Concentration

This command reads the measured concentration for stream xx carbon split component yy. The returned concentration is expressed as a fraction, e.g. 100%=1. The range of yy is from 00 to 04.

Calibration Control Commands

The following gives parameters that are used to control calibration.

CALHM - Calibration Hourly Mode

This command sets the resolution of the automatic calibration timing. The transmitter will always wait until the time specified by CALHR and CALMIN to initiate the first calibration after setting CALSET=01. Then if CALHM=01, the transmitter will delay the number of hours specified by CALNHR before initiating the next calibration. If CALHM=00, the transmitter will delay the specified # of days (CALDAY) before initiating the next calibration. The default is 00.

CALDAY - Calibrate Day

This command sets the # of days until automatic calibration will be initiated. The format is XX. The default is 07 days.

CALHR - Calibrate Hour

This command sets the hour of the day that automatic calibration will be initiated. The format is XX. The default is midnight (00).

CALNHR - Calibrate Delay Hours

This command sets the # of hours to delay between calibrations when CALHM=01.

CALMIN - Calibrate Minute

This command sets the minute of the hour that automatic calibration will be initiated. The format is XX. The default is the top of the hour (00).

CALSET - Enable Timed Automatic Calibration

This command enables or disables timed automatic calibration. Calibration is disabled when set to 00 and calibration is enabled when set to 01. This will change to -1 (0xff) when the timer is set. The default is 00.

ACAL - Enable Startup Automatic Calibration

This command enables or disables automatic calibration at startup. Startup calibration is disabled when set to 00 and enabled when set to 01. The default is 00.

AUTO - Auto Update Mode

This command sets whether to automatically set response factors after a calibration sequence.

MAN - Manually Update Response Factors

This command is used to manually move the newly calculated response factors to be used to calculate concentrations.

LIMIT - Response Factor Change Limit

This command sets the limit value associated with the change in response factors from one calibration to the next. The default is 0.00 meaning that the calibration will occur regardless of the deviation of the response factors. A positive limit value will reject calibrations that generate any response factor deviations greater than the limit. A negative limit value will reject calibrations if all response factor deviations are less than the absolute value of the limit. If a calibration is rejected, a fault is generated and the error counter is incremented. The next action is dependent on the error count (ECT) and error count limit (ECL) commands.

TPAP - Total Peak Area Percent Limit

This command enables checking for total peak area drift. The default value of 0.00 will cause the total peak area of all components to be recorded in memory at the end of a calibration. The TPAP command would then be used to set a limit value of, as an example, 30% or 0.30. Subsequent calibrations would then compare the total peak area with the recorded one and if they differed more than the percent limit, then a fault alarm would occur and the error counter is incremented. NOTE: the transmitter must be calibrated once with this command set to 0.00 before this command would be effective. The next action is dependent on the error count (ECT) and error count limit (ECL) commands.

LCL - Last Cal BTU Limit

This command sets the last calibration BTU limit. The default is 0.00, which means to not check the limit value. If a non-zero value of, as an example, 30% or 0.30 is entered, the BTU value of the current calibration is compared with the value recorded at the end of the last successful calibration. If the two values differ by more than the limit, a fault alarm is generated and the error counter is incremented. The next action is dependent on the error count (ECT) and error count limit (ECL) commands.

ECL - Error Count Limit

This command sets the error count limit. This is used in conjunction with the LIMIT, TPAP, and LCL commands. The default value is 0000, which means that no error count limit is used. When this value is non-zero, the error count as incremented above is compared to the error count limit. When this limit is exceeded, the transmitter will be taken out of run mode and go into hold mode. If the limit is not exceeded, the transmitter will go into run mode.

ECT - Error Count

This command reads out the current error count. This value is incremented if a fault occurs as a result of the usage of the LIMIT, TPAP, or LCL commands. Successful completion of a calibration will result in the error count being reset to zero. The capability of the ECT and ECL commands can be used to preclude a slow creep over a few weeks of the transmitter using automatic timed calibration.

PCTBTU - Startup Percent BTU Window

This command is used during startup to verify that the transmitter is able to verify the calibration sample BTU value. The default is 1% or 0.01. This is used only in the case of an unexpected power outage that is then restored. After all of the basic diagnostics are complete, two dummy cycles are run on the calibration stream. After the calculations are complete on the second run, its BTU value is compared to the BTU value calculated on the calibration sample values entered into the transmitter. If the values do not match within the deviation window specified, a warning is generated and the transmitter will attempt a calibration if the ACAL flag is set. If all of the required peaks during the calibration runs are not found, the transmitter will attempt automatic peak detection if the APEAK flag is set. After successful completion of these events, the transmitter will go back to run mode.

CALSTR - Set Calibration Stream

This command will set which stream will be the calibration stream. The format is XX. The default is 03.

CALCYC - Set Number of Cal Cycles

This command sets the number of calibration cycles that will be taken when automatic or manual calibration is initiated. The format is XXXX. The default is 05 cycles.

CALAVG - Set Number of Cal Cycles to Average

This command sets the number of calibration cycles that will be used when automatic or manual calibration is initiated. The format is XXXX. The default is 03 cycles.

MO - Methane Offset

This command sets the Methane Offset. The default MO is -0.08 representing -8%. Methane Offset is used to compensate for a slight non-linearity in methane's response curve that is due to Methane's typically high concentration in the process stream. To calculate Methane offset, two calibration blends are needed. Blend #1 should be approximately 90% methane and blend #2 should be approximately 70%. The transmitter does not need to be calibrated before running these blends. Several cycles should be run on each blend. Record and average the peak area for methane for the last cycles run. As an example, run 5 cycles, then record and average methane's peak area for the last 3 cycles. Also record with each set of runs the Methane Fraction. As an example if Methane in blend #1 were 90%, then Methane Fraction #1 would be 0.9. Then calculate:

$$MO = \text{MethaneFraction}\#2 - \text{MethanePeakArea}\#2 * \frac{\text{MethaneFraction}\#1 - \text{MethaneFraction}\#2}{\text{MethanePeakArea}\#1 - \text{MethanePeakArea}\#2}$$

After entering the Methane Offset into the transmitter, calibrate normally. Recalculation of the Methane Offset should not be done as often as calibration. The transmitter will have the correct methane offset entered after factory calibration.

xxFACTOR - Manually Set Response Factor

This command sets the response factor associated with component xx. Normally a calibration sequence with an automatic or manual factor update should be used instead. Factors 0-12 are individual component factors. Factors 13-21 are Gas Chromatogram Module Coefficients (GCMC). Factors 0-12 and 13-16 are always used. Factors 17-22 are only used during a GCMC startup

Factor	Description	45/68 Module	59/60 Module
00	C3	5.68e-9	4.50e-9
01	IC4	4.85e-9	4.20e-9
02	NC4	4.79e-9	4.17e-9
03	NEOC5	4.40e-9	3.28e-9
04	IC5	4.38e-9	3.26e-9
05	NC5	4.19e-9	3.14e-9
06	C6+	2.80e-9	1.90e-9
07	N2	1.95e-8	1.43e-8
08	C1	2.59e-8	1.91e-8
09	CO2	1.78e-8	1.30e-8
10	C4+	1.18e-8	7.80e-9
11	C3'	6.90e-7	7.46e-7
12	C2	1.55e-8	1.17e-8
13	C3-NC5 Amplitude - Primary is C3	1.00	1.00
14	C6+ Amplitude	1.00	1.00
15	N2, C1, CO2 Amplitude - Primary is C1	1.00	1.00
16	C4+, C3', C2 Amplitude - Primary is C3'	1.00	1.00
17	Operating Carrier Pressure - sets NC5 PT		
18	C1 Peak Time @ Operating Carrier Pressure		
19	C3' Peak Time @ Operating Carrier Pressure		
20	SV1 Adjust Time		
21	NC5 PT		
22	C3 PT		

CALBLEND - Set Calibration Blend

This command sets the calibration blend:

Blend	Description
01	Standard Blend - Calibration adjusts Factors 0-12 & Sets Factors 13-16 to 1
02	Standard Blend with Magic Module Coefficients - Calibration adjusts Factors 13-16
03	Validation Blend with Magic Module Coefficients - No Adjustment, Warning if shifted
04	Future or No Blend Connected

xxSAMPLE - Set Sample Concentration

This command sets the sample concentration for component xx. The data is entered as a free format floating point number such that 100%=1, .99%=0.0099, etc.

xxPCTCH - Retrieve % Factor Change

This command retrieves the % by which component xx factor changed during last calibration.

BTU Transmitter Parameters

The following are some of the parameters that affect operation.

ASTART - Autostart command

This command sets the autostart flag. During power up, the flag may be used to determine whether to run or not after power up. The format is XX. If unit was not in RUN on last power down and ASTART=01, the analyzer will start running cycles after all other startup activities have been completed successfully. If unit was running when power was interrupted, this flag is ignored, and unit will return to running with old parameters if no fault alarms occur on power up.

APEAK - Autopeak Detect command

This command sets the APEAK flag. During power up, the flag may be used to determine how the peak times are determined. The format is XX.

Value	Meaning
00	No Detection of Peak Times
01	Automatic Peak Time Detection
02	Magic Module Factors 17-22 sets Carrier Pressure and Peak Times during startup

CTIME - Cycle Interval

This command sets the cycle interval. The format is XXXX. The default is 600 seconds. To set cycle interval to 180 seconds type 'CTIME=0180'.

CUNITS - Cycle Interval Units

This command sets the cycle interval units. The default is seconds. The allowed values are:

Value	Meaning
01	System Ticks
02	Seconds
03	Minutes

CLOCK - Read Current Cycle Tick Counter

This command reads the current cycle tick counter. The format returned is XXXX.

CTYPE - Calculation Type

This command sets the calculation type. The default is 01.

CTYPE	Calculation	xxPB Units	xxTB Units
00	AGA5	PSIG	Degrees F
01	NGPA	PSIG	Degrees F
02	ISO	kPA	Degrees C
03	GOST	kg	Degrees C
04	GPA96	PSIG	Degrees F
05	ISOM	kPA	Degrees C

CTYPE will convert xxPB and xxTB to the default values in compatible units as necessary.

PEAKDEV - Retention Peak Time Deviation Factor

This command sets the size of the retention time window that peaks are expected to be within. This is expressed as a fraction relative to the current value. The default is 0.075.

xxSIDELIM - Side to Side Warning Limit

This command sets the side-to-side warning limit. This is expressed as a fraction away from 1.000. The default is 0.10.

NOTE: This parameter will cause a warning or fault alarm only if cross correction is enabled.

Communications Commands

The following commands set communications modes and parameters.

XF - Start X-Frame Protocol

This command starts the X-Frame Protocol. X-Frame is used to collect larger blocked data structures. These include event log, alarm log, current results, history files, stored chromatograms, peak tables, and diagnostic files. Until X-Frame is killed by command or the local device is disconnected, local protocol commands will not be accepted.

WARNING: Since this command switches the protocol to a binary blocked protocol, this command should only be used in conjunction with the local MMI.

xxPORT - Port Protocol

This command sets the protocol to be used on port xx. Ports 00 and 01 are internal ports and are not available. The following ports and protocols are available or planned.

Port	Location	Default Protocol	Hardware Capability
(0)	(internal)	(none)	(none)
(1)	(internal)	(none)	(none)
2	I.S. Term PCBA, J3	Local	RS-232-C
3	RS232/PWR PCBA, J3	Printer/Console	RS-232-A
4	I.S. Term PCBA, J2	Modbus	RS-422
5	I.S. Term PCBA, J1	Remote	RS-485

Code	Protocol
00	(none)
01	Local
02	Printer/Console
03	HCIA (One Only)
04	Modbus
05	Remote
06	PGC PTB Printout
07	DSfG Adapter

xxPFLG - Selective Printout Flag

This command sets the automatic or selective printout flag for each port. xx is the port number to set. The parameter is bit weighted to indicate to print based on end of cycle, top of hour, top of day or top of month. This command also sets whether to send a clear byte (0xff) before the message frame in MODBUS or HCIA protocols. The bit weightings are as follows:

Bit	Meaning
00	End of Cycle
01	Top of Hour
02	Top of Day
03	Disable Clear Byte. Applies only to MODBUS and HCIA protocols.
04	16 Bit Modbus Modes (vs Daniels Modbus) (effective in MODBUS protocol)
05	Modicon Modbus (vs word swap) (effective if bit 04 is set)
06	Top of Month
07	End of Calibration

This command will affect printouts for the Printer/Console, PGC PTB Printout, and DSfG Adapter protocols.

C6IDX – Modbus C6+ Component Index Mode

This command selects how C6+, C6, C7, C8 and C9 are represented to external devices in modbus registers 3001-3032. This command does not modify the actual floating-point values in registers 7000-8999. This mode can be set to one of six values. The allowed values are:

Mode	Meaning
00 (00)	Totalflow Default: actual value of C6+, C7, C8 and C9. REQUIRED for Totalflow devices.
108 (6C)	47.466% C6, 35.340% C7, 17.194% C8.
109 (6D)	50% C6, 50% C7, 0% C8.
110 (6E)	50% C6, 25% C7, 25% C8.
111 (6F)	57.143% C6, 28.572% C7, 14.285% C8.
255 (FF)	C6+ is not reported; C6, C7, C8 and C9 are.

NOTE: When entering the code using printer/console mode, the hexadecimal value in parenthesis in the table above must be entered. Illegal values will cause C6+ to not be represented properly.

The current method of using the manually entered carbon split will still be used for all other purposes. Therefore, depending upon which C6+ index mode is selected, it is required to manually enter the appropriate carbon split shown in the table above in the stream setup menu for the transmitter to correctly compute and report accurately. As an example with the 2100528-003 firmware, the different C6+ index modes will cause a modbus master device to see the following effects on the integer registers 3001-3032 (registers 3017-3032 mirrors registers 3001-3016):

Component	Register	C6IDX					
		0	108	109	110	111	255
C3	3001(17)	0 2	02	02	02	02	02
IC4	3002(18)	0 3	03	03	03	03	03
NC4	3003(19)	0 4	04	04	04	04	04
NEOC5	3004(20)	0 7	07	07	07	07	07
IC5	3005(21)	0 5	05	05	05	05	05
NC5	3006(22)	0 6	06	06	06	06	06
C6+	3007(23)	1 1	08	09	10	11	255
N2	3008(24)	1 4	14	14	14	14	14
C1	3009(25)	0 0	00	00	00	00	00
CO2	3010(26)	1 7	17	17	17	17	17

C4+	3011(27)	4 8	48	48	48	48	48
C9	3012(28)	6 1	255	255	255	255	61
C2	3013(29)	0 1	01	01	01	01	01
C6	3014(30)	3 9	255	255	255	255	39
C7	3015(31)	4 5	255	255	255	255	45
C8	3016(32)	2 0	255	255	255	255	20

These modes are compliant with the Daniels C6+ comp codes 108, 109, 110, 111 and 255. Note that all codes except that unused code is offset by 100. Once this is done, the modbus master device would only receive a C6+ mole percent concentration via register 3007. This allows resolution of the issue of “doubling” the C6+ concentration and allows the flow computer to perform its own AGA8 Detail calculations. NOTE: Using codes 108 through 111 will cause the individual C6, C7, C8 and C9 index codes to not be available.

xxBR - Baud Rate

This command sets the remote protocol's baud rate. xx is the port number to set. The allowed values are:

Value	Meaning
00	1200 Baud
01	2400 Baud
02	4800 Baud
03	9600 Baud

xxWT - Listen Cycle Time

This command sets the remote protocol's listen cycle time. This command along with the baud rate command controls period and duty cycle for the remote protocol to listen for communications through a radio. The allowed values are:

Value	Meaning
00	4 Second Cycle
01	2 Second Cycle
02	1 Second Cycle
03	0 Second Cycle, a.k.a. Magic Mode 0

Stream Commands

The following is available to work with streams.

STRST - Step to Next Stream

This command steps to the next stream.

STREAM - Select Stream

This command sets the next stream to process in hold mode or returns the stream currently being processed. The format is XX. Valid entries are 00-03.

NXTSTR - Next Stream

This command sets the next stream to process in hold mode or returns the stream that is, at this instant, to be processed next. The format is XX. Valid entries are 00-03.

NSTREAM - Set Number of Streams

This command sets the number of streams. The format is XX. Valid entries are 00-04. The default is 01.

NOTE: This parameter is no longer used by the transmitter, but is provided for backward compatibility.

DISSEL - Disable Stream Select

This command disables stream selection. 00 enables stream selection and 01 disables stream selection (analyzer runs current stream continuously).

NSTRIDX - Number of Stream Indexes

This command sets the number of entries in the stream index table. The format is XX. The default is 0A to allow stream indexes to control sequencing.

xxSTRIDX - Stream Indexes

This command sets the stream index table entries. xx indicates which entry to set in the range of 00 to 09. The format is XX. Default index table is 00, 01, 02, FF, FF ---- to run stream 0, 1, and 2 in sequence. An entry can be set to 03 to run stream 03.

xxSKIP - Skip Stream

This command skips stream xx in the stream index table. Set to 00 to process stream and 01 to skip stream. During startup, the transmitter may set streams to be skipped if sample pressure is low. Even though the startup diagnostics always checks all streams, the transmitter will not re-enable a stream automatically.

xxMAMAX - Set Moving Average Cycle for Reported Results

This command sets the moving average cycle for stream xx. Results will be averaged on a moving basis for the specified number of cycles. All reports and histories will be based on this moving average. The format is XX. The default is 01.

xxCBPCTyy - Carbon Split Factor

This command sets the carbon-split factor for stream xx. For C6, yy=00 and for C10+, yy=04. The default is .57 C6 and .43 C7.

xxTB - Temperature Base

This command sets the temperature base for stream xx. Temperature base is used in calculations for Wet CV and Dry CV as required. Always set the appropriate calculation type (CTYPE) before setting a custom temperature base.

xxPB - Pressure Base

This command sets the pressure base for stream xx. Pressure base is used in calculations for Wet CV and Dry CV as required. Always set the appropriate calculation type (CTYPE) before setting a custom pressure base.

xxBTULOW - Set BTU Low Limit

This command sets the low limit for the BTU value. A BTU low warning is generated if the BTU value is below this value with the BTU hi limit being above the low limit. A BTU range warning is generated if the BTU value is below this value and the BTU value is above the high limit with the BTU hi limit being below the low limit.

xxBTUHI - Set BTU Hi Limit

This command sets the high limit for the BTU value. A BTU high warning is generated if the BTU value is above this value with the BTU low limit being below the high limit. A BTU range warning is generated if the BTU value is above this value and the BTU value is below the low limit with the BTU low limit being above the high limit.

The two commands, xxBTULOW and xxBTUHI, work together as follows:

High/Low Mode		Range Mode	
	High Limit Warning		No Warning
High Limit > Low Limit		Low Limit > High Limit	
	No Warning		Range Warning
Low Limit < High Limit		High Limit < Low Limit	
	Low Limit Warning		No Warning

xxXCORR - Cross Correction Enable

This command enables or disables cross correction for stream xx. At cold start this is initialized to 00 to disable cross correction. Set to 00 to disable cross correction. When cross correction is disabled, reports will show the actual cross correction computation enclosed in parentheses.

xxUNL - Un-Normalized Total Concentration Limit

This command sets the un-normalized total concentration limit for stream xx. The default is 0, which turns this feature off. Setting this to a value of 0.03 or 3% will cause a total concentration falling outside of a window of +- 3% from 100% will cause a fault alarm.

xxRTd - Get Date/Time Stream was Last Run

This command returns the date and time that a completed analysis was run on stream xx. Specifying stream 05 gets the date and time for the last calibration cycle. Any other value returns the latest available analysis run.

Chromatograms

The following commands are used to work with Chromatograms. Chromatograms are dumped in the following format:

Column	Meaning
1	Cycle Time (Seconds)
2	Detector 1 Mark
3	Detector 1 Value
4	Detector 2 Mark
5	Detector 2 Value

The Marks has the following format:

Indicator	Meaning
(Blank)	No Mark
+	Positive Mark; Gate On, Detector Balance, Autoslope Start
-	Negative Mark; Gate Off, Autoslope Stop

xxXGRAM - Dump Stored Chromatogram

This command dumps the last stored chromatogram for stream xx. Chromatograms are stored at 20 points per second.

xxIGRAM - Dump I/O Mode Chromatogram

This command dumps chromatogram data. The next xx points are output. If xx is 00, the output is continuous until a key is pressed. The dump proceeds at 10 points/second.

Alarm Commands

The following commands are used to interact with alarms.

ALARM - Get Transmitters Alarm State

This command gets the current Alarm State. A bit that is set indicates that condition exists on some stream. Each bit returned is weighted as follows:

Bit	State
0	Current Warning
1	Current Fault
2	Initial Warning
3	Initial Fault

xxIWARN - Retrieve Initial Warning

This command retrieves the initial warning code. The code is expressed in hex.

xxCWARN - Retrieve Current Warning

This command retrieves the current warning code. The code is expressed in hex.

xxIFault - Retrieve Initial Fault

This command retrieves the initial fault code. The code is expressed in hex.

xxCFault - Retrieve Current Fault

This command retrieves the current fault code. The code is expressed in hex.

LW - Log Warnings

This command sets whether to log warnings in the alarm log. This is on by default. Set to 01 to log warnings or 00 to not log warnings, i.e. only log faults. The initial and current warning are still available in all other reports and are logged with the history.

ALARMLOG - Dump Alarm Log

This command dumps the alarm log. Issuing the command ALARMLOG= clears the log. Clearing the log requires r/w security access.

Alarm Codes

Codes 0-63 are used for warning codes. Codes 64-127 are used for fault codes. The following table summarizes the meaning of all of the codes.

Code	Meaning	Explanation
1	Detector Balance Failed	This warning indicates that the detector signal could not be balanced within 1000 detector counts (approx. 1.192 mV) of zero.
2	Low Power	This warning occurs if the battery voltage drops below 12.00 volts. The warning is re-enabled if power rises to above 12.25 volts.
3	Low Carrier	This warning may occur during start-up or normal cycling. Start-up tests to within 1 PSIG and cycles test to 1.5 PSIG. Carrier is tested to within 5 PSIG during pre-inject. This warning also occurs if the DI for the carrier bottle is closed.
4	Low Oven Temperature	This warning occurs if the oven temperature at cycle start is more than 2 Degrees F lower than the oven set-point.
5	Low Oven Change Rate	This warning is not currently used.
6	Low Carrier Pressure	This warning is not currently used.
7	Unknown Peak Detected	This warning occurs when component peaks do not fall within the peak deviation windows. Extra components, module shifts or a need to

		perform automatic peak detection cause this warning.
8	Sample Pressure Low	This warning occurs if the stream pressure does not build to over 4 PSIG.
9	High Carrier Pressure	This warning may occur during normal cycling. Pre-inject tests to within 5 PSIG and cycle tests to within 1.5 PSIG.

Code	Meaning	Explanation
10	High Oven Temperature	This warning occurs if the oven temperature is more than 2 Degrees F over the set point.
11	Concentration Above High Limit	This warning occurs if the concentration of a component is more than the high limit set for that component and stream.
12	Concentration Below Low Limit	This warning occurs if the concentration of a component is more than the low limit set for that component and stream.
13	Peaks not found in sample	This warning is not currently used.
14	Peaks not found in sample - auto-start	This warning occurs if all peaks are not properly found in the calibration sample following a power on restart. Transmitter would have previously been running and power was off more than 20 seconds.
15	Calculated BTU does not match Measured BTU	This warning occurs if the measured BTU does not match the calculated BTU based on the calibration sample. Transmitter would have been power cycled and would have previously been running and power was off more than 20 seconds.
16	Pressure Regulator Module Out Of Spec	This warning occurs if after three attempts the measured standard deviation of the carrier pressure is more than 0.1 PSIG but less than 0.25 PSIG.
17	Carrier Out of Spec	This warning occurs if the measured standard deviation of the carrier pressure is more than 0.2 PSIG.
18	Oven Temperature not Stable	This warning occurs if the measured standard deviation of the mandrel temperature is more than 0.5 Degrees F.
19	Sample Pressure not Stable	This warning occurs if the sample pressure is not 15 +- 3 PSIG with the stream valve full open and the sample shut off valve closed.
20	Auto-start Delayed for Temperature Stabilization	This warning occurs if the mandrel temperature is not within 3 Degrees F of the oven set point while starting off automatic peak detection.
21	Communications Failure	This warning occurs if the transmitter doesn't receive an OK signal while sending data with HCl-A protocol.
22	Side to Side Correction Factor out of Limits	This warning occurs if the C3 and C3' un-normalized concentrations don't match up within this value. The default range is 10%.
23	Calibration not updated - Results disagree with sample	This warning occurs if the magic module coefficients don't match on C6+, NC5, CO2 or C3. Components are tested to 15% or 5% if tested after failing 15% and auto-started.
24	Calibration not updated - Peaks Missing	This warning occurs if expected peaks are not found in the calibration sample. If the peaks are indeed missing, set their calibration sample concentration for those peaks to zero and try again. Otherwise, perform automatic peak finding.
25	New RF limit exceeded - No longer used	This warning occurs if the percentage change of the response factor of a component is more than a user specified limit and automatic response factor update is not enabled.
26	Calibration Pressure Low (DI)	This warning occurs if the digital input from an external switch closes to indicate low calibration bottle pressure. The bottle should be replaced soon with fresh carrier.
27	Low Ambient Temperature	This warning occurs if the ambient temperature is below 32 Degrees F while starting a calibration sequence.
28	BTU High	This warning occurs if the BTU value of the sample is above a user specified value.
29	BTU Low	This warning occurs if the BTU value of the sample is below a user specified value.

Code	Meaning	Explanation
30	BTU Range Error	This warning occurs if the BTU value is outside of the user specified range.
31	Concentration Range Error	This warning occurs if the concentration of a component is outside of a user-specified range.
32	Side to Side Auto Disable	This warning occurs if the Side to Side Correction is disabled automatically due to either propane being zero or near over-ranged or not recognized.
33	Calculation Error	This warning occurs when an AGA8 calculation error occurs. Exceeding the maximum number of iterations due to non-convergence or pressure having a negative density derivative will cause this.
34	Un-Normalized Concentration Error	This warning occurs if the un-normalized concentration falls outside of a band.
64	Analog to Digital Converter Calibration Failure	This fault occurs if the converter can't be calibrated during start-up. The problem lies in the converter itself or its power supply.
65	Sample System Failure	This fault occurs if a holding pressure is not maintained in the sample system. A positive drop more than 0.5 PSIG indicates a leak after the quad solenoid valve. A negative drop more than 0.5 PSIG indicates a leak with the quad solenoid valve.
66	No Carrier Pressure	This fault occurs if carrier pressure is 5 PSIG less than the set point while the set point is more than 10 PSIG. The occurrence of this fault prevents a cycle from actually happening.
67	Partition System Failure	The occurrence of this fault indicates a serious problem. An immediate cold start is recommended.
68	Task Start Failure	The occurrence of this fault indicates a serious problem. An immediate warm start is recommended. If the condition does not improve, a cold start is recommended.
70	Low Sample Flow	This fault occurs if the flow through the module as indicated by a drop in sample pressure is inadequate.
71	Detector Range Exceeded	This fault occurs if the detector value exceeds +-4000000 counts (approx. 4.75 volts).
72	Replace Carrier Regulator Module	This fault occurs if an impossible carrier pressure is detected.
73	No Pressure Detected at Carrier Regulator Module	This fault occurs if little or no carrier pressure is detected.
74	Carrier Vent Blocked	This fault occurs if the carrier pressure doesn't bleed off.
75	Replace Pressure Regulator Assembly	This fault occurs if the carrier pressure is not 40 +- 5 PSIG after setting 40 PSIG and waiting 10 seconds for stabilization.
76	Replace Pressure Regulator Board	This fault occurs if the carrier pressure standard deviation is not within 0.25 PSIG.
77	Low Carrier Flow Rate	This fault is not currently used.
78	Detector 0 Std Deviation out of Spec	This fault occurs if the detector 0 standard deviation is not within 1000 counts (approx. 1.192 mV).
79	Detector 1 Std Deviation out of Spec	This fault occurs if the detector 1 standard deviation is not within 1000 counts (approx. 1.192 mV).
80	Column 0 Valve did not switch	This fault occurs if the column 0 reverse valve did not switch from forward mode to reverse mode.
81	Column 1 Valve did not switch	This fault occurs if the column 1 reverse valve did not switch from forward mode to reverse mode.

Code	Meaning	Explanation
82	No Calibration Blend Specified	This fault occurs if the no calibration blend is specified and automatic calibration is requested during start-up.
83	Std Sample Flow Failure	This fault occurs if the flow through the module as indicated by a drop in calibrate pressure is inadequate.
84	Std Sample Pressure Failure	This fault occurs if the calibrate stream pressure does not build to over 4 PSIG.
85	Oven Temperature Runaway	This fault occurs if the mandrel temperature exceeds the set point by more than 20 Degrees F. The oven is shut down if this happens.
86	Oven Temperature Failure	This fault occurs if the mandrel temperature is not making progress toward the set-point temperature, if the mandrel temperature exceeds 190 Degrees F, or if the mandrel temperature is more than 3.5 Degrees F from the set point at the start of the cycle.
87	Data Lost - Multi-tasking Overload	This fault occurs if data is lost because all detector readings are not integrated into the peak area. A warm start is recommended.
88	Stream Valve Leak	This fault occurs if the quad solenoid valve is leaking.
89	Carrier > 2 PSIG from set-point	This fault occurs if the carrier pressure at the start of a cycle is more than 2 PSIG from the set point.
90	CO2 Not Found on Column 0	This fault occurs if CO2 can't be identified during automatic peak detection.
91	NC5 Not Found on Column 1	This fault occurs if NC5 can't be identified during automatic peak detection.
92	Ambient Temperature out of range	This fault occurs if the ambient temperature at the start of a cycle is not between 5 and 135 Degrees F. This prevents a cycle from being run. The transmitter waits the user specified cycle time and then will try again.
93	Side to Side limit is ridiculous	This fault occurs if the cross correction factor (ratio) between C3 and C3' is not in the range of 1 +- 0.5. Automatic peak detection and calibration ignore this fault.
94	No Sample Pressure	This fault occurs if the sample pressure is less than 1 PSIG.
95	Replace GC Module	This fault occurs if detector 0 peaks can't be matched up during automatic peak detection.
96	Detector 1 PT Match	This fault occurs if detector 1 peak times can't be matched up during automatic peak detection.
97	C4+ problem	This fault occurs if C4+ front to back ratio is outside 30% during automatic peak detection.
98	Detector 1 2nd half PT	This fault occurs if detector 0 peak times can't be matched up during automatic peak detection on the reverse side (C4+, C3', C2).
99	Peak Area Difference	This fault occurs if the total peak area differs by more than a preset amount.
100	Last Calibration Limit Exceeded	This fault occurs if the Btu value from the last calibration attempt is outside the cal limit window centered on the last good calibration within a fractional window defined by LCL command.
101	New RF limit exceeded	This fault occurs if the percentage change of the response factor of a component is more than a user specified limit and automatic response factor update is not enabled.
102	Un-Normalized Concentration Fault	This fault occurs if the un-normalized concentration falls outside of a band.
103	Alternate DI Triggered Fault	This fault occurs when the transmitter is in alternate DI mode 1 and the trigger fault DI is triggered.
104	Manual Calibration Request	This fault occurs when the transmitter has gone through a calibration cycle without auto update. The transmitter is suggesting to manually update calibration factors.

Event Commands

Events are used to tell about operation changes associated with the transmitter. The following commands interact with the event log.

Event Codes

The following event codes are reserved.

Code	Meaning
0	No Event
1	Date and Time Changed
5	Contract Hour Changed
13	Watchdog Time-out Occurred
15	Security Code Changed
77	Temperature Base Changed
78	Pressure Base Changed
116	Software Changed
147	Event Log Full
148	Event Log Collected
152	Analog to Digital Converter Failed
500	Log Interval Changed
501	Cycle Units Changed
502	Low Carrier Mode Changed
503	Auto-start Mode Changed
504	Low Power Mode Changed
505	Calibrate Start Hour Changed
506	Calibrate Day Changed
507	Calibrate Start Minute Changed
508	Auto Factor Update Mode Changed
509	# of Streams
510	Calibrate Stream
511	Calculation type
512	# of Calibration Cycles
513	# of Calibration Cycles in Average
514	Analyzer Number Changed
515	Disable Stream Select Changed
516	# of Stream Indexes Changed
517	Stream Index Changed
518	Stream Skip Changed
519	Cycle Time Changed
520	Moving Average Changed
521	Gate Time Changed
522	Valve Time Changed
523	Analog Output Scale Multiplier Changed
524	Peak Time Deviation Changed
525	Response Factor Change Limit Changed
526	Response Factor Manually Changed
527	Sample Concentration Changed
528	Retention Time Changed (Detector 1)

529	Retention Time Changed (Detector 0)
530	Port Changed
531	Oven Temperature Changed
532	Carrier Pressure Changed
533	Response Factor Auto Update
534	Calibration Blend Changed
535	Side to Side Limit Changed
536	Concentration Low Limit Changed
537	Concentration High Limit Changed
538	Carbon Split Factor Changed
539	Calibration Hourly Mode
540	Calibration Hour Changed
541	Calibration Time Set Changed
542	Auto Startup Calibration Mode
543	Auto Peak Detect Flag Changed
544	BTU Low Limit Changed
545	BTU High Limit Changed
546	Error print flag (Printer-Console)
547	Cross Correction
548	Pre Purge
549	Alternate DI Mode
550	Alternate DO Mode
551	Log Warnings Mode
552	Detector #2 Minimum Peak Area
553	Log Response Factor Auto Updates
554	Response Factor Update
555	Test Value (Primary) Entered
556	Test Value (Carbon) Entered
557	Specific Gravity of Air
558	Mass of Air
559	Btu Percent Range
560	Selective Port Print Flags
561	Port Baud Rate
562	Port Listen Cycle
563	Total Peak Area Percent Difference
564	Error Count Limit
565	Last Cal Limit
566	Un-normalized concentration limit
567	Back-Peak Ratio
568	C6+ Minimum Peak Area
569	Peak Baseline Adjustment Code
570	Common Gas Factor
571	Carbon Common Gas Factor

572	NGPA Gas Factor
573	Carbon NGPA Gas Factor
574	ISO Gas Factor
575	ISO Carbon Gas Factor
576	ISO Inferior Gas Factor
577	ISO Inferior Carbon Gas Factor
578	GOST Gas Factor
579	GOST Carbon Gas Factor
580	GOST Inferior Gas Factor
581	GOST Carbon Inferior Gas Factor
582	On Threshold
583	Off Threshold
584	Trigger Method
585	Force C3 vs C3/C3' auto select
586	Force 16 Bit MMI Compatibility Mode
587	Raw Component Filter
588	Carbon Component Filter
589	Column Filter
590	Normalized Total Setpoint
591	Pressure Setpoint #2
592	Sum NeoC5 and IsoC5
593	Purge Seconds
594	Up Carrier Trigger Time
595	Sample Equalization
570	(Not Used)
571	(Not Used)
572	(Not Used)
573	(Not Used)
574	(Not Used)
575	(Not Used)

578	(Not Used)
579	(Not Used)
596	(Not Used)
597	GPM Gas Factor
598	GOST Compressibility Gas Factor
599	ISO Ideal BTU Gas Factor
600	NGPA Ideal BTU Gas Factor
601	Carbon GPM Gas Factor
602	Carbon NGPA Ideal BTU Gas Factor
603	ISO Carbon Ideal BTU Gas Factor
604	GOST Carbon Ideal BTU Gas Factor
605	Specific Gravity Gas Factor
606	Carbon Specific Gravity Gas Factor
607	NGPA Compressibility Gas Factor
608	Carbon NGPA Compressibility Gas Factor
609	ISO Compressibility Gas Factor
610	ISO Carbon Compressibility Gas Factor
611	GOST Ideal BTU Gas Factor
612	GOST Carbon Compressibility Gas Factor
613	Key Peaks
614	Methane Offset
615	Modbus C6+ Component Index Code

LRFU - Log Response Updates

This command sets whether to log response factor updates from automatic calibrations. The default is to not log updates. 00 sets to not log updates, else log updates.

NOTE: This command will cause the event log to roll older events off quickly with frequent calibrations.

EVENTLOG - Dump Event Log

This command dumps the event log. Issuing the command EVENTLOG= clears the log. Clearing the log requires r/w security access.

Reports

Reports are available to report the analysis results on a cycle basis, hourly, daily and monthly. Calibration and raw results reports are also available. Reports can have any or all components filtered out or can have any or all columns filtered out.

xxREPORT - Display Analysis Results

This command displays the calculated results. For each stream the latest results, the last hour's results, or the last day's results are available. xxCD affects when last day's results are wrapped up. Refer to the following table for values for xx.

xx	Meaning
00	Stream 0 Latest Results
01	Stream 1 Latest Results
02	Stream 2 Latest Results
03	Stream 3 Latest Results
04	Stream 0 Hourly Results
05	Stream 1 Hourly Results
06	Stream 2 Hourly Results
07	Stream 3 Hourly Results
08	Stream 0 Daily Results
09	Stream 1 Daily Results
10	Stream 2 Daily Results
11	Stream 3 Daily Results
12	Latest Available Results Regardless of Stream and faults
13	Latest Available Calibration Results
14	Stream 0 Monthly Results
15	Stream 1 Monthly Results
16	Stream 2 Monthly Results
17	Stream 3 Monthly Results

xxCLF - Column Filter

This command allows filtering a column out of the Printer/Console report. This command operates on both real components and carbon components simultaneously. The default of 00 turns off the filter.

(Ex. 01CLF=01 will omit the response factor from the printer console report)

xx	Column
00	Name
01	Response Factor
02	Un-normalized Concentration
03	Normalized Concentration
04	Peak Area
05	Peak Height
06	Peak Time
07	Liquid Content
08	Ideal BTU/CV
09	Relative Density

xxRCF - Real Component Filter

This command allows filtering a component out of the Printer/Console report. The default of 00 turns off the filter. Any other value turns the filter on. The component to have the filter set on is indicated by xx.

(Ex. 01RCF=01 will omit IC4 from the printer console report)

xx	Component
00	C3
01	IC4
02	NC4
03	NEOC5
04	IC5
05	NC5
06	C6+
07	N2
08	C1
09	C02
10	C4+
11	C3'
12	C2

xxCCF - Carbon Component Filter

This command allows filtering a carbon split component out of the Printer/Console report. The default of 00 turns off the filter. Any other value turns the filter on. The carbon component to have the filter set on is indicated by xx. (Ex. 01CCF=01 will omit C7 from the printer console report)

xx	Carbon Split Components
00	C6
01	C7
02	C8
03	C9
04	C10+

Efficiency Commands

The following commands are used to improve the efficiency or use of the consumables used during periods of infrequent use.

LOWCAR - Low Carrier Mode

This command sets low carrier mode. Carrier pressure will drop to 5 PSIG during low carrier mode. The format is XX. Normal mode is selected with 00 and low carrier mode is selected with 01.

LOWPOW - Low Power Mode

This command sets low power mode. Oven Temperature will drop to ambient during low power mode. The format is XX. Normal mode is selected with 00 and low carrier mode is selected with 01. When in low power mode, the oven will start to come back up to the proper operating temperature 1 hour before the time of the next cycle.

PP - Pre-Purge Mode

This command sets pre-purge mode. 00 (the default) opens the stream solenoid valve only during sampling prior to beginning the analysis cycle. 01 also opens the valve during the back half of the analysis cycle. The format for this command is XX. This pre-purging allows the stream solenoid and a portion of the flow paths to be flushed with sample from the next stream. This is useful if analyzing sample mixtures with widely varying component concentrations such as high C6+ to no C6+.

NOTE: This command will cause process gas usage to go up dramatically.

UPC – Up Carrier Trigger Time

This command sets the amount of time in seconds allowed for the basic pre-cycle preparations. Included within this time allowance is carrier stabilization, 18 second allowance for basic purging, 4.5 second bleed and final bleed down to 1 PSIG. UPC defaults to 28 seconds. This time could be adjusted lower to cause a module that samples very fast and has a total cycle time of less than 180 seconds to be corrected to a 180 second cycle time.

WARNING: Setting this time higher than 28 seconds without a corresponding increase in cycle time will cause the sampling for the next cycle to overlap active detector operations and may cause sporadic peaks or noise on the detector signals.

PSEC – Purge Seconds

This command sets the number of seconds to purge the sample loops. The default of zero or any value between zero and twenty (20 or 0x14) will cause the transmitter to purge the loops for 20 seconds. Values greater than this in increments of ten seconds will cause the loops to be purged for the additional time. This value is specified in hex format. UPC accounts for the first 20 seconds.

NOTE: This command will cause process gas usage to go up proportionately.

WARNING: Setting this time higher than 20 seconds without a corresponding increase in cycle time will cause the sampling for the next cycle to overlap active detector operations and may cause sporadic peaks or noise on the detector signals.

SE – Sample Equalization

This command sets the amount of time to allow in seconds to bleed the sample loop down from 1 PSIG to 0 PSIG. The default is 10 seconds.

History File

The following is used to interact with the historical file.

xxINTERVAL - Set History File Interval

This command sets the history file interval for stream xx. Hourly update is specified as 00 and daily update as 01. Every cycle update is specified as 02. The default is 00.

xxHISTORY - Dump History File

This command dumps the historical file for stream xx.

xxCD - Contract Hour

This command sets the contract hour. Contract Hour determines when averages for daily numbers are wrapped up and stored in the historical file (and also for last day reports). xxCD affects the historical file when daily update is used. Contract Hour also affects when last day's results are done. The format is XX. xx indicates the stream to set. The default is 00 (midnight).

Gas Constant Commands

The following commands set parameters that the transmitter uses to calculate calorific value and other items. The indexes for the analyzed components range from 00 to 12. The indexes for carbon split components range from 00 to 04. The commands are separated into sections for AGA/GPA and for ISO.

AGA/GPA Gas Constants

The following commands set gas constants according to GPA 2145-95. In all cases, the default values are referenced to 60 Degrees F and 14.696 PSIG (15.56 Degrees C and 1013.25 mbar). The default values are specified for US units. This standard does also contain values for SI units. The method used for the actual calculation is specified in GPA-2172-86.

xxNFHS - GPA Ideal Gross Heating Value

This command sets the GPA ideal gross heating value used by component xx. This contribution is multiplied by the component concentration and then summed up to get the ideal gross heating value for the gas mixture. The units used are BTU per cubic foot.

xxFSPGR - GPA Specific Gravity Contribution

This command sets the specific gravity or density of gas contribution used by component xx. This contribution is multiplied by the component concentration and then summed up to get the specific gravity for the gas mixture. The values used are referenced relative to air.

xxFGPM - GPA Liquid Content Contribution

This command sets the liquid content (GPM) or volume contribution used by component xx. This contribution is multiplied by the component concentration and then summed up to get the GPM for the gas mixture. The units used are cubic foot of ideal gas per gallon of liquid.

xxNFSUM - GPA Summation Factor

This command sets the GPA summation factor used by component xx. This contribution is multiplied by the component concentration and the result is used to calculate the compressibility factor for the gas mixture. These values are from GPA 2172-86 table 4.

xxCBTU - Carbon Split GPA Ideal Gross Heating Value

This command sets the GPA ideal gross heating value used by carbon component xx. This contribution is multiplied by the component concentration and then summed up to get the ideal gross heating value for the gas mixture. The units used are BTU per cubic foot.

xxCSPGR - Carbon Split GPA Specific Gravity Contribution

This command sets the specific gravity or density of gas contribution used by carbon component xx. This contribution is multiplied by the component concentration and then summed up to get the specific gravity for the gas mixture. The values used are referenced relative to air.

xxCGPM - Carbon Split GPA Liquid Content Contribution

This command sets the liquid content (GPM) or volume contribution used by carbon component xx. This contribution is multiplied by the component concentration and then summed up to get the GPM for the gas mixture. The units used are cubic foot of ideal gas per gallon of liquid.

xxCNGPA - Carbon Split GPA Summation Factor

This command sets the GPA summation factor used by carbon component xx. This contribution is multiplied by the component concentration and the result is used to calculate the compressibility factor for the gas mixture. These values are from GPA 2172-86 table 4.

ISO Gas Constants

The following commands set gas constants according to ISO 6976-1983. Prom revisions later than AE2015644-003 implement ISO 6976-1995-12-01 upon cold start.

xxIFSUM - ISO Summation Factor

This command sets the ISO summation factor used by component xx. This factor is multiplied by the component concentration and the result is used to calculate the compressibility factor for the gas mixture. These values are from table 2 referenced to 288.15 K.

xxIFHS - ISO Superior Ideal Calorific Value

This command sets ISO the superior ideal calorific value used by component xx. This factor is multiplied by the component concentration and then summed up to get the superior (dry) ideal calorific value for the gas mixture. These values are from table 5.

xxIHI - ISO Inferior Ideal Calorific Value

This command sets ISO the inferior ideal calorific value used by component xx. This factor is multiplied by the component concentration and then summed up to get the inferior (wet) ideal calorific value for the gas mixture. These values are from table 5.

xxICNGPA - ISO Carbon Split Summation Factor

This command sets the ISO summation factor used by carbon component xx. This factor is multiplied by the component concentration and the result is used to calculate the compressibility factor for the gas mixture. These values are from table 2 referenced to 288.15 K.

xxICBTU - ISO Carbon Split Superior Ideal Calorific Value

This command sets ISO the superior ideal calorific value used by carbon component xx. This factor is multiplied by the component concentration and then summed up to get the superior (dry) ideal calorific value for the gas mixture. These values are from table 5.

xxICHI - ISO Carbon Split Inferior Ideal Calorific Value

This command sets the ISO inferior ideal calorific value used by carbon split component xx. This factor is multiplied by the component concentration and then summed up to get the inferior (wet) ideal calorific value for the gas mixture. These values are from table 5.

xxICSPGR - ISO Carbon Split Ideal Relative Density Factor

This command sets the ISO ideal relative density factor used by carbon component xx. This factor is multiplied by the component concentration and the result is used to calculate the compressibility factor for the gas mixture. These values are from table 2.

xxICGPM - ISO Carbon Split Liquid Content Contribution

This command sets the liquid content (GPM) or volume contribution used by carbon component xx. This contribution is multiplied by the component concentration and then summed up to get the GPM for the gas mixture. The units used are cubic foot of ideal gas per gallon of liquid. The values are from GPA 2145-95 Volume. To adjust the liquid content contribution for the analyzed components, use the xxFGPM command.

Setup Commands

The following commands are used to help set up the transmitter.

ADI - Auxiliary Digital Input Operation

This command sets and/or displays what the digital inputs mean to the transmitter. The following codes are valid:

Code	Meaning
00	DI#1 indicates Carrier Bottle Pressure Low. DI#2 indicates Calibration Bottle Pressure Low.
01	DI#1 indicates top of hour and to set clock rounding to nearest top of hour. DI#2 triggers an Alternate DI fault.

ADO - Auxiliary Digital Output Operation

This command sets and/or displays what meaning the digital outputs convey. The following codes are valid:

Code	Meaning
00	Normal Mode
01	Marquis Mode
02	Flashing Mode

If Normal mode is selected:

Normal DO	Fault DO	Meaning
Asserted	De-asserted	No warnings or faults.
Asserted	Asserted	Warning alarm
De-asserted	Asserted	Fault alarm
De-asserted	De-asserted	Powered off

If Marquis mode is selected:

DO	Meaning if Asserted
Normal	Calibration in progress
Fault	Fault alarm – Except Alternate DI for Validation Blend

If flashing mode is selected:

Mode	DO Fault, Normal Status
Hold	Asserted, Flashing
Fault	Opposite
Warning	Together
Run	De-asserted, Flashing
Single	Flashing, De-asserted
Calibrate/Start	Flashing, Asserted

xxCPEAKS - Display Current Peak Table

This command displays the current peak table for detector xx. This table will build on the fly during a cycle. During a cycle an incomplete table may be displayed. For this reason, it may be more appropriate to use xxPPEAKS to display peak tables.

xxPPEAKS - Display Previous Peak Table

This command displays the previous peak table for detector xx. This can be used to tune the peak retention times.

SV1 - Set Sample Valve 1 Actuation Time

This command sets the actuation time for sample valve 1. The units for this command are in detector samples, i.e. 2 seconds is 0040 detector samples. This command may adjust other values in the gate valve table as appropriate. Normally, this command will take on the values of 0040, 0140, and 0230.

xxDMP - Detector 1 Front Half Minimum Peak Area

This command sets the minimum peak area used during peak detection. This command should be used if the process gas contains a component such as H₂S or C₃= which is interfering with the transmitters ability to correctly identify propane.

xx	Detector Path	Default
00	Detector 0 Front Half	4000
01	Detector 0 Back Half	4000
02	Detector 1 Front Half	3000

WARNING: Setting this number lower than 3000 may result in an increased number of false detection's that may overflow the peak table.

xxONT - Gate On Threshold

This command sets the threshold level for detecting the start of a peak. Refer to xxDMP command for an explanation of xx.

xxOFT - Gate Off Threshold

This command sets the threshold level for detecting the end of a peak. Refer to xxDMP command for an explanation of xx.

Setting a gate off threshold less than 5 is likely to cause some peaks to never end.

xxTRIG - Trigger Method

This command sets the trigger method. When the trigger method is set to the default of 00 for edge triggered method, the current detector reading must exceed the previous detector reading by the amount defined by the gate on threshold to start integrating a peak. When the trigger method is set to 01 for slope triggered method, the current detector reading must exceed the detector value read 100 ms ago (5 readings) by the amount defined by the gate on threshold to start integrating a peak. Refer to xxDMP command for an explanation of xx.

C6MP - C6+ Minimum Peak Area

This command sets the minimum peak area for the C₆+ peak. The default is 0. The action for this command can also be described as the zero concentration area.

BPR - Back-Peak Ratio

This command sets the maximum Back-Peak Ratio. The default is 0.50 or 50%. This ratio is the difference of the back height and the front height divided by the difference of the peak height and the front height. Peaks that are well formed will exhibit low back-peak ratios. Separating iC₄ from nC₄ when nC₄ is much larger than iC₄ may require adjusting this ratio towards 100%.

FC3 - Force C3 Usage

During normal operation, if Propane is not indicated or is outside of the range of 0.1 to 3 percent, C₃' is used instead. This command forces Propane (C₃) to be used.

DSM – Detector Smoothing Method

This command affects how the chromatogram is smoothed. The format of this command is xx. The first level of smoothing is a 4-point “boxcar”. The boxcar is performed by the firmware interrupt service routines and can’t be changed. The second level of smoothing which this command affects can be changed from no smoothing to several levels of moving average and finally using the Savitsky-Golay algorithm. The various levels implement include:

xx	Description
01	Raw (no averaging)
02	2 point moving average
04	4 point moving average
08	8 point moving average
11	Savitsky-Golay (5-1-5)
00	Savitsky-Golay (5-1-5)
Anything else	Savitsky-Golay (5-1-5)

Savitsky-Golay implements a DSP (Multiply-Accumulate) algorithm. The algorithm uses the 5 preceding detector readings, the current reading and the next 5 readings. This causes the chromatogram to be shifted 5 points. The algorithm’s magic comes from the derivation of the 11 weighting constants. Savitsky-Golay has been used since the EFR hardware came into production, but can cause momentary negative diversions in the chromatogram due to the way the weighting constants are derived. For this reason, on non-EFR hardware, DSA may need to be set to an 8 point moving average to prevent false detector peaks.

SNI – Sum NeoC5 and IsoC5 Normalized Concentrations

This command is provided to allow the summation of the NeoC5 and IsoC5 normalized concentrations into a composite Neo/Iso C5 normalized concentration. The default is to not sum NeoC5 and IsoC5.

NOTE: The transmitter will always separate NeoC5 and IsoC5. Certain calculation standards do not explicitly recognize NeoC5 since this does not show up in nature, but only after human processing operations. Gas parameters for NeoC5 in these instances have been interpolated or calculated based on any other available data.

MMI - Set MMI Operating Mode

This command sets the MMI Operating Mode. The default of 00 selects 32-bit mode. Setting this to 01 selects 16-bit mode. 16-bit mode is a work in progress and may not be fully functional.

xxPKC - Baseline Reference Peak Codes

This command sets the baseline reference peak codes. The peak to be used is indicated by xx. These codes determine how the peak area will be adjusted for baseline corrections. The applicable codes are:

Code	Meaning
0	Baseline referenced to the local baseline measurement
1	Baseline referenced to the peak’s front height
2	Baseline referenced to the peak’s back height
3	Baseline referenced to the peak’s front and back height. This method draws a line between front height and back height and uses that as the reference.

xxRTy - Set Retention Time

This command sets the retention time of peak xx on detector y.

Detector 0				Detector 1			
Peak	Name	Default Retention Time (45/68 Module)	Default Retention Time (59/60 Module)	Peak	Name	Default Retention Time (45/68 Module)	Default Retention Time (59/60 Module)
00	N2	21.0	27.7	00	(C1)	12.7	(not used)
01	C1	23.4	30.8	01	(C2)	15.1	8.6
02	CO2	32.0	41.7	02	C3	19.9	12.6
03	C4+	64.8	78.1	03	IC4	28.4	17.9
04	C3'	75.0	91.2	04	NC4	31.8	20.1
05	C2	101.0	123.1	05	NEOC5	40.6	25.7
				06	IC5	53.9	34.0
				07	NC5	63.1	39.8
				08	C6+	108.0	78.0

The transmitter during automatic peak detection may vary the actual retention times.

xxGT - Gate Timing

This command sets the gate timing. This value is the number of detector samples into the cycle to operate the gate (20 samples/second). The following is the position of the various gate events for 59/60 modules:

Event	Description	Seconds	Detector Samples
00	Detector 2 Balance	3.5	70
01	Auto-gate Detector 2 On (C2-, C3, IC4, NC4, NEOC5, IC5, NC5)	6	120
02	Detector 1 Balance	10	200
03	Local Baseline Measurement Detector 1	12	240
04	Auto-gate Detector 1 On (N2, C1, CO2)	13.5	270
05	Auto-gate Detector 1 Off	56.85	1137
06	CO2 Timed gate On	56.85	1137
07	CO2 Timed Gate Off	56.9	1138
08	Auto-gate Detector 2 Off	56.9	1138
09	Pre-purge On	61	1220
10	Detector 1 Balance	64	1280
11	Detector 2 Balance	65	1300
12	Gate Detector 1 On C4+, 2nd C3, C2	67	1340
13	Gate Detector 2 On C6+	71	1420
14	Gate Detector 2 Off C6+	132	2640
15	Local Baseline Measurement Detector 2	133	2660
16	Gate Detector 1 Off C2	150	3000
17	Local Baseline Measurement Detector 1	150.5	3010
18	Pre-purge Off	153.5	3070

NOTE: The CO2 timed gates are provided to allow ultra-low CO2 measurement on the order of 100 PPM. Normally, these should be left at the default. If this type of measurement is required, then the gates will have to be set by hand. Also, any calibration should be done using a certified blend near the levels of CO2 and C1 that are expected.

xxVT - Valve Timing

This command sets the valve timing. This value is the number of detector samples into the cycle to operate the valve (20 samples/second). The format is XXXX. The following is the position of the various valve events for 45/68 modules:

Event	Description	Seconds (45/68 Module)	Detector Samples (45/68 Module)	Seconds (59/60 Module)	Detector Samples (59/60 Module)
00	Sample Valve 2 On	1	20	1	20
01	Sample Valve 1 On	2	40	2	40
02	Sample Valve 2 Off	6	120	57	1140
03	Sample Valve 1 Off	7.8	156	58	1160
04	Reverse Valve 1 On	45	900	59	1180
05	Reverse Valve 2 On	68	1360	60	1200
06	Reverse Valve 1 Off	139	2780	152	3040
07	Reverse Valve 2 Off	140	2800	154	3080

Diagnostic File Commands

The following commands are used to manage the diagnostic file.

DIAG - Dump Diagnostic File

This command dumps the diagnostic file.

xxKPK - Key Peaks

This command set the identity of the key peaks that are stored in the diagnostic file. The diagnostic file includes the peak area and the retention time for each of four key peaks. The key peaks are initially set to store N2 (07), C2 (11), NC5 (05) and C6+(06). xx=00-03. This command does not do anything to alter header lines on reports. If the key peaks are changed from their defaults, it may become difficult to verify diagnostic file contents.

Maintenance Commands

The following commands are used to help maintain the transmitter.

xxAO - Set AO

This command sets analog output xx. The ordering of analog inputs is as follows:

Analog Output	Meaning
1	Detector 1
2	Detector 2
3	Detector 1 Balance
4	Detector 2 Balance
5	Oven Temperature Set-point
6	Carrier Pressure Set-point

Generally speaking, the only values that should be used are the oven temperature and carrier pressure set points.

xxAOSCALE - Set AO Multiplier

This command sets the detector xx multiplier for the analog outputs. The format is XXXX. The default is 25.

DIOS - Display Digital Input / Output Status

This command displays the digital input/output status. The format is XX. The bits displayed are as follows:

Bit	Meaning
0	(Unused)
1	(Unused)
2	(Security Switch)
3	Transmitter State 1 - See CSTATE command - Normal
4	Transmitter State 2 - See CSTATE command - Fault
5	Carrier O.K.
6	Sample O.K.
7	Pass through Mode Status

AIL - Monitor Analog Inputs

This command continuously monitors analog inputs. Every second the inputs are read and displayed in proper engineering units until a key is pressed. Each line contains raw ground voltage, power, mandrel temperature, carrier pressure, sample pressure, spare, and lower platform temperature. If a cycle is not running, the voltage reference voltage is output after the lower platform temperature. This command is generally used to monitor warm up, stream or carrier pressure decay, or for detecting conditions that may cause the analog multiplexer to over-range such as damaged pressure sensors.

xxAI - Read AI

This command displays the current value of analog input xx. The ordering of analog inputs is as follows:

Analog Input	Meaning
1	Ground Channel
2	Primary Power
3	Oven Temperature
4	Carrier Pressure
5	Sample Pressure
6	(Spare -2.5 to +2.5 V Range) (Barometric Pressure)
7	Ambient Temperature
8	(2.5V Voltage Reference) (not measured during active part of analysis cycle)

HTRDUTY - Display Heater Duty Cycle

This command displays the cumulative heater duty cycle. This command resets the accumulation. A running analysis cycle also reads and resets accumulators, so this command should not be used while analysis cycles are being run. This command also requires a board modification to be useful.

xxDET - Get Current Detector Value

This command returns the current detector value for detector xx. The value returned is a long integer and is balance and zero adjusted.

xxBALDR - Balance Detector

This command balances detector xx. This process takes 2 seconds.

SSOC - Close SSO Valve

This command closes the sample shut off (SSO) valve.

SSOO - Open SSO Valve

This command opens the sample shut off (SSO) valve.

SSO - Read/Set SSO

This command operates the SSO valve. Setting this to 01 closes the SSO valve. Setting this to 00 opens the valve.

BLKP - Block Valve Pulsing Operation

This command blocks the normal pulsing operation of the column valves and the sample system valves. Setting a bit to a one blocks automatic deactivation of the valve. The bit weights are as follows:

Bit	Meaning (when set to one)
0	Block Stream Valve Automatic Operation
1	Block Column Valve Automatic Operation

The affected valve will return to its normal state within 300 ms after resetting the proper bit.

xxSAMPSTR - Sample Stream

This command samples stream xx. This process usually takes less than 30 seconds.

xxSELSTRM - Select Stream

This command quickly samples stream xx. Only one pulse is applied. The BLKP command can be used to continuously purge a stream.

xxVALVE - Actuate Solenoid Valve

This command actuates an internal solenoid valve according to the following table.

As an example, to set reverse valve #2 on, enter 03VALVE=00.

xx	Description
00	Reverse Valve #1
01	Sample Valve #2
02	Sample Valve #1
03	Reverse Valve #2

yy	Action
00	On
01	Off

NOTE: Repeated use of this command should allow one second between uses to avoid valve mid-shifting. Valve mid-shifting may completely empty a carrier bottle within a matter of hours.

VALVES - Actuate Solenoid Valves

This command sets or reads the state of all valves.

Bit	Action
00	Reverse Valve #1
01	Sample Valve #2
02	Sample Valve #1
03	Reverse Valve #2

The actions are the same as above. This command will read and write the state of all valves. Multiple valves are actuated with a one second delay between individual valve actuations. These delays will cause the protocol on this port to go inactive during the approximately 4 seconds that it will take to complete this operation.

Test Commands

The following commands are used to run preprogrammed tests on the transmitter. These tests should only be used with the transmitter in hold. These commands are invoked directly from the printer/console mode. This means that once a test is started, the printer/console will no longer respond to any commands until that test is finished. For this reason, it may be better to invoke these tests through the START command. All of these commands make entries into the startup log as necessary unless otherwise noted.

TEST1 - Run Self-Test 1

This command runs Self-Test 1. This test will make an initial test of the pressure regulator module and carrier flow. This test is also run at power up and with the START command. This test does not leave any entries in the start log.

TEST2 - Run Self-Test 2

This command runs Self-Test 2. This test runs three sub-tests. They are the Regulator Test, Sample System Test, and Analysis Module Test. These three tests may be run individually with the appropriate commands. This test is also run at power up and with the START command.

TESTREG - Test Pressure Regulator Module

This command tests the Pressure Regulator Module. These tests are in more detail than those in self-test 1. This test tests ability to set and maintain proper carrier pressure. This test is also run at power up, with the START command, and with the TEST2 command.

TESTSS - Test Sample System Module

This command tests the Sample System Module. Proper pressure and flow through each stream are tested. SSO operation is checked. Leak checks are performed. This test is also run at power up, with the START command, and with the TEST2 command. Any streams that are found to be failing are marked as skipped. Streams that subsequently pass will not be unskipped.

TESTMOD - Test Analysis Module

This command tests the Analysis Module. This test will check the standard deviation of both detectors, pressure and temperature in forward and reverse flow. Checks are also made to verify that the flow does reverse. This test is also run at power up, with the START command, and with the TEST2 command.

TESTPK - Set Peak Times

This command sets up to identify peaks. If APEAK=01, the carrier pressure is adjusted until NC5's peak time is approximately 50 seconds. The peaks expected peak times are ratioed to set new times. If APEAK=02, Factors 15 through 18 are used to set carrier pressure and to ratio peak times. In this mode and with Factors 13-16 set and CALBLEND=04, a calibration blend does not need to be on-site.

NOISE - Measure Detector Noise

This command measures the noise level on both detectors. This test takes approximately 100 seconds. The noise level is calculated by calculating the pooled standard deviation of the detectors' readings using 50 pools with 2 seconds (40 samples) of data per pool. The noise level is output as the number of detector counts. During this test, no other commands will be accepted and no other analysis activity should be taking place. As each pool is started, a greater than sign (>) is output to the port as an indication that the test is proceeding. The noise level for detector 0 and then detector 1 will follow the last (>). Generally will be < 20 after warming up.

xxCALCNOW - Force Calculation Now

This command forces a recalculation of the results in the stream buffer from the concentration of the gas and the carbon split values. Generally, one must set all variables that affect the calculation including setting test concentrations with xxCONCyy and xxCByy, setting calculation type with CTYPE, setting pressure and temperature base with xxPB and xxTB, and gas constants. Then issue xxCALCNOW where xx is 00 to 03. The results can now be read using xxREPORT where xx is again in the range of 00 to 03. This command will not cause logging or accumulation of results.

STARTLOG - Startup Log Report

This command dumps the startup log. This log contains information about the results of the diagnostic tests performed the last time that the transmitter was started or commanded to run diagnostics. An example log follows:

Purge:					Passed
WarmUp:	Purge	Forward	Stream	0	Passed
WarmUp:	Temp Set	140	Current	140.86	Passed
WarmUp:	Status				Passed
PRM:	Pres	26.01	Std Dev	0.05	Passed
PRM:	Status				Passed
SSM:	Resting	-0.07			Passed
SSM:	Quad Valve Leak Ref	0.15	End	0	Passed
SSM:	#0 Pres High	7.66	Ratio	0.04	Passed
SSM:	#0 Pres Max	15.08	Drop	-0.01	Passed
SSM:	#1 Pres High	7.8	Ratio	0.04	Passed
SSM:	#1 Pres Max	15.47	Drop	-0.03	Passed
SSM:	#2 Pres High	7.66	Ratio	0.03	Passed
SSM:	#2 Pres Max	15.33	Drop	-0.01	Passed
SSM:	#3 Pres High	7.38	Ratio	0.03	Passed
SSM:	#3 Pres Max	14.9	Drop	0.03	Passed
SSM:	Status				Passed
GCM:	Avail Pres	49.98			Passed
GCM:	Carr Pres	25.97	Std Dev	0.04	Passed
GCM:	Mod Temp	140.29	Std Dev	0.32	Passed
GCM:	Det 0	72	Std Dev	7.57	Passed
GCM:	Det 1	123	Std Dev	5.61	Passed
GCM:	Valve Chg Det 0	-36478	Det 1	-40851	Passed
GCM:	Carr Pres	25.89	Std Dev	0.04	Passed
GCM:	Mod Temp	140.29	Std Dev	0.36	Passed
GCM:	Det 0	-23	Std Dev	3.93	Passed
GCM:	Det 1	112	Std Dev	9.01	Passed
GCM:	Status				Passed
Auto:	NC5 PT	43.05	@	27.82	Passed
Auto:	CO2 PT	50.65	@	27.82	Passed
Auto:	C2 PT	126.1	@	27.82	Passed
Auto:	Status				Passed

Debugging Commands

The following commands are used to assist with debugging. These commands should be used with care or under advisement from Totalflow Development.

TASKS - Dump Task Table

This command dumps the kernel task table. This command should be used only under advisement from Totalflow Development. An example is shown below.

tskptr	q_link	task	stack	sp	data	queue	pri	slot
009f4c	000000	437c	0783e	7b27	0000	00002	000	0001
009f5c	009fac	4258	06407	64dd	0001	00006	255	0002
009f6c	009f4c	4254	06509	65f1	0000	00002	001	0003
009f7c	00a03c	4174	08540	8774	0020	0000c	200	0004
009f8c	009fec	4304	067cf	6949	0001	00004	210	0005
009f9c	009f7c	4078	06993	6b31	0015	0000c	200	0006
009fac	00a04c	4338	089f4	8bc0	0095	00006	230	0007
009fbc	00a08c	4318	06d7f	6f31	0024	0000c	235	0008
009fcc	009fec	42f8	06f75	7138	0024	0000c	220	0009
009fdc	009f9c	42d4	07b40	7d0c	0020	0000c	205	0010
009fec	00a00c	4360	07d36	7efe	000b	0000c	205	0011
009ffc	009fdc	4298	07f2c	812a	0020	0000c	205	0012
00a00c	00a01c	4278	08154	8316	000b	0000c	205	0013
00a01c	009ffc	42fc	0834a	8510	000c	0000c	205	0014
00a02c	009f6c	4074	0879a	88c0	001b	00002	199	0015
00a03c	000000	4220	06b57	6d33	0028	0000c	200	0016
00a04c	000000	426c	08e76	900c	0063	00006	228	0017
00a06c	00a07c	42d0	0903a	91f9	0024	0000c	225	0019
00a07c	009fcc	42cc	09262	9421	0024	0000c	225	0020
00a08c	00a06c	4284	08bea	8e32	0024	0000c	230	0021

xxCHKRES - Check Resource

This command tells which task has resource xx. This command should be used only advisement from Totalflow Development.

COLD - Force Cold Start

This command forces a cold start the next time power is removed and applied. All parameters will return to their default conditions. All calibration constants and conditions will be lost. Communications will revert back to default. Security codes will be immediately wiped out and reconnection will be required. Power cycling will be required to complete the cold start. NOTE: There is no way to undo this command.

NOTE: This command is obsolete in prom 2100528-006 and later. Use BOOT=08 instead.

BOOT – Restart the Transmitter

This command restarts the transmitter. The format of the command is BOOT=xx. The following table defines the options that are available:

xx	Action
00	Flash Boot
01	PROM Boot
02	Flash from RS-232A port
03	(unused)
04	Flash from RS-232C port
05	Flash from RS-232A port
06	Flash from RS-422 port
07	Flash from RS-485 port
08	Cold Boot
09	Warm Boot
0A	Test Flash Memory

TRAP - Display/Clear TRAP Area

This command displays, then clears, the trap area. The trap area contains information that may be useful to Totalflow Development in the event of an unexpected processor reset. The trap area includes: 1) stack pointer, 2) INT/TRAP register, 3) task slot, 4) task control block address, 5) task address and 6) stack area address.

MEMORY - Display Memory Status

This command displays internal memory pool status. A low or fragmented memory pool may cause system tasks such as gates to not operate properly.

IDLE - Display Idle Time

This command displays the remaining kernel available idle time as a percentage of total available idle time measured during initial startup. This command has been removed.

RELDT - Display Release Date and Time

This command displays the release date and time as encoded in the firmware. This is designed to automatically indicate when the last build was done.

ERRPRNT - Error Print

This command sets a flag to print the raw result table or the result table that would have printed normally. Set this to 00 to print normally. Set to 01 to print the raw result table. The default is 00.

Example Command Sequences

Cold Start Command Sequence

The following command sequence will serve as one example of getting the transmitter up and running.

Command	Description
CODE=0000	Request security access
OK	Access granted?
Td=06/07/95 10:05	Set date and time
02INTERVAL=02	Capture every cycle in history file
AUTO=01	Set automatic factor update after calibration.
ACAL=01	Enable automatic calibration.
APEAK=01	Enable automatic peak detection
CALBLEND=01	Set Blend to Full Blend
00AOSCALE=25	Set analog output multiplier
01AOSCALE=25	Set analog output multiplier
03CBPCT00=.2	Set carbon split percentage for C6 to 20%
03CBPCT01=.8	Set carbon split percentage for C7 to 80%

MMF Cold Start Command Sequence

Command	Description
CODE=0000	Request security access
OK	Access granted?
Td=06/07/95 10:05	Set date and time
CALBLEND=04	Set Blend to No Blend
APEAK=02	Enable MMC Peak Detection
13FACTOR=	Set MMC Amplitude Factor - C3, IC4, NC4, NeoC5, IC5, NC5
14FACTOR=	Set MMC Amplitude Factor - C6+
15FACTOR=	Set MMC Amplitude Factor - N1, C1, CO2
16FACTOR=	Set MMC Amplitude Factor - C4+, C3', C2
17FACTOR=	Set Operating Carrier Pressure
18FACTOR=	Set C1 Peak Time @ Operating Carrier Pressure
19FACTOR=	Set C3' Peak Time @ Operating Carrier Pressure
20FACTOR=	Set SV1 Adjust Time @ Operating Carrier Pressure
21FACTOR=	Set NC5 Peak Time @ Operating Carrier Pressure
22FACTOR=	Set C3 Peak Time @ Operating Carrier Pressure
00AOSCALE=25	Set analog output multiplier
01AOSCALE=25	Set analog output multiplier

Test Limits

Test	Desc1	Item1	Low Limit	High limit	Desc2	Item2	Low Limit	High Limit	Notes
Purge:									
WarmUp:	Temp Set	140			Current	141.26	last	160	fail low limit 3 consecutive times before abort
WarmUp:	Status								
PRM:	Pressure	29.06	Set - 5	Set + 5	Std Dev	0.03		0.25	
PRM:	Status								
SSM:	Resting	-0.06	-0.5	3					
SSM:	Quad Valve Leak Ref	0.07		0.25	End	0			
SSM:	#0 Pressure High	7.28	4		Ratio	0.04		0.6	
SSM:	#0 Pressure Max	13.9	12	18	Drop	0.02	-0.5	0.5	
SSM:	#1 Pressure High	6.66	4		Ratio	0.04		0.6	
SSM:	#1 Pressure Max	13.9	12	18	Drop	0.03	-0.5	0.5	
SSM:	#2 Pressure High	7.13	4		Ratio	0.04		0.6	
SSM:	#2 Pressure Max	13.98	12	18	Drop	0.01	-0.5	0.5	
SSM:	#3 Pressure High	7.62	4		Ratio	0.04		0.6	
SSM:	#3 Pressure Max	15.04	12	18	Drop	0.01	-0.5	0.5	
SSM:	Status								
GCM:	Available Pres	49.98	49	51					
GCM:	Carrier Pres	29.06			Std Dev	0.03		0.2	
GCM:	Module Temp	140.22			Std Dev	0.44		0.75	
GCM:	Detector 0	92		1000	Std Dev	5.28		30	fail 15 consecutive times before abort
GCM:	Detector 1	45		1000	Std Dev	5.42		30	fail 15 consecutive times before abort
GCM:	Valve Chg Det 0	-36964	-105000	-5000	Det 1	-41646	-105000	-5000	
GCM:	Carrier Pres	29.06			Std Dev	0.04		0.2	
GCM:	Module Temp	140.79			Std Dev	0.49		0.75	
GCM:	Detector 0	-97		1000	Std Dev	8.97		30	fail 15 consecutive times before abort
GCM:	Deector 1	-17		1000	Std Dev	2.89		30	fail 15 consecutive times before abort
GCM:	Status								
Auto:	NC5 PT	43.05	41	50	Car Pres	27.82			
Auto:	CO2 PT	50.65	41	50.8	Car Pres	27.82			
Auto:	C2 PT	126.1			Car Pres	27.82			
Auto:	Status								

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