MODEL 2470 SOLARFLOW PLUS

**ENHANCED SOLARFLOW PLUS
(WITH MODBUS COMMUNICATIONS)**

APPLICATION MANUAL

HHDT EPROM 8-2460-239
LD EPROM 8-2460-242
LC EPROM 8-2460-243

**Part Number 3-9003-152
Revision D**

APRIL 1999

DANIEL

Year 2000 Warranty

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      ii)   recognize and accept the year 2000 and every succeeding fourth year as leap years;

      iii)   recognize and accept 29 February in the year 2000 and every succeeding fourth year;

      iv)   record, store, process, sequence, present and output calendar dates and data related to dates falling on or after 1 January 2000, in the same manner and with the same functionality as they do on or before 31 December 1999 and without errors or omissions; and

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DANIEL INDUSTRIES, INC.
MODEL 2470 SOLARFLOW PLUS
ENHANCED SOLARFLOW PLUS
(WITH MODBUS COMMUNICATIONS)
APPLICATION MANUAL

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TABLE OF CONTENTS

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1.0   INTRODUCTION

The Model 2470 Enhanced SolarFlow Plus software applications with Modbus communications have been designed to implement as many of the commonly required features of natural gas flow computers as possible. These applications have been designed to be compatible with existing Model 2470 support programs with minimal changes to those programs. Even with the enhanced features, field upgrades of existing units will be simple and easy. There are minimal or no hardware changes. This enhanced software will calculate volumetric flow rate using equations 3-6b and 3-7 from API Chapter 14.3, Part 3.

The Model 2470 Enhanced SolarFlow Plus with Modbus communications is essentially the same as the standard enhanced version except that Modbus communications has been added in place of Radio Packetized Logon and high speed channel reads with DSI protocol. An additional enhancement is that this supports span compression factors for each differential pressure transducer. This software supports all nine applications listed in this manual. The new HHDT Eprom (3-2460-239) will support the standard enhanced software version as well as the Eprom(s) using Modbus communications. As implemented, this modbus is an extension of Gould Modicon modbus protocol as implemented by Daniel Industries, Inc. Using the standard read and write MODBUS functions, and the special register conventions, all pertinent information in the SolarFlow Plus unit may be accessed remotely via the MODBUS protocol. The event log, and daily and hourly archive data are accessed using the archive registers.

1.1   SCOPE OF THIS MANUAL

A SolarFlow Plus unit delivered from the factory is fitted with a erasable, programmable, read-only memory (EPROM) configured for the application for which the SolarFlow Plus is intended. The Hand Held Data Terminal (HHDT) provided with SolarFlow Plus is compatible with all Model 2470 applications specified. This manual provides specific information on a Model 2470 SolarFlow Plus system which can be configured for one of nine orifice meter applications. Basic reference information on the Model 2470 SolarFlow Plus system is provided in the System Reference Manual (Daniel Part Number 3-9000-451). The System Reference Manual includes sections on system hardware, software, installation, and operating procedures for both the SolarFlow Plus computer and the HHDT. The System Reference manual, together with this application manual, provides a complete information package for nine specific installations of the Model 2470 SolarFlow Plus system. This manual references the System Reference Manual whenever more detailed information is provided in that manual.

This manual includes sections on:

·   Calculation modules for nine different orifice meter applications

·   Field wiring connections for applicable inputs and outputs

·   SETUP LOCATION menu parameters for the Hand Held Data Terminal (HHDT)

·   SETUP UNIT menu parameters for the HHDT

·   DISPLAY, CALIBRATE UNIT, ALARM and MONITOR menus for the HHDT

·   Default user report listing

·   Channel assignments for the unit

·   Default data log list

·   Default security codes

·   Default alarm list

1.2   PRODUCT FEATURES

This enhanced software has many commonly requested features resident in the firmware. All of these features are available regardless of the application for which the device is configured in the field. The primary features of the Enhanced Model 2470 SolarFlow Plus software are as follows:

·   Provides MODBUS communications for remote access

·   Serves as a 1, 2, or 3-run orifice meter application using the new flow equations

·   Supports AGA-8 according to the new standard (both detail and gross methods)

·   Accepts a variety of transducer assignments, including support for stacked DP transmitters on primary meter runs and optional live gas quality inputs

·   Allows the user access to all auxiliary analog inputs and their scales

·   Has a digital gas chromatograph interface, but will default to the use of fixed gas quality values

·   Provides a discrete output to indicate that a user-selected process variable has violated the programmed limits

·   Supports tube switching for configurations with more than one meter run

·   Performs valve positioning using an analog output to control station flow rate

·   Offers an analog output proportional to station flow rate (user scalable)

·   Provides two contact closure pulse outputs based on station volume

All of the application features are available in a single EPROM set which is supported by a single HHDT. The features that are common to all the applications are discussed generally. Features that apply to specific applications such as analog inputs, alarms, User Report lists, etc. will be located in the section dedicated to that particular application. A single channel list is available, containing the possible entries for all nine applications. If a particular application does not use a particular feature, that feature should be ignored.

1.3   ENHANCED APPLICATIONS

The following enhanced applications using flow rate equations from API Chapter 14.3 are included in this manual. The former closest equivalent applications are included for reference.

NEW APPLICATION   PREVIOUS ANALOGOUS APPLICATION

NEW APPLICATION	PREVIOUS ANALOGOUS APPLICATION	
SNGL ORIF	AGA3 SNGL	8-2460-135/136
DUAL ORIF	AGA3 DUAL	8-2460-135/136
TRIPLE ORIF	AGA3 TRIPLE TS	8-2460-159/160
	A TRIPLE TS	8-2460-222/223
DUAL ORIF COM	none - new application	
SSNGL ORIF	AGA3 SSNGL	8-2460-135/136
SDUAL ORIF	AGA3 SDUAL TS	8-2460-157/158
	A SDUAL TS	8-2460-220/221
STRIPLE ORIF	none - new application	
DUAL ORIF SEPT	AGA3 DUAL SEPT	8-2460-127/128
BIDIR DUAL ORIF	none - new application	

All of these applications are implemented in a single EPROM set which is supported by a single HHDT. All have the features listed previously. Where a new application corresponds to a previous application, the transducer assignments are identical to existing ones to allow upgrading of current units in the field without rewiring the analog inputs. However most field upgrades will require the installation of a jumper to ground the discrete input for Channel 2 to prevent the new unit from using a LIVE BTU input. See the section on channel assignments.

The "DUAL ORIF COM" is a dual meter application with common pressure and temperature. The "STRIPLE ORIF" is a stacked triple orifice application that supports measurement on three meter tubes with stacked differential pressure transmitters on the primary meter tube. Daniel Industries had no such previous application. The "BIDIR DUAL ORIF" is a bidirectional orifice meter which measures forward flow on the first meter, and reverse flow on the second meter. Station totals are for "net" (forward minus reverse) values.

1.4   CALCULATIONS

The calculation in the SolarFlow is divided into two distinct processes. These are as follows:

- ·   Analog input sampling

- ·   Rate and volume calculation cycle

These processes are usually operating autonomously without regard for the state of the other. Only when the rate calculation process is ready to begin a new cycle does it signal the sampling process that new inputs are required for a flow calculation. Upon receiving this signal, the sampling process transfers the inputs that have accumulated to the calculation process, and begins new accumulations.

1.4.1   ANALOG INPUT SAMPLING

Each 0.5 seconds all analog inputs are sampled. Six A/D conversions are done on each input in two groups of three successive samples. The time between these groups is about 10 milliseconds. The middle value in each group is kept and the average of the two values is considered the raw analog input value for that 0.5-second sample.

The samples are added to eight running sums which will be converted to average values and placed in SolarFlow Plus Channels 19 - 26 at the beginning of the next calculation cycle. These eight values are simple arithmetic averages of the inputs for the cycle. In addition to these eight averages, "flow time" averages are kept for six inputs to be used in each configured meter run (i.e. 18 averages total in a 3-run configuration). These six values are flow averages for differential pressure, measured static pressure in PSIG, temperature, specific gravity (regardless of source), BTU content (regardless of source) and flow extension.

The flow extension is the square root of the differential pressure times the *upstream, absolute static pressure*. If the pressure is measured from the downstream tap, it is corrected to reflect upstream pressure before the extension is calculated. A meter is considered to be flowing if the differential pressure for that meter is above the cut-off value. If no flow occurs for an entire calculation cycle, straight averages are kept for all inputs.

1.4.2   FLOW RATE EQUATIONS

The SolarFlow calculates volumetric flow rate using equations 3-6b and 3-7 from API Chapter 14.3 Part 3. These equations are:

$$Q_b = (14.73/P_b) * (T_b/519.67) * (Z_b/Z_s) * Q_v \qquad \text{Eqn. 3-7}$$

$$Q_v = 7709.61 * C_d * E_v * Y * d^2 * \qquad \text{Eqn. 3-6b}$$

$$sqrt(P_{f1} * h_w * Z_s / (G_r * Z_{f1} * T_f))$$

where :

Q_b	=	volumetric flow rate in SCFH at base conditions
Q_v	=	volumetric flow rate in SCFH at standard conditions
P_b	=	base pressure in PSIA
T_b	=	base temperature in Rankine
Z_b	=	gas compressibility at base conditions
Z_s	=	gas compressibility at standard conditions
C_d	=	orifice discharge coefficient
E_v	=	velocity of approach factor
Y	=	expansion factor
d	=	temperature corrected orifice diameter
P_{f1}	=	upstream pressure in PSIA
T_f	=	flowing temperature in Rankine
h_w	=	differential pressure in InH2O
G_r	=	real gas relative density at standard conditions
Z_{f1}	=	flowing compressibility at $P_{f1} * T_f$

Standard conditions = 14.73 PSIA and 519.67 Rankine

All compressibility values are calculated in accordance with AGA Report No. 8, 1992. The operator may select the DETAIL (full analysis) or GROSS (short form) method for compressibility calculation. For equations consult AGA Report No. 8.

All input gravity values used in the SolarFlow Plus are assumed to be for reference conditions of 14.73 PSIA and 60 °F. This assumption is consistent with calculation examples given in API Chapter 14.3, Part 3. If the operator indicates that the input gravity is the ideal relative density, the ideal value is converted to G_r before the flow rate calculation is run. This value is internal to the flow rate calculation, and does not replace the specific gravity value in the SolarFlow channels.

The quantity, sqrt(P_{fl} * h_w), is stored as a separate entity in the SolarFlow Plus channel, FLOW EXTN, and is stored in the data log by default. This is in accordance with the API Chapter 21.

1.4.3   RATE AND VOLUME CALCULATION

The SolarFlow Plus recalculates rates, volumes, and compressibility on a continuous basis. The duration of this calculation cycle depends on the configuration chosen. The length of each cycle is fixed, to ensure that no calculation cycle crosses a log period boundary. The cycle periods for various configurations are:

NUMBER OF METERS	AGA-8 DETAIL	AGA-8 GROSS (SHORT FORM)
1	20 SEC	10 SEC
2	60 SEC	15 SEC
3	60 SEC	20 SEC

At the beginning of each cycle, the analog input averages accumulated during the preceding cycle are transferred to the SolarFlow Plus channels. Using these inputs, a new flow calculation is done for each configured meter run. The flowing compressibility is calculated first, followed by the instantaneous flow rate. The rates and volumes are updated last. After all meters have been done, the station rates and volumes are updated.

1.4.4   LOGGING

The logging function is a part of the calculation cycle process. At the end of each cycle, the SolarFlow Plus updates all of the running averages for the log. For channels in the log definition designated as averages, "flow averages" are kept based on flowing conditions for the appropriate meter run. For channels which are associated with all runs (such as specific gravity or common temperature), averages are kept based on the flowing condition of the primary meter run. Straight time averages are kept for an item if the associated meter run is shut-in for the entire log period.

After updating the log averages, the SolarFlow Plus determines if it is time to make another data log entry and makes the new log if necessary.

1.5   GAS CHROMATOGRAPH INTERFACE

The SolarFlow Plus supports retrieval of gas composition and gas quality from the Model 2251 Danalyzer Gas Chromatograph Controller. SolarFlow Plus polls the chromatograph using the auxiliary serial port on the LD computer. Before polling the GC, the SolarFlow raises RTS (request to send) and waits to receive CTS (clear to send). If the CTS signal is not active, the SolarFlow will abort the polling cycle and retry at a later time. The simplest means of providing the CTS signal to the SolarFlow is to install a loopback jumper between RTS and CTS.

To enable the digital gas chromatograph interface, a jumper must be installed grounding digital input Channel 18. In addition to this, only two pieces of information must be programmed into the SolarFlow Plus. These are the MODBUS communication address of the chromatograph, and the chromatograph stream number of the data required.

The SolarFlow Plus initiates a poll of the GC about once every four minutes. If the poll is not successful, the poll will be retried every 20 seconds until the poll succeeds or attempts have been unsuccessful for over six minutes. After that time a communications error is declared and miscellaneous fault bit #4 is set. Each poll of the GC is made up of a series of MODBUS queries for chromatograph data. If any query fails, the poll sequence is aborted.

The first poll to the GC is for the time of the current analysis. This time stamp is saved for comparison later. Next, the current stream number is read. If this stream number does not match the user programmed stream number in the SolarFlow Plus, the poll sequence is ended to be re-tried in four minutes. Next a poll is issued for the BTU content and specific gravity, followed by a poll for the 11 component values supported by the Model 2251. The final poll retrieves some chromatograph alarms and the analysis time stamp again. If the alarms denoted by MODBUS registers 3046 and 3047 are non-zero, the analysis time does not match that of the first poll, or certain values are out of range (SG>2.0, SG<0.4, N2>50, BTU>2000 or BTU<400), the sequence is aborted and the GC analysis is discarded. Otherwise, the data is processed and saved in the SolarFlow Plus channels.

The data read from the GC and the associated MODBUS register numbers are:

C6+	7001	
Propane	7002	
I-Butane	7003	
Butane	7004	
Neo-Pentane	7005	
I-Pentane	7006	
Pentane	7007	
Nitrogen	7008	
Methane	7009	
CO2	7010	
Ethane	7011	
Specific Gravity	7035	(Real Gas Relative Density)
BTU Content	7033	

If the retrieved value for Nitrogen exceeds 50 percent, the data is discarded and no further processing is done. The most common cause of a value greater than 50 percent for Nitrogen is the reassignment of MODBUS register numbers done when Neo-Pentane is deleted from the Model 2251 configuration. If this component must be deleted, a dummy component should be inserted in its place to preserve the register assignments as shown. This is the only check the SolarFlow Plus does on the retrieved data before storing.

Since the AGA-8 equations do not support Neo-Pentane or C6+ as a single component, the retrieved data is partially processed before storing as SolarFlow Plus channels. If Neo-Pentane is present, it is considered to be Iso-Pentane (which is the most chemically similar component supported by AGA-8) and added to that component's value. Any C6+ reported is separated into the following fractions:

Hexane	0.47466
Heptane	0.3534
Octane	0.17194

These fractions are the default values used by Model 2251 in the calculation of the reported value for BTU content.

If the SolarFlow Plus has a prolonged communication error (greater than 6 minutes) with the Model 2251, miscellaneous fault bit number four is set.

1.6   CHANNEL VALUE MONITOR FUNCTION

The Channel Value Monitor Function provides a status output indicating that the monitored channel has exceeded the user-defined limits. Four channels are used to support this function including CVM STATUS on CH-13, CVM CHAN # on CH-110, CVM LO LIMIT on CH-111 and CVM HI LIMIT on CH-112.

CVM CHAN # indicates which channel holds the process variable value to be monitored. The function is disabled by selecting "0" for the "CVM CHAN #", and enabled by entering the channel number of the variable to be monitored. The process variable many be an analog input or calculated value (such as rate or volume).

Every 0.5 second, the value of the monitored process variable value is compared to the high and low limits. If the value is outside the limits, the CVM STATUS is turned ON. When the value of the monitored process variable returns within the user-defined limits for 60 seconds, the CVM status channel returns to the OFF condition.

1.7   TUBE SWITCHING

The double and triple run configurations in the SolarFlow Plus support meter tube switching based on differential pressure (DP). The primary run (meter run #1) is assumed to be always flowing, and the SolarFlow Plus will control the other run(s) by means of contact closure outputs connected to shutoff valves. Two differential pressure setpoints are used for each switched run. The differential open setpoint is the DP which must be observed on a meter run before the next run will be opened. The differential close setpoint is the DP level below which a run must fall before it is closed. (i.e. - Run #2 is opened when run #1 exceeds some predefined DP, and closed when DP #2 falls below a different level of predefined DP.)

The method of control for tube-switching in the SolarFlow Plus is based on the concept of a "control run". On initial startup, all tubes are opened and the last one becomes the control run. Each 0.5 seconds when the tube switching program runs, the DP on the control run is examined. If it exceeds the setpoint to open the next tube, that tube is opened and it becomes the new control run. If the DP falls below the close setpoint, the control run is closed, and the next lower run becomes the new control run.

In addition to the simplified algorithm above, the SolarFlow Plus implements three enhancements. First, the tube-switching feature may be enabled and disabled by an operator entry into the tube-switch enable channel. If the feature is disabled, the SolarFlow Plus completely ignores all other tube-switching parameters and performs no tube-switching control at all.

Second, a switching "dead-time" delay is used to prevent excessive valve wear. The dead-time is the time (in seconds) for which the DP must remain above or below the switching setpoint before the control will occur.

For example, if the delay is 30 seconds and DP on the control run rises above the open setpoint for only five seconds and then decreases again, no control will occur. The same delay applies to close setpoints as to open setpoints. This feature prevents brief "spikes" in flow rate from causing the tube-switching algorithm to oscillate. This dead-time delay feature is effectively disabled by using a delay of zero seconds.

The third refinement is that after any control order is issued by the tube-switching program, the algorithm is suspended for a user specified "valve travel time". This allows the valve time to respond before performing more tube switching controls.

1.8   VALVE POSITIONING

The SolarFlow Plus provides flow control based on rate, pressure, or rate with pressure over-ride and also supports differential pressure over-range protection. The SolarFlow Plus controls the flow by means of an analog output connected to a control valve. For multiple run configurations, the controlled rate is the station flow rate. The valve positioning function can be configured to operate in various ways based on the value of the following configuration variables:

Valve positioning mode	0=none (disabled)
	1=flow rate only
	2=rate w/upstream pres over-ride
	3=rate w/downstream pres over-ride
	4=pres control w/upstrm valve
	5=pres control w/dnstrm valve
Flow setpoint	desired flow rate in MCFH
Deadband	in % of setpoint
Small step	step for fine control
Large step	step for fast control
Fine control error limit	in % of setpoint
Over-ride pressure channel #	analog channel #
Over-ride pressure	in PSIG
Differential pressure over-range limit	in InH2O
Preset valve position	valve position for DP over-ride
Update time in seconds	valve positioning update time

If the function is disabled, or any analog input is under calibration, no control is done. To fix the valve position to a specific value, Channel 28 may be fixed to the desired value. This value will be maintained regardless of any configuration variables. If the function is enabled, and the valve position has not been fixed by the operator, the valve positioning function runs each half second after the analog inputs have been sampled.

1.8.1   DIFFERENTIAL OVER-RANGE PROTECTION

The differential pressure over-range protection feature is enabled by entering a non-zero value for the DP over-range limit. When enabled, this feature takes precedence over other valve positioning modes.

Each 0.5 seconds, the DP on the primary meter run is compared to the over-range limit. If the DP is below the over-range limit, valve positioning continues based on the selected mode. If the DP exceeds the limit, the valve position is set to the preset valve position, and the valve positioning function is aborted. Normal valve positioning resumes with the next analog sample cycle.

Certain combinations of parameters will cause the valve position to oscillate when this feature is enabled.

1.8.2   FLOW RATE CONTROL (VP MODE = 1)

SolarFlow Plus attempts to cause the measured flow rate to match a user entered flow rate setpoint. On initial startup the SolarFlow Plus sets the control output to 50 percent (3.0 volts). Each 0.5 seconds, a timer is incremented. If this timer is less than the programmed update time, the function is postponed for another cycle. After the update time has elapsed, the current flow rate is compared to the setpoint. If the difference (error) is greater than a fine control threshold, a large step is applied to the valve position. Otherwise, if the error is greater than a user programmed deadband, a small step is applied to the valve position. If the error does not exceed the deadband, no change is made to the valve position. The following example illustrates this.

Flow setpoint	500 MCFH
Small step	0.1 %
Deadband	1 %
Large step	0.3 %
Fine control	
Error limit	5 %

If the observed flow rate is below 475 MCFH, 0.3 percent will be added to the valve position (above 525, 0.3 percent will be subtracted). Otherwise, if the rate is below 495 MCFH, 0.1 percent will be added to the valve position (above 505, 0.1 percent will be subtracted). If the observed flow rate is between 495 and 505 MCFH, no control will be performed.

The flow rate for determining the error is estimated from the last system flow rate generated by the calculation cycle and the current flow extension. This estimation is:

$$Q_{vp} = Q_{sys} * Ext_{vp} / Ext_{sys}$$

where:

Q_{sys} Refers to system as contained in SolarFlow channels

Q_{vp} Refers to the most recent 0.5 second value generated during the analog input sampling process.

For multiple run configurations, the extensions in the equation above are simply the sum of the flow extensions for all meters.

1.8.3   FLOW RATE CONTROL WITH PRESSURE OVER-RIDE (VP MODE = 2 OR 3)

Each 0.5 seconds, the instantaneous value of the pressure over-ride channel (fixed value if the channel is fixed) is compared to the over-ride pressure value. If the pressure is less than the over-ride value, normal flow rate control continues. VP MODE = 2 or 3. If the pressure exceeds the over-ride value, the small step is added to the valve position for mode 2 or subtracted from the valve position for mode 3.

1.8.4   PRESSURE CONTROL - UP/DOWNSTREAM VALVES (VP MODE = 4 OR 5)

When the valve positioning is configured for pressure control, the 2470 attempts to make the measured pressure match the pressure set point. Channel 103 has been dedicated as the setpoint for pressure control. The channel on which the pressure is measured is the same "PRES CHAN#" which is used for the pressure override modes. The deadband applied for control is the same as for flow control, and is expressed in a percent of set point. Differential overrange protection may still be used, but no flow rate control is done in these modes.

The valve positioning algorithm runs at the operator defined interval specified by the update time. If the pressure is outside the deadband, but within the fine control limit, a small step is applied to the valve. If the pressure is outside the fine control limit, a large step is applied.

If the valve is upstream of the pressure transmitter, the 2470 closes the valve to lower the pressure (VP MODE = 4). If the valve is downstream of the pressure transmitter, the 2470 closes the valve to raise the pressure (VP MODE = 5).

1.8.5   FLOW RATE OUTPUT

SolarFlow Plus provides an analog output proportional to station volumetric flow rate. This output is provided for use by external equipment which requires an analog indication of the measured flow rate. The flow rate output is updated once each calculation cycle. The user is free to rescale this output.

1.8.6   VOLUME PULSE OUTPUT

SolarFlow Plus provides two separate contact closure outputs based on station volume. Each has a volume per pulse channel and a pulse period channel for configuration. For each output, a volume accumulator holds the volume since the last pulse was output. When the accumulator exceeds the volume per pulse, this volume is subtracted from the accumulator, and a pulse is output. The accumulation is done once each calculation cycle.

1.9   ACCEPTING AND REJECTING CALIBRATION

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the output of the transmitter for analog inputs to the SolarFlow Plus unit. The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP, and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

SolarFlow Plus has a built-in reference table that correlates the 1-to-5 volt analog inputs to the measured variable. If the deviation between the "expected" (VALUE DISPLAYED) and the "actual" (user entered value) process variable is less than 10 percent, SolarFlow Plus will adjust its table to account for the deviation and accept the calibration. This is Case 1 in the following table. If the deviation between the "expected" and the "actual" process variable is greater than 10 percent, "OVER-DEVIATION CALIBRATION REJECTED" will be displayed. No EVENT log record will be made, and SolarFlow Plus will use the *prior* calibration data. This is Case 2.

Recheck the calibration. If calibration is still rejected, refer to the Problem Diagnoses in Section 7 of the System Reference Manual.

	VALUE TRANSMITTER	VALUE DISPLAYED	HHDT DISPLAY	EVENT LOG ENTRY
Case 1	100.5	100	CALIBRATION ACCEPTED	Entries for each calibration
Case 2	50	100	OVER-DEVIATION CALIBRATION REJECTED	(none)

NOTES   ·   Zero scale = 0.0 (1.0 VDC analog input) and full scale = 100.0 in this case or (5.0 VDC analog input).
·   The ACTUAL (XMTR) value shown in the table is for "FULL SET" during calibration.
·   ACTUAL and VALUE DISPLAYED were identical for ZERO SET and LOW BIAS if present.
·   ACTUAL differed from VALUE DISPLAYED by an amount proportional to the FULL SET error for MID SET if present.

1.10   LOG DEFINE PROMPT

The LOG DEFINE prompt in the INPUTS submenu is used to add, delete, or modify items contained in the Data Log list. A six-character alphanumeric entry defines the item to be logged. For example, the six characters "020A61"* are defined as follows by the characters ChTLD:

Ch: Channel number, which is 020 in the example 020A61
T: Type of log, which is A in the example 020A61.
        T can be:
            A for average over log interval
            S for snapshot
            Z for snapshot and zero at logging time.
L: Number of digits to be logged, which is 6 in the
        example 020A61; possible values are 2, 4, 6, 8.
D: Number of decimal places to be displayed, which is
        1 in the example 020A61.

Therefore, "020A61" is decoded to mean that the item to be logged is an input from Channel 20 (Metr Pres), with a value averaged over the logged interval. The item has six digits with one number after the decimal point.

*   Enhanced SolarFlow software must use six digit channel assignments due to the 240 total channels.

1.11   USER LOGON EVENT

This application generates a "User logged on" record in the Event log only if the user performed an action (e.g. changed a measurement parameter, etc.) which generates another event. In other words, no event log entry is made when a user logs on and just reads current values. The number of events in active memory has been increased to 150 before the older events are discarded.

1.12   MODBUS COMMUNICATIONS

1.12.1 SETTING THE MODBUS COMMUNICATION ADDRESS

In order for the SolarFlow Plus to respond to a MODBUS protocol poll, the unit must be configured properly. The discrete input cable status points must indicate that the foreign protocol is active, the unit's MODBUS address must match the address in the message, and the remote protocol baud rate must be set to the proper value. The proper cable status values for MODBUS communication are:

<div align="center">

TB PIN NO.

</div>

D0 = low (grounded)	92
D1 = high (open)	93
D2 = high (open)	94

The MODBUS Address for communications with the SolarFlow Plus is set in the SETUP LOCATION menu by changing the Location ID (LOC ID). The baud rate is set by the "PCOMM RATE" variable, and the Request To Send Delay for radio keying may be set via the "RTS DELAY" variable. This must be done on site with a laptop or HandHeld Data Terminal.

Any valid write message may be broadcasted to all SolarFlow Plus units on a communications channel by addressing the poll to unit #0. This is an excellent way to synchronize the clocks of all slaves. The SolarFlow Plus time is available in the last six registers in the 4000 register series. These are registers 4094-4099. These registers may only be accessed as a group. They must use functions 3 and 16 and specify the start register as 4094, and the register count as six. Any attempt to read or write a subset of these registers will result in an error.

When the SolarFlow Plus time is set, the seconds register must be equal to zero. If a seconds value other than zero is sent to the SolarFlow Plus, the unit uses zero anyway. When a set time command (Fn 16) is received, the SolarFlow Plus checks the message time against the real time clock. If there is a discrepancy of one minute or larger, the SolarFlow Plus clock is set, and the appropriate event is logged.

1.12.2 SUPPORTED FUNCTION CODES

Following are supported function codes for the SolarFlow Plus MODBUS Protocol:

Fn 01   Read Boolean Registers
Fn 03   Read Registers
Fn 05   Write Single Boolean Register
Fn 06   Write Single Register
Fn 15   Write Multiple Boolean Registers
Fn 16   Write Multiple Registers

1.12.3 LOCAL AND REMOTE COMMUNICATIONS

When no local device (laptop or HHDT) is plugged into the SolarFlow Plus, the remote protocol will function normally.   However, when any local device is plugged in, the remote communications port becomes immediately inoperable. If the SolarFlow is busy sending or receiving a MODBUS message, and a local device is plugged in, the remote communications is interrupted and will fail. As soon as the local device is unplugged, the remote communications port will become active, and the message may be retried.

1.12.4 READING DATA FROM THE SOLARFLOW PLUS

The SolarFlow Plus maintains a set of register images which are always ready for reading via MODBUS. The host is free to read as many of these registers in a single poll as the MODBUS message structure supports. However it should be realized that these are not the actual SolarFlow Plus database values. They are only buffered copies of the data. Sometimes when data in the database changes, there will be a brief delay of one or two minutes before these copies reflect the change. The SolarFlow Plus places the message "MODBUS UPDATE ..." on the front panel LCD to indicate when the register images are being refreshed.

1.12.5 WRITING DATA TO THE SOLARFLOW PLUS

When a MODBUS write command is sent to a SolarFlow Plus unit, the data is immediately written directly to the SolarFlow Plus database. This is done before responding to the poll. The MODBUS register images are not immediately updated with this value. For this reason, a brief delay is required before being able to read back data written to a MODBUS register.

When data is written to the SolarFlow Plus database, it can take as long as 0.2 seconds per register for the SolarFlow to transfer the data to the calculation computer. Since this must occur before the unit responds to the MODBUS poll, there can be a substantial delay between the poll and response for multiple register writes. For this reason, it is suggested that the number of registers written in a single MODBUS message be kept to a reasonable number (less than 10).

The SolarFlow Plus dedicates the 700 series registers to archive files. Each archive in the SolarFlow Plus corresponds to a single MODBUS register number. Archive files are read only, and are accessed using the MODBUS function code 3. Each poll for data returns one archive record. All types of archive records start with a 12 byte time stamp.

The historical data log record is user definable in the SolarFlow Plus. The periodic and daily logs have the same format. The current log definition may be retrieved from certain 3000 series integer registers, or the Host computer may assume the format based on configuration data from another source. If the user does not redefine the data log, the record will contain the default items which may be found in the appropriate Application Section of this manual.

The data log may be changed either on site or remotely using the MODBUS protocol by writing to the 3000 series registers which are the log definition. When the data log is redefined, all stored daily and hourly archive data in the SolarFlow Plus is erased. The Event log is not erased. Changing the contract hour or periodic logging interval will not disturb the data log contents.

The general format of the retrieved archive record is:

> Time Stamp
> Underrange Flags
> Overrange Flags
> Miscellaneous Flags
> Log data item #1
> Log data item #2
> Log data item #3
>   .
>   .
>   .
> Log data item #n

1.13   REGISTERS

1000 Series Registers - The Boolean registers in the SolarFlow Plus may be read or written using functions 1, 5, and 15. A request for these registers with any other function code will result in an error. This is consistent with the Gould MODBUS definition.

3000 Series Registers - The 3000 series registers are 16 bit integers. These are accessed using function codes 3, 6, and 16. When transmitted, the high order byte is sent first. This is consistent with the Gould MODBUS definition.

5000 Series Registers - (Long integers) The SolarFlow Plus has no 32 bit integer registers. This register series is reserved to maintain compatibility with certain other Daniel Industries instrumentation.

7000 Series Registers - (Floating Point Data) The 7000 series registers are defined to be IEEE single precision floating point data. When transmitted, the exponent byte is transmitted first followed by the mantissa bytes in order of decreasing significance. For host computers using Intel microprocessors, this implies that the bytes are received in backwards order from their proper order in memory. This convention was chosen for compliance with the Gould convention of transmitting the high order byte of a 16 bit integer first.

9000 Series Registers - (Strings) The SolarFlow Plus can transmit and receive certain text string points. The 9000 series registers are reserved for this type of data. When a string register is transmitted or received, 20 bytes of data are transferred (the maximum length of the string is less than 20, and varies for each register). The string is terminated with a null character. For instance, a text string of length 10 would have a null in the 11th byte and 9 pad characters whose value is indeterminate.

SOLARFLOW PLUS MODBUS REGISTER ASSIGNMENTS

	Register	Description	(Read/Write)

Archives

	701-702	Reserved	
	703	35 Days Daily Historical	R
	704	840 Records Periodical Historical	R
	705-719	Reserved	
	720	150 most recent Event Records	R

Booleans

	1001-1018	SolarFlow Channels 1-18	R
	1019-1024	Reserved	
(1)	1025-1044	Alarm Active Status 1-20	R
	1045-1048	Reserved	
	1049-1068	Alarm Enable Status 1-20	R/W
	1069-1072	Reserved	
	1073-1092	Alarm Acknowledge Status 1-20	R/W
	1093-1096	Reserved	
(2)	1097-1104	Analog Input Source (Live/Fixed) 1-8	R/W
(3)	1105-1106	Analog Output Source (Live/Fixed) 1-2	R/W
	1107-1112	Reserved	

NOTES:

(1) Alarms acknowledged = 0; 1 = needs to be acknowledged.

(2) Analog source bits: input 1 = channel 19; fixed value = 1, live value = 0.

(3) Output 1 = Channel 27; 1 = fixed value, 0 = live data.

SOLARFLOW PLUS MODBUS REGISTER ASSIGNMENTS (CONTINUED)

16 bit Integers

3001	Last Read Hourly Log Index	R
3002	Current Hourly Log Index	R
3003	Last Read Daily Log Index	R
3004	Current Daily Log Index	R
3005	Last Read Event Log Index	R
3006	Current Event Log Index	R
3007-3010	Reserved	
3011	Contract Hour(0-23)	R/W
3012	Periodic Data Log Interval Code	R/W
3013-3020	Reserved	
3021-3066	Data Log Definition	R/W
3067-4093	Reserved	
4094-4099	Date and Time (YYYY,MM,DD,hh,mm,ss)	R/W

32 bit Integers - None

IEEE float

7001-7240	SolarFlow Channels 1-240	R/W
7241-7260	Reserved	
7261-7280	Hi,Lo Scale values, channels 19-28	R/W
7281-7300	Reserved	
7301-7360	X, Y, Z Alarm limit values, Alarms 1-20	R/W
7361-7400	Reserved	
7401-7408	Live Analog Inputs 1-8	R

String

9001	Location ID (10 chars max)	R
9002	Location Name (15 chars max)	R/W
9003	Unit ID (10 chars max)	R/W
9004	Unit Name (15 chars max)	R/W
9005	Calculation Module Name (15 chars exactly)	R

The data log interval code is:

> 0 = logging disabled
> 1 = 5 minute logs
> 2 = 15 minute logs
> 3 = 30 minute logs
> 4 = hourly logs
> 5 = 4 hour log period
> 6 = daily logging only

The log definition has 15 entries in it. Each entry is reported as three sequential registers. The channel number is the binary channel which will be logged. The Log Type is: 0 = snapshot, 1 = snapshot and zero, 2 = average; the precision is a value which determines the number of significant figures to be logged, and the number of digits following the decimal. Channel # 255 (0FFH) is used to signify the end of the list.

The precision byte may specify that 2, 4, 6, or 8 significant figures be kept on a logged item. The codes are 010H, 020H, 030H, and 040H respectively. This code is combined with the number of decimal digits. This is best illustrated with an example:

> 20,   2,   32H

specifies that channel 20 is to be averaged and stored in the log to a precision of 6 significant figures, including 2 digits after the decimal point.

This format defines storage parameters only; all log items are transmitted as IEEE single precision floating point data when accessed via MODBUS.

1.14   SLIDE SWITCH SETTINGS

The main printed circuit (PC) Board of a SolarFlow Plus unit has several sets of slide switches that are factory set for the application installed in the unit. Figure 1 illustrates the locations *only* of the slide switches on the older PC board. This Application Manual shows the slide switch settings for this application. Figure 2 illustrates the locations *only* of the slide switch settings of the newer PC board. The PCA number on the illustration specifies the assembly of this particular board. ***If you have a newer PC board*** *(3-2470-008), the switch reference designators are different, see paragraph 1.13.1.* Note that the slide switches use SW- reference designators on the newer PCB. For a full discussion of the slide switch settings or if the application is changed, refer to the System Reference Manual. Check your installation switch settings with the following tables.

SLIDE SWITCH SETTINGS FOR PC BOARD 3-2470-000
(Refer to Figure 1.)

Switch Set	Switch Position	Configuration in ON position
S1-1	N/A	Reserved
S1-2	N/A	Reserved
S3-1	N/A	Reserved
S3-2	N/A	Reserved
S2-1	ON	Always ON
S2-2	N/A	Reserved for future use
S2-3	N/A	Reserved for future use
S2-4	N/A	Reserved

Switches S2-5 through S2-8 should be ON.

S4-1	ON	Relay K1 activated by Channel 5
S4-2	OFF	Relay K1 activated by Channel 7
S4-3	ON	Relay K2 activated by Channel 6
S4-3	OFF	Relay K2 activated by Channel 8
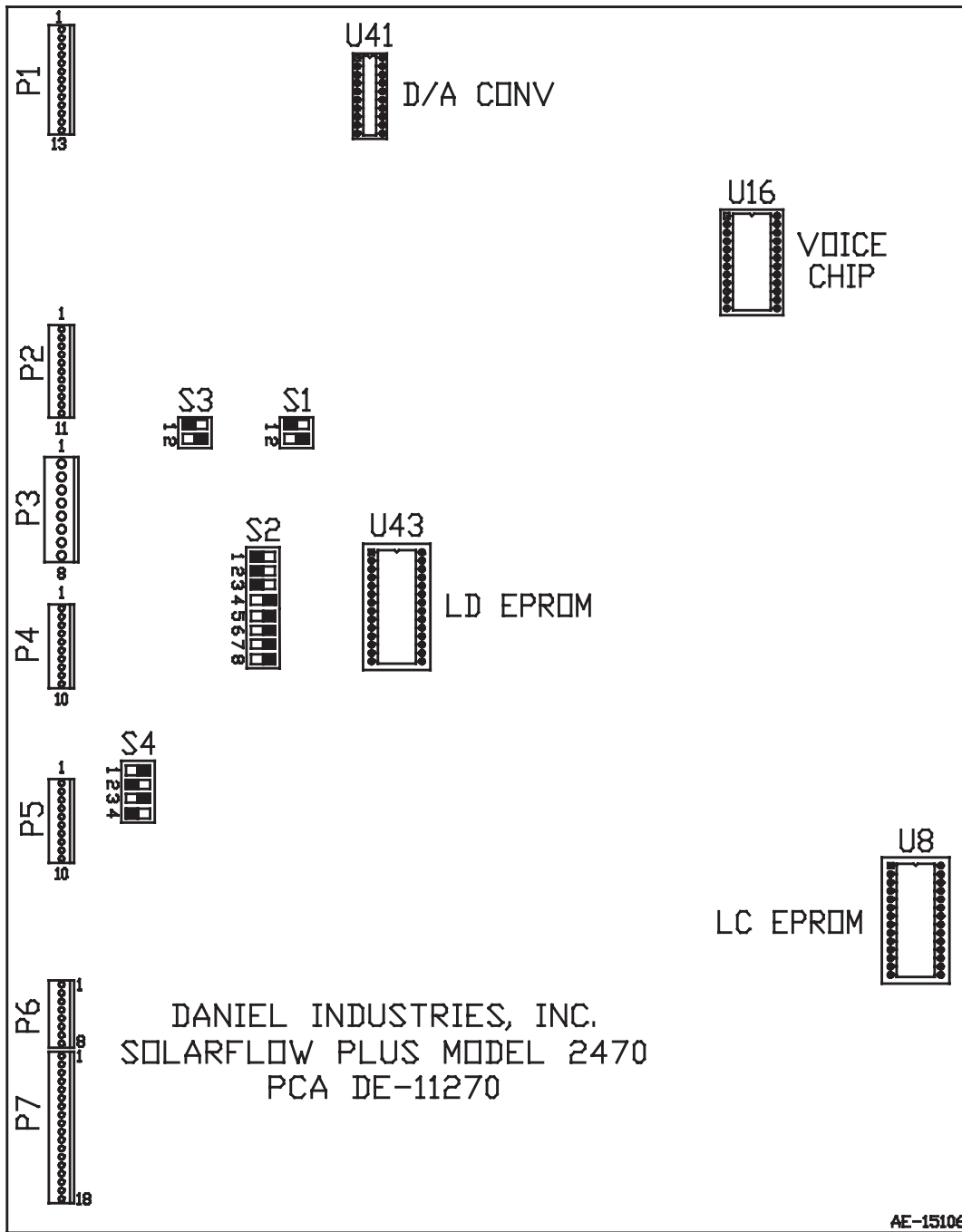
Figure 1. Model 2470 Slide Switch Locations
(PC Board Assembly Part No. 3-2470-000)
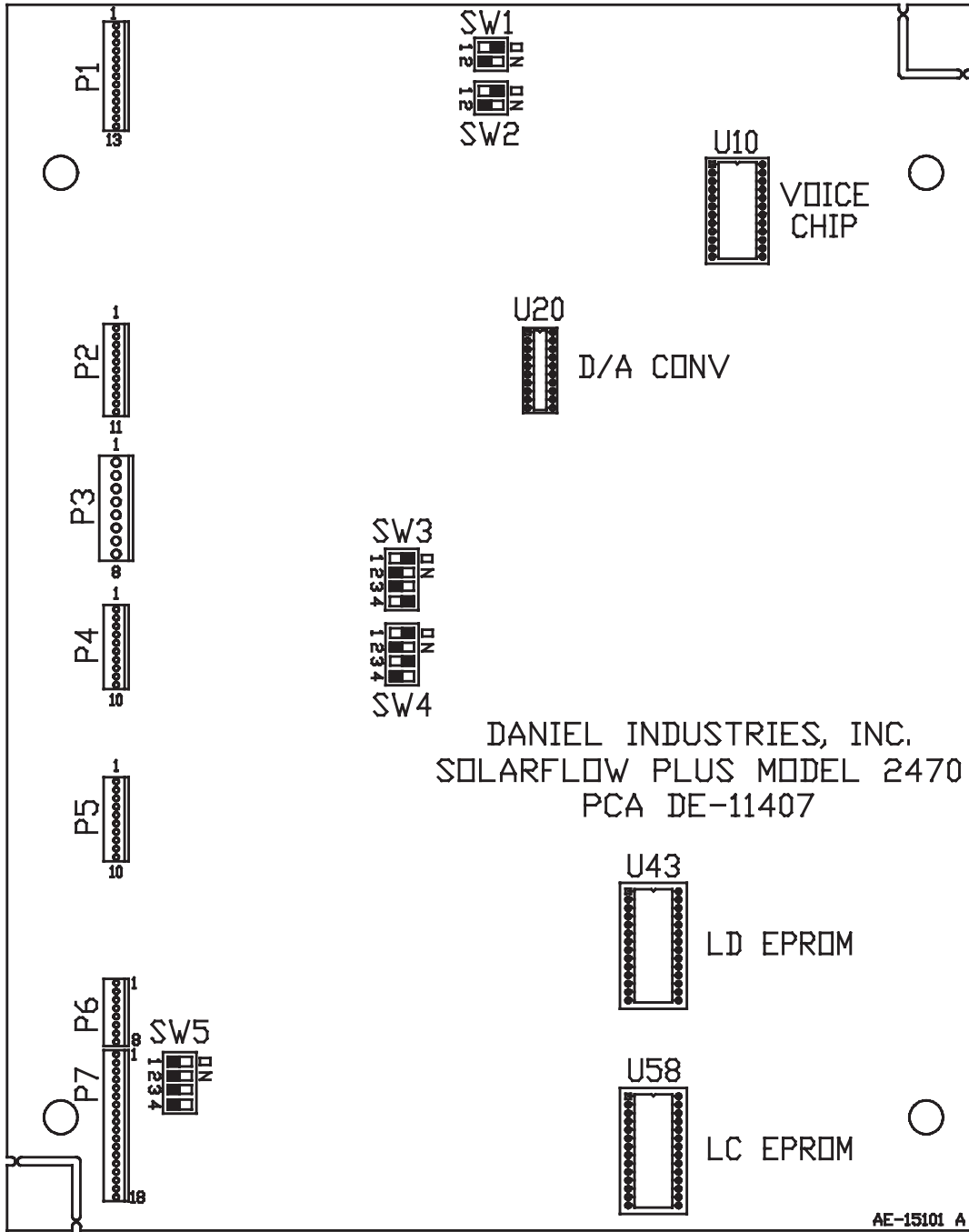
Figure 2. Model 2470 Slide Switch Locations
(PC Board Assembly Part No. 3-2470-008)

1.14.1   CHANGED SLIDE SWITCH SETTINGS FOR PC BOARD 3-2470-008

These slide switch settings are for newer PC Board 3-2470-008. These settings will be set at the factory when the application is known. Figure 2 illustrates the locations *only* of the slide switch settings of the newer PC board. Note that the slide switches use SW- reference designators on this newer PCB. For a full discussion of the slide switch settings or if the application is changed, refer to the System Reference Manual. Check your installation switch settings with the following tables.

SLIDE SWITCH SETTINGS FOR PC BOARD 3-2470-008
(Refer to Figure 2.)

Switch Set	Switch Position	Configuration in ON position
SW1-1	N/A	Reserved
SW1-2	N/A	Reserved
SW2-1	N/A	Reserved
SW2-2	N/A	Reserved
SW3-1	ON	Always ON
SW3-2	N/A	Reserved for future use
SW3-3	N/A	Reserved for future use
SW3-4	N/A	Reserved
SW4-1	ON	Relay K1 activated by Channel 5
SW4-2	OFF	Relay K1 activated by Channel 7
SW4-3	ON	Relay K2 activated by Channel 6
SW4-4	OFF	Relay K2 activated by Channel 8

1.15   ENHANCED SOFTWARE MISCELLANEOUS CONDITION BITS

The Misc. column of a data log printout indicates system conditions that occurred or were present during the log interval by replacing a dot with a number that identifies a specified condition. These numbers represent a designated system condition regardless of the ALARM setup in the SolarFlow Plus menu. These condition bits cannot be activated, deactivated, or acknowledged. They will appear on the SolarFlow Plus data log. The Channel 30 system alarm (SYS ERROR) equals these miscellaneous bits converted to decimal representation if they occur. An exception is that a cold start will not cause a SYS ERROR occurrence caused only by a cold start. Note that normally Channel 30 is 0.0. The data log will show the Misc. dots as follows:

Date___ Time_   __METR TEMP_ METR PRES_ DIFF PRES_ TODAY VOL
U-Range_ O-Range_ _Misc._

MM/DD/YY HH:MM   xxxx   xxxx   xxxx   xxxx
....

The enhanced version of these miscellaneous bits is as follows:

Dot No.	System Conditions	Weight in CH 30
8	System Failure	1.0
7	Cold Start	2.0
6	Warm Start	4.0
5	Designates Daily Log	8.0
4	Chromatograph Communications Failure	16.0
3	Reserved	32.0
2	Floating Point Error	64.0
1	Reserved	128.0

Any condition that occurs will be shown in Channel 30 as a decimal number. For example if dot No. 2 (Floating Point Error) had occurred, the binary number would be converted to decimal 64.0. This number would be < > 0.0 and it would be seen in Channel 30 (SYS ERROR) as the decimal number. Counting the dots from left to right, it would show in the data log as decimal 2 in the second position under Misc.

1.16   SPAN COMPRESSION OF DP FOR ELEVATED STATIC PRESSURE

A span compression function has been added to the enhanced software. The added channels are :

106	SPAN COMPL Low range on stacked applications	
107	SPAN COMP1	For meter tube 1
108	SPAN COMP2	For meter tube 2
109	SPAN COMP3	For meter tube 3

The units are a percentage of Differential Pressure span per 1000 psi of static pressure, and the adjustment to differential pressure is made according to:

$$\text{DP corrected} = \text{DP}/(1 - [(\text{SPAN COMP}/100)\ (\text{pressure}/1000)])$$

No correction is made if the Differential Pressure is fixed or if the unit is undergoing calibration. If DP is live and static is fixed, the DP is corrected according to the fixed static. When this correction is not desired, all SPAN COMP numbers default to 0.0, effectively disabling this feature. Therefore it may be ignored if not desired.

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2.0   ENHANCED SOLARFLOW PLUS CHANNEL ASSIGNMENTS

The enhanced SolarFlow Plus software features a comprehensive set of channels which should satisfy all of the expected applications with some room for future growth. It is expected that these channels will be capable of handling all the needs of API Chapter 14.3. The enhanced SolarFlow Plus supports 240 channels. The first 28 channels have the same special meaning as in the past. The remaining channels are the calculation channels which contain all rates, volumes, calculated results and configuration entries. The calculation channels begin with the "system" channels which apply to the whole unit without regard for a specific meter tube, followed by three groups of channels for information specific to each of the three meter tubes. Most of the supported applications do not use all of the channels defined. The channels not used by a particular configuration are reserved if that application has been selected, and are not available for other purposes.

All nine applications have identical channel assignments except for the analog inputs.

The sections devoted to a particular application will contain the channels and other items specific to a particular application.

If LIVE SG and/or LIVE BTU channels are not in use, that unused channel becomes available as an auxiliary. However, the HHDT will still describe the channel as specific gravity or BTU.

The following list is a comprehensive channel list for all nine applications with the exception of the channels defined by a particular application.

2.1 CHANNEL ONE THROUGH 18 ASSIGNMENTS

Assignments for the multiple usage application Channels one through 18 are tabulated as follows.

CH	LABEL	INPUT OUTPUT	0-LABEL	1-LABEL	DEFAULT	DESCRIP
001*	LIVE SG	INP	NO	YES	NO	Live gravity in use
002*	LIVE BTU	INP	NO	YES	NO	Live BTU in use
003	INPUT 3	INP	OFF	ON	ON	Spare status point
004	INPUT 4	INP	OFF	ON	ON	Spare status point
005	VP 1	OUT	OFF	ON	OFF	Volume pulse output 1
006	VP 2	OUT	OFF	ON	OFF	Volume pulse output 2
007	OPEN 2	OUT	ON	OFF	ON	Tube switching control
008	CLOSE 2	OUT	OFF	ON	OFF	Tube switching control
009	INPUT 9	INP	OFF	ON	ON	Spare status point
010	INPUT 10	INP	OFF	ON	ON	Spare status point

CH	LABEL	INPUT OUTPUT	0-LABEL	1-LABEL	DEFAULT	DESCRIP
011	OPEN 3	OUT	ON	OFF	ON	Tube switching control
012	CLOSE 3	OUT	OFF	ON	OFF	Tube switching control
013	CVM STATUS	OUT	OFF	ON	OFF	CVM function
014	OUTPUT 14	OUT	OFF	ON	OFF	Spare status point
015	OUTPUT 15	OUT	OFF	ON	OFF	Spare status point
016	INPUT 16	INP	OFF	ON	ON	Spare status point
017	INPUT 17	INP	OFF	ON	ON	Spare status point
018	CHROM		ENABL	DISAB	DISAB	Jumper installed enables GC**

* FIXED SG for channel 001 indicates pin 59 jumpered to pin 60. FIXED BTU for channel 002 indicates pin 52 jumpered to pin 61. When a Model 2251 Chromatograph Controller is used to obtain SG and BTU, input terminals 60 and 61 should be jumpered to ground as per FIXED SG/BTU.

** To enable the serial gas chromatograph interface, install a jumper between pin 68 and pin 59 (ground). Install jumpers between pins 60 and 61 and ground as when SG and BTU are fixed.

2.2   CHANNEL 19 THROUGH 240 ASSIGNMENTS

Assignments for the Enhanced SolarFlow Plus software Channels 19 through 28 are shown here for reference only. The column labeled DP in the table indicates the number of digits displayed past the decimal point. Channel assignments 20 through 26 will change depending on the requirements for the individual application. Refer to the section specifying the particular assignments for your desired application for the actual assignments.

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
019	BATTERY	VOLTS	2	0.00	Scale 3.2 -16
Channels 20-26 as per applications					
027	FLW RT OUT	MCF/H	1	0.0	Analog Flow Rate
028	VALVE POS	%	1	50.0	Current Valve Position
029	VERSION		1	1.0	Software version
030	SYS ERROR		0	0	System alarm
031	RESERVED		0	0	
032	COMP DPRES	InH2O	1	0.0	Composite DP if stacked
033	ATMS PRES	PSIA	2	14.73	Atmospheric pressure
034	PRES BASE	PSIA	2	14.73	Pressure base
035	TEMP BASE	DEG F	0	60	Temperature base
036	ORIF MTRL	(None)	0	1	Orifice material 0=carbon steel 1=stainless steel 2=monel
037	PIPE MTRL	(None)	0	0	Pipe material 0=carbon steel 1=stainless steel 2=monel
038	TREF ORIF	DEG F	1	68.0	Reference temp of orifice plate
039	TREF PIPE	DEG F	1	68.0	Reference temp of pipe

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
040	VISCOSITY	#/FTS	7	0.0000069	Fluid viscosity
041	SPEC HEAT		2	1.30	Specific heat ratio
042	SG SELECT		0	0	Input Specific Gravity 0=ideal, 1=real
043	AGA8 MTHD		0	0	AGA-8 Method 0=detail 1=GR, CO2, BTU 2=GR, CO2, N2
044	ZS		6	1.000000	Standard compressibility
045	ZB		6	1.000000	Base compressibility
046	MOL WT		4	16.8000	Calculated by AGA-8
047	B		6	0.000000	AGA-8 2nd virial coeff.
048	C		6	0.000000	AGA-8 3rd virial coeff.
049	D		6	0.000000	AGA-8 reduced density
050	K3		6	0.000000	AGA-8 mixture size param
051	SPEC GRAV	(None)	4	0.6000	Current SG
052	BTU	(None)	1	1000.0	Current BTU
053	METHANE	MOL%	3	95.000	Methane MOL%
054	N2	MOL%	3	0.000	Nitrogen MOL%
055	CO2	MOL%	3	0.000	Carbon dioxide MOL%
056	ETHANE	MOL%	3	5.000	Ethane MOL%
057	PROPANE	MOL%	3	0.000	Propane MOL%
058	H2O	MOL%	3	0.000	Water MOL%
059	H2S	MOL%	3	0.000	Hydrogen Sulphide MOL%

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
060	HYDROGEN	MOL%	3	0.000	Hydrogen MOL%
061	CO	MOL%	3	0.000	Carbon Monoxide MOL%
062	OXYGEN	MOL%	3	0.000	Oxygen MOL%
063	I-BUTANE	MOL%	3	0.000	I-butane MOL%
064	BUTANE	MOL%	3	0.000	Butane MOL%
065	I-PENTANE	MOL%	3	0.000	I-pentane MOL%
066	PENTANE	MOL%	3	0.000	Pentane MOL%
067	HEXANE	MOL%	3	0.000	Hexane MOL%
068	HEPTANE	MOL%	3	0.000	Heptane MOL%
069	OCTANE	MOL%	3	0.000	Octane MOL%
070	NONANE	MOL%	3	0.000	Nonane MOL%
071	DECANE	MOL%	3	0.000	Decane MOL%
072	HELIUM	MOL%	3	0.000	Helium MOL%
073	ARGON	MOL%	3	0.000	Argon MOL%
074	CHROM ADDR	(None)	0	1	Chrom address
075	CHROM STRM	(None)	0	1	Chrom stream No.
076	VPP 1	MCF	1	100.0	Volume per pulse 1
077	PP 1	SEC	0	1	Pulse period 1
078	VPP 2	MCF	1	100.0	Volume per pulse 2
079	PP 2	SEC	0	1	Pulse period 2
080-081 RESERVED					
082	TS ENABLE	(None)	0	0	0=disable, 1=enable
083	OPEN 2 SP	InH2O	1	80.0	Valve 2 DP open

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
084	CLOSE 2 SP	InH2O	1	20.0	Valve 2 DP close
085	OPEN 3 SP	InH2O	1	80.0	Valve 3 DP open
086	CLOSE 3 SP	InH2O	1	20.0	Valve 3 DP close
087	TS DELAY	SEC	0	30	Tube switching delay time
088	VALVE TIME	SEC	0	30	Valve travel time
089-090 RESERVED					
091	VP MODE	(None)	0	0	Valve positioning option 0=disabled 2=rate w/upstrm pres ovrd 3=rate w/dnstrm pres ovrd 4=pres control w/upstrm valve 5=pres control w/dnstrm valve
092	FLW SETPNT	MCF/H	1	0.0	Flow rate setpoint
093	DEADBAND	%	1	2.0	Control deadband %
094	SMALL STEP	%	2	0.05	Fine valve step %
095	LARGE STEP	%	1	0.5	Coarse valve step %
096	FINE CNTRL	%	0	5	Error limit control %
097	PRES CHAN#		0	20	Ch. No. for press ovrd
098	OVRD PRESS	PSIG	0	0	Press over-ride limit
099	DP LIMIT	InH2O	0	0	DP over-ride limit 0=disabled
100	PRESET POS	%	0	100	Valve position for DP ovrd
101	UPDATE TIM	SEC	0	10	Valve position update time
102 RESERVED					

SECTION 2

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
103	PRES SETPT	PSIG	0	100	Set Point for pres control
104-105 RESERVED					
106	SPAN COMPL	%	2	0.00	Low range on stacked applications
107	SPAN COMP1	%	2	0.00	For meter tube 1
108	SPAN COMP2	%	2	0.00	For meter tube 2
109	SPAN COMP3	%	2	0.00	For meter tube 3
110	CVM CHAN #	(None)	0	0	Selected channel to be monitored by the CVM function
111	CVM LO LMT	(None)	1	0.0	Low limit value
112	CVM HI LMT	(None)	1	5000.0	High limit value
113-119 RESERVED					
120	ORIF DIAM1	IN	3	4.000	Meter 1 orifice diameter
121	PIPE DIAM1	IN	3	8.071	Meter 1 pipe diameter
122	TAP LCTN1	(None)	0	0	Tap location 0=downstream 1=upstream
123	ZFLOW LIM1	InH2O	2	0.50	Low flow cutoff in Inh2o
124	CORR OD1	IN	4	0.0000	Temp corrected orifice diameter 1
125	CORR PD1	IN	4	0.0000	Temp corrected pipe
126	CORR BETA1	(None)	5	0.00000	Temp corrected Beta ratio
127	EV1	(None)	5	1.00000	Velocity of approach factor
128	CD 1	(None)	6	0.600000	Coefficient of discharge
129	ZF 1	(None)	6	1.000000	Flowing compressibility

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
130	Y FCTR 1	(None)	6	1.000000	Expansion factor
131	FLW EXTN 1	(None)	3	0.000	$\text{sqrt}(H_w * P_f)$
132	FLW TIME 1	MIN	2	0.00	Flow time
133	FLOW RATE1	MCF/H	1	0.0	Hourly flow rate
134	FLOW RATE1	MCF/D	1	0.0	Daily flow rate
135	LOG VOL 1	MCF	1	0.0	Logged accumulated volume
136	TODAY VOL1	MCF	1	0.0	Daily accumulated volume
137	YSDAY VOL1	MCF	1	0.0	Ysday's accumulated volume
138	TOT VOL 1	MCF	1	0.0	Total accumulated volume (Rolls over @ 10,000,000)
139	ERATE 1	DTH/H	1	0.0	Energy flow rate
140	LOG ENRGY1	DTH	1	0.0	Logged accumulated energy
141	TDY ENRGY1	DTH	1	0.0	Today's accumulated energy
142	YSY ENRGY1	DTH	1	0.0	Ysday's accumulated energy
143	TOT ENRGY1	DTH	1	0.0	Total accumulated energy (Rolls over @ 10,000,000)
144-149 RESERVED					
150	ORIF DIAM2	IN	3	4.000	Meter 2 orifice diameter
151	PIPE DIAM2	IN	3	8.071	Meter 2 pipe diameter
152	TAP LCTN2	(None)	0	0	Tap location 0=downstream 1=upstream
153	ZFLOW LIM2	InH2O	2	0.50	Low flow cutoff

SECTION 2

2-9

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
154	CORR OD2	IN	4	0.0000	Temp corrected orifice diameter 2
155	CORR PD2	IN	4	0.0000	Temp corrected pipe diameter 2
156	CORR BETA2	(None)	5	0.00000	Temp corrected Beta ratio
157	EV2	(None)	5	1.00000	Velocity of approach factor
158	CD 2	(None)	6	0.600000	Coefficient of discharge
159	ZF 2	(None)	6	1.000000	Flowing compressibility
160	Y FCTR 2	(None)	6	1.000000	Expansion Factor
161	FLW EXTN 2	(None)	3	0.000	$sqrt(H_w * P_f)$
162	FLW TIME 2	MIN	2	0.00	Flow time tube 2
163	FLOW RATE2	MCF/H	1	0.0	Hourly flow rate
164	FLOW RATE2	MCF/D	1	0.0	Daily flow rate
165	LOG VOL 2	MCF	1	0.0	Logged accumulated volume
166	TODAY VOL2	MCF	1	0.0	Today's accumulated volume
167	YSDAY VOL2	MCF	1	0.0	Ysday's accumulated volume
168	TOT VOL 2	MCF	1	0.0	Total accumulated volume (Rolls over @ 10,000,000)
169	ERATE 2	DTH/H		0.0	Energy flow rate
170	LOG ENRGY2	DTH	1	0.0	Logged accumulated energy
171	TDY ENRGY2	DTH	1	0.0	Today's accumulated energy

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
172	YSY ENRGY2	DTH	1	0.0	Ysday's accumulated energy
173	TOT ENRGY2	DTH	1	0.0	Total accumulated energy (Rolls over @ 10,000,000)
174-179 RESERVED					
180	ORIF DIAM3	IN	3	4.000	Meter 3 orifice diameter
181	PIPE DIAM3	IN	3	8.071	Meter 3 pipe diameter
182	TAP LCTN3	(None)	0	0	Tap location 0=downstream 1=upstream
183	ZFLOW LIM3	InH2O	2	0.50	Low flow cutoff
184	CORR OD3	IN	4	4.0000	Temp corrected orifice diameter 3
185	CORR PD3	IN	4	8.0710	Temp corrected pipe diameter 3
186	CORR BETA3	(None)	5	0.00000	Temp corrected Beta ratio
187	EV3	(None)	5	1.00000	Velocity of approach factor
188	CD 3	(None)	6	0.600000	Coefficient of discharge
189	ZF 3	(None)	6	1.000000	Flowing compressibility
190	Y FCTR 3	(None)	6	1.000000	Expansion factor
191	FLW EXTN 3	(None)	3	0.000	$\sqrt{H_w * P_f}$
192	FLW TIME 3	MIN	2	0.00	Flow time tube 3
193	FLOW RATE3	MCF/H	1	0.0	Hourly flow rate tube 3
194	FLOW RATE3	MCF/D	1	0.0	Daily flow rate tube 3
195	LOG VOL 3	MCF	1	0.0	Logged accumulated volume

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
196	TODAY VOL3	MCF	1	0.0	Daily accumulated volume
197	YSDAY VOL3	MCF	1	0.0	Ysday's accumulated volume
198	TOT VOL 3	MCF	1	0.0	Total accumulated volume (Rolls over @ 10,000,000)
199	ERATE 3	DTH/H	1	0.0	Energy flow rate/hour
200	LOG ENRGY3	DTH	1	0.0	Logged accumulated energy
201	TDY ENRGY3	DTH	1	0.0	Today's accumulated energy
202	YSY ENRGY3	DTH	1	0.0	Ysday's accumulated energy
203	TOT ENRGY3	DTH	1	0.0	Total accumulated energy (Rolls over @ 10,000,000)
204-209 RESERVED					
210	STN FLW RT	MCF/H	1	0.0	Flow rate per hour
211	STN FLW RT	MCF/D	1	0.0	Flow rate per day
212	ST LOG VOL	MCF	1	0.0	Station logged volume
213	ST TDY VOL	MCF	1	0.0	Station today's volume
214	YSDAY VOL	MCF	1	0.0	Station ysday's volume
215	ST TOT VOL	MCF	1	0.0	* Station total volume
216	STN ERATE	DTH/H	1	0.0	Station flow rate
217	LOG ENERGY	DTH	1	0.0	Station logged energy
218	TDY ST ENG	DTH	1	0.0	Station today's energy

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
219	YSY ST ENG	DTH	1	0.0	Station ysday's energy
220	TOT ENERGY	DTH	1	0.0	* Station total energy
221 - 240 Reserved					
* All totals roll over at 10,000,000 so adjust your units accordingly.					

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3.0   SINGLE ORIFICE APPLICATION

Section 3 covers the individual requirements for the single orifice application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The single orifice application supports measurement on a single meter tube with MODBUS communications. Optional capabilities such as valve positioning, chromatograph inputs, etc. are listed as part of the setup. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). Channels 1 and 2 are digital inputs which indicate whether an analog input is used for live specific gravity and BTU respectively. To select fixed values, these inputs should be jumpered to ground; for live values, the inputs should be left open. Analog inputs use Channels 19 through 26. Any unused analog input should be jumpered to ground.

When the SolarFlow Plus is configured for a new application, all channels are set to default values, and the Alarm definitions, Log definition, User Report list, and Analog Input channels are set to the values corresponding to the configuration chosen. The event log remains intact, but the data log is emptied.

3.1   FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed.   Make sure that your slide switch settings are set in accordance with the information in paragraph 1.13. No changes should be required unless the previously used application has been significantly different. Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2470 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

The wiring configuration for the single orifice analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters.

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure (factory installed)	White (Blue*) Green (Black*) Black (Red*)	23 26 25	Signal in + Analog ground 8 to 10 VDC
*	SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.			
		or		
20	EXTERNAL, static pressure (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	None, Jumper pin 27 to 30	Black Black	27 30	Signal in + Analog ground
22	EXTERNAL, temperature (to be installed by user)	Blue Black Red Gray	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	INTERNAL, differential pressure (DP) (factory installed)	Violet Black Gray	35 38 37	Signal in + Analog ground 8 to 10 VDC
		or		
23	EXTERNAL, differential (DP) (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	None, jumper pin 39 to 42	Black Black	39 42	Signal in + Analog ground
25	EXTERNAL, LIVE SG[1] [2] (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
26	EXTERNAL, LIVE BTU (to be installed by user)		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

NOTES: (1)   Since fixed values are normally desired for BTU and SG, digital input channels 1 and 2 are factory-wired to ground. When live values are desired, remove the jumpers between pins 59 and 60, 52 and 61 on the rear termination board. The fixed values for BTU and the specific gravity are entered in the GAS DATA submenu of the SETUP UNIT menu by keying in the desired value. Refer to the System Wiring Diagram.

(2)   Wire for connecting the external transmitter inputs is user-supplied.

3.2   STATUS SIGNAL CONNECTIONS

This application supports one status input that is activated by a dry contact closure between the status input pin number and common.

3.2.1   INPUTS

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
1	Live or fixed SG	LIVE SG	60 51 (GND)	Open, means use LIVE SG Shorted, means use FIXED SG
2	Live or fixed BTU	LIVE BTU	61 52 (GND)	Open, means use LIVE BTU Shorted, means use FIXED BTU
18	Chromatograph option	CHROM	68 59 (GND)	Open = no chromatograph Shorted, means use chromatograph

Following are valid combinations:

	CH 1	CH 2	CH 18
LIVE SG and BTU	No jumper	No jumper	No jumper
FIXED SG and BTU	Jumper/GND	Jumper/GND	No jumper
Serial Chromatograph	Jumper/GND	Jumper/GND	Jumper/GND

Note that serial chromatograph inputs require that SG and BTU be jumpered to ground as if fixed.

3.2.2   OUTPUTS

NOTE: All output signals from a SolarFlow Plus unit installed in a hazardous location must be isolated by means of intrinsic safety barriers.

This application has two form-A relays (mounted on the SolarFlow Plus PC board) that provide digital outputs for corrected station volume on Channels 5 and 6. The volume per pulse and the pulse period of the relays may be changed using the HHDT. Prompts for changing the relay volume per pulse (VPP 1 and VPP 2) and pulse period (PP 1 and PP 2) are included in the discussion of the CONFIG submenu of the SETUP UNIT menu.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	15 16	Form-A relay Common
6	Volume pulse output 2	VP 2	17 18	Form-A relay Common

TTL level outputs for Channels 5 and 6 are available at the termination board pin numbers shown in the following table.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	78 69	TTL output Common
6	Volume pulse output 2	VP 2	79 70	TTL output Common
13	Channel Value Monitor Indication	CVM STATUS	84 75	TTL output Common

3.2.3   ANALOG OUTPUT CONNECTIONS

This application provides two 1-5 VDC analog outputs.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
27	Flow rate output	FLW RT OUT	3 4	Analog output 1 Ground
28	Valve positioning	VALVE POS	1 2	Analog output 2 Ground

3.2.4   CHROMATOGRAPH INTER-CONNECTIONS

For more detail in wiring the Model 2251 Chromatograph Controller to the Model 2470, refer to the field wiring diagram in the Model 2470 systems Reference Manual.

MODEL 2251	MODEL 2470	
Signal Type	Pin No.	Signal Type
Serial out Serial in Ground	102 103 106	DI in DI out DI ground

3.3   SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the enhanced single orifice plate application that can be changed in the SETUP LOCATION menu are shown in the following table described by the HHDT prompt for the parameter, the factory-installed default value, and a blank space for entering the desired value if different from the factory default. Additional information on the SETUP LOCATION menu is provided in paragraph 5.10.1 of the Model 2470 System Reference Manual. For applications using MODBUS communications, refer to paragraph 1.11 in this manual.

HHDT PROMPT	DEFAULT	DESIRED
LOC NAME	BLANK LOCATION	_____
LOC ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE[1]	120	_____
USER REP[2]	****	_____
PCOMM RATE[3]	1200 BPS	_____
RTS DELAY[4]	0 1/100s	_____

NOTES: (1)   Refer to paragraph 5.10.1.6 in the Model 2470 System Reference Manual for a complete discussion of the SEC CODE prompt.

(2)   Refer to paragraph 5.10.1.7 in the Model 2470 System Reference Manual for a complete discussion of the USER REP prompt.

(3)   Refer to paragraph 5.10.1.8 in the Model 2470 System Reference Manual for a complete discussion of the PCOMM RATE prompt.

(4)   Refer to paragraph 5.10.1.9 in the Model 2470 System Reference Manual for a complete discussion of the RTS DELAY prompt.

3.4   SETUP UNIT MENU

The parameters for the enhanced single orifice plate application of SolarFlow Plus that can be changed in the submenus of the SETUP UNIT menu using the HHDT are tabulated as follows. The SETUP MENU has eight submenus: GENERAL, ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, AND CALC DATA.   The parameters are tabulated by the HHDT prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

3.4.1   GENERAL SUBMENU

The following parameters can be changed in the GENERAL submenu of the SETUP UNIT menu of the HHDT.

HHDT PROMPT	DEFAULT	DESIRED
UNIT NAME	BLANK UNIT	_____
UNIT ID	BLANK-ID	_____
CONTRCT HR	7 (0-23)	_____
LOG INTRVL	1 HOUR	_____
LOG DEFINE[1]		_____
RESET CMOD[2]	OFF	_____

NOTES: (1)   All data logs in the SolarFlow Plus memory are automatically erased and can no longer be recovered any time a change is made in the LOG DEFINE menu. Refer to paragraph 1.9 for a description of the LOG DEFINE prompt.

(2)   The RESET CMOD (Reset Calculations Module) prompt selects the calculation module for an alternate SolarFlow Plus application . RESET CMOD is discussed in detail in paragraph 5.10.2.1.6 in the Model 2470 SolarFlow Plus System Reference Manual.

3.4.2   ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu the enhanced single orifice application provides for toggling between LIVE and FIXED values of the following analogs. The AUX1 key on the HHDT toggles the input between the fixed and live values. A fixed value is shown by an asterisk (*) following the analog value in the display. For additional information, refer to the Model 2470 System Reference Manual.

HHDT PROMPT	DEFAULT
METR PRES	0.0 PSIG
METR TEMP	0.0 DEG F
DIFF PRESS	0.0 INH2O
LIVE SG	0.000
BATTERY	0.0 VOLTS
AUX ANLG 3	0.0 %
AUX ANLG 6	0.0 %
LIVE BTU	0.0
FLW RT OUT	0.0 MCFH
VALVE POS	50.0 %

3.4.3   SCALES SUBMENU

The high- and low-scale values for the analogs shown in the following table can be modified in the SCALES submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.3 in the Model 2470 System Reference Manual for additional information about the SCALES submenu.

HHDT PROMPT	DEFAULT		DESIRED
SPAN COMP1	0.00	%	_____
M PRES/LO	0.0	PSIG	_____
M PRES/HI	1000.0	PSIG	_____
M TEMP/LO	0.0	DEG F	_____
M TEMP/HI	150.0	DEG F	_____
D PRESS/LO	0.0	InH2O	_____
D PRESS/HI	150.0	InH2O	_____
LIVE SG/LO	0.50		_____
LIVE SG/HI	1.00		_____
BTU/LO	800.0		_____
BTU/HI	1200.0		_____
FLW RT LOW	0.0	MCFH	_____
FLW RT HI	5000.0	MCFH	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____
AUX 3 LOW	0.0	%	_____
AUX 3 HI	100.0	%	_____
AUX 6 LOW	0.0	%	_____
AUX 6 HI	100.0	%	_____

3.4.4 DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
CVM STATUS	OFF
OUTPUT 14	OFF
OUTPUT 15	OFF

3.4.5   CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.4 in the Model 2470 System Reference Manual for additional information about the CONFIG submenu.

HHDT PROMPT	SAMPLE VALUES		DESIRED
ORIF DIAM1	4.000	IN IN	_____
PIPE DIAM1	8.071	INH2O	_____
ZFLOW LIM1	0.50		_____
TAP LCTN 1	0	PSIA	_____
ATMS PRES	14.73	PSIA	_____
PRES BASE	14.73	DEG F	_____
TEMP BASE	60		_____
AGA8 MTHD	0		_____
SG SELECT	0		_____
ORIF MTRL	1		_____
PIPE MTRL	0	DEG F	_____
TREF ORIF	68.0	DEG F	_____
TREF PIPE	68.0		_____
CHROM ADDR	1		_____
CHROM STRM	1		_____
VERSION	1.0		_____

3.4.6   GAS DATA

This enhanced SolarFlow Plus software can accept information from the Model 2251 Danalyzer Chromatograph Gas Controller. This option requires that a jumper be installed grounding digital Channel 18. Install the jumper between pin 68 and pin 59 on the termination board. In addition, the MODBUS communication address and the chromatograph stream number desired must be programmed in by the HHDT. The Solarflow Plus will then poll the chromatograph once every four minutes automatically. Refer to paragraph 1.5.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.6000		_____
BTU	1000.0		_____
CO2	0.000	MOL%	_____
N2	0.000	MOL%	_____
VISCOSITY	0.0000069	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.000	MOL%	_____
ETHANE	5.000	MOL%	_____
PROPANE	0.000	MOL%	_____
H2O	0.000	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.000	MOL%	_____
BUTANE	0.000	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.000	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____
ARGON	0.000	MOL%	_____

3.4.7   CONTROL SUBMENU

The CONTROL submenu of the SETUP UNIT menu provides for entering the control values for the volume pulse outputs and valve positioning. Refer to paragraph 1.7 for more information.

HHDT PROMPT	SAMPLE VALUES		DESIRED
VPP 1	100.0	MCF	_____
PP 1	1	SEC	_____
VPP 2	100.0	MCF	_____
PP 2	1	SEC	_____
CVM CHAN #	0		_____
CVM LO LMT	0.0		_____
CVM HI LMT	5000.0		_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFH	_____
PRES SETPT	100	PSIG	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5.0	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
DP LIMIT	0	InH2O	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

3.4.8   CALCULATED DATA

The CALC DATA submenu of the SETUP UNIT menu allows the user to determine the calculated values for specified application inputs. The values shown here are typical values and not default values.

HHDT PROMPT	SAMPLE VALUES	DESIRED
FLOW RATE1	1000.0 MCFH	_____
EV 1	1.03164	_____
CD 1	0.603166	_____
Y 1	0.999892	_____
FLW EXTN 1	94.841	_____
AGA8 MTHD	0	_____
ZS	1.038190	_____
ZB	1.038190	_____
ZF 1	0.927767	_____
B - AGA8	0.033417	_____
C - AGA8	0.002236	_____
D - AGA8	0.266296	_____
K - AGA8	0.100912	_____
MOL WT.	16.7444	_____

3.5   DISPLAY MENU

The DISPLAY Menu of the HHDT provides for viewing the various setup parameters and calculated values in a SolarFlow Plus unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu. The Display menu has eight selections: ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CALC DATA and RATE/VOLS.

3.5.1   ANALOGS

METR PRES
METR TEMP
DIFF PRESS
LIVE SG
AUX ANALG3
AUX ANALG6
BATTERY
LIVE BTU
FLW RT OUT
VALVE POS

3.5.2   SCALES

SPAN COMP1	AUX 3 LOW
M PRES/LO	AUX 3 HI
M PRES/HI	AUX 6 LOW
M TEMP/LO	AUX 6 HI
M TEMP/HI	
D PRESS/LO	
D PRESS/HI	
LIVE SG/LO	
LIVE SG/HI	
BTU/LO	
BTU/HI	
FLW RT LOW	
FLW RT HI	
VLV POS LO	
VLV POS HI	

3.5.3   DISCRETES

LIVE SG
LIVE BTU
CHROM
VP 1
VP 2
CVM STATUS
INPUT 3
INPUT 4
INPUT 9
INPUT 10
INPUT 16
INPUT 17

3.5.4   CONFIG

ORIF DIAM1
PIPE DIAM1
ZFLOW LIM1
TAP LCTN 1
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF
TREF PIPE
CHROM ADDR
CHROM STRM
VERSION

3.5.5   GAS DATA

SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H20
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

3.5.6   CONTROL

>VPP 1
>PP 1
>VPP 2
>PP 2
>CVM CHAN #
>CVM LO LMT
>CVM HI LMT
>VP MODE
>FLW SETPNT
>PRES SETPT
>DEADBAND
>SMALL STEP
>LARGE STEP
>FINE CNTRL
>PRES CHAN#
>OVRD PRESS
>DP LIMIT
>PRESET POS
>UPDATE TIM
>VALVE POS

3.5.7   CALC DATA

FLOW RATE1
EV 1
CD 1
Y 1
FLW EXTN 1
AGA8 MTHD
ZS
ZB
ZF 1
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

3.5.8   RATE/VOLS

FLOW RATE1   (MCFH)
FLOW RATE1   (MCFD)
TODAY VOL1
YSDAY VOL1
TOT VOL 1
ERATE 1
TDY ENRGY1
YSY ENRGY1
TOT ENRGY1

3.6   CALIBRATE UNIT MENU

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the outputs of the transmitters for analog inputs to the SolarFlow Plus unit. The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

3.6.1   PRESSURES

The PRESSURES selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

    METR PRES
    DIFF PRESS

3.6.2   TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the METR TEMP selection.

3.6.3   OTHERS

The analog inputs listed as follows are calibrated in the OTHERS submenu of the CALIBRATE UNIT MENU:

    LIVE SG
    LIVE BTU
    AUX ANLG 3
    AUX ANLG 6

3.7 MONITOR MENU

The MONITOR menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs listed are available in the MONITOR menu in the triple orifice application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

    METR PRES
    METR TEMP
    DIFF PRESS
    LIVE SG
    LIVE BTU
    AUX ANLG 3
    AUX ANLG 6

3.8 USER REPORT (CHANNEL 0)

Channel zero (0) is a predefined report list containing a report header and the channel data shown in the following table. The SolarFlow Plus unit displays the Users Report on the front panel in a scrolling format.

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
020	METR PRES1	Live pressure meter No.1 in PSIG
023	DIFF PRES1	Live DP, Run No.1, value in inches of water
022	FLOW TEMP1	Live temperature in degrees Fahrenheit (^{o}F)
025	LIVE SG	Live value for specific gravity
133	FLOW RATE1	Flow rate for meter No.1
138	TOT VOL 1	Total volume for meter No.1
136	TODAY VOL1	Today's volume in MCF
137	YSDAY VOL1	Yesterday's volume in MCF

3.9 DATA LOG LIST CONTENTS

The following items are included on the data log. The data log is set to a 1-hour log interval. The default contract hour is 7:00 am.

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
023	DIFF PRES1	2	6	AVERAGE
020	METR PRES1	1	6	AVERAGE
022	FLW TEMP1	1	4	AVERAGE
132	FLW TIME	1	6	SNAPSHOT & ZERO
131	FLW EXTN	2	6	AVERAGE
135	LOG VOL	1	6	SNAPSHOT & ZERO

3.10 DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

M PRES/LO
M PRES/HI
M TEMP/LO
M TEMP/HI
D PRESS/LO
D PRESS/HI
ORIF DIAM1
PIPE DIAM1
ZFLOW LIM1
TAP LCTN 1
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
ORIF MTRL

(Continued on the next page)

Header Block Contents (Continued)

PIPE MTRL
TREF ORIF
TREF PIPE
SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

3.11   ALARM DEFINITIONS

The following is a listing of the Alarm definitions for this application. Note that the alarms will show up in the event log.

Number of Retries: 5 for alarms 1 through 9, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
1	C(19) < X	LOW BATTER	16.0	10.8	0.0	0
2	C(20) < X*S(20,F) or C(20) > Y*S(20,F)	METR PRES	1000	0.0	1.01	0
3*	C(21) < X*S(21,F) or C(21) > Y*S(21,F)	AUX ANALG3	-	0.0	1.01	0
4	C(22) < X*S(22,F) or C(22) > Y*S(22,F)	FLOW TEMP	150.0	0.0	1.01	0
5	C(23) < X*S(23,F) or C(23) > Y*S(23,F)	DIFF PRES	150.0	0.0	1.01	0
6*	C(24) < X*S(24,F) or C(24) > Y*S(24,F)	AUX ANALG6	-	0.0	1.01	0
7*	C(25) < X*S(25,F) or C(25) > Y*S(25,F)	LIVE SG	1.0	0.0	1.01	0
8*	C(26) < X*S(26,F) or C(26) > Y*S(26,F)	LIVE BTU	1200	0.0	1.01	0

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
9	C(210) < X or C(210) > Y	STN FLW RT	-	0.0	999999.0	0
10	C(30) <> 0.0	SYS ERROR	-	0.0	0.0	0

* This alarm should be disabled.

EXAMPLE:

Alarm # 2

   Y1   =   1.01

S(20,F)   =   The full-scale value for channel 20, which is the static pressure transmitter. SolarFlow Plus automatically generates this value based on the full-scale value entered while in the SETUP UNIT submenu.

   F   =   1000 PSIG

Therefore, the alarm setpoint for alarm #2 is 1.01(1000) = 1010 PSIG.

When the ALARM menu is entered using the HHDT the user may modify the X, Y, or Z values shown in the above alarm conditions by changing the values for LOW, HIGH, and ALT. This enables the user to adjust the alarm limit(s) to match the requirements.

The value for X is represented by LOW on the HHDT ALARM SETUP menu. The value for Y is represented by HIGH on the HHDT ALARM SETUP menu. The value for Z is represented by ALT on the HHDT ALARM SETUP menu.

The ALARM menu is also used to acknowledge alarms and to activate or deactivate alarms.

To acknowledge an alarm condition displayed on the LCD of SolarFlow Plus, enter the ALARM menu of the HHDT and select the ACKNOWLEDGE sub-menu. Any existing unacknowledged alarms are displayed and the HHDT prompts: "ACKNOWLEDGE ? Y/N". Press the ENTER key to acknowledge the alarm. Once this has been done and the user has logged off SolarFlow Plus the activated alarm is displayed with the message "ACKNOWLEDGED" following the alarm condition. If the alarm condition no longer exists and has not been acknowledged it remains on the LCD until acknowledged.

To activate or deactivate alarms, enter the HHDT ALARM menu and select the SETUP sub-menu. The HHDT displays the various alarms that are available in the program. Scroll to the desired alarm and press the ENTER key at the desired alarm condition. The HHDT provides four options; STAT, LOW, HIGH, and ALT. Press ENTER at the STAT option. The HHDT shows either ON or OFF and prompts OK?. To turn off the alarm, press the NO key until OFF is displayed, then press ENTER.

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4.0   DUAL ORIFICE APPLICATION

Section 4 covers the individual requirements for the dual orifice application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The dual orifice application supports measurement on two meter tubes with a common temperature and separate meter (static) pressure with MODBUS communications. Optional capabilities such as valve positioning, chromatograph inputs, etc. are listed as part of the setup. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). Channels 1 and 2 are digital inputs which indicate whether an analog input is used for live specific gravity and BTU respectively. To select fixed values, these inputs should be jumpered to ground; for live values, the inputs should be left open. Analog inputs use channels 19 through 26. Any unused analog input should be jumpered to ground.

When the SolarFlow Plus is configured for a new application, all channels are set to default values, and the Alarm definitions, Log definition, User Report list, and Analog Input channels are set to the values corresponding to the configuration chosen. The event log remains intact, but the data log is emptied.

4.1   FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed.   Make sure that your slide switch settings are set in accordance with the information in paragraph 1.13. No changes should be required unless the previously used application has been significantly different. Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2470 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

The wiring configuration for the dual orifice analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters.

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure (factory installed)	White (Blue*) Green (Black*) Black (Red*)	23 26 25	Signal in + Analog ground 8 to 10 VDC
*	SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.			
		or		
20	EXTERNAL, static pressure (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	EXTERNAL, static pressure Meter Tube No.2 (to be installed by user)	Blue Black Red Shield	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, temperature (to be installed by the user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	INTERNAL, differential pressure (DP) No.1 (factory installed)	Violet Black Gray	35 38 37	Signal in + Analog ground 8 to 10 VDC
		or		
23	EXTERNAL, differential (DP) No.1 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	EXTERNAL, DP No.2 (to be installed by user)	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
25	EXTERNAL, LIVE SG[1][2] (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	EXTERNAL, LIVE BTU (to be installed by user)		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

NOTES:

(1)   Since fixed values are normally desired for BTU and SG, digital input channels 1 and 2 are factory-wired to ground. When live values are desired, remove the jumpers between pins 59 and 60, 52 and 61 on the rear termination board. The fixed values for BTU and the specific gravity are entered in the GAS DATA submenu of the SETUP UNIT menu by keying in the desired value. Refer to the System Wiring Diagram.

(2)   Wire for connecting the external transmitter inputs is user-supplied.

(3)   If only one meter run is used with this application, jumper the unused inputs to analog ground e.g., if channels 24 or 25 are not used, jumper pin No. 39 to 42 and/or pin No. 43 to 46.

4.2   STATUS SIGNAL CONNECTIONS

This application supports status inputs that are activated by a dry contact closure between the status input pin number and common.

4.2.1   INPUTS

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
1	Live or fixed SG	LIVE SG	60 51 (GND)	Open, means use LIVE SG Shorted, means use FIXED SG
2	Live or fixed BTU	LIVE BTU	61 52 (GND)	Open, means use LIVE BTU Shorted, means use FIXED BTU
18	Chromatograph option	CHROM	68 59 (GND)	Open = no chromatograph Shorted, means use chromatograph

Following are valid combinations:

	CH 1	CH 2	CH 18
LIVE SG and BTU	No jumper	No jumper	No jumper
FIXED SG and BTU	Jumper/GND	Jumper/GND	No jumper
Serial Chromatograph	Jumper/GND	Jumper/GND	Jumper/GND

Note that serial chromatograph inputs require that SG and BTU be jumpered to ground as if fixed.

4.2.2   OUTPUTS

NOTE: All output signals from a SolarFlow Plus unit installed in a hazardous location must be isolated by means of intrinsic safety barriers.

This application has two form-A relays (mounted on the SolarFlow Plus PC board) that provide digital outputs for corrected station volume on Channels 5 and 6. The volume per pulse and the pulse period of the relays may be changed using the HHDT. Prompts for changing the relay volume per pulse (VPP 1 and VPP 2) and pulse period (PP 1 and PP 2) are included in the discussion of the CONFIG submenu of the SETUP UNIT menu.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	15 16	Form-A relay Common
6	Volume pulse output 2	VP 2	17 18	Form-A relay Common

TTL level outputs for the following channels are available at the termination board pin numbers shown in the following table.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	78 69	TTL Output Common
6	Volume pulse output 2	VP 2	79 70	TTL Output Common
7	Valve control open	OPEN 2	80 71	TTL Output Common
8	Valve control close	CLOSE 2	81 72	TTL Output Common
13	Channel Value Monitor Indication	CVM STATUS	84 75	TTL Output Common

---

4.2.3   ANALOG OUTPUT CONNECTIONS

This application provides two 1-5 VDC analog outputs.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
27	Flow rate output	FLW RT OUT	3 4	Analog Output 1 Ground
28	Valve positioning	VALVE POS	1 2	Analog Output 2 Ground

4.2.4   CHROMATOGRAPH INTER-CONNECTIONS

For more detail in wiring the Model 2251 Chromatograph Controller to the Model 2470, refer to the field wiring diagram in the Model 2470 systems Reference Manual.

MODEL 2251	MODEL 2470	
Signal Type	Pin No.	Signal Type
Serial out	102	DI in
Serial in	103	DI out
Ground	106	DI ground

4.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the enhanced dual orifice plate application that can be changed in the SETUP LOCATION menu are shown in the following table described by the HHDT prompt for the parameter, the factory-installed default value, and a blank space for entering the desired value if different from the factory default. Additional information on the SETUP LOCATION menu is provided in paragraph 5.10.1 of the Model 2470 System Reference Manual. For applications using MODBUS communications, refer to paragraph 1.11 in this manual.

HHDT PROMPT	DEFAULT	DESIRED
LOC NAME	BLANK LOCATION	_____
LOC ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE[1]	120	_____
USER REP[2]	****	_____
PCOMM RATE[3]	1200 BPS	_____
RTS DELAY[4]	0 1/100s	_____

NOTES:

(1)   Refer to paragraph 5.10.1.6 in the Model 2470 System Reference Manual for a complete discussion of the SEC CODE prompt.

(2)   Refer to paragraph 5.10.1.7 in the Model 2470 System Reference Manual for a complete discussion of the USER REP prompt.

(3)   Refer to paragraph 5.10.1.8 in the Model 2470 System Reference Manual for a complete discussion of the PCOMM RATE prompt.

(4)   Refer to paragraph 5.10.1.9 in the Model 2470 System Reference Manual for a complete discussion of the RTS DELAY prompt.

4.4   SETUP UNIT MENU

The parameters for the enhanced dual orifice plate application of SolarFlow Plus that can be changed in the submenus of the SETUP UNIT menu using the HHDT are tabulated as follows. The SETUP MENU has eight submenus: GENERAL, ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, AND CALC DATA.   The parameters are tabulated by the HHDT prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

4.4.1   GENERAL SUBMENU

The following parameters can be changed in the GENERAL submenu of the SETUP UNIT menu of the HHDT.

HHDT PROMPT	DEFAULT	DESIRED
UNIT NAME	BLANK UNIT	_____
UNIT ID	BLANK-ID	_____
CONTRCT HR	7 (0-23)	_____
LOG INTRVL	1 HOUR	_____
LOG DEFINE [1]		_____
RESET CMOD[2]	OFF	_____

NOTES: (1)   All data logs in the SolarFlow Plus memory are automatically erased and can no longer be recovered any time a change is made in the LOG DEFINE menu. Refer to paragraph 1.9 for a description of the LOG DEFINE prompt.

(2)   The RESET CMOD (Reset Calculations Module) prompt selects the calculation module for an alternate SolarFlow Plus application. RESET CMOD is discussed in detail in paragraph 5.10.2.1.6 in the Model 2470 SolarFlow Plus System Reference Manual.

4.4.2   ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu of the enhanced dual orifice application provides for toggling between LIVE and FIXED values of the following analogs. The AUX1 key on the HHDT toggles the input between the fixed and live values. A fixed value is shown by an asterisk (*) following the analog value in the HHDT display. For additional information, refer to the Model 2470 System Reference Manual.

HHDT PROMPT	DEFAULT
METR PRES1	0.0 PSIG
METR PRES2	0.0 PSIG
METR TEMP	0.0 DEG F
DIFF PRES1	0.0 InH2O
DIFF PRES2	0.0 InH2O
LIVE SG	0.0000
BATTERY	0.0 VOLTS
LIVE BTU	0.0
FLW RT OUT	0.0 MCFH
VALVE POS	50.0 %

4.4.3   SCALES SUBMENU

The high- and low-scale values for the analogs shown in the following table can be modified in the SCALES submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.3 in the Model 2470 System Reference Manual for additional information about the SCALES submenu.

HHDT PROMPT	DEFAULT		DESIRED
SPAN COMP1	0.00	%	_____
SPAN COMP2	0.00	%	_____
M PRES1/LO	0.0	PSIG	_____
M PRES1/HI	1000.0	PSIG	_____
M PRES2/LO	0.0	PSIG	_____
M PRES2/HI	1000.0	PSIG	_____
M TEMP/LO	0.0	DEG F	_____
M TEMP/HI	150.0	DEG F	_____
D PRES1/LO	0.0	InH2O	_____
D PRES1/HI	150.0	InH2O	_____
D PRES2/LO	0.0	InH2O	_____
D PRES2/HI	150.0	InH2O	_____
LIVE SG/LO	0.50		_____
LIVE SG/HI	1.0		_____
BTU/LO	800.0		_____
BTU/HI	1200.0		_____
FLW RT LOW	0.0	MCFH	_____
FLW RT HI	5000.0	MCFH	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____

4.4.4   DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
OPEN 2	ON
CLOSE 2	OFF
CVM STATUS	OFF
OUTPUT 14	OFF
OUTPUT 15	OFF

4.4.5   CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.4 in the Model 2470 System Reference Manual for additional information about the CONFIG submenu.

HHDT PROMPT	SAMPLE VALUES		DESIRED
ORIF DIAM1	4.000	IN IN	_____
PIPE DIAM1	8.071	InH2O	_____
ZFLOW LIM1	0.50		_____
TAP LCTN 1	0	IN	_____
ORIF DIAM2	4.000	IN	_____
PIPE DIAM2	8.071	InH2O	_____
ZFLOW LIM2	0.50		_____
TAP LCTN 2	0	PSIA	_____
ATMS PRES	14.73	PSIA	_____
PRES BASE	14.73	DEG F	_____
TEMP BASE	60		_____
AGA8 MTHD	0		_____
SG SELECT	0		_____
ORIF MTRL	1		_____
PIPE MTRL	0	DEG F	_____
TREF ORIF	68.0	DEG F	_____
TREF PIPE	68.0		_____
CHROM ADDR	1		_____
CHROM STRM	1		_____
VERSION	1.0		_____

4.4.6   GAS DATA

This enhanced SolarFlow Plus software can accept information from the Model 2251 Danalyzer Chromatograph Gas Controller. This option requires that a jumper be installed grounding digital Channel 18. Install the jumper between pin 68 and pin 59 on the termination board. In addition, the MODBUS communication address and the chromatograph stream No. desired must be programmed in by the HHDT (CONFIG SUBMENU). The Solarflow Plus will then poll the chromatograph once every four minutes automatically. Refer to paragraph 1.5.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.6000		_____
BTU	1000.0		_____
CO2	0.000	MOL%	_____
N2	0.000	MOL%	_____
VISCOSITY	0.0000092	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.000	MOL%	_____
ETHANE	5.000	MOL%	_____
PROPANE	0.000	MOL%	_____
H2O	0.000	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.000	MOL%	_____
BUTANE	0.000	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.000	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____
ARGON	0.000	MOL%	_____

4.4.7   CONTROL SUBMENU

The CONTROL submenu of the SETUP UNIT menu provides for entering the control values primarily for the valve positioning and tube switching. Refer to paragraphs 1.6 and 1.7 for more information.

HHDT PROMPT	DEFAULT		DESIRED
VPP 1	100.0	MCF	_____
PP 1	1	SEC	_____
VPP 2	100.0	MCF	_____
PP 2	1	SEC	_____
CVM CHAN #	0		_____
CVM LO LMT	0.0		_____
CVM HI LMT	5000.0		_____
TS ENABLE	0		_____
OPEN 2 SP	80.0	InH2O	_____
CLOSE 2 SP	20.0	InH2O	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFH	_____
PRES SETPT	100	PSIG	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
DP LIMIT	0	InH2O	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

4.4.8   CALCULATED DATA

The CALC DATA submenu of the SETUP UNIT menu allows the user to determine the calculated values for specified application inputs. The values shown here are typical values and not default values.

HHDT PROMPT	SAMPLE VALUES	
AGA8 MTHD	0	
ZS	0.997811	
ZB	0.997811	
FLOW RATE1	100.0	MCFH
EV 1	1.03164	
CD 1	0.603166	
Y 1	0.999892	
FLW EXTN 1	94.841	
ZF 1	0.927767	
FLOW RATE2	772.6	MCFH
EV 2	1.0000	
CD 2	0.600000	
Y 2	1.000000	
FLW EXTN 2	184.017	
ZF 2	1.000000	
B - AGA8	0.033417	
C - AGA8	0.002236	
D - AGA8	0.266296	
K - AGA8	0.100912	
MOL WT.	16.7444	

4.5 DISPLAY MENU

The DISPLAY Menu of the HHDT provides for viewing the various setup parameters and calculated values in a SolarFlow Plus unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu. The Display menu has eight selections: ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CALC DATA and RATE/VOLS.

4.5.1 ANALOGS

METR PRES1
METR PRES2
METR TEMP
DIFF PRES1
DIFF PRES2
LIVE SG
BATTERY
LIVE BTU
FLW RT OUT
VALVE POS

4.5.2 SCALES

SPAN COMP1	BTU/LO
SPAN COMP2	BTU/HI
M PRES1/LO	FLW RT LOW
M PRES1/HI	FLW RT HI
M PRES2/LO	VLV POS LO
M PRES2/HI	VLV POS HI
M TEMP/LO	
M TEMP/HI	
D PRES1/LO	
D PRES1/HI	
D PRES2/LO	
D PRES2/HI	
LIVE SG/LO	
LIVE SG/HI	

4.5.3   DISCRETES

LIVE SG
LIVE BTU
CHROM
VP 1
VP 2
CVM STATUS
OPEN 2
CLOSE 2
INPUT 3
INPUT 4
INPUT 9
INPUT 10
INPUT 16
INPUT 17
OPEN 3
CLOSE 3
OUTPUT 14
OUTPUT 15

4.5.4   CONFIG

ORIF DIAM1   TREF PIPE
PIPE DIAM1   CHROM ADDR
ZFLOW LIM1   CHROM STRM
TAP LCTN 1   VERSION
ORIF DIAM2
PIPE DIAM2
ZFLOW LIM2
TAP LCTN 2
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF

4.5.5   GAS DATA

SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H20
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

4.5.6   CONTROL

    VPP 1
    PP 1
    VPP 2
    PP 2
    CVM CHAN #
    CVM LO LIMIT
    CVM HI LIMIT
    TS ENABLE
    OPEN 2 SP
    CLOSE 2 SP
    TS DELAY
    TS VLV TIM
    VP MODE
    FLW SETPNT
    PRES SETPT
    DEADBAND
    SMALL STEP
    LARGE STEP
    FINE CNTRL
    PRES CHAN#
    OVRD PRESS
    DP LIMIT
    PRESET POS
    UPDATE TIM
    VALVE POS

4.5.7   CALC DATA

AGA8 MTHD
ZS
ZB
FLOW RATE1
EV 1
CD 1
Y 1
FLW EXTN 1
ZF 1
FLOW RATE2
EV 2
CD 2
Y 2
FLW EXTN 2
ZF 2
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

4.5.8   RATE/VOLS

      FLOW RATE1   (MCFH)
      FLOW RATE1   (MCFD)
      TODAY VOL1
      YSDAY VOL1
      TOT VOL 1
      FLOW RATE2   (MCFH)
      FLOW RATE2   (MCFD)
      TODAY VOL2
      YSDAY VOL2
      TOT VOL 2
      STN FLW RT   (MCFH)
      STN FLW RT   (MCFD)
      STN TDY VOL
      STN YSY VOL
      ST TOT VOL
      ERATE 1
      TDY ENRGY1
      YSY ENRGY1
      TOT ENRGY1
      ERATE 2
      TDY ENRGY2
      YSY ENRGY2
      TOT ENRGY2
      STN ERATE
      TDY ENERGY
      YSY ENERGY
      TOT ENERGY

4.6 CALIBRATE UNIT MENU

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the outputs of the transmitters for analog inputs to the SolarFlow Plus unit. The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

4.6.1 PRESSURES

The PRESSURES selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

> METR PRES1
> METR PRES2
> DIFF PRES1
> DIFF PRES2

4.6.2 TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the METR TEMP selection.

4.6.3 OTHERS

The analog inputs listed as follows are calibrated in the OTHERS submenu of the CALIBRATE UNIT MENU:

> LIVE SG
> LIVE BTU

4.7   MONITOR MENU

The MONITOR menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs listed are available in the MONITOR menu in the dual orifice application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

    METR PRES1
    METR PRES2
    METR TEMP
    DIFF PRES1
    DIFF PRES2
    LIVE SG
    LIVE BTU

4.8   USER REPORT (CHANNEL 0)

Channel zero (0) is a predefined report list containing a report header and the channel data shown in the following table. The SolarFlow Plus unit displays the Users Report on the front panel in a scrolling format.

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
020	METR PRES1	Live pressure meter No.1 in PSIG
023	DIFF PRES1	Live DP, Run No.1, value in inches of water
021	METR PRES2	Live pressure meter No.2 in PSIG
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
022	FLOW TEMP1	Live temperature in degrees Fahrenheit ($^{\circ}$F)
025	LIVE SG	Live value for specific gravity
133	FLOW RATE1	Flow rate for meter No.1
138	TOT VOL 1	Total volume for meter No.1
163	FLOW RATE2	Flow rate for meter No.2
168	TOT VOL 2	Total volume for meter No.2
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

4.9   DATA LOG LIST CONTENTS

The following items are included on the data log. The data log is set to a 1-hour log interval. The default contract hour is 7:00 am.

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
023	DIFF PRES1	2	6	AVERAGE
020	METR PRES1	2	6	AVERAGE
022	FLW TEMP	1	4	AVERAGE
132	FLW TIME 1	1	6	SNAPSHOT & ZERO
131	FLW EXTN 1	2	6	AVERAGE
135	LOG VOL1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	2	6	AVERAGE
021	METR PRES2	1	6	AVERAGE
162	FLW TIME 2	1	6	SNAPSHOT & ZERO
161	FLW EXTN 2	2	6	AVERAGE
165	LOG VOL2	1	6	SNAPSHOT & ZERO

4.10   DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

M PRES1/LO
M PRES1/HI
M PRES2/LO
M PRES2/HI
M TEMP/LO
M TEMP/HI
D PRES1/LO
D PRES1/HI
D PRES2/LO
D PRES2/HI
ORIF DIAM1
PIPE DIAM1
ZFLOW LIM1
TAP LCTN 1
ORIF DIAM2
PIPE DIAM2
ZFLOW LIM2
TAP LCTN 2
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF
TREF PIPE
SPEC GRAV
BTU
CO2
N2
VISCOSITY

Data Log Header Block (Continued)

SPEC HEAT
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

4.11   ALARM DEFINITIONS

The following is a listing of the Alarm definitions for this application. Note that the alarms will show up in the event log.

Number of Retries: 5 for alarms 1 through 9, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
1	$C(19) < X$	LOW BATTER	16.0	10.8	0.0	0
2	$C(20) < X*S(20,F)$ or $C(20) > Y*S(20,F)$	METR PRES1	1000	0.0	1.01	0
3	$C(21) < X*S(21,F)$ or $C(21) > Y*S(21,F)$	METR PRES2	1000	0.0	1.01	0
4	$C(22) < X*S(22,F)$ or $C(22) > Y*S(22,F)$	FLOW TEMP1	150.0	0.0	1.01	0
5	$C(23) < X*S(23,F)$ or $C(23) > Y*S(23,F)$	DIFF PRES1	150.0	0.0	1.01	0
6	$C(24) < X*S(24,F)$ or $C(24) > Y*S(24,F)$	DIFF PRES2	150.0	0.0	1.01	0
7*	$C(25) < X*S(25,F)$ or $C(25) > Y*S(25,F)$	LIVE SG	-	0.0	1.01	0
8*	$C(26) < X*S(26,F)$ or $C(26) > Y*S(26,F)$	LIVE BTU	-	0.0	1.01	0

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
9	C(210) < X or C(210) > Y	STN FLW RT	-	0.0	999999.0	0
10	C(30) <> 0.0	SYS ERROR	-	0.0	0.0	0

* These alarms should be disabled.

EXAMPLE:

Alarm # 2

Y   =   1.01

S(20,F) =   The full-scale value for channel 20, which is the static pressure transmitter. SolarFlow Plus automatically generates this value based on the full-scale value entered while in the SETUP UNIT submenu.

F   =   1000 PSIG

Therefore, the alarm setpoint for alarm #2 is 1.01(1000) = 1010 PSIG.

When the ALARM menu is entered using the HHDT the user may modify the X, Y, or Z values shown in the above alarm conditions by changing the values for LOW, HIGH, and ALT. This enables the user to adjust the alarm limit(s) to match the requirements.

The value for X is represented by LOW on the HHDT ALARM SETUP menu. The value for Y is represented by HIGH on the HHDT ALARM SETUP menu. The value for Z is represented by ALT on the HHDT ALARM SETUP menu.

The ALARM menu is also used to acknowledge alarms and to activate or deactivate alarms.

To acknowledge an alarm condition displayed on the LCD of SolarFlow Plus, enter the ALARM menu of the HHDT and select the ACKNOWLEDGE sub-menu. Any existing unacknowledged alarms are displayed and the HHDT prompts: "ACKNOWLEDGE ? Y/N". Press the ENTER key to acknowledge the alarm. Once this has been done and the user has logged off SolarFlow Plus the activated alarm is displayed with the message "ACKNOWLEDGED" following the alarm condition. If the alarm condition no longer exists and has not been acknowledged it remains on the LCD until acknowledged.

To activate or deactivate alarms, enter the HHDT ALARM menu and select the SETUP sub-menu. The HHDT displays the various alarms that are available in the program. Scroll to the desired alarm and press the ENTER key at the desired alarm condition. The HHDT provides four options; STAT, LOW, HIGH, and ALT. Press ENTER at the STAT option. The HHDT shows either ON or OFF and prompts OK?. To turn off the alarm, press the NO key until OFF is displayed, then press ENTER.

5.0   TRIPLE ORIFICE APPLICATION

Section 5 covers the individual requirements for the triple orifice application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The triple orifice application supports measurement on three meter tubes with a common temperature and meter (static) pressure with MODBUS communications. Optional capabilities such as valve positioning, chromatograph inputs, etc. are listed as part of the setup. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). Channels 1 and 2 are digital inputs which indicate whether an analog input is used for live specific gravity and BTU respectively. To select fixed values, these inputs should be jumpered to ground; for live values, the inputs should be left open. Analog inputs use Channels 19 through 26. Any unused analog input should be jumpered to ground.

When the SolarFlow Plus is configured for a new application, all channels are set to default values, and the Alarm definitions, Log definition, User Report list, and Analog Input channels are set to the values corresponding to the configuration chosen. The event log remains intact, but the data log is emptied.

5.1   FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed.   Make sure that your slide switch settings are set in accordance with the information in paragraph 1.13. No significant changes should be required unless the previously used application has been significantly different.   Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2470 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

The wiring configuration for the triple orifice analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters.

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure (factory installed)	White (Blue*) Green (Black*) Black (Red*)	23 26 25	Signal in + Analog ground 8 to 10 VDC
*	SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.			
		or		
20	EXTERNAL, static pressure (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	EXTERNAL, LIVE SG [1] [2] (to be installed by user)	Blue Black Red Shield	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, temperature (to be installed by user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	INTERNAL, differential pressure (DP) No. 1 (factory installed)	Violet Black Gray	35 38 37	Signal in + Analog ground 8 to 10 VDC
		or		
23	EXTERNAL, differential (DP) No. 1 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	EXTERNAL, DP No.2 (to be installed by user)	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
25	EXTERNAL, DP No.3 (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	EXTERNAL, LIVE BTU (to be installed by user)		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

NOTES:

(1) Since fixed values are normally desired for BTU and SG, digital input channels 1 and 2 are factory-wired to ground. When live values are desired, remove the jumpers between pins 59 and 60, 52 and 61 on the rear termination board. The fixed values for BTU and the specific gravity are entered in the GAS DATA submenu of the SETUP UNIT menu by keying in the desired value. Refer to the System Wiring Diagram.

(2) Wire for connecting the external transmitter inputs is user-supplied.

(3) If only one meter run is used with this application, jumper the unused inputs to analog ground e.g., if channels 24 or 25 are not used, jumper pin No. 39 to 42 and/or pin No. 43 to 46.

5.2 STATUS SIGNAL CONNECTIONS

This application supports status inputs that are activated by a dry contact closure between the status input pin number and common.

5.2.1 INPUTS

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
1	Live or fixed SG	LIVE SG	60 51 (GND)	Open, means use LIVE SG Shorted, means use FIXED SG
2	Live or fixed BTU	LIVE BTU	61 52 (GND)	Open, means use LIVE BTU Shorted, means use FIXED BTU
18	Chromatograph option	CHROM	68 59 (GND)	Open = no chromatograph Shorted, means use chromatograph

Following are valid combinations:

	CH 1	CH 2	CH 18
LIVE SG and BTU	No jumper	No jumper	No jumper
FIXED SG and BTU	Jumper/GND	Jumper/GND	No jumper
Serial Chromatograph	Jumper/GND	Jumper/GND	Jumper/GND

Note that serial chromatograph inputs require that SG and BTU be jumpered to ground as if fixed.

5.2.2 OUTPUTS

NOTE: All output signals from a SolarFlow Plus unit installed in a hazardous location must be isolated by means of intrinsic safety barriers.

This application has two form-A relays (mounted on the SolarFlow Plus PC board) that provide digital outputs for corrected station volume on Channels 5 and 6. The volume per pulse and the pulse period of the relays may be changed using the HHDT. Prompts for changing the relay volume per pulse (VPP 1 and VPP 2) and pulse period (PP 1 and PP 2) are included in the discussion of the CONFIG submenu of the SETUP UNIT menu.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	15 16	Form-A relay Common
6	Volume pulse output 2	VP 2	17 18	Form-A relay Common

TTL level outputs for the following channels are available at the termination board pin numbers shown in the following table.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	78 69	TTL Output Common
6	Volume pulse output 2	VP 2	79 70	TTL Output Common
7	Valve control open	OPEN 2	80 71	TTL Output Common
8	Valve control close	CLOSE 2	81 72	TTL Output Common
11	Valve control open	OPEN 3	82 73	TTL Output Common
12	Valve control close	CLOSE 3	83 74	TTL Output Common
13	Channel Value Monitor Indication	CVM STATUS	84 75	TTL Output Common

5.2.3   ANALOG OUTPUT CONNECTIONS

This application provides two 1-5 VDC analog outputs.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
27	Flow rate output	FLW RT OUT	3 4	Analog Output 1 Ground
28	Valve positioning	VALVE POS	1 2	Analog Output 2 Ground

5.2.4   CHROMATOGRAPH INTER-CONNECTIONS

For more detail in wiring the Model 2251 Chromatograph Controller to the Model 2470, refer to the field wiring diagram in the Model 2470 systems Reference Manual.

MODEL 2251	MODEL 2470	
Signal Type	Pin No.	Signal Type
Serial out Serial in Ground	102 103 106	DI in DI out DI ground

5.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the enhanced triple orifice plate application that can be changed in the SETUP LOCATION menu are shown in the following table described by the HHDT prompt for the parameter, the factory-installed default value, and a blank space for entering the desired value if different from the factory default. Additional information on the SETUP LOCATION menu is provided in paragraph 5.10.1 of the Model 2470 System Reference Manual. For applications using MODBUS communications, refer to paragraph 1.11 in this manual.

HHDT PROMPT	DEFAULT	DESIRED
LOC NAME	BLANK LOCATION	_____
LOC ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE[1]	120	_____
USER REP[2]	****	_____
PCOMM RATE[3]	1200 BPS	_____
RTS DELAY[4]	0 1/100s	_____

NOTES:

(1)   Refer to paragraph 5.10.1.6 in the Model 2470 System Reference Manual for a complete discussion of the SEC CODE prompt.

(2)   Refer to paragraph 5.10.1.7 in the Model 2470 System Reference Manual for a complete discussion of the USER REP prompt.

(3)   Refer to paragraph 5.10.1.8 in the Model 2470 System Reference Manual for a complete discussion of the PCOMM RATE prompt.

(4)   Refer to paragraph 5.10.1.9 in the Model 2470 System Reference Manual for a complete discussion of the RTS DELAY prompt.

5.4   SETUP UNIT MENU

The parameters for the enhanced triple orifice plate application of SolarFlow Plus that can be changed in the submenus of the SETUP UNIT menu using the HHDT are tabulated as follows. The SETUP MENU has eight submenus: GENERAL, ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, AND CALC DATA.   The parameters are tabulated by the HHDT prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

5.4.1   GENERAL SUBMENU

The following parameters can be changed in the GENERAL submenu of the SETUP UNIT menu of the HHDT.

HHDT PROMPT	DEFAULT	DESIRED
UNIT NAME	BLANK UNIT	_____
UNIT ID	BLANK-ID	_____
CONTRCT HR	7 (0-23)	_____
LOG INTRVL	1 HOUR	_____
LOG DEFINE[1]		_____
RESET CMOD[2]	OFF	_____

NOTES: (1)   All data logs in the SolarFlow Plus memory are automatically erased and can no longer be recovered any time a change is made in the LOG DEFINE menu. Refer to paragraph 1.9 for a description of the LOG DEFINE prompt.

(2)   The RESET CMOD (Reset Calculations Module) prompt selects the calculation module for an alternate SolarFlow Plus application. RESET CMOD is discussed in detail in paragraph 5.10.2.1.6 in the Model 2470 SolarFlow Plus System Reference Manual.

5.4.2   ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu provides for toggling between LIVE and FIXED values of the following analogs. The AUX1 key on the HHDT toggles the input between the fixed and live values. A fixed value is shown by an asterisk (*) following the analog value in the display. for additional information, refer to the Model 2470 System Reference Manual.

HHDT PROMPT	DEFAULT
METR PRES	0.0 PSIG
METR TEMP	0.0 DEG F
DIFF PRES1	0.0 InH2O
DIFF PRES2	0.0 InH2O
DIFF PRES3	0.0 InH2O
LIVE SG	0.0000
LIVE BTU	0.0
BATTERY	0.0 VOLTS
FLW RT OUT	0.0 MCFH
VALVE POS	50.0 %

5.4.3   SCALES SUBMENU

The high- and low-scale values for the analogs shown in the following table can be modified in the SCALES submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.3 in the Model 2470 System Reference Manual for additional information about the SCALES submenu.

HHDT PROMPT	DEFAULT		DESIRED
SPAN COMP1	0.00	%	_____
SPAN COMP2	0.00	%	_____
SPAN COMP3	0.00	%	_____
M PRES/LO	0.0	PSIG	_____
M PRES/HI	1000.0	PSIG	_____
M TEMP/LO	0.0	DEG F	_____
M TEMP/HI	150.0	DEG F	_____
D PRES1/LO	0.0	InH2O	_____
D PRES1/HI	150.0	InH2O	_____
D PRES2/LO	0.0	InH2O	_____
D PRES2/HI	150.0	InH2O	_____
D PRES3/LO	0.0	InH2O	_____
D PRES3/HI	150.0	InH2O	_____
LIVE SG/LO	0.50		_____
LIVE SG/HI	1.0		_____
BTU/LO	800.0		_____
BTU/HI	1200.0		_____
FLW RT LOW	0.0	MCFH	_____
FLW RT HI	5000.0	MCFH	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____

5.4.4   DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
OPEN 2	ON
CLOSE 2	OFF
OPEN 3	ON
CLOSE 3	OFF
CVM STATUS	OFF
OUTPUT 14	OFF
OUTPUT 15	OFF

5.4.5   CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.4 in the Model 2470 System Reference Manual for additional information about the CONFIG submenu.

HHDT PROMPT	SAMPLE VALUES		DESIRED
ORIF DIAM1	4.000	IN IN	_____
PIPE DIAM1	8.071	INH2O	_____
ZFLOW LIM1	0.50		_____
TAP LCTN 1	0	IN	_____
ORIF DIAM2	4.000	IN	_____
PIPE DIAM2	8.071	INH2O	_____
ZFLOW LIM2	0.50		_____
TAP LCTN 2	0	IN	_____
ORIF DIAM3	4.000	IN	_____
PIPE DIAM3	8.071	INH2O	_____
ZFLOW LIM3	0.50		_____
TAP LCTN 3	0	PSIA	_____
ATMS PRES	14.73	PSIA	_____
PRES BASE	14.73	DEG F	_____
TEMP BASE	60		_____
AGA8 MTHD	0		_____
SG SELECT	0		_____
ORIF MTRL	1		_____
PIPE MTRL	0	DEG F	_____
TREF ORIF	68.0	DEG F	_____
TREF PIPE	68.0		_____
CHROM ADDR	1		_____
CHROM STRM	1		_____
VERSION	1.0		_____

5.4.6   GAS DATA

This enhanced SolarFlow Plus software can accept information from the Model 2251 Danalyzer Chromatograph Gas Controller. This option requires that a jumper be installed grounding digital Channel 18. Install the jumper between pin 68 and pin 59 on the termination board. In addition, the MODBUS communication address and the chromatograph stream No. desired must be programmed in by the HHDT (CONFIG submenu). The Solarflow Plus will then poll the chromatograph once every four minutes automatically. Refer to paragraph 1.5.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.6000		_____
BTU	1000.0		_____
CO2	0.000	MOL%	_____
N2	0.000	MOL%	_____
VISCOSITY	0.0000092	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.000	MOL%	_____
ETHANE	5.000	MOL%	_____
PROPANE	0.000	MOL%	_____
H2O	0.000	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.000	MOL%	_____
BUTANE	0.000	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.000	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____
ARGON	0.000	MOL%	_____

5.4.7   CONTROL SUBMENU

The CONTROL submenu of the SETUP UNIT menu provides for entering the control values primarily for the valve positioning and tube switching. Refer to paragraphs 1.6 and 1.7 for more information.

HHDT PROMPT	DEFAULT		DESIRED
VPP 1	100.0	MCF	_____
PP 1	1	SEC	_____
VPP 2	100.0	MCF	_____
PP 2	1	SEC	_____
CVM CHAN #	0		_____
CVM LO LMT	0.0		_____
CVM HI LMT	5000.0		_____
TS ENABLE	0		_____
OPEN 2 SP	80.0	InH2O	_____
CLOSE 2 SP	20.0	InH2O	_____
OPEN 3 SP	80.0	InH2O	_____
CLOSE 3 SP	20.0	InH2O	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFH	_____
PRES SETPT	100	PSIG	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
DP LIMIT	0	InH20	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

5.4.8   CALCULATED DATA

The CALC DATA submenu of the SETUP UNIT menu allows the user to determine the calculated values for specified application inputs. The values shown here are typical values and not default values.

HHDT PROMPT	SAMPLE VALUES	
AGA8 MTHD	0	
ZS	0.997811	
ZB	0.997811	
FLOW RATE1	0.0	MCFH
EV 1	1.03164	
CD 1	0.603166	
Y 1	0.999892	
FLW EXTN 1	94.841	
ZF 1	0.927767	
FLOW RATE2	964.4	MCFH
EV 2	1.0000	
CD 2	0.600000	
Y 2	1.000000	
FLW EXTN 2	227.345	
ZF 2	0.947390	
FLOW RATE3	830.3	MCFH
EV 3	1.03164	
CD 3	0.604273	
Y 3	0.998278	
FLW EXTN 3	195.615	
ZF 3	0.92785	
B - AGA8	0.033417	
C - AGA8	0.002236	
D - AGA8	0.266296	
K - AGA8	0.100912	
MOL WT.	16.7444	

5.5   DISPLAY MENU

The DISPLAY Menu of the HHDT provides for viewing the various setup parameters and calculated values in a SolarFlow Plus unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu. The Display menu has eight selections: ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CALC DATA and RATE/VOLS.

5.5.1   ANALOGS

METR PRES
METR TEMP
DIFF PRES1
DIFF PRES2
DIFF PRES3
LIVE SG
LIVE BTU
BATTERY
FLW RT OUT
VALVE POS

5.5.2   SCALES

SPAN COMP1	D PRES3/HI
SPAN COMP2	LIVE SG/LO
SPAN COMP3	LIVE SG/HI
M PRES/LO	BTU/LO
M PRES/HI	BTU/HI
M TEMP/LO	FLW RT LOW
M TEMP/HI	FLW RT HI
D PRES1/LO	VLV POS LO
D PRES1/HI	VLV POS HI
D PRES2/LO	
D PRES2/HI	
D PRES3/LO	

5.5.3   DISCRETES

        LIVE SG
        LIVE BTU
        CHROM
        VP 1
        VP 2
        CVM STATUS
        OPEN 2
        CLOSE 2
        OPEN 3
        CLOSE 3
        INPUT 3
        INPUT 4
        INPUT 9
        INPUT 10
        INPUT 16
        INPUT 17
        OUTPUT 14
        OUTPUT 15

5.5.4   CONFIG

        ORIF DIAM1   SG SELECT
        PIPE DIAM1   ORIF MTRL
        ZFLOW LIM1   PIPE MTRL
        TAP LCTN 1   TREF ORIF
        ORIF DIAM2   TREF PIPE
        PIPE DIAM2   CHROM ADDR
        ZFLOW LIM2   CHROM STRM
        TAP LCTN 2   VERSION
        ORIF DIAM3
        PIPE DIAM3
        ZFLOW LIM3
        TAP LCTN 3
        ATMS PRES
        PRES BASE
        TEMP BASE
        AGA8 MTHD

5.5.5   GAS DATA

SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H20
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

5.5.6   CONTROL

   VPP 1
   PP 1
   VPP 2
   PP 2
   CVM CHAN #
   CVM LO LMT
   CVM HI LMT
   TS ENABLE
   OPEN 2 SP
   CLOSE 2 SP
   OPEN 3 SP
   CLOSE 3 SP
   TS DELAY
   TS VLV TIM
   VP MODE
   FLW SETPNT
   PRES SETPT
   DEADBAND
   SMALL STEP
   LARGE STEP
   FINE CNTRL
   PRES CHAN#
   OVRD PRESS
   DP LIMIT
   PRESET POS
   UPDATE TIM
   VALVE POS

5.5.7   CALC DATA

AGA8 MTHD
ZS
ZB
FLOW RATE1
EV 1
CD 1
Y 1
FLW EXTN 1
ZF 1
FLOW RATE2
EV 2
CD 2
Y 2
FLW EXTN 2
ZF 2
FLOW RATE 3
EV 3
CD 3
Y 3
FLW EXTN 3
ZF 3
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

5.5.8   RATE/VOLS

        FLOW RATE1   (MCFH)
        FLOW RATE1   (MCFD)
        TODAY VOL1
        YSDAY VOL1
        TOT VOL 1
        FLOW RATE2   (MCFH)
        FLOW RATE2   (MCFD)
        TODAY VOL2
        YSDAY VOL2
        TOT VOL 2
        FLOW RATE3   (MCFH)
        FLOW RATE3   (MCFD)
        TODAY VOL3
        YSDAY VOL3
        TOT VOL 3
        STN FLW RT   (MCFH)
        STN FLW RT   (MCFD)
        ST TDY VOL
        ST YSY VOL
        ST TOT VOL
        ERATE 1
        TDY ENRGY1
        YSY ENRGY1
        TOT ENRGY1
        ERATE 2
        TDY ENRGY2
        YSY ENRGY2
        TOT ENRGY2
        ERATE 3
        TDY ENRGY3
        YSY ENRGY3
        TOT ENRGY3
        STN ERATE
        TDY ENERGY
        YSY ENERGY
        TOT ENERGY

5.6 CALIBRATE UNIT MENU

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the outputs of the transmitters for analog inputs to the SolarFlow Plus unit. The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

5.6.1 PRESSURES

The PRESSURES selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

METR PRES
DIFF PRES1
DIFF PRES2
DIFF PRES3

5.6.2 TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the METR TEMP selection.

5.6.3 OTHERS

The analog inputs listed as follows are calibrated in the OTHERS submenu of the CALIBRATE UNIT MENU:

LIVE SG
LIVE BTU

5.7   MONITOR MENU

The MONITOR menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs listed are available in the MONITOR menu in the triple orifice application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

    METR PRES
    METR TEMP
    DIFF PRES1
    DIFF PRES2
    DIFF PRES3
    LIVE SG
    LIVE BTU

5.8 USER REPORT (CHANNEL 0)

Channel zero (0) is a predefined report list containing a report header and the channel data shown in the following table. The SolarFlow Plus unit displays the Users Report on the front panel in a scrolling format.

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
020	METR PRES1	Live pressure meter No.1 in PSIG
022	FLOW TEMP1	Live temperature in degrees Fahrenheit (ºF)
023	DIFF PRES1	Live DP, Run No.1, value in inches of water
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
025	DIFF PRES3	Live DP, Run No.3, value in inches of water
021	LIVE SG	Live value for specific gravity
133	FLOW RATE1	Flow rate for meter No.1
138	TOT VOL 1	Total volume for meter No.1
163	FLOW RATE2	Flow rate for meter No.2
168	TOT VOL 2	Total volume for meter No.2
193	FLOW RATE3	Flow rate for meter No.3
198	TOT VOL 3	Total volume for meter No.3
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

5.9   DATA LOG LIST CONTENTS

The following items are included on the data log. The data log is set to a 1-hour log interval.
The default contract hour is 7:00 am.

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
023	DIFF PRES1	2	6	AVERAGE
020	METR PRES	2	6	AVERAGE
022	FLW TEMP	1	4	AVERAGE
132	FLW TIME 1	1	6	SNAPSHOT & ZERO
131	FLW EXTN 1	2	6	AVERAGE
135	LOG VOL1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	2	6	AVERAGE
162	FLW TIME 2	1	6	SNAPSHOT & ZERO
161	FLW EXTN 2	2	6	AVERAGE
165	LOG VOL2	1	6	SNAPSHOT & ZERO
025	DIFF PRES3	2	6	AVERAGE
192	FLOW TIME 3	1	6	SNAPSHOT & ZERO
191	FLW EXTN 3	2	6	AVERAGE
195	LOG VOL3	1	6	SNAPSHOT & ZERO

5.10   DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

> M PRES/LO
> M PRES/HI
> M TEMP/LO
> M TEMP/HI
> D PRES1/LO
> D PRES1/HI
> D PRES2/LO
> D PRES2/HI
> D PRES3/LO
> D PRES3/HI
> ORIF DIAM1
> PIPE DIAM1
> ZFLOW LIM1
> TAP LCTN 1
> ORIF DIAM2
> PIPE DIAM2
> ZFLOW LIM2
> TAP LCTN 2
> ORIF DIAM3
> PIPE DIAM3
> ZFLOW LIM3
> TAP LCTN 3
> ATMS PRES
> PRES BASE
> TEMP BASE

Data Log Header Block (Continued)

AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF
TREF PIPE
SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
 PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

5.11 ALARM DEFINITIONS

The following is a listing of the Alarm definitions for this application. Note that the alarms will show up in the event log.

Number of Retries: 5 for alarms 1 through 9, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
1	C(19) < X	LOW BATTER	16.0	10.8	0.0	0
2	C(20) < X*S(20,F) or C(20) > Y*S(20,F)	METR PRES1	1000	0.0	1.01	0
3*	C(21) < X*S(21,F) or C(21) > Y*S(21,F)	LIVE SG	1.0	0.0	1.01	0
4	C(22) < X*S(22,F) or C(22) > Y*S(22,F)	FLOW TEMP1	150.0	0.0	1.01	0
5	C(23) < X*S(23,F) or C(23) > Y*S(23,F)	DIFF PRES1	150.0	0.0	1.01	0
6	C(24) < X*S(24,F) or C(24) > Y*S(24,F)	DIFF PRES2	150.0	0.0	1.01	0
7	C(25) < X*S(25,F) or C(25) > Y*S(25,F)	DIFF PRES3	150.0	0.0	1.01	0
8*	C(26) < X*S(26,F) or C(26) > Y*S(26,F)	LIVE BTU	1200	0.0	1.01	0

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
9	C(210) < X or C(210) > Y	STN FLW RT	-	0.0	999999.0	0
10	C(30) <> 0.0	SYS ERROR	-	0.0	0.0	0

* These alarms should be disabled.

EXAMPLE:

Alarm # 2

   Y1   =   1.01

S(20,F)   =   The full-scale value for channel 20, which is the static pressure transmitter. SolarFlow Plus automatically generates this value based on the full-scale value entered while in the SETUP UNIT submenu.

   F   =   1000 PSIG

Therefore, the alarm setpoint for alarm #2 is 1.01(1000) = 1010 PSIG.

When the ALARM menu is entered using the HHDT the user may modify the X, Y, or Z values shown in the above alarm conditions by changing the values for LOW, HIGH, and ALT. This enables the user to adjust the alarm limit(s) to match the requirements.

The value for X is represented by LOW on the HHDT ALARM SETUP menu. The value for Y is represented by HIGH on the HHDT ALARM SETUP menu. The value for Z is represented by ALT on the HHDT ALARM SETUP menu.

The ALARM menu is also used to acknowledge alarms and to activate or deactivate alarms.

To acknowledge an alarm condition displayed on the LCD of SolarFlow Plus, enter the ALARM menu of the HHDT and select the ACKNOWLEDGE sub-menu. Any existing unacknowledged alarms are displayed and the HHDT prompts: "ACKNOWLEDGE ? Y/N". Press the ENTER key to acknowledge the alarm. Once this has been done and the user has logged off SolarFlow Plus the activated alarm is displayed with the message "ACKNOWLEDGED" following the alarm condition. If the alarm condition no longer exists and has not been acknowledged it remains on the LCD until acknowledged.

To activate or deactivate alarms, enter the HHDT ALARM menu and select the SETUP sub-menu. The HHDT displays the various alarms that are available in the program. Scroll to the desired alarm and press the ENTER key at the desired alarm condition. The HHDT provides four options; STAT, LOW, HIGH, and ALT. Press ENTER at the STAT option. The HHDT shows either ON or OFF and prompts OK?. To turn off the alarm, press the NO key until OFF is displayed, then press ENTER.

6.0   DUAL ORIFICE COMMON APPLICATION

Section 6 covers the individual requirements for the dual orifice common application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The dual orifice common application supports measurement on two meter tubes with a common temperature and meter (static) pressure with MODBUS communications. Optional capabilities such as valve positioning, chromatograph inputs, etc. are listed as part of the setup. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). Channels 1 and 2 are digital inputs which indicate whether an analog input is used for live specific gravity and BTU respectively. To select fixed values, these inputs should be jumpered to ground; for live values, the inputs should be left open. Analog inputs use Channels 19 through 26. Any unused analog input should be jumpered to ground.

When the SolarFlow Plus is configured for a new application, all channels are set to default values, and the Alarm definitions, Log definition, User Report list, and Analog Input channels are set to the values corresponding to the configuration chosen. The event log remains intact, but the data log is emptied.

6.1   FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed.   Make sure that your slide switch settings are set in accordance with the information in paragraph 1.13. No significant changes should be required unless the previously used application has been significantly different.   Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2470 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

The wiring configuration for the dual orifice common analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters.

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure (factory installed)	White (Blue*) Green (Black*) Black (Red*)	23 26 25	Signal in + Analog ground 8 to 10 VDC
*	SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.			
		or		
20	EXTERNAL, static pressure (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	EXTERNAL, LIVE SG[1] [2] (to be installed by user)	Blue Black Red Shield	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, temperature (to be installed by user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	INTERNAL, differential pressure (DP) No.1 (factory installed)	Violet Black Gray	35 38 37	Signal in + Analog ground 8 to 10 VDC
		or		
23	EXTERNAL, differential (DP) No. 1 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	EXTERNAL. DP No.2 (to be installed by user)	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
25	EXTERNAL, AUX ANALG6 (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	EXTERNAL, LIVE BTU (to be installed by user)		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

NOTES: (1)   Since fixed values are normally desired for BTU and SG, digital input channels 1 and 2 are factory-wired to ground. When live values are desired, remove the jumpers between pins 59 and 60, 52 and 61 on the rear termination board. The fixed values for BTU and the specific gravity are entered in the GAS DATA submenu of the SETUP UNIT menu by keying in the desired value. Refer to the System Wiring Diagram.

                     (2)   Wire for connecting the external transmitter inputs is user-supplied.

                     (3)   If only one meter run is used with this application, jumper the unused inputs to analog ground e.g., if channels 24 or 25 are not used, jumper pin No. 39 to 42 and/or pin No. 43 to 46.

6.2   STATUS SIGNAL CONNECTIONS

This application supports three status inputs that are activated by a dry contact closure between the status input pin number and common.

6.2.1   INPUTS

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
1	Live or fixed SG	LIVE SG	60 51 (GND)	Open, means use LIVE SG Shorted, means use FIXED SG
2	Live or fixed BTU	LIVE BTU	61 52 (GND)	Open, means use LIVE BTU Shorted, means use FIXED BTU
18	Chromatograph option	CHROM	68 59 (GND)	Open = no chromatograph Shorted, means use chromatograph

Following are valid combinations:

	CH 1	CH 2	CH 18
LIVE SG and BTU	No jumper	No jumper	No jumper
FIXED SG and BTU	Jumper/GND	Jumper/GND	No jumper
Serial Chromatograph	Jumper/GND	Jumper/GND	Jumper/GND

Note that serial chromatograph inputs require that SG and BTU be jumpered to ground as if fixed.

6.2.2   OUTPUTS

NOTE: All output signals from a SolarFlow Plus unit installed in a hazardous location must be isolated by means of intrinsic safety barriers.

This application has two form-A relays (mounted on the SolarFlow Plus PC board) that provide digital outputs for corrected station volume on Channels 5 and 6. The volume per pulse and the pulse period of the relays may be changed using the HHDT. Prompts for changing the relay volume per pulse (VPP 1 and VPP 2) and pulse period (PP 1 and PP 2) are included in the discussion of the CONFIG submenu of the SETUP UNIT menu.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	15 16	Form-A relay Common
6	Volume pulse output 2	VP 2	17 18	Form-A relay Common

TTL level outputs for the following channels are available at the termination board pin numbers shown in the following table.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	78 69	TTL Output Common
6	Volume pulse output 2	VP 2	79 70	TTL Output Common
7	Valve control open	OPEN 2	80 71	TTL Output Common
8	Valve control close	CLOSE 2	81 72	TTL Output Common
13	Channel Value Monitor Indication	CVM STATUS	84 75	TTL Output Common

---

6.2.3   ANALOG OUTPUT CONNECTIONS

This application provides two 1-5 VDC analog outputs.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
27	Flow rate output	FLW RT OUT	3 4	Analog Output 1 Ground
28	Valve positioning	VALVE POS	1 2	Analog Output 2 Ground

6.2.4   CHROMATOGRAPH INTER-CONNECTIONS

For more detail in wiring the Model 2251 Chromatograph Controller to the Model 2470, refer to the field wiring diagram in the Model 2470 systems Reference Manual.

MODEL 2251	MODEL 2470	
Signal Type	Pin No.	Signal Type
Serial out Serial in Ground	102 103 106	DI in DI out DI ground

6.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the enhanced dual orifice common application that can be changed in the SETUP LOCATION menu are shown in the following table described by the HHDT prompt for the parameter, the factory-installed default value, and a blank space for entering the desired value if different from the factory default. Additional information on the SETUP LOCATION menu is provided in paragraph 5.10.1 of the Model 2470 System Reference Manual. For applications using MODBUS communications, refer to paragraph 1.11 in this manual.

HHDT PROMPT	DEFAULT	DESIRED
LOC NAME	BLANK LOCATION	_____
LOC ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE[1]	120	_____
USER REP[2]	****	_____
PCOMM RATE[3]	1200 BPS	_____
RTS DELAY[4]	0 1/100s	_____

NOTES: (1)   Refer to paragraph 5.10.1.6 in the Model 2470 System Reference Manual for a complete discussion of the SEC CODE prompt.

(2)   Refer to paragraph 5.10.1.7 in the Model 2470 System Reference Manual for a complete discussion of the USER REP prompt.

(3)   Refer to paragraph 5.10.1.8 in the Model 2470 System Reference Manual for a complete discussion of the PCOMM RATE prompt.

(4)   Refer to paragraph 5.10.1.9 in the Model 2470 System Reference Manual for a complete discussion of the RTS DELAY prompt.

6.4 SETUP UNIT MENU

The parameters for the enhanced dual orifice common application of SolarFlow Plus that can be changed in the submenus of the SETUP UNIT menu using the HHDT are tabulated as follows. The SETUP MENU has eight submenus: GENERAL, ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, AND CALC DATA. The parameters are tabulated by the HHDT prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

6.4.1 GENERAL SUBMENU

The following parameters can be changed in the GENERAL submenu of the SETUP UNIT menu of the HHDT.

HHDT PROMPT	DEFAULT	DESIRED
UNIT NAME	BLANK UNIT	_____
UNIT ID	BLANK-ID	_____
CONTRCT HR	7 (0-23)	_____
LOG INTRVL	1 HOUR	_____
LOG DEFINE[1]		_____
RESET CMOD[2]	OFF	_____

NOTES: (1)   All data logs in the SolarFlow Plus memory are automatically erased and can no longer be recovered any time a change is made in the LOG DEFINE menu. Refer to paragraph 1.9 for a description of the LOG DEFINE prompt.

(2)   The RESET CMOD (Reset Calculations Module) prompt selects the calculation module for an alternate SolarFlow Plus application. RESET CMOD is discussed in detail in paragraph 5.10.2.1.6 in the Model 2470 SolarFlow Plus System Reference Manual.

6.4.2   ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu provides for toggling between LIVE and FIXED values of the following analog inputs. The AUX1 key on the HHDT toggles the input between the fixed and live values. A fixed value is shown by an asterisk (*) following the analog value in the display. For additional information, refer to the Model 2470 System Reference Manual.

HHDT PROMPT	DEFAULT
METR PRES	0.0 PSIG
METR TEMP	0.0 DEG F
DIFF PRES1	0.0 InH2O
DIFF PRES2	0.0 InH20
AUX ANLG 7	0.0 %
BATTERY	0.0 VOLTS
LIVE SG	0.0000
LIVE BTU	0.0
FLW RT OUT	0.0 MCFH
VALVE POS	50.0 %

6.4.3   SCALES SUBMENU

The high- and low-scale values for the analogs shown in the following table can be modified in the SCALES submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.3 in the Model 2470 System Reference Manual for additional information about the SCALES submenu.

HHDT PROMPT	DEFAULT		DESIRED
SPAN COMP1	0.00	%	_____
SPAN COMP2	0.00	%	_____
M PRES/LO	0.0	PSIG	_____
M PRES/HI	1000.0	PSIG	_____
M TEMP/LO	0.0	DEG F	_____
M TEMP/HI	150.0	DEG F	_____
D PRES1/LO	0.0	InH2O	_____
D PRES1/HI	150.0	InH2O	_____
D PRES2/LO	0.0	InH2O	_____
D PRES2/HI	150.0	InH2O	_____
AUX 7 LOW	0.0	%	_____
AUX 7 HI	100.0	%	_____
LIVE SG/LO	0.50		_____
LIVE SG/HI	1.0		_____
BTU/LO	800.0		_____
BTU/HI	1200.0		_____
FLW RT LOW	0.0	MCFH	_____
FLW RT HI	5000.00	MCFH	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____

6.4.4   DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
OPEN 2	ON
CLOSE 2	OFF
CVM STATUS	OFF
OUTPUT 14	OFF
OUTPUT 15	OFF

6.4.5   CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.4 in the Model 2470 System Reference Manual for additional information about the CONFIG submenu.

HHDT PROMPT	SAMPLE VALUES			DESIRED
ORIF DIAM1	4.000	IN	IN	_____
PIPE DIAM1	8.071	InH2O		_____
ZFLOW LIM1	0.50			_____
TAP LCTN 1	0	IN		_____
ORIF DIAM2	4.000	IN		_____
PIPE DIAM2	8.071	IN		_____
ZFLOW LIM2	0.50			_____
TAP LCTN 2	0	PSIA		_____
ATMS PRES	14.73	PSIA		_____
PRES BASE	14.73	DEG F		_____
TEMP BASE	60			_____
AGA8 MTHD	0			_____
SG SELECT	0			_____
ORIF MTRL	1			_____
PIPE MTRL	0	DEG F		_____
TREF ORIF	68.0	DEG F		_____
TREF PIPE	68.0			_____
CHROM ADDR	1			_____
CHROM STRM	1			_____
VERSION	1.0			_____

6.4.6   GAS DATA

This enhanced SolarFlow Plus software can accept information from the Model 2251 Danalyzer Chromatograph Gas Controller. This option requires that a jumper be installed grounding digital Channel 18. Install the jumper between pin 68 and pin 59 on the termination board. In addition, the MODBUS communication address and the chromatograph stream No. desired must be programmed in by the HHDT (CONFIG SUBMENU). The Solarflow Plus will then poll the chromatograph once every four minutes automatically. Refer to paragraph 1.5.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.6000		_____
BTU	1000.0		_____
CO2	0.000	MOL%	_____
N2	0.000	MOL%	_____
VISCOSITY	0.0000092	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.000	MOL%	_____
ETHANE	5.000	MOL%	_____
PROPANE	0.000	MOL%	_____
H2O	0.000	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.000	MOL%	_____
BUTANE	0.000	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.000	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____
ARGON	0.000	MOL%	_____

6.4.7   CONTROL SUBMENU

The CONTROL submenu of the SETUP UNIT menu provides for entering the control values primarily for the valve positioning and tube switching. Refer to paragraphs 1.6 and 1.7 for more information.

HHDT PROMPT	DEFAULT		DESIRED
VPP 1	100.0	MCF	_____
PP 1	1	SEC	_____
VPP 2	100.0	MCF	_____
PP 2	1	SEC	_____
CVM CHAN #	0		_____
CVM LO LMT	0.0		_____
CVM HI LMT	5000.0		_____
TS ENABLE	0		_____
OPEN 2 SP	80.0	InH2O	_____
CLOSE 2 SP	20.0	InH2O	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFH	_____
PRES SETPT	100	PSIG	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
DP LIMIT	0	InH2O	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

6.4.8   CALCULATED DATA

The CALC DATA submenu of the SETUP UNIT menu allows the user to determine the calculated values for specified application inputs. The values shown here are typical values and not default values.

HHDT PROMPT	SAMPLE VALUES	
AGA8 MTHD	0	
ZS	0.997811	
ZB	0.997811	
FLOW RATE1	1000.8	MCFH
EV 1	1.03164	
CD 1	0.603166	
Y 1	0.999892	
FLW EXTN 1	94.841	
ZF 1	0.927767	
FLOW RATE2	964.4	MCFH
EV 2	1.0000	
CD 2	0.600000	
Y 2	1.000000	
FLW EXTN 2	227.361	
ZF 2	1.000000	
B - AGA8	0.033417	
C - AGA8	0.002236	
D - AGA8	0.266296	
K - AGA8	0.100912	
MOL WT.	16.7444	

6.5   DISPLAY MENU

The DISPLAY Menu of the HHDT provides for viewing the various setup parameters and calculated values in a SolarFlow Plus unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu. The Display menu has eight selections: ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, CALC DATA and RATE/VOLS.

6.5.1   ANALOGS

        METR PRES
        METR TEMP
        DIFF PRES1
        DIFF PRES2
        AUX ANLG 7
        BATTERY
        LIVE SG
        LIVE BTU
        FLW RT OUT
        VALVE POS

6.5.2   SCALES

        SPAN COMP1   BTU/LO
        SPAN COMP2   BTU/HI
        M PRES/LO   FLW RT LOW
        M PRES/HI   FLW RT HI
        M TEMP/LO   VLV POS LO
        M TEMP/HI   VLV POS HI
        D PRES1/LO
        D PRES1/HI
        D PRES2/LO
        D PRES2/HI
        AUX 7 LOW
        AUX 7 HI
        LIVE SG/LO
        LIVE SG/HI

6.5.3   DISCRETES

LIVE SG
LIVE BTU
CHROM
VP 1
VP 2
CVM STATUS
OPEN 2
CLOSE 2
INPUT 3
INPUT 4
INPUT 9
INPUT 10
INPUT 16
INPUT 17
OPEN 3
CLOSE 3
OUTPUT 14
OUTPUT 15

6.5.4   CONFIG

ORIF DIAM1   SG SELECT
PIPE DIAM1   ORIF MTRL
ZFLOW LIM1   PIPE MTRL
TAP LCTN 1   TREF ORIF
ORIF DIAM2   TREF PIPE
PIPE DIAM2   CHROM ADDR
ZFLOW LIM2   CHROM STRM
TAP LCTN 2   VERSION
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD

6.5.5   GAS DATA

SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H20
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

6.5.6   CONTROL

      VPP 1
      PP 1
      VPP 2
      PP 2
      CVM CHAN #
      CVM LO LMT
      CVM HI LMT
      TS ENABLE
      OPEN 2 SP
      CLOSE 2 SP
      TS DELAY
      TS VLV TIM
      VP MODE
      FLW SETPNT
      PRES SETPT
      DEADBAND
      SMALL STEP
      LARGE STEP
      FINE CNTRL
      PRES CHAN#
      OVRD PRESS
      DP LIMIT
      PRESET POS
      UPDATE TIM
      VALVE POS

6.5.7   CALC DATA

AGA8 MTHD
ZS
ZB
FLOW RATE1
EV 1
CD 1
Y 1
FLW EXTN 1
ZF 1
FLOW RATE2
EV 2
CD 2
Y 2
FLW EXTN 2
ZF 2
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

6.5.8   RATE/VOLS

      FLOW RATE1   (MCFH)
      FLOW RATE1   (MCFD)
      TODAY VOL1
      YSDAY VOL1
      TOT VOL 1
      FLOW RATE2   (MCFH)
      FLOW RATE2   (MCFD)
      TODAY VOL2
      YSDAY VOL2
      TOT VOL 2
      STN FLW RT   (MCFH)
      STN FLW RT   (MCFD)
      STN TDY VOL
      STN YSY VOL
      ST TOT VOL
      ERATE 1
      TDY ENRGY1
      YSY ENRGY1
      TOT ENRGY1
      ERATE 2
      TDY ENRGY2
      YSY ENRGY2
      TOT ENRGY2
      STN ERATE
      TDY ENERGY
      YSY ENERGY
      TOT ENERGY

6.6   CALIBRATE UNIT MENU

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the outputs of the transmitters for analog inputs to the SolarFlow Plus unit.   The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

6.6.1   PRESSURES

The PRESSURES selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

        METR PRES
        DIFF PRES1
        DIFF PRES2.

6.6.2   TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the METR TEMP selection.

6.6.3   OTHERS

The analog inputs listed as follows are calibrated in the OTHERS submenu of the CALIBRATE UNIT MENU:

        AUX ANLG 7
        LIVE SG
        LIVE BTU.

6.7 MONITOR MENU

The MONITOR menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs listed are available in the MONITOR menu in the dual orifice common application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

    METR PRES
    METR TEMP
    DIFF PRES1
    DIFF PRES2
    AUX ANLG 7
    LIVE SG
    LIVE BTU

6.8   USER REPORT (CHANNEL 0)

Channel zero (0) is a predefined report list containing a report header and the channel data shown in the following table. The SolarFlow Plus unit displays the Users Report on the front panel in a scrolling format.

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
020	METR PRES1	Live pressure meter No.1 in PSIG
022	FLOW TEMP1	Live temperature in degrees Fahrenheit (°F)
023	DIFF PRES1	Live DP, Run No.1, value in inches of water
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
021	LIVE SG	Live value for specific gravity
133	FLOW RATE1	Flow rate for meter No.1
138	TOT VOL 1	Total volume for meter No.1
163	FLOW RATE2	Flow rate for meter No.2
168	TOT VOL 2	Total volume for meter No.2
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

6.9   DATA LOG LIST CONTENTS

The following items are included on the data log. The data log is set to a 1-hour log interval. The default contract hour is 7:00 am.

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
023	DIFF PRES1	2	6	AVERAGE
020	METR PRES	1	4	AVERAGE
022	FLW TEMP	1	4	AVERAGE
132	FLW TIME 1	1	6	SNAPSHOT & ZERO
131	FLW EXTN 1	2	6	AVERAGE
135	LOG VOL1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	2	6	AVERAGE
162	FLW TIME 2	1	6	SNAPSHOT & ZERO
161	FLW EXTN 2	2	6	AVERAGE
165	LOG VOL2	1	6	SNAPSHOT & ZERO

6.10   DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

M PRES1/LO
M PRES1/HI
M TEMP/LO
M TEMP/HI
D PRES1/LO
D PRES1/HI
D PRES2/LO
D PRES2/HI
ORIF DIAM1
PIPE DIAM1
ZFLOW LIM1
TAP LCTN 1
ORIF DIAM2
PIPE DIAM2
ZFLOW LIM2
TAP LCTN 2
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF
TREF PIPE
SPEC GRAV
BTU
CO2
N2
VISCOSITY

(Continued on the next page)

SPEC HEAT
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

6.11   ALARM DEFINITIONS

The following is a listing of the Alarm definitions for this application. Note that the alarms will show up in the event log.

Number of Retries: 5 for alarms 1 through 9, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
1	C(19) < X	LOW BATTER	16.0	10.8	0.0	0
2	C(20) < X*S(20,F) or C(20) > Y*S(20,F)	METR PRES1	1000	0.0	1.01	0
3*	C(21) < X*S(21,F) or C(21) > Y*S(21,F)	LIVE SG	1.0	0.0	1.01	0
4	C(22) < X*S(22,F) or C(22) > Y*S(22,F)	FLOW TEMP1	150.0	0.0	1.01	0
5	C(23) < X*S(23,F) or C(23) > Y*S(23,F)	DIFF PRES1	150.0	0.0	1.01	0
6	C(24) < X*S(24,F) or C(24) > Y*S(24,F)	DIFF PRES2	150.0	0.0	1.01	0
7*	C(25) < X*S(25,F) or C(25) > Y*S(25,F)	AUX ANALG7	-	0.0	1.01	0
8*	C(26) < X*S(26,F) or C(26) > Y*S(26,F)	LIVE BTU	1200	0.0	1.01	0

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
9	C(210) < X or C(210) > Y	STN FLW RT	-	0.0	999999.0	0
10	C(30) <> 0.0	SYS ERROR	-	0.0	0.0	0

* These alarms should be disabled.

EXAMPLE:

Alarm # 2

Y   = 1.01

S(20,F) = The full-scale value for channel 20, which is the static pressure transmitter. SolarFlow Plus automatically generates this value based on the full-scale value entered while in the SETUP UNIT submenu.

F   = 1000 PSIG

Therefore, the alarm setpoint for alarm #2 is 1.01(1000) = 1010 PSIG.

When the ALARM menu is entered using the HHDT the user may modify the X, Y, or Z values shown in the above alarm conditions by changing the values for LOW, HIGH, and ALT. This enables the user to adjust the alarm limit(s) to match the requirements.

The value for X is represented by LOW on the HHDT ALARM SETUP menu. The value for Y is represented by HIGH on the HHDT ALARM SETUP menu. The value for Z is represented by ALT on the HHDT ALARM SETUP menu.

The ALARM menu is also used to acknowledge alarms and to activate or deactivate alarms.

To acknowledge an alarm condition displayed on the LCD of SolarFlow Plus, enter the ALARM menu of the HHDT and select the ACKNOWLEDGE sub-menu. Any existing unacknowledged alarms are displayed and the HHDT prompts: "ACKNOWLEDGE ? Y/N". Press the ENTER key to acknowledge the alarm. Once this has been done and the user has logged off SolarFlow Plus the activated alarm is displayed with the message "ACKNOWLEDGED" following the alarm condition. If the alarm condition no longer exists and has not been acknowledged it remains on the LCD until acknowledged.

To activate or deactivate alarms, enter the HHDT ALARM menu and select the SETUP sub-menu. The HHDT displays the various alarms that are available in the program. Scroll to the desired alarm and press the ENTER key at the desired alarm condition. The HHDT provides four options; STAT, LOW, HIGH, and ALT. Press ENTER at the STAT option. The HHDT shows either ON or OFF and prompts OK?. To turn off the alarm, press the NO key until OFF is displayed, then press ENTER.

7.0   STACKED SINGLE ORIFICE APPLICATION

Section 7 covers the individual requirements for the enhanced stacked single orifice application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The stacked single orifice application supports measurement on one meter tube with stacked differential pressure transmitters and MODBUS communications. Optional capabilities such as valve positioning, chromatograph inputs, etc. are listed as part of the setup. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). Channels 1 and 2 are digital inputs which indicate whether an analog input is used for live specific gravity and BTU respectively. To select fixed values, these inputs should be jumpered to analog ground; for live values, the inputs should be left open. Analog inputs use Channels 19 through 26. Any unused analog input should be jumpered to analog ground.

When the SolarFlow Plus is configured for a new application, all channels are set to default values, and the Alarm definitions, Log definition, User Report list, and Analog Input channels are set to the values corresponding to the configuration chosen. The event log remains intact, but the data log is emptied.

7.1   FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed.   Make sure that your slide switch settings are set in accordance with the information in paragraph 1.13. No changes should be required unless the previously used application has been significantly different. Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2470 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

The wiring configuration for the stacked single orifice analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters.

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure (factory installed)	White (Blue*) Green (Black*) Black (Red*)	23 26 25	Signal in + Analog ground 8 to 10 VDC
*	SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.			
	or			
20	EXTERNAL, static pressure (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	EXTERNAL, AUX ANLG3 (to be installed by user)	Blue Black Red Shield	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, temperature (to be installed by user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	INTERNAL, differential pressure (low) No.1 (factory installed)	Violet Black Gray	35 38 37	Signal in + Analog ground 8 to 10 VDC
	or			
23	EXTERNAL, differential pressure low (DP) No. 1 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
24	EXTERNAL, DP high No.1 (to be installed by user)	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground
25	EXTERNAL, LIVE SG [1] [2] (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	EXTERNAL, LIVE BTU (to be installed by user)		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

NOTES: (1)   Since fixed values are normally desired for BTU and SG, digital input Channels 1 and 2 are factory-wired to ground. When live values are desired, remove the jumpers between pins 59 and 60, 52 and 61 on the rear termination board. The fixed values for BTU and the specific gravity are entered in the GAS DATA submenu of the SETUP UNIT menu by keying in the desired value. Refer to the System Wiring Diagram.

                 (2)   Wire for connecting the external transmitter inputs is user-supplied.

                 (3)   Jumper any unused analog input to analog ground.

7.2 STATUS SIGNAL CONNECTIONS

This application supports two status inputs that are activated by a dry contact closure between the status input pin number and common.

7.2.1 INPUTS

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
1	Live or fixed SG	LIVE SG	60 51 (GND)	Open, means use LIVE SG Shorted, means use FIXED SG
2	Live or fixed BTU	LIVE BTU	61 52 (GND)	Open, means use LIVE BTU Shorted, means use FIXED BTU
18	Chromatograph option	CHROM	68 59 (GND)	Open = no chromatograph Shorted, means use chromatograph

Following are valid combinations:

	CH 1	CH 2	CH 18
LIVE SG and BTU	No jumper	No jumper	No jumper
FIXED SG and BTU	Jumper/GND	Jumper/GND	No jumper
Serial Chromatograph	Jumper/GND	Jumper/GND	Jumper/GND

Note that serial chromatograph inputs require that SG and BTU be jumpered to ground as if fixed.

7.2.2   OUTPUTS

NOTE: All output signals from a SolarFlow Plus unit installed in a hazardous location must be isolated by means of intrinsic safety barriers.

This application has two form-A relays (mounted on the SolarFlow Plus PC board) that provide digital outputs for corrected station volume on Channels 5 and 6. The volume per pulse and the pulse period of the relays may be changed using the HHDT. Prompts for changing the relay volume per pulse (VPP 1 and VPP 2) and pulse period (PP 1 and PP 2) are included in the discussion of the CONFIG submenu of the SETUP UNIT menu.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	15 16	Form-A relay Common
6	Volume pulse output 2	VP 2	17 18	Form-A relay Common

TTL level outputs for the following channels are available at the termination board pin numbers shown in the following table.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	78 69	TTL Output Common
6	Volume pulse output 2	VP 2	79 70	TTL Output Common
13	Channel Value Monitor Indication	CVM STATUS	84 75	TTL Output Common

---

7.2.3   ANALOG OUTPUT CONNECTIONS

This application provides one 1-5 VDC analog output.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
27	Flow rate output	FLW RT OUT	3 4	Analog output 1 Ground
28	Valve positioning	VALVE POS	1 2	Analog output 2 Ground

7.2.4   CHROMATOGRAPH INTER-CONNECTIONS

For more detail in wiring the Model 2251 Chromatograph Controller to the Model 2470, refer to the field wiring diagram in the Model 2470 systems Reference Manual.

MODEL 2251	MODEL 2470	
Signal Type	Pin No.	Signal Type
Serial out Serial in Ground	102 103 106	DI in DI out DI ground

7.3   SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the enhanced stacked single orifice application that can be changed in the SETUP LOCATION menu are shown in the following table described by the HHDT prompt for the parameter, the factory-installed default value, and a blank space for entering the desired value if different from the factory default. Additional information on the SETUP LOCATION menu is provided in paragraph 5.10.1 of the Model 2470 System Reference Manual. For applications using MODBUS communications, refer to paragraph 1.11 in this manual.

HHDT PROMPT	DEFAULT	DESIRED
LOC NAME	BLANK LOCATION	_____
LOC ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE[1]	120	_____
USER REP[2]	****	_____
PCOMM RATE[3]	1200 BPS	_____
RTS DELAY[4]	0 1/100s	_____

NOTES: (1)   Refer to paragraph 5.10.1.6 in the Model 2470 System Reference Manual for a complete discussion of the SEC CODE prompt.

(2)   Refer to paragraph 5.10.1.7 in the Model 2470 System Reference Manual for a complete discussion of the USER REP prompt.

(3)   Refer to paragraph 5.10.1.8 in the Model 2470 System Reference Manual for a complete discussion of the PCOMM RATE prompt.

(4)   Refer to paragraph 5.10.1.9 in the Model 2470 System Reference Manual for a complete discussion of the RTS DELAY prompt.

7.4   SETUP UNIT MENU

The parameters for the enhanced stacked single orifice application of SolarFlow Plus that can be changed in the submenus of the SETUP UNIT menu using the HHDT are tabulated as follows. The SETUP MENU has eight submenus: GENERAL, ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, AND CALC DATA.   The parameters are tabulated by the HHDT prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

7.4.1   GENERAL SUBMENU

The following parameters can be changed in the GENERAL submenu of the SETUP UNIT menu of the HHDT.

HHDT PROMPT	DEFAULT	DESIRED
UNIT NAME	BLANK UNIT	_____
UNIT ID	BLANK-ID	_____
CONTRCT HR	7 (0-23)	_____
LOG INTRVL	1 HOUR	_____
LOG DEFINE[1]		_____
RESET CMOD[2]	OFF	_____

NOTES: (1)   All data logs in the SolarFlow Plus memory are automatically erased and can no longer be recovered any time a change is made in the LOG DEFINE menu. Refer to paragraph 1.9 for a description of the LOG DEFINE prompt.

(2)   The RESET CMOD (Reset Calculations Module) prompt selects the calculation module for an alternate SolarFlow Plus application. RESET CMOD is discussed in detail in paragraph 5.10.2.1.6 in the Model 2470 SolarFlow Plus System Reference Manual.

2.5

7.4.2   ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu of the enhanced stacked single orifice application provides for toggling between LIVE and FIXED values of the following analog inputs. The AUX1 key on the HHDT toggles the input between the fixed and live values. A fixed value is shown by an asterisk (*) following the analog value in the HHDT display. For additional information, refer to the Model 2470 System Reference Manual.

HHDT PROMPT	DEFAULT
METR PRES	0.0 PSIG
METR TEMP	0.0 DEG F
DIFF PRESL	0.0 InH2O
DIFF PRESH	0.0 InH20
LIVE SG	0.0000
BATTERY	0.0 VOLTS
AUX ANLG 3	0.0 %
LIVE BTU	0.0
FLW RT OUT	0.0 MCFH
VALVE POS	50.0 %

7.4.3   SCALES SUBMENU

The high- and low-scale setpoints for the analog inputs shown in the following table can be modified in the SCALES submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.3 in the Model 2470 System Reference Manual for additional information about the SCALES submenu.

HHDT PROMPT	DEFAULT		DESIRED
SPAN COMPL	0.00	%	_____
SPAN COMP1	0.00	%	_____
M PRES/LO	0.0	PSIG	_____
M PRES/HI	1000.0	PSIG	_____
M TEMP/LO	0.0	DEG F	_____
M TEMP/HI	150.0	DEG F	_____
D PRESL/LO	0.0	InH2O	_____
D PRESL/HI	30.0	InH2O	_____
D PRESH/LO	0.0	InH2O	_____
D PRESH/HI	150.0	InH2O	_____
LIVE SG/LO	0.50		_____
LIVE SG/HI	1.0		_____
BTU/LO	800.0		_____
BTU/HI	1200.0		_____
FLW RT LOW	0.0	MCFH	_____
FLW RT HI	5000.0	MCFH	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____
AUX 3 LOW	0.0	%	_____
AUX 3 HI	100.0	%	_____

7.4.4   DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
CVM STATUS	OFF
OUTPUT 14	OFF
OUTPUT 15	OFF

7.4.5   CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.4 in the Model 2470 System Reference Manual for additional information about the CONFIG submenu.

HHDT PROMPT	SAMPLE VALUES		DESIRED
ORIF DIAM1	4.000	IN IN	_____
PIPE DIAM1	8.071	InH2O	_____
ZFLOW LIM1	0.50		_____
TAP LCTN 1	0	PSIA	_____
ATMS PRES	14.73	PSIA	_____
PRES BASE	14.73	DEG F	_____
TEMP BASE	60		_____
AGA8 MTHD	0		_____
SG SELECT	0		_____
ORIF MTRL	1		_____
PIPE MTRL	0	DEG F	_____
TREF ORIF	68.0	DEG F	_____
TREF PIPE	68.0		_____
CHROM ADDR	1		_____
CHROM STRM	1		_____
VERSION	1.0		_____

7.4.6   GAS DATA

This enhanced SolarFlow Plus software can accept information from the Model 2251 Danalyzer Chromatograph Gas Controller. This option requires that a jumper be installed grounding digital Channel 18. Install the jumper between pin 68 and pin 59 on the termination board. In addition, the MODBUS communication address and the chromatograph stream No. desired must be programmed in by the HHDT (CONFIG SUBMENU). The Solarflow Plus will then poll the chromatograph once every four minutes automatically. Refer to paragraph 1.5.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.6000		_____
BTU	1000.0		_____
CO2	0.000	MOL%	_____
N2	0.000	MOL%	_____
VISCOSITY	0.0000092	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.000	MOL%	_____
ETHANE	5.000	MOL%	_____
PROPANE	0.000	MOL%	_____
H2O	0.000	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.000	MOL%	_____
BUTANE	0.000	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.000	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____
ARGON	0.000	MOL%	_____

7.4.7   CONTROL SUBMENU

The CONTROL submenu of the SETUP UNIT menu provides for entering the control values primarily for the valve positioning and tube switching. Refer to paragraphs 1.6 and 1.7 for more information.

HHDT PROMPT	DEFAULT		DESIRED
VPP 1	100.0	MCF	_____
PP 1	1	SEC	_____
VPP 2	100.0	MCF	_____
PP 2	1	SEC	_____
CVM CHAN #	0		_____
CVM LO LMT	0.0		_____
CVM HI LMT	5000.0		_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFH	_____
PRES SETPT	100	PSIG	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRES	0	PSIG	_____
DP LIMIT	0	InH2O	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

7.4.8   CALCULATED DATA

The CALC DATA submenu of the SETUP UNIT menu allows the user to determine the calculated values for specified application inputs. The values shown here are typical values and not default values.

HHDT PROMPT	SAMPLE VALUES
FLOW RATE1	1000.0 MCFH
EV 1	1.03164
CD 1	0.603166
Y 1	0.999892
FLW EXTN 1	94.841
AGA8 MTHD	0
ZS	0.997811
ZB	0.997811
ZF 1	0.927767
B - AGA8	0.033417
C - AGA8	0.002236
D - AGA8	0.266296
K - AGA8	0.100912
MOL WT.	16.7444

7.5   DISPLAY MENU

DISPLAY Menu of the HHDT provides for viewing the various setup parameters and calculated values in a SolarFlow Plus unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu. The Display menu has eight selections: ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, CALC DATA and RATE/VOLS.

7.5.1   ANALOGS

METR PRES
METR TEMP
DIFF PRESL
DIFF PRESH
LIVE SG
BATTERY
AUX ANLG 3
LIVE BTU
FLW RT OUT
VALVE POS

7.5.2   SCALES

SPAN COMPL	LIVE SG/LO
SPAN COMP1	LIVE SG/HI
M PRES/LO	BTU/LO
M PRES/HI	BTU/HI
M TEMP/LO	FLW RT LOW
M TEMP/HI	FLW RT HI
D PRESL/LO	VLV POS LO
D PRESL/HI	VLV POS HI
D PRESH/LO	AUX 3 LOW
D PRESH/HI	AUX 3 HI

7.5.3   DISCRETES

      LIVE SG
      LIVE BTU
      CHROM
      VP 1
      VP 2
      INPUT 3
      INPUT 4
      INPUT 9
      INPUT 10
      INPUT 16
      INPUT 17

7.5.4   CONFIG

      ORIF DIAM1
      PIPE DIAM1
      ZFLOW LIM1
      TAP LCTN 1
      ATMS PRES
      PRES BASE
      TEMP BASE
      AGA8 MTHD
      SG SELECT
      ORIF MTRL
      PIPE MTRL
      TREF ORIF
      TREF PIPE
      CHROM ADDR
      CHROM STRM
      VERSION

7.5.5   GAS DATA

SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H20
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

7.5.6   CONTROL

    VPP 1
    PP 1
    VPP 2
    PP 2
    CVM CHAN #
    CVM LO LMT
    CVM HI LMT
    VP MODE
    FLW SETPNT
    PRES SETPT
    DEADBAND
    SMALL STEP
    LARGE STEP
    FINE CNTRL
    PRES CHAN#
    OVRD PRESS
    DP LIMIT
    PRESET POS
    UPDATE TIM
    VALVE POS

7.5.7   CALC DATA

    FLOW RATE1
    EV 1
    CD 1
    Y 1
    FLW EXTN 1
    AGA8 MTHD
    ZS
    ZB
    ZF 1
    B - AGA8
    C - AGA8
    D - AGA8
    K - AGA8
    MOL WT.

7.5.8   RATE/VOLS

    FLOW RATE1   (MCFH)
    FLOW RATE1   (MCFD)
    TODAY VOL1
    YSDAY VOL1
    TOT VOL 1
    ERATE 1
    TDY ENRGY1
    YSY ENRGY1
    TOT ENRGY1

7.6   CALIBRATE UNIT MENU

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the outputs of the transmitters for analog inputs to the SolarFlow Plus unit. The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

7.6.1   PRESSURES

The PRESSURES selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

    METR PRES
    DIFF PRESL
    DIFF PRESH

7.6.2   TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the METR TEMP selection.

7.6.3   OTHERS

The analog inputs listed as follows are calibrated in the OTHERS submenu of the CALIBRATE UNIT MENU:

    LIVE SG
    LIVE BTU
    AUX ANLG 3

7.7   MONITOR MENU

The MONITOR menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs listed are available in the MONITOR menu in the stacked single orifice application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

> METR PRES
> METR TEMP
> DIFF PRESL
> DIFF PRESH
> LIVE SG
> LIVE BTU
> AUX ANLG 3

7.8   USER REPORT (CHANNEL 0)

Channel zero (0) is a predefined report list containing a report header and the channel data shown in the following table. The SolarFlow Plus unit displays the Users Report on the front panel in a scrolling format.

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
020	METR PRES1	Live pressure meter No.1 in PSIG
032	COMP DPRES	Composite DP, Run No.1, value in inches of water
022	FLOW TEMP1	Live temperature in degrees Fahrenheit (^{o}F)
025	LIVE SG	Live value for specific gravity
133	FLOW RATE1	Flow rate for meter No.1
138	TOT VOL 1	Total volume for meter No.1
136	TODAY VOL1	Today's volume in MCF
137	YSDAY VOL1	Yesterday's volume in MCF

7.9   DATA LOG LIST CONTENTS

The following items are included on the data log. The data log is set to a 1-hour log interval.
The default contract hour is 7:00 am.

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
032	COMP DPRES	2	6	AVERAGE
020	METR PRES	1	6	AVERAGE
022	FLW TEMP	1	4	AVERAGE
132	FLW TIME	1	6	SNAPSHOT & ZERO
131	FLW EXTN	2	6	AVERAGE
135	LOG VOL	1	6	SNAPSHOT & ZERO

7.10   DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

> M PRES/LO
> M PRES/HI
> M TEMP/LO
> M TEMP/HI
> D PRESL/LO
> D PRESL/HI
> D PRESH/LO
> D PRESH/HI
> ORIF DIAM1
> PIPE DIAM1
> ZFLOW LIM1
> TAP LCTN 1
> ATMS PRES
> PRES BASE
> TEMP BASE

(Continued on the next page)

Data Log Header Block (Continued)

AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF
TREF PIPE
SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

7.11   ALARM DEFINITIONS

The following is a listing of the Alarm definitions for this application. Note that the alarms will show up in the event log.

Number of Retries: 5 for alarms 1 through 9, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
1	C(19) < X	LOW BATTER	16.0	10.8	0.0	0
2	C(20) < X*S(20,F) or C(20) > Y*S(20,F)	METR PRES	1000	0.0	1.01	0
3*	C(21) < X*S(21,F) or C(21) > Y*S(21,F)	LIVE SG	1000	0.0	1.01	0
4	C(22) < X*S(22,F) or C(22) > Y*S(22,F)	FLOW TEMP	150.0	0.0	1.01	0
5*	C(23) < X*S(23,F) or C(23) > Y*S(23,F)	DIFF PRES1	30.0	0.0	1.01	0
6	C(24) < X*S(24,F) or C(24) > Y*S(24,F)	DIFF PRES1	150.0	0.0	1.01	0
7*	C(25) < X*S(25,F) or C(25) > Y*S(25,F)	LIVE SG	1.0	0.0	1.01	0
8*	C(26) < X*S(26,F) or C(26) > Y*S(26,F)	LIVE BTU	1200	0.0	1.01	0

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
9	C(210) < X or C(210) > Y	STN FLW RT	-	0.0	999999.0	0
10	C(30) <> 0.0	SYS ERROR	-	0.0	0.0	0

* This alarm should be disabled.

EXAMPLE:

Alarm # 2

Y   =   1.01

S(20,F)   =   The full-scale value for channel 20, which is the static pressure transmitter. SolarFlow Plus automatically generates this value based on the full-scale value entered while in the SETUP UNIT submenu.

F   =   1000 PSIG

Therefore, the alarm setpoint for alarm #2 is 1.01(1000) = 1010 PSIG.

When the ALARM menu is entered using the HHDT the user may modify the X, Y, or Z values shown in the above alarm conditions by changing the values for LOW, HIGH, and ALT. This enables the user to adjust the alarm limit(s) to match the requirements.

The value for X is represented by LOW on the HHDT ALARM SETUP menu. The value for Y is represented by HIGH on the HHDT ALARM SETUP menu. The value for Z is represented by ALT on the HHDT ALARM SETUP menu.

The ALARM menu is also used to acknowledge alarms and to activate or deactivate alarms.

To acknowledge an alarm condition displayed on the LCD of SolarFlow Plus, enter the ALARM menu of the HHDT and select the ACKNOWLEDGE sub-menu. Any existing unacknowledged alarms are displayed and the HHDT prompts: "ACKNOWLEDGE ? Y/N". Press the ENTER key to acknowledge the alarm. Once this has been done and the user has logged off SolarFlow Plus the activated alarm is displayed with the message "ACKNOWLEDGED" following the alarm condition. If the alarm condition no longer exists and has not been acknowledged it remains on the LCD until acknowledged.

To activate or deactivate alarms, enter the HHDT ALARM menu and select the SETUP sub-menu. The HHDT displays the various alarms that are available in the program. Scroll to the desired alarm and press the ENTER key at the desired alarm condition. The HHDT provides four options; STAT, LOW, HIGH, and ALT. Press ENTER at the STAT option. The HHDT shows either ON or OFF and prompts OK?. To turn off the alarm, press the NO key until OFF is displayed, then press ENTER.

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8.0   STACKED DUAL ORIFICE APPLICATION

Section 8 covers the individual requirements for the enhanced stacked dual orifice application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The stacked dual orifice application supports measurement on two meter tubes with stacked differential pressure transmitters on the primary meter. MODBUS communications are available with this application. Optional capabilities such as valve positioning, chromatograph inputs, etc. are listed as part of the setup. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). Channels 1 and 2 are digital inputs which indicate whether an analog input is used for live specific gravity and BTU respectively. To select fixed values, these inputs should be jumpered to ground; for live values, the inputs should be left open. Analog inputs use Channels 19 through 26. Any unused analog input should be jumpered to ground.

When the SolarFlow Plus is configured for a new application, all channels are set to default values, and the Alarm definitions, Log definition, User Report list, and Analog Input channels are set to the values corresponding to the configuration chosen. The event log remains intact, but the data log is emptied.

8.1   FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed.   Make sure that your slide switch settings are set in accordance with the information in paragraph 1.13.   No changes should be required unless the previously used application has been significantly different.   Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2470 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

The wiring configuration for the stacked dual orifice analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters.

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure (factory installed)	White (Blue*) Green (Black*) Black (Red*)	23 26 25	Signal in + Analog ground 8 to 10 VDC
*	SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.			
		or		
20	EXTERNAL, static pressure (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	EXTERNAL, LIVE SG [1][2] (to be installed by user)	Blue Black Red Shield	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, temperature (to be installed by user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	INTERNAL, differential pressure low (DP) No. 1 (factory installed)	Violet Black Gray	35 38 37	Signal in + Analog ground 8 to 10 VDC
		or		
23	EXTERNAL, differential pressure low (DP) No. 1 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	EXTERNAL, DP high No.1 (to be installed by user)	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
25	EXTERNAL, DIFF PRES2 (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	EXTERNAL, LIVE BTU (to be installed by user)		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

NOTES:

(1) Since fixed values are normally desired for BTU and SG, digital input channels 1 and 2 are factory-wired to ground. When live values are desired, remove the jumpers between pins 59 and 60, 52 and 61 on the rear termination board. The fixed values for BTU and the specific gravity are entered in the GAS DATA submenu of the SETUP UNIT menu by keying in the desired value. Refer to the System Wiring Diagram.

(2) Wire for connecting the external transmitter inputs is user-supplied.

(3) Jumper any unused analog input to analog ground.

8.2 STATUS SIGNAL CONNECTIONS

This application supports two status inputs that are activated by a dry contact closure between the status input pin number and common.

8.2.1 INPUTS

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
1	Live or fixed SG	LIVE SG	60 51 (GND)	Open, means use LIVE SG Shorted, means use FIXED SG
2	Live or fixed BTU	LIVE BTU	61 52 (GND)	Open, means use LIVE BTU Shorted, means use FIXED BTU
18	Chromatograph option	CHROM	68 59 (GND)	Open = no chromatograph Shorted, means use chromatograph

Following are valid combinations:

	CH 1	CH 2	CH 18
LIVE SG and BTU	No jumper	No jumper	No jumper
FIXED SG and BTU	Jumper/GND	Jumper/GND	No jumper
Serial Chromatograph	Jumper/GND	Jumper/GND	Jumper/GND

Note that serial chromatograph inputs require that SG and BTU be jumpered to ground as if fixed.

8.2.2   OUTPUTS

NOTE: All output signals from a SolarFlow Plus unit installed in a hazardous location must be isolated by means of intrinsic safety barriers.

This application has two form-A relays (mounted on the SolarFlow Plus PC board) that provide digital outputs for corrected station volume on Channels 5 and 6. The volume per pulse and the pulse period of the relays may be changed using the HHDT. Prompts for changing the relay volume per pulse (VPP 1 and VPP 2) and pulse period (PP 1 and PP 2) are included in the discussion of the CONFIG submenu of the SETUP UNIT menu.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	15 16	Form-A relay Common
6	Volume pulse output 2	VP 2	17 18	Form-A relay Common

TTL level outputs for the following channels are available at the termination board pin numbers shown in the following table.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	78 69	TTL Output Common
6	Volume pulse output 2	VP 2	79 70	TTL Output Common
7	Valve control open	OPEN 2	80 71	TTL Output Common
8	Valve control close	CLOSE 2	81 72	TTL Output Common
13	Channel Value Monitor Indication	CVM STATUS	84 75	TTL Output Common

---

8.2.3   ANALOG OUTPUT CONNECTIONS

This application provides one 1-5 VDC analog output.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
27	Flow rate output	FLW RT OUT	3 4	Analog output 1 Ground
28	Valve positioning	VALVE POS	1 2	Analog output 2 Ground

8.2.4   CHROMATOGRAPH INTER-CONNECTIONS

For more detail in wiring the Model 2251 Chromatograph Controller to the Model 2470, refer to the field wiring diagram in the Model 2470 systems Reference Manual.

MODEL 2251	MODEL 2470	
Signal Type	Pin No.	Signal Type
Serial out Serial in Ground	102 103 106	DI in DI out DI ground

8.3   SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the enhanced stacked dual orifice application that can be changed in the SETUP LOCATION menu are shown in the following table described by the HHDT prompt for the parameter, the factory-installed default value, and a blank space for entering the desired value if different from the factory default. Additional information on the SETUP LOCATION menu is provided in paragraph 5.10.1 of the Model 2470 System Reference Manual. For applications using MODBUS communications, refer to paragraph 1.11 in this manual.

HHDT PROMPT	DEFAULT	DESIRED
LOC NAME	BLANK LOCATION	_____
LOC ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE[1]	120	_____
USER REP[2]	****	_____
PCOMM RATE[3]	1200 BPS	_____
RTS DELAY[4]	0 1/100s	_____

NOTES: (1)   Refer to paragraph 5.10.1.6 in the Model 2470 System Reference Manual for a complete discussion of the SEC CODE prompt.

(2)   Refer to paragraph 5.10.1.7 in the Model 2470 System Reference Manual for a complete discussion of the USER REP prompt.

(3)   Refer to paragraph 5.10.1.8 in the Model 2470 System Reference Manual for a complete discussion of the PCOMM RATE prompt.

(4)   Refer to paragraph 5.10.1.9 in the Model 2470 System Reference Manual for a complete discussion of the RTS DELAY prompt.

8.4   SETUP UNIT MENU

The parameters for the enhanced stacked dual orifice application of SolarFlow Plus that can be changed in the submenus of the SETUP UNIT menu using the HHDT are tabulated as follows. The SETUP MENU has eight submenus: GENERAL, ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, AND CALC DATA.   The parameters are tabulated by the HHDT prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

8.4.1   GENERAL SUBMENU

The following parameters can be changed in the GENERAL submenu of the SETUP UNIT menu of the HHDT.

HHDT PROMPT	DEFAULT	DESIRED
UNIT NAME	BLANK UNIT	_____
UNIT ID	BLANK-ID	_____
CONTRCT HR	7 (0-23)	_____
LOG INTRVL	1 HOUR	_____
LOG DEFINE[1]		_____
RESET CMOD[2]	OFF	_____

NOTES: (1)   All data logs in the SolarFlow Plus memory are automatically erased and can no longer be recovered any time a change is made in the LOG DEFINE menu. Refer to paragraph 1.9 for a description of the LOG DEFINE prompt.

(2)   The RESET CMOD (Reset Calculations Module) prompt selects the calculation module for an alternate SolarFlow Plus application. RESET CMOD is discussed in detail in paragraph 5.10.2.1.6 in the Model 2470 SolarFlow Plus System Reference Manual.

8.4.2   ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu of the enhanced stacked dual orifice application provides for toggling between LIVE and FIXED values of the following analog inputs. The AUX1 key on the HHDT toggles the input between the fixed and live values. A fixed value is shown by an asterisk (*) following the analog value in the HHDT display. For additional information, refer to the Model 2470 System Reference Manual.

HHDT PROMPT	DEFAULT
METR PRES	0.0 PSIG
METR TEMP	0.0 DEG F
DIFF PRESL	0.0 InH2O
DIFF PRESH	0.0 InH2O
DIFF PRES2	0.0 InH2O
LIVE SG	0.0000
BATTERY	0.0 VOLTS
LIVE BTU	0.0
FLW RT OUT	0.0 MCFH
VALVE POS	50.0 %

8.4.3   SCALES SUBMENU

The high- and low-scale setpoints for the analog inputs shown in the following table can be modified in the SCALES submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.3 in the Model 2470 System Reference Manual for additional information about the SCALES submenu.

HHDT PROMPT	DEFAULT		DESIRED
SPAN COMPL	0.00	%	_____
SPAN COMP1	0.00	%	_____
SPAN COMP2	0.00	%	_____
M PRES/LO	0.0	PSIG	_____
M PRES/HI	1000.0	PSIG	_____
M TEMP/LO	0.0	DEG F	_____
M TEMP/HI	150.0	DEG F	_____
D PRESL/LO	0.0	InH2O	_____
D PRESL/HI	30.0	InH2O	_____
D PRESH/LO	0.0	InH2O	_____
D PRESH/HI	150.0	InH2O	_____
D PRES2/LO	0.0	InH2O	_____
D PRES2/HI	150.0	InH2O	_____
LIVE SG/LO	0.50		_____
LIVE SG/HI	1.0		_____
BTU/LO	800.0		_____
BTU/HI	1200.0		_____
FLW RT LOW	0.0	MCFH	_____
FLW RT HI	5000.0	MCFH	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____

8.4.4   DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
OPEN 2	ON
CLOSE 2	OFF
CVM STATUS	OFF
OUTPUT 14	OFF
OUTPUT 15	OFF

8.4.5   CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.4 in the Model 2470 System Reference Manual for additional information about the CONFIG submenu.

HHDT PROMPT	SAMPLE VALUES			DESIRED
ORIF DIAM1	4.000	IN	IN	_____
PIPE DIAM1	8.071	InH2O		_____
ZFLOW LIM1	0.50			_____
TAP LCTN 1	0	IN		_____
ORIF DIAM2	4.000	IN		_____
PIPE DIAM2	8.071	InH2O		_____
ZFLOW LIM2	0.50			_____
TAP LCTH 2	0	PSIA		_____
ATMS PRES	14.73	PSIA		_____
PRES BASE	14.73	DEG F		_____
TEMP BASE	60			_____
AGA8 MTHD	0			_____
SG SELECT	0			_____
ORIF MTRL	1			_____
PIPE MTRL	0	DEG F		_____
TREF ORIF	68.0	DEG F		_____
TREF PIPE	68.0			_____
CHROM ADDR	1			_____
CHROM STRM	1			_____
VERSION	1.0			_____

8.4.6   GAS DATA

This enhanced SolarFlow Plus software can accept information from the Model 2251 Danalyzer Chromatograph Gas Controller. This option requires that a jumper be installed grounding digital Channel 18. Install the jumper between pin 68 and pin 59 on the termination board. In addition, the MODBUS communication address and the chromatograph stream No. desired must be programmed in by the HHDT (CONFIG submenu). The Solarflow Plus will then poll the chromatograph once every four minutes automatically. Refer to paragraph 1.5.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.6000		_____
BTU	1000.0		_____
CO2	0.000	MOL%	_____
N2	0.000	MOL%	_____
VISCOSITY	0.0000069	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.000	MOL%	_____
ETHANE	5.000	MOL%	_____
PROPANE	0.000	MOL%	_____
H2O	0.000	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.000	MOL%	_____
BUTANE	0.000	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.000	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____
ARGON	0.000	MOL%	_____

8.4.7   CONTROL SUBMENU

The CONTROL submenu of the SETUP UNIT menu provides for entering the control values primarily for the valve positioning and tube switching. Refer to paragraphs 1.6 and 1.7 for more information.

HHDT PROMPT	DEFAULT		DESIRED
VPP 1	100.0	MCF	_____
PP 1	1	SEC	_____
VPP 2	100.0	MCF	_____
PP 2	1	SEC	_____
CVM CHAN #	0		_____
CVM LO LMT	0.0		_____
CVM HI LMT	5000.0		_____
TS ENABLE	0		_____
OPEN 2 SP	80.0	InH20	_____
CLOSE 2 SP	20.0	InH20	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFH	_____
PRES SETPT	100	PSIG	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
DP LIMIT	0	InH2O	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

8.4.8   CALCULATED DATA

The CALC DATA submenu of the SETUP UNIT menu allows the user to determine the calculated values for specified application inputs. The values shown here are typical values and not default values.

HHDT PROMPT	SAMPLE VALUES	
AGA8 MTHD	0	
ZS	0.997811	
ZB	0.997811	
FLOW RATE1	727.9	MCFH
EV 1	1.03164	
CD 1	0.603166	
Y 1	0.999892	
FLW EXTN 1	94.841	
ZF 1	0.927767	
FLOW RATE2	552.0	MCFH
EV 2	0.031590	
CD 2	0.600000	
Y 2	0.998869	
FLW EXTN 2	241.502	
ZF 2	0.863807	
B - AGA8	0.033417	
C - AGA8	0.002236	
D - AGA8	0.266296	
K - AGA8	0.100912	
MOL WT.	16.7444	

8.5   DISPLAY MENU

The DISPLAY Menu of the HHDT provides for viewing the various setup parameters and calculated values in a SolarFlow Plus unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu. The Display menu has eight selections: ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, CALC DATA and RATE/VOLS.

8.5.1   ANALOGS

METR PRES
METR TEMP
DIFF PRESL
DIFF PRESH
DIFF PRES2
LIVE SG
BATTERY
LIVE BTU
FLW RT OUT
VALVE POS

8.5.2   SCALES

SPAN COMPL	D PRES2/HI
SPAN COMP1	LIVE SG/LO
SPAN COMP2	LIVE SG/HI
M PRES/LO	BTU/LO
M PRES/HI	BTU/HI
M TEMP/LO	FLW RT LOW
M TEMP/HI	FLW RT HI
D PRESL/LO	VLV POS LO
D PRESL/HI	VLV POS HI
D PRESH/LO	
D PRESH/HI	
D PRES2/LO	

8.5.3 DISCRETES

LIVE SG	OPEN 3
LIVE BTU	CLOSE 3
CHROM	OUTPUT 14
VP 1	OUTPUT 15
VP 2	
CVM STATUS	
OPEN 2	
CLOSE 2	
INPUT 3	
INPUT 4	
INPUT 9	
INPUT 10	
INPUT 16	
INPUT 17	

8.5.4 CONFIG

ORIF DIAM1	SG SELECT
PIPE DIAM1	ORIF MTRL
ZFLOW LIM1	PIPE MTRL
TAP LCTN 1	TREF ORIF
ORIF DIAM2	TREF PIPE
PIPE DIAM2	CHROM ADDR
ZFLOW LIM2	CHROM STRM
TAP LCTN 2	VERSION
ATMS PRES	
PRES BASE	
TEMP BASE	
AGA8 MTHD	

8.5.5   GAS DATA

SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H20
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

8.5.6   CONTROL

      VPP 1
      PP 1
      VPP 2
      PP 2
      CVM CHAN #
      CVM LO LMT
      CVM HI LMT
      TS ENABLE
      OPEN 2 SP
      CLOSE 2 SP
      TS DELAY
      TS VLV TIM
      VP MODE
      FLW SETPNT
      PRES SETPT
      DEADBAND
      SMALL STEP
      LARGE STEP
      FINE CNTRL
      PRES CHAN#
      OVRD PRESS
      DP LIMIT
      PRESET POS
      UPDATE TIM
      VALVE POS

8.5.7   CALC DATA

     AGA8 MTHD
     ZS
     ZB
     FLOW RATE1
     EV 1
     CD 1
     Y 1
     FLW EXTN 1
     ZF 1
     FLOW RATE2
     EV 2
     CD 2
     Y 2
     FLW EXTN 2
     ZF 2
     B - AGA8
     C - AGA8
     D - AGA8
     K - AGA8
     MOL WT.

8.5.8   RATE/VOLS

FLOW RATE1   (MCFH)
FLOW RATE1   (MCFD)
TODAY VOL1
YSDAY VOL1
TOT VOL 1
FLOW RATE2   (MCFH)
FLOW RATE2   (MCFD)
TODAY VOL2
YSDAY VOL2
TOT VOL 2
STN FLW RT   (MCFH)
STN FLW RT   (MCFD)
STN TDY VOL
STN YSY VOL
ST TOT VOL
ERATE 1
TDY ENRGY1
YSY ENRGY1
TOT ENRGY1
ERATE 2
TDY ENRGY2
YSY ENRGY2
TOT ENRGY2
STN ERATE
TDY ENERGY
YSY ENERGY
TOT ENERGY

8.6 CALIBRATE UNIT MENU

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the outputs of the transmitters for analog inputs to the SolarFlow Plus unit. The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

8.6.1 PRESSURES

The PRESSURES selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

    METR PRES
    DIFF PRESL
    DIFF PRESH
    DIFF PRES2

8.6.2 TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the METR TEMP selection.

8.6.3 OTHERS

The analog inputs listed as follows are calibrated in the OTHERS submenu of the CALIBRATE UNIT MENU:

    LIVE SG
    LIVE BTU

8.7   MONITOR MENU

The MONITOR menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs listed are available in the MONITOR menu in the triple orifice application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

METR PRES	DIFF PRES2
METR TEMP	LIVE SG
DIFF PRESL	LIVE BTU
DIFF PRESH	

8.8   USER REPORT (CHANNEL 0)

Channel zero (0) is a predefined report list containing a report header and the channel data shown in the following table. The SolarFlow Plus unit displays the Users Report on the front panel in a scrolling format.

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
020	METR PRES1	Live pressure meter No.1 in PSIG
032	COMP DPRES	Composite DP, Run No.1, value in inches of water
025	DIFF PRES2	Live DP, Run No.2, value in inches of water
022	FLOW TEMP1	Live temperature in degrees Fahrenheit (°F)
021	LIVE SG	Live value for specific gravity
133	FLOW RATE1	Flow rate for meter No.1
138	TOT VOL 1	Total volume for meter No.1
163	FLOW RATE2	Flow rate for meter No.2
168	TOT VOL 2	Total volume for meter No.2
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

8.9   DATA LOG LIST CONTENTS

The following items are included on the data log. The data log is set to a 1-hour log interval. The default contract hour is 7:00 am.

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
032	COMP DPRES	2	6	AVERAGE
020	METR PRES	1	6	AVERAGE
022	FLW TEMP	1	4	AVERAGE
132	FLW TIME 1	1	6	SNAPSHOT & ZERO
131	FLW EXTN 1	2	6	AVERAGE
135	LOG VOL1	1	6	SNAPSHOT & ZERO
025	DIFF PRES2	2	6	AVERAGE
162	FLW TIME 2	1	6	SNAPSHOT & ZERO
161	FLW EXTN 2	2	6	AVERAGE
165	LOG VOL2	1	6	SNAPSHOT & ZERO

8.10   DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

        M PRES/LO
        M PRES/HI
        M TEMP/LO
        M TEMP/HI
        D PRESL/LO
        D PRESL/HI
        D PRESH/LO
        D PRESH/HI
        D PRES2/LO
        D PRES2/HI
        ORIF DIAM1
        PIPE DIAM1

(Continued on the next page)

Data Log Header Block (Continued)

ZFLOW LIM1	NONANE
TAP LCTN 1	DECANE
ORIF DIAM2	HELIUM
PIPE DIAM2	ARGON
ZFLOW LIM2	
TAP LCTN 2	
ATMS PRES	
PRES BASE	
TEMP BASE	
AGA8 MTHD	
SG SELECT	
ORIF MTRL	
PIPE MTRL	
TREF ORIF	
TREF PIPE	
SPEC GRAV	
BTU	
CO2	
N2	
VISCOSITY	
SPEC HEAT	
METHANE	
ETHANE	
PROPANE	
H2O	
H2S	
HYDROGEN	
CO	
OXYGEN	
I-BUTANE	
BUTANE	
I-PENTANE	
PENTANE	
HEXANE	
HEPTANE	
OCTANE	

8.11   ALARM DEFINITIONS

The following is a listing of the Alarm definitions for this application. Note that the alarms will show up in the event log.

Number of Retries: 5 for alarms 1 through 9, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
1	C(19) < X	LOW BATTER	16.0	10.8	0.0	0
2	C(20) < X*S(20,F) or C(20) > Y*S(20,F)	METR PRES	1000	0.0	1.01	0
3*	C(21) < X*S(21,F) or C(21) > Y*S(21,F)	LIVE SG	-	0.0	1.01	0
4	C(22) < X*S(22,F) or C(22) > Y*S(22,F)	FLOW TEMP	150.0	0.0	1.01	0
5*	C(23) < X*S(23,F) or C(23) > Y*S(23,F)	DIFF PRES1	30.0	0.0	1.01	0
6	C(24) < X*S(24,F) or C(24) > Y*S(24,F)	DIFF PRES1	150.0	0.0	1.01	0
7	C(25) < X*S(25,F) or C(25) > Y*S(25,F)	DIFF PRES2	-	0.0	1.01	0
8*	C(26) < X*S(26,F) or C(26) > Y*S(26,F)	LIVE BTU	1200	0.0	1.01	0

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
9	C(210) < X or C(210) > Y	STN FLW RT	-	0.0	999999.0	0
10	C(30) <> 0.0	SYS ERROR	-	0.0	0.0	0

* These alarms should be disabled.

EXAMPLE:

Alarm # 2

    Y   =   1.01

S(20,F)   =   The full-scale value for channel 20, which is the static pressure transmitter. SolarFlow Plus automatically generates this value based on the full-scale value entered while in the SETUP UNIT submenu.

    F   =   1000 PSIG

Therefore, the alarm setpoint for alarm #2 is 1.01(1000) = 1010 PSIG.

When the ALARM menu is entered using the HHDT the user may modify the X, Y, or Z values shown in the above alarm conditions by changing the values for LOW, HIGH, and ALT. This enables the user to adjust the alarm limit(s) to match the requirements.

The value for X is represented by LOW on the HHDT ALARM SETUP menu. The value for Y is represented by HIGH on the HHDT ALARM SETUP menu. The value for Z is represented by ALT on the HHDT ALARM SETUP menu.

The ALARM menu is also used to acknowledge alarms and to activate or deactivate alarms.

To acknowledge an alarm condition displayed on the LCD of SolarFlow Plus, enter the ALARM menu of the HHDT and select the ACKNOWLEDGE sub-menu. Any existing unacknowledged alarms are displayed and the HHDT prompts: "ACKNOWLEDGE ? Y/N". Press the ENTER key to acknowledge the alarm. Once this has been done and the user has logged off SolarFlow Plus the activated alarm is displayed with the message "ACKNOWLEDGED" following the alarm condition. If the alarm condition no longer exists and has not been acknowledged it remains on the LCD until acknowledged.

To activate or deactivate alarms, enter the HHDT ALARM menu and select the SETUP sub-menu. The HHDT displays the various alarms that are available in the program. Scroll to the desired alarm and press the ENTER key at the desired alarm condition. The HHDT provides four options; STAT, LOW, HIGH, and ALT. Press ENTER at the STAT option. The HHDT shows either ON or OFF and prompts OK?. To turn off the alarm, press the NO key until OFF is displayed, then press ENTER.

9.0 STACKED TRIPLE ORIFICE APPLICATION

Section 9 covers the individual requirements for the enhanced stacked triple orifice application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The stacked triple orifice application supports measurement on three meter tubes with stacked differential pressure transmitters on the primary meter. MODBUS communications are available with this application. Optional capabilities such as valve positioning, chromatograph inputs, etc. are listed as part of the setup. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). Channels 1 and 2 are digital inputs which indicate whether an analog input is used for live specific gravity and BTU respectively. To select fixed values, these inputs should be jumpered to ground; for live values, the inputs should be left open. Analog inputs use Channels 19 through 26. Any unused analog input should be jumpered to ground.

When the SolarFlow Plus is configured for a new application, all channels are set to default values, and the Alarm definitions, Log definition, User Report list, and Analog Input channels are set to the values corresponding to the configuration chosen. The event log remains intact, but the data log is emptied.

9.1 FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed. Make sure that your slide switch settings are set in accordance with the information in paragraph 1.13. No changes should be required unless the previously used application has been significantly different. Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2470 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

The wiring configuration for the stacked dual orifice analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters.

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure (factory installed)	White (Blue*) Green (Black*) Black (Red*)	23 26 25	Signal in + Analog ground 8 to 10 VDC
*	SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.			
		or		
20	EXTERNAL, static pressure [2] (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	EXTERNAL, temperature (to be installed by user)	Blue Black Red Shield	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, DP No.1 low (to be installed by user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	INTERNAL, differential pressure high (DP) No. 1 (factory installed)	Violet Black Gray	35 38 37	Signal in + Analog ground 8 to 10 VDC
		or		
23	EXTERNAL, differential pressure high (DP) No.1 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	EXTERNAL, DP No. 2, (to be installed by user)	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
25	EXTERNAL, DP No.3 (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	EXTERNAL, LIVE SG [1] [2] (to be installed by user)		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

NOTES: (1) Since fixed values are normally desired for BTU and SG, digital input channels 1 and 2 are factory-wired to ground. When live values are desired, remove the jumpers between pins 59 and 60, 52 and 61 on the rear termination board. The fixed values for BTU and the specific gravity are entered in the GAS DATA submenu of the SETUP UNIT menu by keying in the desired value. Refer to the System Wiring Diagram.

(2) Wire for connecting the external transmitter inputs is user-supplied.

(3) Jumper any unused analog input to analog ground.

9.2   STATUS SIGNAL CONNECTIONS

This application supports two status inputs that are activated by a dry contact closure between the status input pin number and common.

9.2.1   INPUTS

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
1	Live or fixed SG	LIVE SG	60 51 (GND)	Open, means use LIVE SG Shorted, means use FIXED SG
2	Live or fixed BTU	LIVE BTU	61 52 (GND)	Open, means use LIVE BTU Shorted, means use FIXED BTU
18	Chromatograph option	CHROM	68 59 (GND)	Open = no chromatograph Shorted, means use chromatograph

Following are valid combinations:

	CH 1	CH 2	CH 18
LIVE SG and BTU	No jumper	No jumper	No jumper
FIXED SG and BTU	Jumper/GND	Jumper/GND	No jumper
Serial Chromatograph	Jumper/GND	Jumper/GND	Jumper/GND

Note that serial chromatograph inputs require that SG and BTU be jumpered to ground as if fixed.

9.2.2   OUTPUTS

NOTE: All output signals from a SolarFlow Plus unit installed in a hazardous location must be isolated by means of intrinsic safety barriers.

This application has two form-A relays (mounted on the SolarFlow Plus PC board) that provide digital outputs for corrected station volume on Channels 5 and 6. The volume per pulse and the pulse period of the relays may be changed using the HHDT. Prompts for changing the relay volume per pulse (VPP 1 and VPP 2) and pulse period (PP 1 and PP 2) are included in the discussion of the CONFIG submenu of the SETUP UNIT menu.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	15 16	Form-A relay Common
6	Volume pulse output 2	VP 2	17 18	Form-A relay Common

TTL level outputs for the following channels are available at the termination board pin numbers shown in the following table.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	78 69	TTL Output Common
6	Volume pulse output 2	VP 2	79 70	TTL Output Common
7	Valve control open	OPEN 2	80 71	TTL Output Common
8	Valve control close	CLOSE 2	81 72	TTL Output Common
11	Valve control open	OPEN 3	82 73	TTL Output Common
12	Valve control close	CLOSE 3	83 74	TTL Output Common
13	Channel Value Monitor Indication	CVM STATUS	84 75	TTL Output Common

9.2.3   ANALOG OUTPUT CONNECTIONS

This application provides one 1-5 VDC analog output.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
27	Flow rate output	FLW RT OUT	3 4	Analog output 1 Ground
28	Valve positioning	VALVE POS	1 2	Analog output 2 Ground

9.2.4   CHROMATOGRAPH INTER-CONNECTIONS

For more detail in wiring the Model 2251 Chromatograph Controller to the Model 2470, refer to the field wiring diagram in the Model 2470 systems Reference Manual.

MODEL 2251	MODEL 2470	
Signal Type	Pin No.	Signal Type
Serial out Serial in Ground	102 103 106	DI in DI out DI ground

9.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the enhanced stacked triple orifice application that can be changed in the SETUP LOCATION menu are shown in the following table described by the HHDT prompt for the parameter, the factory-installed default value, and a blank space for entering the desired value if different from the factory default. Additional information on the SETUP LOCATION menu is provided in paragraph 5.10.1 of the Model 2470 System Reference Manual. For applications using MODBUS communications, refer to paragraph 1.11 in this manual.

HHDT PROMPT	DEFAULT	DESIRED
LOC NAME	BLANK LOCATION	_____
LOC ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE[1]	120	_____
USER REP[2]	****	_____
PCOMM RATE[3]	1200 BPS	_____
RTS DELAY[4]	0 1/100s	_____

NOTES: (1)   Refer to paragraph 5.10.1.6 in the Model 2470 System Reference Manual for a complete discussion of the SEC CODE prompt.

(2)   Refer to paragraph 5.10.1.7 in the Model 2470 System Reference Manual for a complete discussion of the USER REP prompt.

(3)   Refer to paragraph 5.10.1.8 in the Model 2470 System Reference Manual for a complete discussion of the PCOMM RATE prompt.

(4)   Refer to paragraph 5.10.1.9 in the Model 2470 System Reference Manual for a complete discussion of the RTS DELAY prompt.

9.4 SETUP UNIT MENU

The parameters for the enhanced stacked triple orifice application of SolarFlow Plus that can be changed in the submenus of the SETUP UNIT menu using the HHDT are tabulated as follows. The SETUP MENU has eight submenus: GENERAL, ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, AND CALC DATA. The parameters are tabulated by the HHDT prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

9.4.1 GENERAL SUBMENU

The following parameters can be changed in the GENERAL submenu of the SETUP UNIT menu of the HHDT.

HHDT PROMPT	DEFAULT	DESIRED
UNIT NAME	BLANK UNIT	_____
UNIT ID	BLANK-ID	_____
CONTRCT HR	7 (0-23)	_____
LOG INTRVL	1 HOUR	_____
LOG DEFINE[1]		_____
RESET CMOD[2]	OFF	_____

NOTES:
(1) All data logs in the SolarFlow Plus memory are automatically erased and can no longer be recovered any time a change is made in the LOG DEFINE menu. Refer to paragraph 1.9 for a description of the LOG DEFINE prompt.

(2) The RESET CMOD (Reset Calculations Module) prompt selects the calculation module for an alternate SolarFlow Plus application. RESET CMOD is discussed in detail in paragraph 5.10.2.1.6 in the Model 2470 SolarFlow Plus System Reference Manual.

9.4.2   ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu provides for toggling between LIVE and FIXED values of the following analog inputs. The AUX1 key on the HHDT toggles the input between the fixed and live values. A fixed value is shown by an asterisk (*) following the analog value in the display. For additional information, refer to the Model 2470 System Reference Manual.

HHDT PROMPT	DEFAULT
METR PRES	0.0 PSIG
METR TEMP	0.0 DEG F
DIFF PRESL	0.0 InH2O
DIFF PRESH	0.0 InH20
DIFF PRES2	0.0 InH2O
DIFF PRES3	0.0 InH20
LIVE SG	0.0000
BATTERY	0.0 VOLTS
FLW RT OUT	0.0 MCFH
VALVE POS	50.0 %

9.4.3   SCALES SUBMENU

The high- and low-scale setpoints for the analog inputs shown in the following table can be modified in the SCALES submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.3 in the Model 2470 System Reference Manual for additional information about the SCALES submenu.

HHDT PROMPT	DEFAULT		DESIRED
SPAN COMPL	0.00	%	_____
SPAN COMP1	0.00	%	_____
SPAN COMP2	0.00	%	_____
SPAN COMP3	0.00	%	_____
M PRES/LO	0.0	PSIG	_____
M PRES/HI	1000.0	PSIG	_____
M TEMP/LO	0.0	DEG F	_____
M TEMP/HI	150.0	DEG F	_____
D PRESL/LO	0.0	InH2O	_____
D PRESL/HI	30.0	InH2O	_____
D PRESH/LO	0.0	InH2O	_____
D PRESH/HI	150.0	InH2O	_____
D PRES2/LO	0.0	InH2O	_____
D PRES2/HI	150.0	InH2O	_____
D PRES3/LO	0.0	InH2O	_____
D PRES3/HI	150.0	InH2O	_____
LIVE SG/LO	0.50		_____
LIVE SG/HI	1.0		_____
FLW RT LOW	0.0	MCFH	_____
FLW RT HI	5000.0	MCFH	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____

9.4.4   DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
OPEN 2	ON
CLOSE 2	OFF
OPEN 3	ON
CLOSE 3	OFF
CVM STATUS	OFF
OUTPUT 14	OFF
OUTPUT 15	OFF

9.4.5   CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.4 in the Model 2470 System Reference Manual for additional information about the CONFIG submenu.

HHDT PROMPT	SAMPLE VALUES		DESIRED
ORIF DIAM1	4.000	IN IN	_____
PIPE DIAM1	8.071	InH2O	_____
ZFLOW LIM1	0.50		_____
TAP LCTN 1	0	IN	_____
ORIF DIAM2	4.000	IN	_____
PIPE DIAM2	8.071	InH2O	_____
ZFLOW LIM2	0.50		_____
TAP LCTN 2	0	IN	_____
ORIF DIAM3	4.000	IN	_____
PIPE DIAM3	8.071	InH2O	_____
ZFLOW LIM3	0.50		_____
TAP LCTN 3	0	PSIA	_____
ATMS PRES	14.73	PSIA	_____
PRES BASE	14.73	DEG F	_____
TEMP BASE	60		_____
AGA8 MTHD	0		_____
SG SELECT	0		_____
ORIF MTRL	1		_____
PIPE MTRL	0	DEG F	_____
TREF ORIF	68.0	DEG F	_____
TREF PIPE	68.0		_____
CHROM ADDR	1		_____
CHROM STRM	1		_____
VERSION	1.0		_____

9.4.6   GAS DATA

This enhanced SolarFlow Plus software can accept information from the Model 2251 Danalyzer Chromatograph Gas Controller. This option requires that a jumper be installed grounding digital Channel 18. Install the jumper between pin 68 and pin 59 on the termination board. In addition, the MODBUS communication address and the chromatograph stream No. desired must be programmed in by the HHDT (CONFIG submenu). The Solarflow Plus will then poll the chromatograph once every four minutes automatically. Refer to paragraph 1.5.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.6000		_____
BTU	1000.0		_____
CO2	0.000	MOL%	_____
N2	0.000	MOL%	_____
VISCOSITY	0.0000092	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.000	MOL%	_____
ETHANE	5.000	MOL%	_____
PROPANE	0.000	MOL%	_____
H2O	0.000	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.000	MOL%	_____
BUTANE	0.000	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.000	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____
ARGON	0.000	MOL%	_____

9.4.7   CONTROL SUBMENU

The CONTROL submenu of the SETUP UNIT menu provides for entering the control values primarily for the valve positioning and tube switching. Refer to paragraphs 1.6 and 1.7 for more information.

HHDT PROMPT	DEFAULT		DESIRED
VPP 1	100.0	MCF	_____
PP 1	1	SEC	_____
VPP 2	100.0	MCF	_____
PP 2	1	SEC	_____
CVM CHAN #	0		_____
CVM LO LMT	0.0		_____
CVM HI LMT	5000.0		_____
TS ENABLE	0		_____
OPEN 2 SP	80.0	InH2O	_____
CLOSE 2 SP	20.0	InH2O	_____
OPEN 3 SP	80.0	InH2O	_____
CLOSE 3 SP	20.0	InH2O	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFH	_____
PRES SETPT	100	PSIG	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
DP LIMIT	0	InH2O	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

9.4.8   CALCULATED DATA

The CALC DATA submenu of the SETUP UNIT menu allows the user to determine the calculated values for specified application inputs. The values shown here are typical values and not default values.

HHDT PROMPT	SAMPLE VALUES	
AGA8 MTHD	0	
ZS	0.997811	
ZB	0.997811	
FLOW RATE1	1000.8	MCFH
EV 1	1.03164	
CD 1	0.603166	
Y 1	0.999892	
FLW EXTN 1	94.841	
ZF 1	0.927767	
FLOW RATE2	480.0	MCFH
EV 2	1.000000	
CD 2	0.600000	
Y 2	1.000000	
FLW EXTN 2	227.361	
ZF 2	1.000000	
FLOW RATE3	0.0	MCFH
EV 3	1.03164	
CD 3	0.604273	
Y 3	1.000000	
FLW EXTN 3	24.495	
ZF 3	0.92785	
B - AGA8	0.033417	
C - AGA8	0.002236	
D - AGA8	0.266296	
K - AGA8	0.100912	
MOL WT.	16.7444	

9.5 DISPLAY MENU

The DISPLAY Menu of the HHDT provides for viewing the various setup parameters and calculated values in a SolarFlow Plus unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu. The Display menu has eight selections: ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CALC DATA, CONTROL and RATE/VOLS.

9.5.1 ANALOGS

METR PRES
METR TEMP
DIFF PRESL
DIFF PRESH
DIFF PRES2
DIFF PRES3
LIVE SG
BATTERY
FLW RT OUT
VALVE POS

9.5.2 SCALES

SPAN COMPL	D PRES3/LO
SPAN COMP1	D PRES3/HI
SPAN COMP2	LIVE SG/LO
SPAN COMP3	LIVE SG/HI
M PRES/LO	FLW RT LOW
M PRES/HI	FLW RT HI
M TEMP/LO	VLV POS LO
M TEMP/HI	VLV POS HI
D PRESL/LO	
D PRESL/HI	
D PRESH/LO	
D PRESH/HI	
D PRES2/LO	
D PRES2/HI	

9.5.3   DISCRETES

LIVE GRAV
LIVE BTU
CHROM
VP 1
VP 2
CVM STATUS
OPEN 2
CLOSE 2
OPEN 3
CLOSE 3
INPUT 3
INPUT 4
INPUT 9
INPUT 10
INPUT 16
INPUT 17
OUTPUT 14
OUTPUT 15

9.5.4   CONFIG

ORIF DIAM1   SG SELECT
PIPE DIAM1   ORIF MTRL
ZFLOW LIM1   PIPE MTRL
TAP LCTN 1   TREF ORIF
ORIF DIAM2   TREF PIPE
PIPE DIAM2   CHROM ADDR
ZFLOW LIM2   CHROM STRM
TAP LCTN 2   VERSION
ORIF DIAM3
PIPE DIAM3
ZFLOW LIM3
TAP LCTN 3
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD

9.5.5   GAS DATA

SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H20
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

9.5.6   CONTROL

      VPP 1
      PP 1
      VPP 2
      PP 2
      CVM CHAN #
      CVM LO LMT
      CVM HI LMT
      TS ENABLE
      OPEN 2 SP
      CLOSE 2 SP
      OPEN 3 SP
      CLOSE 3 SP
      TS DELAY
      TS VLV TIM
      VP MODE
      FLW SETPNT
      PRES SETPT
      DEADBAND
      SMALL STEP
      LARGE STEP
      FINE CNTRL
      PRES CHAN#
      OVRD PRESS
      DP LIMIT
      PRESET POS
      UPDATE TIM
      VALVE POS

9.5.7   CALC DATA

AGA8 MTHD
ZS
ZB
FLOW RATE1
EV 1
CD 1
Y 1
FLW EXTN 1
ZF 1
FLOW RATE2
EV 2
CD 2
Y 2
FLW EXTN 2
ZF 2
FLOW RATE 3
EV 3
CD 3
Y 3
FLW EXTN 3
ZF 3
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

9.5.8   RATE/VOLS

     FLOW RATE1   (MCFH)
     FLOW RATE1   (MCFD)
     TODAY VOL1
     YSDAY VOL1
     TOT VOL 1
     FLOW RATE2   (MCFH)
     FLOW RATE2   (MCFD)
     TODAY VOL2
     YSDAY VOL2
     TOT VOL 2
     FLOW RATE3   (MCFH)
     FLOW RATE3   (MCFD)
     TODAY VOL3
     YSDAY VOL3
     TOT VOL 3
     STN FLW RT   (MCFH)
     STN FLW RT   (MCFD)
     STN TDY VOL
     STN YSY VOL
     ST TOT VOL
     ERATE 1
     TDY ENRGY1
     YSY ENRGY1
     TOT ENRGY1
     ERATE 2
     TDY ENRGY2
     YSY ENRGY2
     TOT ENRGY2
     ERATE 3
     TDY ENRGY3
     YSY ENRGY3
     TOT ENRGY3
     STN ERATE
     TDY ENERGY
     YSY ENERGY
     TOT ENERGY

9.6   CALIBRATE UNIT MENU

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the outputs of the transmitters for analog inputs to the SolarFlow Plus unit.   The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

9.6.1   PRESSURES

The PRESSURES selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

    METR PRES
    DIFF PRESL
    DIFF PRESH
    DIFF PRES2
    DIFF PRES3

9.6.2   TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the METR TEMP selection.

9.6.3   OTHERS

The analog inputs listed as follows are calibrated in the OTHERS submenu of the CALIBRATE UNIT MENU:

    LIVE SG

9.7   MONITOR MENU

The MONITOR menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs listed are available in the MONITOR menu in the triple orifice application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

    METR PRES
    METR TEMP
    DIFF PRESL
    DIFF PRESH
    DIFF PRES2
    DIFF PRES3
    LIVE SG

9.8 USER REPORT (CHANNEL 0)

Channel zero (0) is a predefined report list containing a report header and the channel data shown in the following table. The SolarFlow Plus unit displays the Users Report on the front panel in a scrolling format.

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
020	METR PRES1	Live pressure meter No.1 in PSIG
021	FLOW TEMP1	Live temperature in degrees Fahrenheit ($^{\circ}$F)
032	COMP DPRES	Composite DP, Run No.1, value in inches of water
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
025	DIFF PRES3	Live DP, Run No.3, value in inches of water
026	LIVE SG	Live value for specific gravity
133	FLOW RATE1	Flow rate for meter No.1
138	TOT VOL 1	Total volume for meter No.1
163	FLOW RATE2	Flow rate for meter No.2
168	TOT VOL 2	Total volume for meter No.2
193	FLOW RATE3	Flow rate for meter No.3
198	TOT VOL 3	Total volume for meter No.3
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

9.9   DATA LOG LIST CONTENTS

The following items are included on the data log. The data log is set to a 1-hour log interval. The default contract hour is 7:00 am.

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
032	COMP DPRES	2	6	AVERAGE
020	METR PRES	1	6	AVERAGE
022	FLW TEMP	1	4	AVERAGE
132	FLW TIME 1	1	6	SNAPSHOT & ZERO
131	FLW EXTN 1	2	6	AVERAGE
135	LOG VOL1	1	6	SNAPSHOT & ZERO
025	DIFF PRES2	2	6	AVERAGE
162	FLW TIME 2	1	6	SNAPSHOT & ZERO
161	FLW EXTN 2	2	6	AVERAGE
165	LOG VOL2	1	6	SNAPSHOT & ZERO
025	DIFF PRES 3	2	6	AVERAGE
192	FLW TIME 2	1	6	SNAPSHOT & ZERO
191	FLW EXTN 3	2	6	AVERAGE
195	LOG VOL 3	1	6	SNAPSHOT & ZERO

9.10   DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

> M PRES/LO
> M PRES/HI
> M TEMP/LO
> M TEMP/HI
> D PRESL/LO
> D PRESL/HI
> D PRESH/LO
> D PRESH/HI
> D PRES2/LO
> D PRES2/HI

(Continued on the next page)

Data Log Header Block (Continued)

D PRES3/LO	I-BUTANE
D PRES3/HI	BUTANE
ORIF DIAM1	I-PENTANE
PIPE DIAM1	PENTANE
ZFLOW LIM1	HEXANE
TAP LCTN 1	HEPTANE
ORIF DIAM2	OCTANE
PIPE DIAM2	NONANE
ZFLOW LIM2	DECANE
TAP LCTN 2	HELIUM
ORIF DIAM3	ARGON
PIPE DIAM3	
ZFLOW LIM3	
TAP LCTN 3	
ATMS PRES	
PRES BASE	
TEMP BASE	
AGA8 MTHD	
SG SELECT	
ORIF MTRL	
PIPE MTRL	
TREF ORIF	
TREF PIPE	
SPEC GRAV	
BTU	
CO2	
N2	
VISCOSITY	
SPEC HEAT	
METHANE	
ETHANE	
PROPANE	
H2O	
H2S	
HYDROGEN	
CO	
OXYGEN	

9.11   ALARM DEFINITIONS

The following is a listing of the Alarm definitions for this application. Note that the alarms will show up in the event log.

Number of Retries: 5 for alarms 1 through 9, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
1	C(19) < X	LOW BATTER	16.0	10.8	0.0	0
2	C(20) < X*S(20,F) or C(20) > Y*S(20,F)	METR PRES	1000	0.0	1.01	0
3	C(21) < X*S(21,F) or C(21) > Y*S(21,F)	FLOW TEMP	150.0	0.0	1.01	0
4*	C(22) < X*S(22,F) or C(22) > Y*S(22,F)	DIFF PRES1	30.0	0.0	1.01	0
5	C(23) < X*S(23,F) or C(23) > Y*S(23,F)	DIFF PRES1	150.0	0.0	1.01	0
6	C(24) < X*S(24,F) or C(24) > Y*S(24,F)	DIFF PRES2	150.0	0.0	1.01	0
7	C(25) < X*S(25,F) or C(25) > Y*S(25,F)	DIFF PRES3	150.0	0.0	1.01	0
8*	C(26) < X*S(26,F) or C(26) > Y*S(26,F)	LIVE SG	1.0	0.0	1.01	0

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
9	C(210) < X or C(210) > Y	STN FLW RT	-	0.0	999999.0	0
10	C(30) <> 0.0	SYS ERROR	-	0.0	0	0

* These alarms should be disabled.

EXAMPLE:

Alarm # 2

   Y   =   1.01

S(20,F)   =   The full-scale value for channel 20, which is the static pressure transmitter. SolarFlow Plus automatically generates this value based on the full-scale value entered while in the SETUP UNIT submenu.

   F   =   1000 PSIG

Therefore, the alarm setpoint for alarm #2 is 1.01(1000) = 1010 PSIG.

When the ALARM menu is entered using the HHDT the user may modify the X, Y, or Z values shown in the above alarm conditions by changing the values for LOW, HIGH, and ALT. This enables the user to adjust the alarm limit(s) to match the requirements.

The value for X is represented by LOW on the HHDT ALARM SETUP menu. The value for Y is represented by HIGH on the HHDT ALARM SETUP menu. The value for Z is represented by ALT on the HHDT ALARM SETUP menu.

The ALARM menu is also used to acknowledge alarms and to activate or deactivate alarms.

To acknowledge an alarm condition displayed on the LCD of SolarFlow Plus, enter the ALARM menu of the HHDT and select the ACKNOWLEDGE sub-menu. Any existing unacknowledged alarms are displayed and the HHDT prompts: "ACKNOWLEDGE ? Y/N". Press the ENTER key to acknowledge the alarm. Once this has been done and the user has logged off SolarFlow Plus the activated alarm is displayed with the message "ACKNOWLEDGED" following the alarm condition. If the alarm condition no longer exists and has not been acknowledged it remains on the LCD until acknowledged.

To activate or deactivate alarms, enter the HHDT ALARM menu and select the SETUP sub-menu. The HHDT displays the various alarms that are available in the program. Scroll to the desired alarm and press the ENTER key at the desired alarm condition. The HHDT provides four options; STAT, LOW, HIGH, and ALT. Press ENTER at the STAT option. The HHDT shows either ON or OFF and prompts OK?. To turn off the alarm, press the NO key until OFF is displayed, then press ENTER.

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10.0 DUAL ORIFICE SEPARATE TEMPERATURE APPLICATION

Section 10 covers the individual requirements for the enhanced dual orifice separate temperature application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The dual orifice separate temperature application supports measurement on two meter tubes with separate temperatures and pressures. MODBUS communications are available with this application. Optional capabilities such as valve positioning, chromatograph inputs, etc. are listed as part of the setup. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). Channels 1 and 2 are digital inputs which indicate whether an analog input is used for live specific gravity and BTU respectively. To select fixed values, these inputs should be jumpered to ground; for live values, the inputs should be left open. Analog inputs use Channels 19 through 26. Any unused analog input should be jumpered to ground.

When the SolarFlow Plus is configured for a new application, all channels are set to default values, and the Alarm definitions, Log definition, User Report list, and Analog Input channels are set to the values corresponding to the configuration chosen. The event log remains intact, but the data log is emptied.

10.1 FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed. Make sure that your slide switch settings are set in accordance with the information in paragraph 1.13. No changes should be required unless the previously used application has been significantly different. Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2470 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

The wiring configuration for the dual orifice separate temperature analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters.

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure (factory installed)	White (Blue*) Green (Black*) Black (Red*)	23 26 25	Signal in + Analog ground 8 to 10 VDC
*	SolarFlow Plus units fitted with Statham 35PG series static pressure transmitters are wired with the blue, black, and red wires.			
	or			
20	EXTERNAL, static pressure (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	EXTERNAL, static pressure Meter Tube No.2 (to be installed by user)	Blue Black Red Shield	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, temperature (to be installed by user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	INTERNAL, differential pressure (DP) No.1 (factory installed)	Violet Black Gray	35 38 37	Signal in + Analog ground 8 to 10 VDC
	or			
23	EXTERNAL, differential (DP) No.1 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	EXTERNAL, DP No.2 (to be installed by user)	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
25	EXTERNAL, LIVE SG [1] [2] (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	EXTERNAL, Meter temperature No.2 (to be installed by user)		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

NOTES: (1) Since fixed values are normally desired for BTU and SG, digital input channels 1 and 2 are factory-wired to ground. When live values are desired, remove the jumpers between pins 59 and 60, 52 and 61 on the rear termination board. The fixed values for BTU and the specific gravity are entered in the GAS DATA submenu of the SETUP UNIT menu by keying in the desired value. Refer to the System Wiring Diagram.

(2) Wire for connecting the external transmitter inputs is user-supplied.

(3) Jumper any unused analog inputs to analog ground.

10.2   STATUS SIGNAL CONNECTIONS

This application supports three status inputs that are activated by a dry contact closure between the status input pin number and common.

10.2.1   INPUTS

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
1	Live or fixed SG	LIVE SG	60 51 (GND)	Open, means use LIVE SG Shorted, means use FIXED SG
2	Live or fixed BTU	LIVE BTU	61 52 (GND)	Open, means use LIVE BTU Shorted, means use FIXED BTU
18	Chromatograph option	CHROM	68 59 (GND)	Open = no chromatograph Shorted, means use chromatograph

Following are valid combinations:

	CH 1	CH 2	CH 18
LIVE SG and BTU	No jumper	No jumper	No jumper
FIXED SG and BTU	Jumper/GND	Jumper/GND	No jumper
Serial Chromatograph	Jumper/GND	Jumper/GND	Jumper/GND

Note that serial chromatograph inputs require that SG and BTU be jumpered to ground as if fixed.

10.2.2   OUTPUTS

NOTE: All output signals from a SolarFlow Plus unit installed in a hazardous location must be isolated by means of intrinsic safety barriers.

This application has two form-A relays (mounted on the SolarFlow Plus PC board) that provide digital outputs for corrected station volume on Channels 5 and 6. The volume per pulse and the pulse period of the relays may be changed using the HHDT. Prompts for changing the relay volume per pulse (VPP 1 and VPP 2) and pulse period (PP 1 and PP 2) are included in the discussion of the CONFIG submenu of the SETUP UNIT menu.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	15 16	Form-A relay Common
6	Volume pulse output 2	VP 2	17 18	Form-A relay Common

TTL level outputs for the following channels are available at the termination board pin numbers shown in the following table.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	78 69	TTL Output Common
6	Volume pulse output 2	VP 2	79 70	TTL Output Common
7	Valve control open	OPEN 2	80 71	TTL Output Common
8	Valve control close	CLOSE 2	81 72	TTL Output Common
13	Channel Value Monitor Indication	CVM STATUS	84 75	TTL Output Common

10.2.3   ANALOG OUTPUT CONNECTIONS

This application provides two 1-5 VDC analog outputs.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
27	Flow rate output	FLW RT OUT	3 4	Analog output 1 Ground
28	Valve positioning	VALVE POS	1 2	Analog output 2 Ground

10.2.4   CHROMATOGRAPH INTER-CONNECTIONS

For more detail in wiring the Model 2251 Chromatograph Controller to the Model 2470, refer to the field wiring diagram in the Model 2470 systems Reference Manual.

MODEL 2251	MODEL 2470	
Signal Type	Pin No.	Signal Type
Serial out Serial in Ground	102 103 106	DI in DI out DI ground

10.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the enhanced dual orifice separate temperature application that can be changed in the SETUP LOCATION menu are shown in the following table described by the HHDT prompt for the parameter, the factory-installed default value, and a blank space for entering the desired value if different from the factory default. Additional information on the SETUP LOCATION menu is provided in paragraph 5.10.1 of the Model 2470 System Reference Manual. For applications using MODBUS communications, refer to paragraph 1.11 in this manual.

HHDT PROMPT	DEFAULT	DESIRED
LOC NAME	BLANK LOCATION	_____
LOC ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE[1]	120	_____
USER REP[2]	****	_____
PCOMM RATE[3]	1200 BPS	_____
RTS DELAY[4]	0 1/100s	_____

NOTES: (1) Refer to paragraph 5.10.1.6 in the Model 2470 System Reference Manual for a complete discussion of the SEC CODE prompt.

(2) Refer to paragraph 5.10.1.7 in the Model 2470 System Reference Manual for a complete discussion of the USER REP prompt.

(3) Refer to paragraph 5.10.1.8 in the Model 2470 System Reference Manual for a complete discussion of the PCOMM RATE prompt.

(4) Refer to paragraph 5.10.1.9 in the Model 2470 System Reference Manual for a complete discussion of the RTS DELAY prompt.

10.4   SETUP UNIT MENU

The parameters for the enhanced dual orifice separate temperature application of SolarFlow Plus that can be changed in the submenus of the SETUP UNIT menu using the HHDT are tabulated as follows. The SETUP MENU has eight submenus: GENERAL, ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, AND CALC DATA.   The parameters are tabulated by the HHDT prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

10.4.1   GENERAL SUBMENU

The following parameters can be changed in the GENERAL submenu of the SETUP UNIT menu of the HHDT.

HHDT PROMPT	DEFAULT	DESIRED
UNIT NAME	BLANK UNIT	_____
UNIT ID	BLANK-ID	_____
CONTRCT HR	7 (0-23)	_____
LOG INTRVL	1 HOUR	_____
LOG DEFINE[1]		_____
RESET CMOD[2]	OFF	_____

NOTES: (1)   All data logs in the SolarFlow Plus memory are automatically erased and can no longer be recovered any time a change is made in the LOG DEFINE menu. Refer to paragraph 1.9 for a description of the LOG DEFINE prompt.

(2)   The RESET CMOD (Reset Calculations Module) prompt selects the calculation module for an alternate SolarFlow Plus application. RESET CMOD is discussed in detail in paragraph 5.10.2.1.6 in the Model 2470 SolarFlow Plus System Reference Manual.

10.4.2   ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu provides for toggling between LIVE and FIXED values of the following analog inputs. The AUX1 key on the HHDT toggles the input between the fixed and live values. A fixed value is shown by an asterisk (*) following the analog value in the display. For additional information, refer to the Model 2470 System Reference Manual.

HHDT PROMPT	DEFAULT
METR PRES1	0.0 PSIG
METR PRES2	0.0 PSIG
METR TEMP1	0.0 DEG F
METR TEMP2	0.0 DEG F
DIFF PRES1	0.0 InH20
DIFF PRES2	0.0 InH2O
LIVE SG	0.0000
BATTERY	0.0 VOLTS
FLW RT OUT	0.0 MCFH
VALVE POS	50.0 %

10.4.3   SCALES SUBMENU

The high- and low-scale values for the analogs shown in the following table can be modified in the SCALES submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.3 in the Model 2470 System Reference Manual for additional information about the SCALES submenu.

HHDT PROMPT	DEFAULT		DESIRED
SPAN COMP1	0.00	%	_____
SPAN COMP2	0.00	%	_____
M PRES1/LO	0.0	PSIG	_____
M PRES1/HI	1000.0	PSIG	_____
M PRES2/LO	0.0	PSIG	_____
M PRES2/HI	1000.0	PSIG	_____
M TEMP1/LO	0.0	DEG F	_____
M TEMP1/HI	150.0	DEG F	_____
M TEMP2/LO	0.0	DEG F	_____
M TEMP2/HI	150.0	DEG F	_____
D PRES1/LO	0.0	InH2O	_____
D PRES1/HI	150.0	InH2O	_____
D PRES2/LO	0.0	InH2O	_____
D PRES2/HI	150.0	InH2O	_____
LIVE SG/LO	0.50		_____
LIVE SG/HI	1.0		_____
FLW RT LOW	0.0	MCFH	_____
FLW RT HI	5000.0	MCFH	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____

10.4.4   DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
OPEN 2	ON
CLOSE 2	OFF
OPEN 3	ON
CLOSE 3	OFF
CVM STATUS	OFF
OUTPUT 14	OFF
OUTPUT 15	OFF

10.4.5   CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.4 in the Model 2470 System Reference Manual for additional information about the CONFIG submenu.

HHDT PROMPT	SAMPLE VALUES		DESIRED
ORIF DIAM1	4.000	IN IN	_____
PIPE DIAM1	8.071	INH2O	_____
ZFLOW LIM1	0.50		_____
TAP LCTN 1	0	IN	_____
ORIF DIAM2	4.000	IN	_____
PIPE DIAM2	8.071	INH2O	_____
ZFLOW LIM2	0.50		_____
TAP LCTN 2	0	PSIA	_____
ATMS PRES	14.73	PSIA	_____
PRES BASE	14.73	DEG F	_____
TEMP BASE	60		_____
AGA8 MTHD	0		_____
SG SELECT	0		_____
ORIF MTRL	1		_____
PIPE MTRL	0	DEG F	_____
TREF ORIF	68.0	DEG F	_____
TREF PIPE	68.0		_____
CHROM ADDR	1		_____
CHROM STRM	1		_____
VERSION	1.0		_____

10.4.6   GAS DATA

This enhanced SolarFlow Plus software can accept information from the Model 2251 Danalyzer Chromatograph Gas Controller. This option requires that a jumper be installed grounding digital Channel 18. Install the jumper between pin 68 and pin 59 on the termination board. In addition, the MODBUS communication address and the chromatograph stream number desired must be programmed in by the HHDT (CONFIG SUBMENU). The Solarflow Plus will then poll the chromatograph once every four minutes automatically. Refer to paragraph 1.5.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.6000		_____
BTU	1000.0		_____
CO2	0.000	MOL%	_____
N2	0.000	MOL%	_____
VISCOSITY	0.0000092	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.000	MOL%	_____
ETHANE	5.000	MOL%	_____
PROPANE	0.000	MOL%	_____
H2O	0.000	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.000	MOL%	_____
BUTANE	0.000	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.000	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____
ARGON	0.000	MOL%	_____

10.4.7   CONTROL SUBMENU

The CONTROL submenu of the SETUP UNIT menu provides for entering the control values primarily for the valve positioning and tube switching. Refer to paragraphs 1.6 and 1.7 for more information.

HHDT PROMPT	DEFAULT		DESIRED
VPP 1	100.0	MCF	_____
PP 1	1	SEC	_____
VPP 2	100.0	MCF	_____
PP 2	1	SEC	_____
CVM CHAN #	0		_____
CVM LO LMT	0.0		_____
CVM HI LMT	5000.0		_____
TS ENABLE	0		_____
OPEN 2 SP	80.0	InH2O	_____
CLOSE 2 SP	20.0	InH2O	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFH	_____
PRES SETPT	100	PSIG	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
DP LIMIT	0	InH2O	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

10.4.8   CALCULATED DATA

The CALC DATA submenu of the SETUP UNIT menu allows the user to determine the calculated values for specified application inputs. The values shown here are typical values and not default values.

HHDT PROMPT	SAMPLE VALUES	
AGA8 MTHD	0.0	
ZS	0.997811	
ZB	0.997811	
FLOW RATE1	1000.8	MCFH
EV 1	1.03164	
CD 1	0.603166	
Y 1	0.999892	
FLW EXTN 1	94.841	
ZF 1	0.927767	
FLOW RATE2	964.4	MCFH
EV 2	1.00000	
CD 2	0.600000	
Y 2	1.000000	
FLW EXTN 2	227.361	
ZF 2	1.000000	
B - AGA8	0.033417	
C - AGA8	0.002236	
D - AGA8	0.266296	
K - AGA8	0.100912	
MOL WT.	16.7444	

10.5 DISPLAY MENU

The DISPLAY Menu of the HHDT provides for viewing the various setup parameters and calculated values in a SolarFlow Plus unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu. The Display menu has eight selections: ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, CALC DATA and RATE/VOLS.

10.5.1 ANALOGS

METR PRES1
METR PRES2
METR TEMP1
METR TEMP2
DIFF PRES1
DIFF PRES2
LIVE SG
BATTERY
FLW RT OUT
VALVE POS

10.5.2 SCALES

SPAN COMP1   LIVE SG/LO
SPAN COMP2   LIVE SG/HI
M PRES1/LO   FLW RT LOW
M PRES1/HI   FLW RT HI
M PRES2/LO   VLV POS LO
M PRES2/HI   VLV POS HI
M TEMP1/LO
M TEMP1/HI
M TEMP2/LO
M TEMP2/HI
D PRES1/LO
D PRES1/HI
D PRES2/LO
D PRES2/HI

10.5.3   DISCRETES

LIVE SG
LIVE BTU
CHROM
VP 1
VP 2
CVM STATUS
OPEN 2
CLOSE 2
INPUT 3
INPUT 4
INPUT 9
INPUT 10
INPUT 16
INPUT 17
OPEN 3
CLOSE 3
OUTPUT 14
OUTPUT 15

10.5.4   CONFIG

ORIF DIAM1   SG SELECT
PIPE DIAM1   ORIF MTRL
ZFLOW LIM1   PIPE MTRL
TAP LCTN 1   TREF ORIF
ORIF DIAM2   TREF PIPE
PIPE DIAM2   CHROM ADDR
ZFLOW LIM2   CHROM STRM
TAP LCTN 2   VERSION
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD

10.5.5   GAS DATA

SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H20
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

10.5.6   CONTROL

VPP 1
PP 1
VPP 2
PP 2
CVM CHAN #
CVM LO LMT
CVM HI LMT
TS ENABLE
OPEN 2 SP
CLOSE 2 SP
TS DELAY
TS VLV TIM
VP MODE
FLW SETPNT
PRES SETPT
DEADBAND
SMALL STEP
LARGE STEP
FINE CNTRL
PRES CHAN#
OVRD PRESS
DP LIMIT
PRESET POS
UPDATE TIM
VALVE POS

10.5.7   CALC DATA

AGA8 MTHD
ZS
ZB
FLOW RATE1
EV 1
CD 1
Y 1
FLW EXTN 1
ZF 1
FLOW RATE2
EV 2
CD 2
Y 2
FLW EXTN 2
ZF 2
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

10.5.8   RATE/VOLS

FLOW RATE1   (MCFH)
FLOW RATE1   (MCFD)
TODAY VOL1
YSDAY VOL1
TOT VOL 1
FLOW RATE2   (MCFH)
FLOW RATE2   (MCFD)
TODAY VOL2
YSDAY VOL2
TOT VOL 2
STN FLW RT   (MCFH)
STN FLW RT   (MCFD)
ST TDY VOL
ST YSY VOL
ST TOT VOL
ERATE 1
TDY ENRGY1
YSY ENRGY1
TOT ENRGY1
ERATE 2
TDY ENRGY2
YSY ENRGY2
TOT ENRGY2
STN ERATE
TDY ENERGY
YSY ENERGY
TOT ENERGY

10.6   CALIBRATE UNIT MENU

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the outputs of the transmitters for analog inputs to the SolarFlow Plus unit. The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

10.6.1   PRESSURES

The PRESSURES selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

    METR PRES1
    METR PRES2
    DIFF PRES1
    DIFF PRES2

10.6.2   TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the METR TEMP selections.

    METR TEMP1
    METR TEMP2

10.6.3   OTHERS

The analog input listed as follows is calibrated in the OTHERS submenu of the CALIBRATE UNIT MENU:

    LIVE SG

10.7   MONITOR MENU

The MONITOR menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs listed are available in the MONITOR menu in the dual orifice common application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

        METR PRES1
        METR PRES2
        DIFF PRES1
        DIFF PRES2
        METR TEMP1
        METR TEMP2
        LIVE SG

10.8   USER REPORT (CHANNEL 0)

Channel zero (0) is a predefined report list containing a report header and the channel data shown in the following table. The SolarFlow Plus unit displays the Users Report on the front panel in a scrolling format.

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
020	METR PRES1	Live pressure meter No.1 in PSIG
023	DIFF PRES1	Live DP, Run No.1, value in inches of water
022	FLOW TEMP1	Live temperature in degrees Fahrenheit (°F)
021	METR PRES2	Live pressure meter No.2 in PSIG
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
026	FLOW TEMP2	Live temperature in degrees Fahrenheit (°F)
025	LIVE SG	Live value for specific gravity
133	FLOW RATE1	Flow rate for meter No.1
138	TOT VOL 1	Total volume for meter No.1
163	FLOW RATE2	Flow rate for meter No.2
168	TOT VOL 2	Total volume for meter No.2
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

10.9   DATA LOG LIST CONTENTS

The following items are included on the data log. The data log is set to a 1-hour log interval.
The default contract hour is 7:00 am.

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
023	DIFF PRES1	2	6	AVERAGE
020	METR PRES1	1	6	AVERAGE
022	FLW TEMP1	1	4	AVERAGE
132	FLW TIME 1	1	6	SNAPSHOT & ZERO
131	FLW EXTN 1	2	6	AVERAGE
135	LOG VOL1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	2	6	AVERAGE
021	METR PRES2	1	6	AVERAGE
162	FLW TIME 2	1	6	SNAPSHOT & ZERO
161	FLW EXTN 2	2	6	AVERAGE
165	LOG VOL2	1	6	SNAPSHOT & ZERO

10.10   DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

M PRES1/LO
M PRES1/HI
M PRES2/LO
M PRES2/HI
M TEMP1/LO
M TEMP1/HI
M TEMP2/LO
M TEMP2/HI
D PRES1/LO
D PRES1/HI
D PRES2/LO
D PRES2/HI
ORIF DIAM1
PIPE DIAM1
ZFLOW LIM1
TAP LCTN 1
ORIF DIAM2
PIPE DIAM2
ZFLOW LIM2
TAP LCTN 2
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF
TREF PIPE
SPEC GRAV
BTU
CO2
N2
VISCOSITY

(Continued on the next page)

SPEC HEAT
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
NONANE
DECANE
HELIUM
ARGON

10.11   ALARM DEFINITIONS

The following is a listing of the Alarm definitions for this application. Note that the alarms will show up in the event log.

Number of Retries: 5 for alarms 1 through 9, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
1	C(19) < X	LOW BATTER	16.0	10.8	0.0	0
2	C(20) < X*S(20,F) or C(20) > Y*S(20,F)	METR PRES1	1000.0	0.0	1.01	0
3	C(21) < X*S(21,F) or C(21) > Y*S(21,F)	METR PRES2	1000.0	0.0	1.01	0
4	C(22) < X*S(22,F) or C(22) > Y*S(22,F)	FLOW TEMP1	150.0	0.0	1.01	0
5	C(23) < X*S(23,F) or C(23) > Y*S(23,F)	DIFF PRES1	150.0	0.0	1.01	0
6	C(24) < X*S(24,F) or C(24) > Y*S(24,F)	DIFF PRES2	150.0	0.0	1.01	0
7*	C(25) < X*S(25,F) or C(25) > Y*S(25,F)	LIVE SG	100.0	0.0	1.01	0
8*	C(26) < X*S(26,F) or C(26) > Y*S(26,F)	FLOW TEMP2	150.0	0.0	1.01	0

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
9	C(210) < X or C(210) > Y	STN FLW RT	-	0.0	999999.0	0
10	C(30) <> 0.0	SYS ERROR	-	0.0	0.0	0

* These alarms should be disabled.

EXAMPLE:

Alarm # 2

    Y   =   1.01

S(20,F)   =   The full-scale value for channel 20, which is the static pressure transmitter. SolarFlow Plus automatically generates this value based on the full-scale value entered while in the SETUP UNIT submenu.

    F   =   1000 PSIG

Therefore, the alarm setpoint for alarm #2 is 1.01(1000) = 1010 PSIG.

When the ALARM menu is entered using the HHDT the user may modify the X, Y, or Z values shown in the above alarm conditions by changing the values for LOW, HIGH, and ALT. This enables the user to adjust the alarm limit(s) to match the requirements.

The value for X is represented by LOW on the HHDT ALARM SETUP menu. The value for Y is represented by HIGH on the HHDT ALARM SETUP menu. The value for Z is represented by ALT on the HHDT ALARM SETUP menu.

The ALARM menu is also used to acknowledge alarms and to activate or deactivate alarms.

To acknowledge an alarm condition displayed on the LCD of SolarFlow Plus, enter the ALARM menu of the HHDT and select the ACKNOWLEDGE sub-menu. Any existing unacknowledged alarms are displayed and the HHDT prompts: "ACKNOWLEDGE ? Y/N". Press the ENTER key to acknowledge the alarm. Once this has been done and the user has logged off SolarFlow Plus the activated alarm is displayed with the message "ACKNOWLEDGED" following the alarm condition. If the alarm condition no longer exists and has not been acknowledged it remains on the LCD until acknowledged.

To activate or deactivate alarms, enter the HHDT ALARM menu and select the SETUP sub-menu. The HHDT displays the various alarms that are available in the program. Scroll to the desired alarm and press the ENTER key at the desired alarm condition. The HHDT provides four options; STAT, LOW, HIGH, and ALT. Press ENTER at the STAT option. The HHDT shows either ON or OFF and prompts OK?. To turn off the alarm, press the NO key until OFF is displayed, then press ENTER.

11.0   BIDIRECTIONAL DUAL ORIFICE APPLICATION

Section 11 covers the individual requirements for the bidirectional dual orifice application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The bidirectional dual orifice application supports measurement on two meter tubes with a common temperature and meter (static) pressure. Note that the station rates and volumes represent meter run No. 1 <u>minus</u> meter run No. 2 instead of the sum. MODBUS communications are available with this application. Optional capabilities such as valve positioning, chromatograph inputs, etc. are listed as part of the setup. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). Channels 1 and 2 are digital inputs which indicate whether an analog input is used for live specific gravity and BTU respectively. To select fixed values, these inputs should be jumpered to ground; for live values, the inputs should be left open. Analog inputs use channels 19 through 26. Any unused analog input should be jumpered to ground.

When the SolarFlow Plus is configured for a new application, all channels are set to default values, and the Alarm definitions, Log definition, User Report list, and Analog Input channels are set to the values corresponding to the configuration chosen. The event log remains intact, but the data log is emptied.

11.1   FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed.   Make sure that your slide switch settings are set in accordance with the information in paragraph 1.13.   No changes should be required unless the previously used application has been significantly different. Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2470 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

The wiring configuration for the bidirectional dual orifice analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters.

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure (factory installed)	White (Blue*) Green (Black*) Black (Red*)	23 26 25	Signal in + Analog ground 8 to 10 VDC
*	SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.			
	or			
20	EXTERNAL, static pressure (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	EXTERNAL, LIVE SG [1] [2] (to be installed by user)	Blue Black Red Shield	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, temperature (to be installed by user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	INTERNAL, differential pressure (DP) No.1 (factory installed)	Violet Black Gray	35 38 37	Signal in + Analog ground 8 to 10 VDC
	or			
23	EXTERNAL, differential (DP) No.1 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	EXTERNAL, DP No.2 (to be installed by user)	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
25	EXTERNAL, AUX ANLG7 (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	EXTERNAL, LIVE BTU (to be installed by user)		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

NOTES:

(1) Since fixed values are normally desired for BTU and SG, digital input channels 1 and 2 are factory-wired to ground. When live values are desired, remove the jumpers between pins 59 and 60, 52 and 61 on the rear termination board. The fixed values for BTU and the specific gravity are entered in the GAS DATA submenu of the SETUP UNIT menu by keying in the desired value. Refer to the System Wiring Diagram.

(2) Wire for connecting the external transmitter inputs is user-supplied.

(3) If only one meter run is used with this application, jumper the unused differential pressure inputs to analog ground e.g., if channels 24 or 25 are not used, jumper pin No. 39 to 42 and/or pin No. 43 to 46.

11.2   STATUS SIGNAL CONNECTIONS

This application supports status inputs that are activated by a dry contact closure between the status input pin number and common.

11.2.1   INPUTS

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
1	Live or fixed SG	LIVE SG	60 51 (GND)	Open, means use LIVE SG Shorted, means use FIXED SG
2	Live or fixed BTU	LIVE BTU	61 52 (GND)	Open, means use LIVE BTU Shorted, means use FIXED BTU
18	Chromatograph option	CHROM	68 59 (GND)	Open = no chromatograph Shorted, means use chromatograph

Following are valid combinations:

	CH 1	CH 2	CH 18
LIVE SG and BTU	No jumper	No jumper	No jumper
FIXED SG and BTU	Jumper/GND	Jumper/GND	No jumper
Serial Chromatograph	Jumper/GND	Jumper/GND	Jumper/GND

Note that serial chromatograph inputs require that SG and BTU be jumpered to ground as if fixed.

11.2.2   OUTPUTS

NOTE: All output signals from a SolarFlow Plus unit installed in a hazardous location must be isolated by means of intrinsic safety barriers.

This application has two form-A relays (mounted on the SolarFlow Plus PC board) that provide digital outputs for corrected station volume on Channels 5 and 6. The volume per pulse and the pulse period of the relays may be changed using the HHDT. Prompts for changing the relay volume per pulse (VPP 1 and VPP 2) and pulse period (PP 1 and PP 2) are included in the discussion of the CONFIG submenu of the SETUP UNIT menu.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	15 16	Form-A relay Common
6	Volume pulse output 2	VP 2	17 18	Form-A relay Common

TTL level outputs for the following channels are available at the termination board pin numbers shown in the following table.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output 1	VP 1	78 69	TTL Output Common
6	Volume pulse output 2	VP 2	79 70	TTL Output Common
7	Valve control open	OPEN 2	80 71	TTL Output Common
8	Valve control close	CLOSE 2	81 72	TTL Output Common
13	Channel Value Monitor Indication	CVM STATUS	84 75	TTL Output Common

---

11.2.3   ANALOG OUTPUT CONNECTIONS

This application provides two 1-5 VDC analog outputs.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
27	Flow rate output	FLW RT OUT	3 4	Analog output 1 Ground
28	Valve positioning	VALVE POS	1 2	Analog output 2 Ground

11.2.4   CHROMATOGRAPH INTER-CONNECTIONS

For more detail in wiring the Model 2251 Chromatograph Controller to the Model 2470, refer to the field wiring diagram in the Model 2470 systems Reference Manual.

MODEL 2251	MODEL 2470	
Signal Type	Pin No.	Signal Type
Serial out	102	DI in
Serial in	103	DI out
Ground	106	DI ground

11.3   SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the enhanced bidirectional dual orifice plate application that can be changed in the SETUP LOCATION menu are shown in the following table described by the HHDT prompt for the parameter, the factory-installed default value, and a blank space for entering the desired value if different from the factory default. Additional information on the SETUP LOCATION menu is provided in paragraph 5.10.1 of the Model 2470 System Reference Manual. For applications using MODBUS communications, refer to paragraph 1.11 in this manual.

HHDT PROMPT	DEFAULT	DESIRED
LOC NAME	BLANK LOCATION	_____
LOC ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE[1]	120	_____
USER REP[2]	****	_____
PCOMM RATE[3]	1200 BPS	_____
RTS DELAY[4]	0 1/100s	_____

NOTES: (1)   Refer to paragraph 5.10.1.6 in the Model 2470 System Reference Manual for a complete discussion of the SEC CODE prompt.

(2)   Refer to paragraph 5.10.1.7 in the Model 2470 System Reference Manual for a complete discussion of the USER REP prompt.

(3)   Refer to paragraph 5.10.1.8 in the Model 2470 System Reference Manual for a complete discussion of the PCOMM RATE prompt.

(4)   Refer to paragraph 5.10.1.9 in the Model 2470 System Reference Manual for a complete discussion of the RTS DELAY prompt.

11.4 SETUP UNIT MENU

The parameters for the enhanced bidirectional dual orifice plate application of SolarFlow Plus that can be changed in the submenus of the SETUP UNIT menu using the HHDT are tabulated as follows. The SETUP MENU has eight submenus: GENERAL, ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CONTROL, AND CALC DATA. The parameters are tabulated by the HHDT prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

11.4.1 GENERAL SUBMENU

The following parameters can be changed in the GENERAL submenu of the SETUP UNIT menu of the HHDT.

HHDT PROMPT	DEFAULT	DESIRED
UNIT NAME	BLANK UNIT	_____
UNIT ID	BLANK-ID	_____
CONTRCT HR	7 (0-23)	_____
LOG INTRVL	1 HOUR	_____
LOG DEFINE[1]		_____
RESET CMOD[2]	OFF	_____

NOTES: (1)   All data logs in the SolarFlow Plus memory are automatically erased and can no longer be recovered any time a change is made in the LOG DEFINE menu. Refer to paragraph 1.9 for a description of the LOG DEFINE prompt.

                     (2)   The RESET CMOD (Reset Calculations Module) prompt selects the calculation module for an alternate SolarFlow Plus application. RESET CMOD is discussed in detail in paragraph 5.10.2.1.6 in the Model 2470 SolarFlow Plus System Reference Manual.

11.4.2   ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu of the enhanced bidirectional dual orifice application provides for toggling between LIVE and FIXED values of the following analogs. The AUX1 key on the HHDT toggles the input between the fixed and live values. A fixed value is shown by an asterisk (*) following the analog value in the HHDT display. For additional information, refer to the Model 2470 System Reference Manual.

HHDT PROMPT	DEFAULT
METR PRES	0.0 PSIG
METR TEMP	0.0 DEG F
DIFF PRES1	0.0 InH2O
DIFF PRES2	0.0 InH20
AUX ANLG 7	0.0 %
BATTERY	0.0 VOLTS
LIVE SG	0.0000
LIVE BTU	0.0
FLW RT OUT	0.0 MCFH
VALVE POS	50.0 %

11.4.3   SCALES SUBMENU

The high- and low-scale values for the analogs shown in the following table can be modified in the SCALES submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.3 in the Model 2470 System Reference Manual for additional information about the SCALES submenu.

HHDT PROMPT	DEFAULT		DESIRED
SPAN COMP1	0.00	%	_____
SPAN COMP2	0.00	%	_____
M PRES/LO	0.0	PSIG	_____
M PRES/HI	1000.0	PSIG	_____
M TEMP/LO	0.0	DEG F	_____
M TEMP/HI	150.0	DEG F	_____
D PRES1/LO	0.0	InH2O	_____
D PRES1/HI	150.0	InH2O	_____
D PRES2/LO	0.0	InH2O	_____
D PRES2/HI	150.0	InH2O	_____
AUX 7 LOW	0.0	%	_____
AUX 7 HI	100.0	%	_____
LIVE SG/LO	0.50		_____
LIVE SG/HI	1.0		_____
BTU/LO	800.0		_____
BTU/HI	1200.0		_____
FLW RT LOW	0.0	MCFH	_____
FLW RT HI	5000.0	MCFH	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____

11.4.4   DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
OPEN 2	ON
CLOSE 2	OFF
OPEN 3	ON
CLOSE 3	OFF
CVM STATUS	OFF
OUTPUT 14	OFF
OUTPUT 15	OFF

11.4.5   CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu. Refer to paragraph 5.10.2.4 in the Model 2470 System Reference Manual for additional information about the CONFIG submenu.

HHDT PROMPT	SAMPLE VALUES			DESIRED
ORIF DIAM1	4.000	IN	IN	_____
PIPE DIAM1	8.071	INH2O		_____
ZFLOW LIM1	0.50			_____
TAP LCTN 1	0	IN		_____
ORIF DIAM2	4.000	IN		_____
PIPE DIAM2	8.071	IN		_____
ZFLOW LIM2	0.50			_____
TAP LCTN 2	0	PSIA		_____
ATMS PRES	14.73	PSIA		_____
PRES BASE	14.73	DEG F		_____
TEMP BASE	60			_____
AGA8 MTHD	0			_____
SG SELECT	0			_____
ORIF MTRL	1			_____
PIPE MTRL	0	DEG F		_____
TREF ORIF	68.0	DEG F		_____
TREF PIPE	68.0			_____
CHROM ADDR	1			_____
CHROM STRM	1			_____
VERSION	1.0			_____

11.4.6   GAS DATA

This enhanced SolarFlow Plus software can accept information from the Model 2251 Danalyzer Chromatograph Gas Controller. This option requires that a jumper be installed grounding digital Channel 18. Install the jumper between pin 68 and pin 59 on the termination board. In addition, the MODBUS communication address and the chromatograph stream No. desired must be programmed in by the HHDT (CONFIG SUBMENU). The Solarflow Plus will then poll the chromatograph once every four minutes automatically. Refer to paragraph 1.5.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.6000		_____
BTU	1000.0		_____
CO2	0.000	MOL%	_____
N2	0.000	MOL%	_____
VISCOSITY	0.0000092	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.000	MOL%	_____
ETHANE	5.000	MOL%	_____
PROPANE	0.000	MOL%	_____
H2O	0.000	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.000	MOL%	_____
BUTANE	0.000	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.000	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____
ARGON	0.000	MOL%	_____

11.4.7   CONTROL SUBMENU

The CONTROL submenu of the SETUP UNIT menu provides for entering the control values primarily for the valve positioning and tube switching. Refer to paragraphs 1.6 and 1.7 for more information.

HHDT PROMPT	DEFAULT		DESIRED
VPP 1	100.0	MCF	_____
PP 1	1	SEC	_____
VPP 2	100.0	MCF	_____
PP 2	1	SEC	_____
CVM CHAN #	0		_____
CVM LO LMT	0.0		_____
CVM HI LMT	5000.0		_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFH	_____
PRES SETPT	100	PSIG	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
DP LIMIT	0	InH2O	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

11.4.8   CALCULATED DATA

The CALC DATA submenu of the SETUP UNIT menu allows the user to determine the calculated values for specified application inputs. The values shown here are typical values and not default values.

HHDT PROMPT	SAMPLE VALUES	
AGA8 MTHD	0.0	
ZS	0.997811	
ZB	0.997811	
FLOW RATE1	0.0	MCFH
EV 1	1.03164	
CD 1	0.603166	
Y 1	0.999892	
FLW EXTN 1	94.841	
ZF 1	0.927767	
FLOW RATE2	0.0	MCFH
EV 2	1.000000	
CD 2	0.600000	
Y 2	1.000000	
FLW EXTN 2	0.0	
ZF 2	1.000000	
B - AGA8	0.033417	
C - AGA8	0.002236	
D - AGA8	0.266296	
K - AGA8	0.100912	
MOL WT.	16.7444	

11.5   DISPLAY MENU

The DISPLAY Menu of the HHDT provides for viewing the various setup parameters and calculated values in a SolarFlow Plus unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu. The Display menu has eight selections: ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CALC DATA and RATE/VOLS.

11.5.1   ANALOGS

METR PRES
METR TEMP
DIFF PRES1
DIFF PRES2
AUX ANLG 7
BATTERY
LIVE SG
LIVE BTU
FLW RT OUT
VALVE POS

11.5.2   SCALES

SPAN COMP1	LIVE SG/LO
SPAN COMP2	LIVE SG/HI
M PRES/LO	BTU/LO
M PRES/HI	BTU/HI
M TEMP/LO	FLW RT LOW
M TEMP/HI	FLW RT HI
D PRES1/LO	VLV POS LO
D PRES1/HI	VLV POS HI
D PRES2/LO	
D PRES2/HI	
AUX 7 LOW	
AUX 7 HI	

11.5.3   DISCRETES

LIVE SG
LIVE BTU
CHROM
VP 1
VP 2
CVM STATUS
OPEN 2
CLOSE 2
INPUT 3
INPUT 4
INPUT 9
INPUT 10
INPUT 16
INPUT 17
OPEN 3
CLOSE 3
OUTPUT 14
OUTPUT 15

11.5.4   CONFIG

ORIF DIAM1   TREF ORIF
PIPE DIAM1   TREF PIPE
ZFLOW LIM1   CHROM ADDR
TAP LCTN 1   CHROM STRM
ORIF DIAM2   VERSION
PIPE DIAM2
ZFLOW LIM2
TAP LCTN 2
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL

11.5.5   GAS DATA

SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H20
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

11.5.6   CONTROL

VPP 1
PP 1
VPP 2
PP 2
CVM CHAN #
CVM LO LMT
CVM HI LMT
VP MODE
FLW SETPNT
PRES SETPT
DEADBAND
SMALL STEP
LARGE STEP
FINE CNTRL
PRES CHAN#
OVRD PRESS
DP LIMIT
PRESET POS
UPDATE TIM
VALVE POS

11.5.7   CALC DATA

    AGA8 MTHD
    ZS
    ZB
    FLOW RATE1
    EV 1
    CD 1
    Y 1
    FLW EXTN 1
    ZF 1
    FLOW RATE2
    EV 2
    CD 2
    Y 2
    FLW EXTN 2
    ZF 2
    B - AGA8
    C - AGA8
    D - AGA8
    K - AGA8
    MOL WT.

11.5.8   RATE/VOLS

This application shows station flow rates and volumes as meter run No. 1 minus meter run No. 2.

      FLOW RATE1   (MCFH)
      FLOW RATE1   (MCFD)
      TODAY VOL1
      YSDAY VOL1
      TOT VOL 1
      FLOW RATE2   (MCFH)
      FLOW RATE2   (MCFD)
      TODAY VOL2
      YSDAY VOL2
      TOT VOL 2
      STN FLW RT   (MCFH)
      STN FLW RT   (MCFD)
      ST TDY VOL
      ST YSY VOL
      ST TOT VOL
      ERATE 1
      TDY ENRGY1
      YSY ENRGY1
      TOT ENRGY1
      ERATE 2
      TDY ENRGY2
      YSY ENRGY2
      TOT ENRGY2
      STN ERATE
      TDY ENERGY
      YSY ENERGY
      TOT ENERGY

11.6   CALIBRATE UNIT MENU

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the outputs of the transmitters for analog inputs to the SolarFlow Plus unit. The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

11.6.1   PRESSURES

The PRESSURES selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

    METR PRES
    DIFF PRES1
    DIFF PRES2

11.6.2   TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the METR TEMP selection.

11.6.3   OTHERS

The analog inputs listed as follows are calibrated in the OTHERS submenu of the CALIBRATE UNIT MENU:

    AUX ANLG 7
    LIVE SG
    LIVE BTU

11.7   MONITOR MENU

The MONITOR menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs listed are available in the MONITOR menu in the triple orifice application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

        METR PRES
        METR TEMP
        DIFF PRES1
        DIFF PRES2
        AUX ANLG 7
        LIVE SG
        LIVE BTU

11.8   USER REPORT (CHANNEL 0)

Channel zero (0) is a predefined report list containing a report header and the channel data shown in the following table. The SolarFlow Plus unit displays the Users Report on the front panel in a scrolling format.

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
020	FLOW PRES1	Live pressure meter No.1 in PSIG
022	FLOW TEMP1	Live temperature in degrees Fahrenheit (°F)
023	DIFF PRES1	Live DP, Run No.1, value in inches of water
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
021	LIVE SG	Live value for specific gravity
133	FLOW RATE1	Flow rate for meter No.1
138	TOT VOL 1	Total volume for meter No.1
163	FLOW RATE2	Flow rate for meter No.2
168	TOT VOL 2	Total volume for meter No.2
213	ST TDY VOL	Station today's volume for meter No.1 minus meter No.2
214	YSDAY VOL	Station yesterday's volume for meter No.1 minus meter No.2

11.9 DATA LOG LIST CONTENTS

The following items are included on the data log. The data log is set to a 1-hour log interval. The default contract hour is 7:00 am.

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
023	DIFF PRES1	2	6	AVERAGE
020	FLOW PRES1	2	6	AVERAGE
022	FLOW TEMP1	1	4	AVERAGE
132	FLW TIME 1	1	6	SNAPSHOT & ZERO
131	FLW EXTN 1	2	6	AVERAGE
135	LOG VOL1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	2	6	AVERAGE
162	FLW TIME 2	1	6	SNAPSHOT & ZERO
161	FLW EXTN 2	2	6	AVERAGE
165	LOG VOL2	1	6	SNAPSHOT & ZERO

11.10   DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

        M PRES/LO
        M PRES/HI
        M TEMP/LO
        M TEMP/HI
        D PRES1/LO
        D PRES1/HI
        D PRES2/LO
        D PRES2/HI
        ORIF DIAM1
        PIPE DIAM1
        ZFLOW LIM1
        TAP LCTN 1
        ORIF DIAM2
        PIPE DIAM2
        ZFLOW LIM2
        TAP LCTN 2
        ATMS PRES
        PRES BASE
        TEMP BASE

Data Log Header Block (Continued)

AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF
TREF PIPE
SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

11.11   ALARM DEFINITIONS

The following is a listing of the Alarm definitions for this application. Note that the alarms will show up in the event log.

Number of Retries: 5 for alarms 1 through 9, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	**X**	**Y**	**Z**
1	$C(19) < X$	LOW BATTER	16.0	10.8	0.0	0
2	$C(20) < X*S(20,F)$ or $C(20) > Y*S(20,F)$	METR PRES1	1000.0	0.0	1.01	0
3*	$C(25) < X*S(25,F)$ or $C(25) > Y*S(25,F)$	LIVE SG	1.0	0.0	1.01	0
4	$C(22) < X*S(22,F)$ or $C(22) > Y*S(22,F)$	FLOW TEMP1	150.0	0.0	1.01	0
5	$C(23) < X*S(23,F)$ or $C(23) > Y*S(23,F)$	DIFF PRES1	150.0	0.0	1.01	0
6	$C(24) < X*S(24,F)$ or $C(24) > Y*S(24,F)$	DIFF PRES2	150.0	0.0	1.01	0
7*	$C(25) < X*S(25,F)$ or $C(25) > Y*S(25,F)$	AUX ANALG7	-	0.0	1.01	0
8*	$C(26) < X*S(26,F)$ or $C(26) > Y*S(26,F)$	LIVE BTU	1200	0.0	1.01	0

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	VARIABLE VALUES			
			F	X	Y	Z
9	C(210) < X or C(210) > Y	STN FLW RT	-	0.0	999999.0	0
10	C(30) <> 0.0	SYS ERROR	-	0.0	0.0	0

* These alarms should be disabled.

EXAMPLE:

Alarm # 2

Y $\quad$ = $\quad$ 1.01

S(20,F) $\quad$ = $\quad$ The full-scale value for channel 20, which is the static pressure transmitter. SolarFlow Plus automatically generates this value based on the full-scale value entered while in the SETUP UNIT submenu.

F $\quad$ = $\quad$ 1000 PSIG

Therefore, the alarm setpoint for alarm #2 is 1.01(1000) = 1010 PSIG.

When the ALARM menu is entered using the HHDT the user may modify the X, Y, or Z values shown in the above alarm conditions by changing the values for LOW, HIGH, and ALT. This enables the user to adjust the alarm limit(s) to match the requirements.

The value for X is represented by LOW on the HHDT ALARM SETUP menu. The value for Y is represented by HIGH on the HHDT ALARM SETUP menu. The value for Z is represented by ALT on the HHDT ALARM SETUP menu.

The ALARM menu is also used to acknowledge alarms and to activate or deactivate alarms.

To acknowledge an alarm condition displayed on the LCD of SolarFlow Plus, enter the ALARM menu of the HHDT and select the ACKNOWLEDGE sub-menu. Any existing unacknowledged alarms are displayed and the HHDT prompts: "ACKNOWLEDGE ? Y/N". Press the ENTER key to acknowledge the alarm. Once this has been done and the user has logged off SolarFlow Plus the activated alarm is displayed with the message "ACKNOWLEDGED" following the alarm condition. If the alarm condition no longer exists and has not been acknowledged it remains on the LCD until acknowledged.

To activate or deactivate alarms, enter the HHDT ALARM menu and select the SETUP sub-menu. The HHDT displays the various alarms that are available in the program. Scroll to the desired alarm and press the ENTER key at the desired alarm condition. The HHDT provides four options; STAT, LOW, HIGH, and ALT. Press ENTER at the STAT option. The HHDT shows either ON or OFF and prompts OK?. To turn off the alarm, press the NO key until OFF is displayed, then press ENTER.

WARRANTY CLAIM REQUIREMENTS

To make a warranty claim, you, the Purchaser, must:

1.   Provide Daniel with proof of the Date of Purchase and proof of the Date of Shipment of the product in question.

2.   Return the product to Daniel within twelve (12) months of the date of original shipment of the product, or within eighteen (18) months of the date of original shipment of the product to destinations outside of the United States. The Purchaser must prepay any shipping charges. In addition, the Purchaser is responsible for insuring any product shipped for return, and assumes the risk of loss of the product during shipment.

3.   To obtain Warranty service or to locate the nearest Daniel office, sales, or service center call (281) 897-2900, Fax (281) 897-2901, or contact:

Daniel Measurement Services
19203 Hempstead Highway
Houston, Texas 77065

When contacting Daniel for product service, the purchaser is asked to provide information as indicated on the following "Customer Problem Report".

Daniel Measurement Services offers both on call and contract maintenance service designed to afford single source responsibility for all its products.

Daniel Industries, Inc. reserves the right to make changes at any time to any product to improve its design and to insure the best available product.

DANIEL INDUSTRIES, INC.
CUSTOMER PROBLEM REPORT

FOR FASTEST SERVICE, COMPLETE THIS FORM, AND RETURN IT ALONG WITH THE AFFECTED EQUIPMENT TO CUSTOMER SERVICE AT THE ADDRESS INDICATED BELOW.

COMPANY NAME:_____

TECHNICAL CONTACT:_____ PHONE:_____

REPAIR P. O. #:_____ IF WARRANTY, UNIT S/N: _____

    INVOICE ADDRESS:_____

    _____

    _____

    SHIPPING ADDRESS:_____

    _____

    _____

RETURN SHIPPING METHOD:_____

EQUIPMENT MODEL #:_____ S/N:_____FAILURE DATE: _____

DESCRIPTION OF PROBLEM: _____

_____

_____

WHAT WAS HAPPENING AT TIME OF FAILURE?_____

_____

ADDITIONAL COMMENTS: _____

_____

_____

REPORT PREPARED BY:_____ TITLE:_____

IF YOU REQUIRE TECHNICAL ASSISTANCE, PLEASE FAX OR WRITE THE MAIN CUSTOMER SERVICE DEPARTMENT AT:

DANIEL MEASUREMENT SERVICES   PHONE: (281) 897-2900
ATTN: CUSTOMER SERVICE   FAX: (281) 897-2901
19203 HEMPSTEAD HIGHWAY
HOUSTON, TEXAS 77065

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The sales and service offices of Daniel Industries, Inc. are located
throughout the United States and in major countries overseas.
Please contact Daniel Measurement Services at
19203 Hempstead Highway, Houston, Texas 77065, or phone (281) 897-2900
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