

MODEL 2470 SOLARFLOW PLUS

ENRON ENHANCED SOLARFLOW PLUS APPLICATION MANUAL

"ENRON AGA3, AGA7, 7/3"

HHDT EPROM 8-2470-105
LD EPROM 8-2470-103
LC EPROM 8-2470-104

**Part Number 3-9003-153
Revision D**

OCTOBER 1998

DANIEL

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**DANIEL INDUSTRIES, INC.
MODEL 2470 SOLARFLOW PLUS
ENRON ENHANCED SOLARFLOW PLUS
WITH MODBUS COMMUNICATIONS
APPLICATION MANUAL**

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INTRODUCTION

ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS

1.0 INTRODUCTION

The Model 2470 Enhanced SolarFlow Plus software applications 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 ENRON version of the enhanced SolarFlow Plus software does not have a digital gas chromatograph interface but has MODBUS communications. Section 1 discusses some of the common functions of these applications. The specific differences are covered in the sections devoted to the separate applications.

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 both orifice and turbine/PD meter applications. This software supports all eleven applications listed in this manual. Some of the functions listed on the HHDT may not be used in a specific application. Skip the particular items that are not used in the selected application. 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 Handheld Data Terminal (HHDT). The System Reference manual, together with this application manual, provides a complete information package for 11 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 11 different applications (orifice and turbine/PD)
- 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 alarm list
- MODBUS communications

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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:

- Serves as a 1 or 2-run orifice meter application using the new flow equations
- Serves as a 1 or 2-run turbine/PD meter application using the new flow equations
- Supports AGA-8 according to the new standard (both detail and gross methods)
- Allows the user access to spare analog inputs and their scales
- Supports tube switching for dual meter run configurations
- 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
- Supports MODBUS communications

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 11 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.

NEW ENHANCED APPLICATIONS

ENRON AGA3 SNGL ORIF

ENRON AGA3 DUAL ORIFICE (1P1T)*

ENRON AGA3 DUAL ORIFICE (2P1T)*

ENRON AGA3 DUAL ORIFICE (2P2T)*

ENRON AGA7 SNGL TURBINE/PD

ENRON AGA7 DUAL TURBINE/PD (1P1T)*

ENRON AGA7 DUAL TURBINE/PD (2P1T)*

ENRON AGA7 DUAL TURBINE/PD (2P2T)*

ENRON AGA7/3 DUAL TURBINE/ORIFICE 1P1T*

ENRON AGA7/3 DUAL TURBINE/ORIFICE (2P1T)*

ENRON AGA7/3 DUAL TURBINE/ORIFICE (2P2T)*

* Refers to pressure (P) and temperature (T) analog inputs for the various applications.

All of these applications are implemented in a single EPROM set which is supported by a single HHDT EPROM. 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.

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1.4 CALCULATIONS

The calculations in the SolarFlow Plus are 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 FOR ORIFICE UNITS

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:

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

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

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

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
- F_{wv} = water vapor 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.

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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 Plus channels.

The quantity, $\sum \text{sqrt}(P_{fi} * h_w)$, 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 COGM document on electronic flow meters.

1.4.3 ANALOG INPUT SAMPLING AND UNCORRECTED RATE CALCULATION (AGA-7)

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 four inputs to be used in each configured meter run (i.e. eight averages total in a 2-run configuration). These values are flow averages for measured static pressure in PSIG, temperature, specific gravity (regardless of source), and BTU content (regardless of source).

A meter is considered to be flowing if the uncorrected flow rate for that meter is above zero. If no flow occurs for an entire calculation cycle, straight averages are kept for all inputs.

Each 0.5 seconds, the uncorrected flow rates for each configured meter are updated. The uncorrected flow rate is:

$$Q_u = (\text{PULSES})/(\text{METER FACTOR} * T_r)$$

where

Q_u = Uncorrected rate in actual cubic feet/h (ACF/H)

Pulses = The number of pulses used in rate calculation

Meter Factor = In pulses per actual cubic foot/hour (PP/CF)

T_r = Time in hours over which the pulses were received
 T_r may vary between 2.5 and 60 seconds.

SolarFlow Plus attempts to provide the best rate approximation possible while still providing a responsive uncorrected rate value. At very low input frequencies the rate is smoothed over as much as 60 seconds; at frequencies above approximately 160Hz the rate is smoothed over a period of 2.5 seconds. The approximate uncertainty and bounce in the uncorrected rate value is shown vs. frequency as follows:

<u>Frequency</u>	<u>Uncertainty</u>
< 2 pulses/minute (ppm)	N/A -- rate = 0.0
2-4 ppm	~ 3%
4-10 ppm	< 2%
10 ppm - 6.5Hz	~ 1%
6.5Hz - 160Hz	≤ 0.25%
> 160Hz	< 0.25%

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1.4.4 FLOW RATE EQUATIONS

The SolarFlow Plus AGA-7 applications calculate volumetric flow rate using the following equations:

$$Q_b = 0.001 * Q_u * CF \text{ (correction factor)}$$

$$V_u = PP / \text{(meter factor)}$$

$$V_c = V_u * CF$$

$$CF = \frac{(P_f + P_{atm})}{(P_b)} * \frac{(T_b + 459.67)}{(T_f + 459.67)} * \frac{Z_b}{Z_f} * F_{wv}$$

where :

- Q_b = volumetric flow rate in MCFH at base conditions
- V_u = uncorrected volume this cycle
- V_c = corrected volume this cycle
- CF = correction factor
- P_b = base pressure in PSIA
- P_{atm} = atmospheric pressure in PSIA
- P_f = line pressure in PSIG
- Z_b = gas compressibility at base conditions
- Z_f = gas compressibility at flowing conditions
- F_{wv} = water vapor factor
- T_f = flowing temperature in DEG F
- T_b = base temperature in DEG F
- pp = pulses received this calculation cycle

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 AGA Report No. 8. 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 Plus channels.

1.4.5 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

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.

1.4.6 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.

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1.5 TUBE SWITCHING

The double run configurations in the SolarFlow Plus support meter tube switching based on differential pressure (DP) and/or uncorrected flow rate. In AGA-3 or orifice plate settings, DP is used to perform meter tube switching. In AGA-7 or turbine/PD meter settings, uncorrected flow rate is used to perform meter tube switching. 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. 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 (or uncorrected flow rate) 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 (or uncorrected flow rate) 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 (or uncorrected flow rate) must remain above or below the switching setpoint before the control will occur.

For example, if the delay is 30 seconds and DP (or uncorrected flow rate) 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. After the valve travel time elapses, all control relays are deactivated. If you wish to leave the controls latched, the valve travel time should be set to zero (0).

1.6 VALVE POSITIONING

The SolarFlow Plus provides flow rate control based on rate or rate with pressure over-ride and also supports differential pressure over-range protection. The SolarFlow Plus controls the flow rate 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
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.

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1.6.1 DIFFERENTIAL OVER-RANGE PROTECTION

The differential (or uncorrected flow rate) 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 (or uncorrected flow rate) on the primary meter run is compared to the over-range limit. If the DP (or uncorrected flow rate) is below the over-range limit, valve positioning continues based on the selected mode. If the DP (or uncorrected flow rate) 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.

1.6.2 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 MCF/D
Small step	0.1 %
Deadband	1 %
Large step	0.3 %
Fine control	
Error limit	5 %

If the observed flow rate is below 475 MCFD, 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 MCFD, 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 MCFD, 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 Plus 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.

1.6.3 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.

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1.6.4 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.

1.6.5 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.

1.7 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.

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1.8 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:

<u>Date</u>	<u>Time</u>	<u>METR TEMP</u>	<u>METR PRES</u>	<u>DIFF PRES</u>	<u>TODAY VOL</u>
<u>U-Range</u>	<u>O-Range</u>	<u>Misc.</u>			
MM/DD/YY	HH:MM	xxxx	xxxx	xxxx	xxxx
.....			

The enhanced version of these miscellaneous bits is as follows:

<u>Dot No.</u>	<u>System Conditions</u>	<u>Weight in CH 30</u>
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.

1.9 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 1.9.1.*** 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	OFF	PD meter No. 2 active
S1-2	OFF	Turbine meter No. 2 active
S3-1	OFF	PD meter active
S3-2	OFF	Turbine meter active
S2-1	ON	Always ON
S2-2	N/A	Reserved for future use
S2-3	N/A	Reserved for future use
S2-4	ON	For a DP transmitter using orifice meters
S2-4	OFF	For stacked DP transmitters using orifice meters
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

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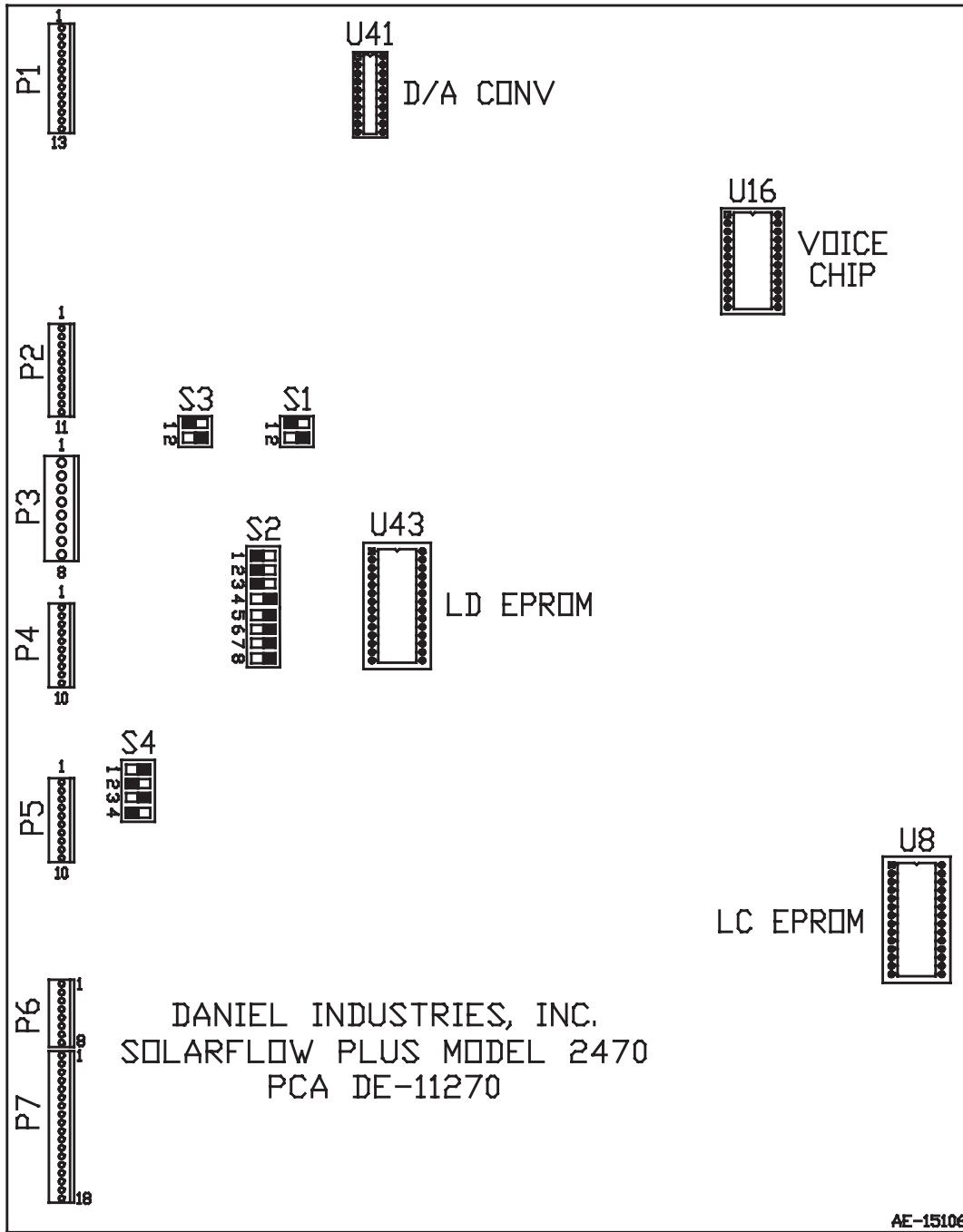


Figure 1. Model 2470 Slide Switch Locations
(PC Board Assembly Part No. 3-2470-000)

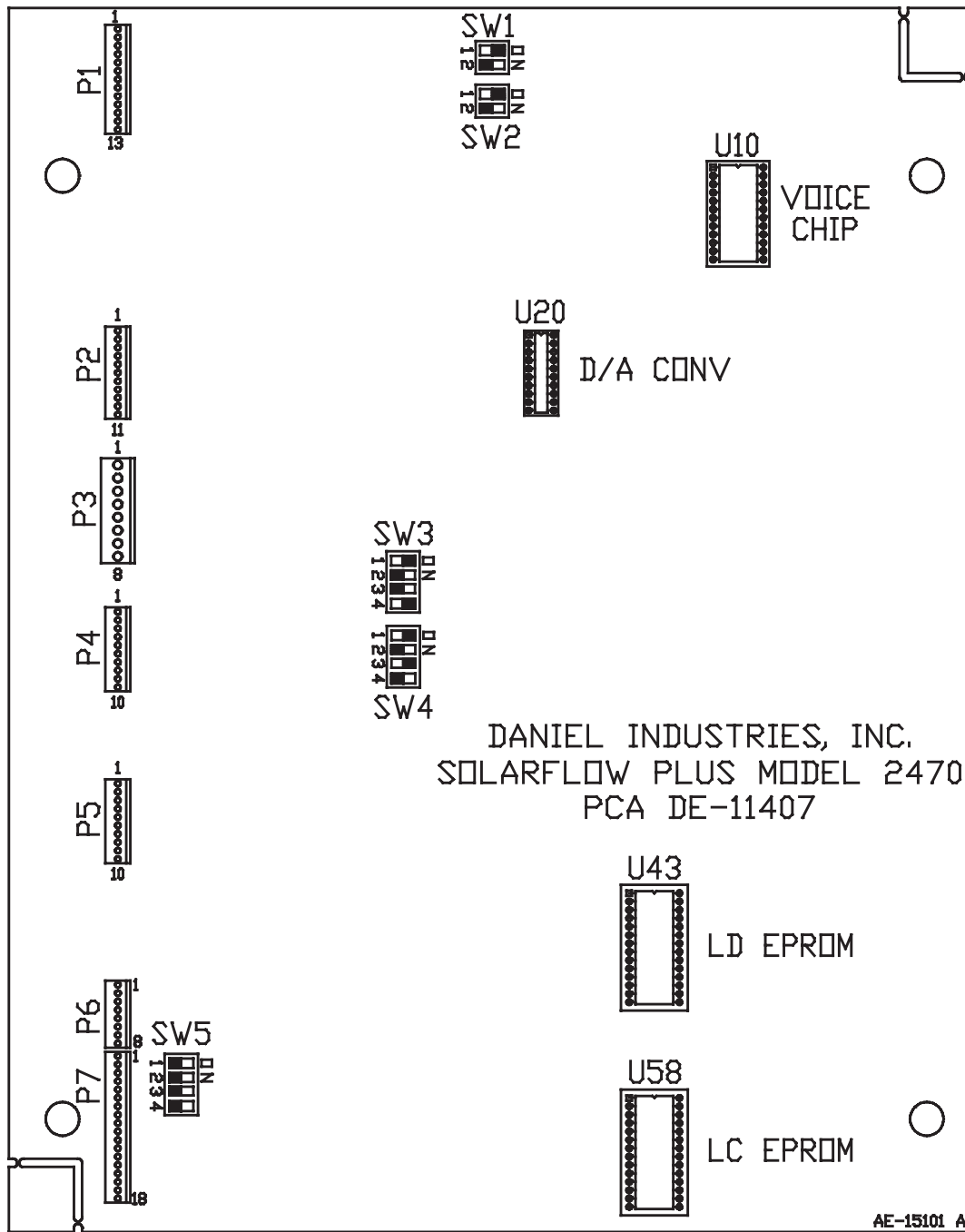


Figure 2. Model 2470 Slide Switch Locations
(PC Board Assembly Part No. 3-2470-008)

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1.9.1 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	ON	For a DP transmitter using orifice meters
SW3-4	OFF	For stacked DP transmitters using orifice meters
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

1.10 MODBUS COMMUNICATIONS

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 defaults for Master Serial Port Communications Protocol for Enron Modbus are:

1200 Baud
Even parity
7 Data bits
1 Stop bit

All Modbus registers are four byte IEEE floating point.

The daily and hourly archive data are accessed using the archive registers. The Audit Trail is accessed using the special purpose register number 32.

The following register ranges and their associated data types are supported by SolarFlow Plus:

<u>Registers</u>	<u>Data Type</u>	<u>Register Size</u>
700-799	Archive File	1 file per register
1000-1999	Boolean	1 bit (8 per byte)
3000-4999	Integer	2 bytes (16 bit)
5000-6999	Integer	4 bytes (32 bit)
7000-8999	IEEE Float	4 bytes
9000-9999	String data	20 bytes

1.10.1 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:

	<u>TB PIN NO.</u>
D0 = low (grounded)	92
D1 = high (open)	93
D2 = high (open)	94

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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 broadcast 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.

1.10.2 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

1.10.3 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 Plus 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.

1.10.4 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.

1.10.5 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 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.

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1.11 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.

1.11.1 GENERAL MODBUS MESSAGE FORMAT

Each message, either to or from the SolarFlow, conforms to the following general format:

PACKAGE HEADER / MODBUS MESSAGE / TRAILER

For the SolarFlow Plus MODBUS Ascii implementation, the header consists of an ascii ':' character. The package trailer consists of the LRC followed by a CRLF (carriage return and line feed). This framing is consistent with Gould MODBUS, and a description of the LRC calculation may be found in Gould's documentation. The data contained in the message portion is binary data, but is transmitted in Ascii Hex format. This means that each byte of binary data will be transmitted as two bytes which are the Ascii Hex representation of the data.

For the MODBUS RTU protocol (not currently supported in the SolarFlow Plus), the package header is not transmitted information, but is defined as a time duration of longer than 3 character transmission times in which no data is received. The transmitted data begins with the message itself. The package trailer is the CRC-16. The data transmitted in the message portion is transmitted in raw binary format.

Other than the differences noted above, the Ascii and RTU versions of the MODBUS protocol are identical. The remainder of this document makes no further distinction between them.

1.11.2 MODBUS ERROR MESSAGES

When the SolarFlow receives a proper MODBUS message format, but the content of the message is in error, an error response is returned to the host. The format of the error response is:

ADDRESS / FN CODE + 80 H / ERROR CODE

Valid error codes are:

- 1 - Illegal Function code
- 2 - Illegal Data Address (register number)
- 3 - Illegal Data Value

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1.11.3 MODBUS BROADCAST MESSAGES

Any valid write message may be sent to all SolarFlow units on a communications channel by addressing the poll to unit #0. This is an excellent way to synchronize the clocks of all slaves.

1.11.4 SUPPORTED FUNCTION CODES

Read Boolean Registers (Fn 01)

This function is used to retrieve the value of one or more boolean registers. The format of the message and response is consistent with the Gould definition.

Poll format:

ADDRESS / FN CODE (01) / START REG / REG COUNT

Response format:

ADDRESS / FN CODE / BYTE COUNT / DATA

The data is returned packed eight bits (registers) per byte, with bit 0 of the first data byte being the first requested register, bit 1 the next register etc...

Read Registers (03)

This function is used to retrieve the value of one or more registers. The byte count of the response will depend on the data type implied by the register number. For instance, reading two string registers will return 40 bytes of data.

Poll format:

ADDRESS / FN CODE (03) / START REG / REG COUNT

Response format:

ADDRESS / FN CODE / BYTE COUNT / DATA

Write Single Boolean Register (Fn 05)

Poll format:

ADDRESS / FN CODE (05) / REGISTER / 0 or OFFH

Response format:

ADDRESS / FN CODE / REGISTER / 0 or OFFH

To write a single boolean register, the register number and the new state are sent to the SolarFlow Plus. The response to this poll is an echo of the command. If a read only register is specified, an error is returned.

Write Single Register (06)

This function is used to set the value of a register. The byte length of the data field is dependent on the data type implied by the register number.

Poll format:

ADDRESS / FN CODE (06) / REGISTER / VALUE

Response format:

ADDRESS / FN CODE / REGISTER / VALUE

To write a register, the register number and the new value are sent to the SolarFlow Plus. The response to this poll is an echo of the command. If a read only register is specified, an error is returned.

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Write Multiple Boolean Registers (Fn 15)

This function is used to set the value of one or more boolean registers. The format of the message and response is consistent with the Gould definition.

Poll format:

ADDR / FN CODE / STRT REG / REG CNT / BYTE CNT / DATA

Response format:

ADDR / FN CODE / STRT REG / REG CNT

The byte count field is a single byte containing the number of bytes of data in the data field. The data is sent packed eight bits (registers) per byte, with bit 0 of the first data byte being the first requested register, bit 1 the next register etc...

If any of the registers implied by the start register and the register count are read only, an error response will be returned.

Write Multiple Registers (Fn 16)

This function is used to set the value of one or more registers. The byte length of the data field is dependent on the data type implied by the register number.

Poll format:

ADDR / FN CODE / STRT REG / REG CNT / BYTE CNT / DATA

Response format:

ADDR / FN CODE / STRT REG / REG CNT

The byte count field is a single byte containing the number of bytes of data in the data field. The data is sent in the format determined by the register number.

If any of the registers implied by the start register and the register count are read only, an error response will be returned.

1.11.5 READING OR SETTING THE SOLARFLOW PLUS TIME

The SolarFlow Plus time is available in the last 6 registers in the 3000 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 6. 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 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.

1.11.6 READING ARCHIVE DATA

To read data from a SolarFlow Plus Archive file, the host issues a poll using function code 3. The start register field specifies the archive register number, and the field normally used for register count is redefined to be the record index. The record index is a 16-bit unsigned integer which is incremented each time a new record is entered in an archive. There is a separate index for each archive file. When the index eventually reaches 840 for hourly archives, or 35 for daily archives, it increments back to one (1) on the next record.

The record index is initialized to zero (0) on unit coldstart. To retrieve the very first record entered in the archive, the host would issue a poll for record #1. If the host asks for a record which does not exist (such as the 100th entry in an archive with only 90 records), the unit returns a blank record which is all zeroes.

To assist the host in determining which data has been previously read from a unit, the SolarFlow Plus maintains the last index number read and the current value of the index for each archive. These indexes are made available to the host computer in the 3000 series registers. Since some ambiguity always exists in the SolarFlow Plus as to which records have been transferred to the host without communication errors, the host should keep its own copies of the last successfully retrieved record index.

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Poll format:

ADDRESS / FN CODE (03) /ARCHIVE # / RECORD #

Response format:

ADDRESS / FN CODE /BYTE COUNT / DATA

The SolarFlow Plus always returns exactly one record. To retrieve all previously unreported archive records, the host should poll the SolarFlow Plus for the current record index and last index read. The difference between these values is the number of unreported records (after accounting for the MODULO 840 or 35). If these values are not the same, the host should poll the unit for records after the last reported index up to and including the most current index.

Because of irregularities in logging from such circumstances as system shut downs, power ups, and clock changes, the time stamps on sequential records may not always be in order. The record index associated with the data indicates the actual sequence of the creation of the records.

1.12 ARCHIVE FILES (700 SERIES REGISTERS)

The SolarFlow Plus dedicates the 700 series registers to archive files. Each archive in the SolarFlow 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 formats of the archives in the SolarFlow are described as follows.

The historical data log record in the Enron SolarFlow Plus has a fixed format. The periodic and daily logs have the same format.

The format of the retrieved archive record for an orifice meter is:

Date Stamp	YYMMDD.0
Time Stamp	hhmmss.0
Average Flowing Differential	4 byte IEEE Float
Average Flowing Pressure	4 byte IEEE Float
Average Flowing Temperature	4 byte IEEE Float
Integrated Flow Extension	4 byte IEEE Float
Volume for log period	4 byte IEEE Float
Energy for log period	4 byte IEEE Float
Log Time (duration in minutes)	4 byte IEEE Float

The format of the retrieved archive record for a Turbine/PD meter is:

Date Stamp	YYMMDD.0
Time Stamp	hhmmss.0
Flow Time in minutes	4 byte IEEE Float
Average Flowing Pressure	4 byte IEEE Float
Average Flowing Temperature	4 byte IEEE Float
Uncorrected Volume for period	4 byte IEEE Float
Volume for log period	4 byte IEEE Float
Energy for log period	4 byte IEEE Float
Log Time (duration in minutes)	4 byte IEEE Float

The general format of the retrieved event record is:

Event Bit Map	2 bytes
Register Number	2 bytes
Time Stamp	hhmmss.0
Date Stamp	YYMMDD.0
Old Value	4 byte IEEE Float
New Value	4 byte IEEE Float

The Enron Enhanced SolarFlow is capable of storing the 150 most recent events.

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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.

The format of the messages sent and received by the SolarFlow for these function codes works exactly as detailed in the Gould MODBUS documentation.

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. The format of the messages sent and received by the SolarFlow for these function codes works exactly as detailed in the Gould MODBUS documentation.

The SolarFlow has no 32-bit integer registers. This register series is reserved to maintain compatibility with certain other Daniel Industries instrumentation.

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.

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.

1.13 SOLARFLOW PLUS MODBUS REGISTER ASSIGNMENTS

<u>Register</u>	<u>Description</u>	<u>(Read/Write)</u>
Archives		
701-702	Reserved	
703	35 Days Daily Run #1	R
704	840 Records Hourly Run #1	R
705	35 Days Daily Run #2	R
706	840 Records Hourly Run #2	R
707-720	Reserved	
Booleans		
1001-1018	SolarFlow Channels 1-18	R/W
1019-1024	Reserved	
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	
1097-1104	Analog Input Source (Live/Fixed) 1-8	R/W
1105-1106	Analog Output Source (Live/Fixed) 1-2	R/W
1107-1112	Reserved	

-
- NOTES:**
- (1) Alarm 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.
-

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SOLARFLOW PLUS MODBUS REGISTER ASSIGNMENTS (CONTINUED)

<u>Register</u>	<u>Description</u>	<u>(Read/Write)</u>
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	Current Number of Events	R
3006-3010	Reserved	
3011	Contract Hour(0-23)	R/W
3012	Periodic Data Log Interval Code	R/W
3013-4093	Reserved	
4094	Day of Month (1-31)	R/W
4095	Month (1-12)	R/W
4096	Year (1994 etc...)	R/W
4097	Hour (0-23)	R/W
4098	Minute (0-59)	R/W
4099	Second (0-59)	R/W

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

32 bit Integers

None

SOLARFLOW PLUS MODBUS REGISTER ASSIGNMENTS (CONTINUED)

<u>Register</u>	<u>Description</u>	<u>(Read/Write)</u>
IEEE float		
7001	Manufacturer's ID number	R
7002	RTU Operating System ID number	R
7003	RTU Firmware Revision Number	R
7004	Calculation Mudule Number	R
	1 = AGA3 single	
	2 = AGA3 dual with shared P & T	
	3 = AGA3 dual with shared T	
	4 = AGA3 dual with separate P & T	
	5 = AGA7 single	
	6 = AGA7 dual with shared P & T	
	7 = AGA7 dual with shared T	
	8 = AGA7 dual with separate P & T	
	9 = AGA7/3 dual with shared P & T	
	10 = AGA7/3 dual with shared T	
	11 = AGA7/3 dual with separate P & T	
7005-7009	Reserved	
7010	Location ID	R
7011	Unit ID	R
7012-7018	Reserved	
7019	Current Date	R/W
7020	Current Time	R/W
7021	Last Read Hourly Log Index	R
7022	Current Hourly Log Index	R
7023	Last Read Daily Log Index	R
7024	Current Daily Log Index	R
7025	Current Number of Events	R
7026-7030	Reserved	
7031	Contract Hour(0-23)	R/W
7032-7042	Reserved	
7043	Yesterday's Volume Run #1	R
7044	Yesterday's Volume Run #2	R
7045	SolarFlow Valve Positioning Setpoint	R
7046	Current Station Flow Rate Output	R

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SOLARFLOW PLUS MODBUS REGISTER ASSIGNMENTS (CONTINUED)

<u>Register</u>	<u>Description</u>	<u>(Read/Write)</u>
7047	Current Setpoint Output	R
7048	Current Station Energy Rate	R
7049	Today's Station Accumulated Energy	R
7050	Yesterday's Station Accumulated Energy	R
7051	Date (MMDDYY.0)	R
7052	Time (hhmm.ss)	R
7053	Current Battery Voltage	R
7054	Current Station Flow Rate	R
7055	Today's Station Accumulated Volume	R
7056	Yesterday's Station Accumulated Volume	R
7057	Current Flow Rate Run #1	R
7058	Current Flow Rate Run #2	R
7059	Current Differential Pressure Run #1	R
7060	Current Pressure Run #1	R
7061	Current Temperature Run #1	R
7062	Current Uncorrected Volume Run #1	R
7063	Current Volume Run #1	R
7064	Current Energy Run #1	R
7065	Current Differential Pressure Run #2	R
7066	Current Pressure Run #2	R
7067	Current Temperature Run #2	R
7068	Current Uncorrected Volume Run #2	R
7069	Current Volume Run #2	R
7070	Current Energy Run #2	R
7071	Spare Analog Input #1	R
7072	Spare Analog Input #2	R
7073	Spare Analog Input #3	R
7074	Reserved	
7075	Current Number of Events	R
7076	Current Hourly Index Pointer (1-840)	R
7077	Previous Hour Date	R
7078	Previous Hour Time	R
7079	Previous Hour Avg DP 1 / Flow Time 1	R
7080	Previous Hour Avg Pressure 1	R
7081	Previous Hour Avg Temperature 1	R

SOLARFLOW PLUS MODBUS REGISTER ASSIGNMENTS (CONTINUED)

<u>Register</u>	<u>Description</u>	<u>(Read/Write)</u>
7082	Previous Hour Extension 1 / Unc. Volume 1	R
7083	Previous Hour Volume 1	R
7084	Previous Hour Energy 1	R
7085	Previous Hour Log Duration	R
7086	Previous Hour Avg DP 2 / Flow Time 2	R
7087	Previous Hour Avg Pressure 2	R
7088	Previous Hour Avg Temperature 2	R
7089	Previous Hour Extension 2 / Unc. Volume 2	R
7090	Previous Hour Volume 2	R
7091	Previous Hour Energy 2	R
7092	Previous Hour Log Duration	R
7093-7094	Reserved	
7095	Current Number of Events	R
7096	Current Hourly Index Pointer (1-840)	R
7097	Previous Day Date	R
7098	Previous Day Time	R
7099	Previous Day Avg DP 1 / Flow Time 1	R
7100	Previous Day Avg Pressure 1	R
7101	Previous Day Avg Temperature 1	R
7102	Previous Day Extension 1 / Unc. Volume 1	R
7103	Previous Day Volume 1	R
7104	Previous Day Energy 1	R
7105	Previous Day Log Duration	R
7106	Previous Day Avg DP 2 / Flow Time 2	R
7107	Previous Day Avg Pressure 2	R
7108	Previous Day Avg Temperature 2	R
7109	Previous Day Extension 2 / Unc. Volume 2	R
7110	Previous Day Volume 2	R
7111	Previous Day Energy 2	R
7112	Previous Day Log Duration	R

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SOLARFLOW PLUS MODBUS REGISTER ASSIGNMENTS (CONTINUED)

<u>Register</u>	<u>Description</u>	<u>(Read/Write)</u>
7113-7120	Reserved	
7121-7360	SolarFlow Channels 1-240	R/W
7361-7380	Hi,Lo Scale values, channels 19-28	R/W
7381-7400	Reserved	
7401-7460	X, Y, Z Alarm limit values, Alarms 1-20	R/W
7461-7500	Reserved	
7501-7508	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

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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 groups of channels for information specific to each of the 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 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.

The following list is a comprehensive channel list for all 11 applications. The channels defined by a particular application are shown with the specific application.

ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS

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 through 004 are reserved for later use						
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 through 018 reserved for later use						

ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS

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 may 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					
020	FLOW PRES1	PSIG	1	0.0	Analog flow pressure
021	DIFF PRES1 SPARE 2	InH20	1	0.0	Analog differential pressure
022	FLOW TEMP1	DEG F	1	0.0	Analog flowing temperature
023	FLOW PRES2	PSIG	1	0.0	Analog flow pressure
024	DIFF PRES2 SPARE 3	InH20	1	0.0	Analog differential pressure 2
025	FLOW TEMP2	DEG F	1	0.0	Analog flowing temperature
026	SPARE 1	%	1	0.0	
027	FLW RT OUT	MCF/D	1	0.0	Analog Flow Rate/day
028	VALVE POS	%	1	50.0	Current Valve Position
029	VERSION		1	1.0	Software version
030	SYS ERROR		0	0	System alarm
031	DP CUTOFF	InH20	2	0.25	
032	ZFLOW LIM	SEC	0	15	Low flow cutoff
033	ATMS PRES	PSIA	2	14.70	Atmospheric pressure
034	PRES BASE	PSIA	2	14.73	Pressure base

**ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS**

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
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
040	VISCOSITY	#/FTS	7	0.0000069	Fluid viscosity
041	SPEC HEAT		2	1.30	Specific heat ratio
042	SG SELECT		0	1	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	0.5861	Current SG

ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
052	BTU	(None)	1		Current BTU
053	METHANE	MOL%	3	95.515	Methane MOL%
054	N2	MOL%	3	0.166	Nitrogen MOL%
055	CO2	MOL%	3	0.916	Carbon dioxide MOL%
056	ETHANE	MOL%	3	2.798	Ethane MOL%
057	PROPANE	MOL%	3	0.351	Propane MOL%
058	H2O	MOL%	3	0.000	Water MOL%
059	H2S	MOL%	3	0.000	Hydrogen Sulphide MOL%
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	0.093	I-butane MOL%
064	BUTANE	MOL%	3	0.077	Butane MOL%
065	I-PENTANE	MOL%	3	0.000	I-pentane MOL%
066	PENTANE	MOL%	3	0.000	Pentane MOL%
067	HEXANE	MOL%	3	0.084	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	LOG TIME	MIN	1	0.0	Duration of log

**ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS**

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
075	CLOSE LOGS	(None)	0		End of log
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
084	CLOSE 2 SP	InH2O	1	20.0	Valve 2 DP close
085	OPEN 2 SP	MACFD	0	4000	Valve 2 DP open
086	CLOSE 2 SP	MACFD	0	1000	Valve 2 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 1=flow rate only 2=rate w/upstrm pres ovrd 3=rate w/dnstrm pres ovrd
092	FLW SETPNT	MCF/D	0	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

ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
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	AFR LIMIT	MACFD	0	0	Actual flow rate over- range limit 0 = disabled
103 RESERVED					
104	FW MODE		0	0	0= Disabled 1= Operator entered 2= Calculated
105	H2O CNTENT	LB/MM	0	0	Water content; LBS per million cubic feet
106	FW FACTOR		5	1.00000	Water vapor factor
107-119 RESERVED					
120	ORIF DIAM1	IN	3	1.000	Meter 1 orifice diameter
121	PIPE DIAM1	IN	3	4.000	Meter 1 pipe diameter
122	TAP LCTN1	(None)	0	0	Tap location 0=downstream 1=upstream
123	METR FCTR1	PPCF	1	1.0	Meter factor in pulses per actual cubit foot
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

**ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS**

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
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
130	Y FCTR 1	(None)	6	1.000000	Expansion factor
131	FLOW PRES1	PSIG	1	0.0	Analog flowing pressure
132	FLOW TEMP1	DEG F	1	0.0	Analog flowing temperature
133	Reserved				
134	FLW EXTN 1	NONE	3	0.000	$\sum \text{sqrt}(H_w * P_f)$
135	CORR FCTR1	%	2	0.00	
136	FLW TIME 1	MIN	2	0.00	Flow time
137	FLOW RATE1	MCF/H	1	0.0	Hourly flow rate
138	FLOW RATE1	MCF/D	1	0.0	Daily flow rate
139	LOG VOL 1	MCF	0	0	Logged accumulated volume
140	TODAY VOL1	MCF	0	0	Daily accumulated volume
141	YSDAY VOL1	MCF	0	0	Ysday's accumulated volume
142	TOT VOL 1	MCF	0	0	Total accumulated volume (Rolls over @ 10,000,000)
143	ERATE 1	DTH/D	1	0.0	Energy flow rate/day
144	LOG ENRGY1	DTH	0	0	Logged accumulated energy
145	TDY ENRGY1	DTH	0	0	Today's accumulated energy

ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
146	YSY ENRGY1	DTH	0	0	Ysday's accumulated energy
147	TOT ENRGY1	DTH	0	0	Total accumulated energy (Rolls over @ 10,000,000)
148	UNCR RATE1	MACFD	1	0.0	Uncorrected rate/day
149	LOG UVOL1	MACFD	0	0	Uncorrected logged volume 1
150	TDY UVOL1	MACFD	0	0	Uncorrected today's volume 1
151	YSY UVOL1	MACFD	0	0	Uncorrected yesterday's volume 1
152	TOT UVOL1	MACFD	0	0	Uncorrected total volume 1
153-159 RESERVED					
160	ORIF DIAM2	IN	3	1.000	Meter 2 orifice diameter
161	PIPE DIAM2	IN	3	4.000	Meter 2 pipe diameter
162	TAP LCTN2	(None)	0	0	Tap location 0=downstream 1=upstream
163	METR FCTR2	PPCF	1	1.0	Meter factor in pulses per actual cubit foot
164	CORR OD2	IN	4	0.0000	Temp corrected orifice diameter 2
165	CORR PD2	IN	4	0.0000	Temp corrected pipe diameter 2
166	CORR BETA2	(None)	5	0.00000	Temp corrected Beta ratio
167	EV2	(None)	5	1.00000	Velocity of approach factor
168	CD 2	(None)	6	0.600000	Coefficient of discharge

**ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS**

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
169	ZF 2	(None)	6	1.000000	Flowing compressibility
170	Y FCTR 2	(None)	6	1.000000	Expansion Factor
171	FLOW PRES2	PSIG	1	0.0	Analog flowing pressure
172	FLOW TEMP2	DEG F	1	0.0	Flowing temperature 2
173	Reserved				
174	FLW EXTN 2	(NONE)	3	0.000	$\sum \text{sqrt}(H_w * P_f)$
175	CORR FCTR2	NONE	2	0.00	
176	FLW TIME 2	MIN	2	0.00	Flow time tube 2
177	FLOW RATE2	MCF/H	1	0.0	Hourly flow rate
178	FLOW RATE2	MCF/D	1	0.0	Daily flow rate
179	LOG VOL 2	MCF	0	0	Logged accumulated volume
180	TODAY VOL2	MCF	0	0	Today's accumulated volume
181	YSDAY VOL2	MCF	0	0	Ysday's accumulated volume
182	TOT VOL 2	MCF	0	0	Total accumulated volume (Rolls over @ 10,000,000)
183	ERATE 2	DTH/D	1	0.0	Energy flow rate
184	LOG ENRGY2	DTH	0	0	Logged accumulated energy
185	TDY ENRGY2	DTH	0	0	Today's accumulated energy
186	YSY ENRGY2	DTH	0	0	Ysday's accumulated energy
187	TOT ENRGY2	DTH	0	0	Total accumulated energy (Rolls over @ 10,000,000)

ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
188	UNCR RATE2	MACFD	1	0.0	Uncorrected flow rate/day
189	LOG UVOL2	MACF	0	0	Uncorrected logged volume 2
190	TDY UVOL2	MACF	0	0	Uncorrected today's volume 2
191	YSY UVOL2	MACF	0	0	Uncorrected yesterday's volume 2
192	TOT UVOL2	MACF	0	0	Uncorrected total volume 2
193-209 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	0	0	Station logged volume
213	ST TDY VOL	MCF	0	0	Station today's volume
214	YSDAY VOL	MCF	0	0	Station ysdays volume
215	ST TOT VOL	MCF	0	0	* Station total volume
216	STN ERATE	DTH/D	1	0.0	Station flow rate/day
217	LOG ENERGY	DTH/H	0	0	Station logged energy
218	TDY ST ENG	DTH	0	0	Station today's energy
219	YSY ST ENG	DTH	0	0	Station ysdays energy
220	TOT ENERGY	DTH	0	0	*Station total energy
221	STN UNC RT	MACFD	1	0.0	Station uncorrected rate/d
222	ST LG UVOL	MACFD	0	0	Station logged uncorrected volume/day
223	STN TDY UV	MACFD	0	0	Station today's uncorrected volume/day

ENHANCED CHANNEL ASSIGNMENTS
ENHANCED MODEL 2470 SOLARFLOW PLUS

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
224	STN YSY UV	MACFD	0	0	Station yesterday's uncorrected volume
225	ST TOT UV	MACFD	0	0	* Station total Uncorrected volume
226 - 240 Reserved					
* All totals roll over at 10,000,000 so adjust your units accordingly.					

SINGLE ORIFICE APPLICATION (SNGL) ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

3.0 SINGLE ORIFICE APPLICATION (SNGL)

Section 3 covers the individual requirements for the ENRON single orifice enhanced application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The single orifice application (ENRON AGA3 SNGL) supports measurement on a single meter tube. Optional capabilities such as valve positioning, tube switching, etc. are listed as part of the setup. This application supports MODBUS communications. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). 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 1.9. 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.

SINGLE ORIFICE APPLICATION (SNGL)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure Meter Tube No. 1(factory installed)	White (Blue ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
20	EXTERNAL, static pressure Meter Tube No.1 (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	INTERNAL, differential pressure (DP) No. 1 (factory installed)	Blue Black Red	27 30 29	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
21	EXTERNAL, differential pressure (DP) No. 1 (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 Meter Tube No. 1 (to be installed by user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	EXTERNAL, static pressure Meter Tube No.2 (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, differential (DP) Meter Tube 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

**SINGLE ORIFICE APPLICATION (SNGL)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____**

25	EXTERNAL, Meter temperature No. 2 (To be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	Spare No. 1		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
 - (3) Jumper any unused analog input to analog ground.
-

**SINGLE ORIFICE APPLICATION (SNGL)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS**

3.2 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 76	TTL output Common
6	Volume pulse output 2	VP 2	79 70	TTL output Common

**SINGLE ORIFICE APPLICATION (SNGL)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____**

3.2.1 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

3.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced single orifice plate application (ENRON AGA3 SNGL) 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 Section 1 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⁾	300 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.
-

SINGLE ORIFICE APPLICATION (SNGL)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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
FLOW PRES1	xxxxx PSIG
DIFF PRES1	xxxxx InH2O
FLOW TEMP1	xxxxx DEG F
SPARE 1	
FLW RT OUT	xxxxx MCFH
VALVE POS	xxxxx %

**SINGLE ORIFICE APPLICATION (SNGL)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____**

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
M PRES1/LO	0.0	PSIG	_____
M PRES1/HI	1000.0	PSIG	_____
D PRES1/LO	0.0	InH2O	_____
D PRES1/HI	100.0	InH2O	_____
M TEMP1/LO	0.0	DEG F	_____
M TEMP1/HI	150.0	DEG F	_____
SPARE 1/LO	0.0		_____
SPARE 1/HI	100.0		_____
FLW RT LOW	0	MCFD	_____
FLW RT HI	100000	MCFD	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____

SINGLE ORIFICE APPLICATION (SNGL)
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3.4.4 DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF

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ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____**

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	1.000 IN	_____
PIPE DIAM1	4.000 IN	_____
TAP LCTN 1	0	_____
DP CUTOFF	0.50 InH2O	_____
ATMS PRES	14.70 PSIA	_____
PRES BASE	14.73 PSIA	_____
TEMP BASE	60 DEG F	_____
AGA8 MTHD	0	_____
FW MODE	0 LB/mm	_____
H2O CNTENT	0	_____
CLOSE LOGS	0	_____

SINGLE ORIFICE APPLICATION (SNGL)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS

3.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

SINGLE ORIFICE APPLICATION (SNGL)
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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 1.6 for more information.

HHDT PROMPT	SAMPLE VALUES		DESIRED
VPP 1	100.0	MCF	_____
PP 1	1.0	SEC	_____
VPP 2	100.0	MCF	_____
PP 2	1.0	SEC	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFD	_____
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	%	_____

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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	0.0	MCFD	_____
CORR OD 1	4.0016	IN	_____
CORR PD 1	8.0732	IN	_____
CORR BETA1	0.49567		_____
EV 1	1.03164		_____
CD 1	0.603166		_____
ZF 1	0.947718		_____
Y 1	0.999892		_____
FW MODE	0		_____
H2O CNTENT	0	LB/mm	_____
FW FACTOR	1.00000		_____
AGA8 MTHD	0		_____
ZS	0.97811		_____
ZB	0.038190		_____
B - AGA8	0.927767		_____
C - AGA8	0.033417		_____
D - AGA8	0.002236		_____
K - AGA8	0.266296		_____
MOL WT.	16.7444		_____

**SINGLE ORIFICE APPLICATION (SNGL)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____**

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

FLOW PRES1
DIFF PRES1
FLOW TEMP1
SPARE 1
FLW RT OUT
VALVE POS

3.5.2 SCALES

M PRES1/LO
M PRES1/HI
D PRES1/LO
D PRES1/HI
M TEMP1/LO
M TEMP1/HI
SPARE 1/LO
SPARE 1/HI
FLW RT LOW
FLW RT HI
VLV POS LO
VLV POS HI

3.5.3 DISCRETES

Discrettes are not used in this application.

3.5.4 CONFIG

ORIF DIAM1
PIPE DIAM1
TAP LCTN 1
DP CUTOFF
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
FW MODE
H2O CNTENT
CLOSE LOGS

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ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS** _____

3.5.5 GAS DATA

Digital gas chromatograph inputs are not used in this application.

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

3.5.6 CONTROL

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

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3.5.7 CALC DATA

FLOW RATE1
CORR OD 1
CORR PD 1
CORR BETA1
EV 1
CD 1
ZF 1
Y 1
FW MODE
H2O CNTENT
FW FACTOR
AGA8 MTHD
ZS
ZB
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

3.5.8 RATE/VOLS

FLOW RATE1 (MCF/H)
FLOW RATE1 (MCF/D)
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 SPARES. 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:

FLOW PRES1
DIFF PRES1

3.6.2 DP BIAS

DIFF PRES1

3.6.3 TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the FLOW TEMP1 selection.

3.6.4 SPARES

The analog inputs listed as follows are calibrated in the SPARES submenunu of the CALIBRATE UNIT MENU:

SPARE 1

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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.

FLOW PRES1
DIFF PRES1
FLOW TEMP1
SPARE 1

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	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
138	FLOW RATE1	Flow rate for meter No.1
142	TOT VOL 1	Total volume for meter No.1
140	TODAY VOL1	Today's volume in MCFD
141	YSDAY VOL1	Yesterday's volume in MCFD

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
021	DIFF PRES1	1	4	AVERAGE
131	FLOW PRES1	1	6	AVERAGE
132	FLOW TEMP1	1	4	AVERAGE
134	FLW EXTN 1	2	6	SNAPSHOT & ZERO
139	LOG VOL1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
074	LOG TIME	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)

**SINGLE ORIFICE APPLICATION (SNGL)
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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

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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 19, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTERY low	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5*	C(23) < X	FLOW PRES2 low	0	
6*	C(24) < X	DIFF PRES2 low	0	
7*	C(25) < X	FLOW TEMP2 low	0	
8*	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10*	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14*	C(23) > Y	FLOW PRES2 high		1000
15*	C(24) > Y	DIFF PRES2 high		100
16*	C(25) > Y	FLOW TEMP2 high		150
17	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000

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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
19	C(139) > Y	LOG VOL 1 high		100000
20	C(30) < > X	SYS ERROR	0	

* This alarm should be disabled in this application.

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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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DUAL ORIFICE APPLICATION (1P1T) ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

4.0 DUAL ORIFICE APPLICATION (1P1T)

Section 3 covers the individual requirements for the ENRON dual orifice enhanced application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. This dual orifice application (ENRON AGA3 1P1T) supports measurement on two meter tubes with a common static pressure and temperature. Optional capabilities such as valve positioning, tube switching, etc. are listed as part of the setup. This application supports MODBUS communications. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). 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 1.9. 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.

DUAL ORIFICE APPLICATION (IPIT)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure Meter Tube No. 1(factory installed)	White (Blue ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
20	EXTERNAL, static pressure Meter Tube No.1 (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	INTERNAL, differential pressure (DP) No. 1 (factory installed)	Blue Black Red	27 30 29	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
21	EXTERNAL, differential pressure (DP) No. 1 (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 Meter Tube No. 1 (to be installed by user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	EXTERNAL, static pressure Meter Tube No.2 (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, differential (DP) Meter Tube 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

DUAL ORIFICE APPLICATION (1P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

25	EXTERNAL, Meter temperature No. 2 (To be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	Spare No. 1		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
 - (3) Jumper any unused analog input to analog ground.
-

DUAL ORIFICE APPLICATION (IPIT)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS

4.2 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 76	TTL output Common
6	Volume pulse output 2	VP 2	79 70	TTL output Common

DUAL ORIFICE APPLICATION (1P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

4.2.1 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

4.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced dual orifice plate application (ENRON AGA3 1P1T) 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 Section 1 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⁾	300 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.
-

DUAL ORIFICE APPLICATION (1P1T)
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4.4 SETUP UNIT MENU

The parameters for the enhanced dual orifice plate application (1P1T) 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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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 the enhanced dual orifice (1P1T) 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
FLOW PRES1	xxxxx PSIG
DIFF PRES1	xxxxx InH2O
FLOW TEMP1	xxxxx DEG F
DIFF PRES2	xxxxx InH2O
SPARE 1	
FLW RT OUT	xxxxx MCFD
VALVE POS	xxxxx %

DUAL ORIFICE APPLICATION (1P1T)
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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
M PRES1/LO	0.0 PSIG	_____
M PRES1/HI	1000.0 PSIG	_____
D PRES1/LO	0.0 InH2O	_____
D PRES1/HI	100.0 InH2O	_____
M TEMP1/LO	0.0 DEG F	_____
M TEMP1/HI	150.0 DEG F	_____
D PRES2/LO	0.0 InH2O	_____
D PRES2/HI	100.0 InH2O	_____
SPARE 1/LO	0.0	_____
SPARE 1/HI	100.0	_____
FLW RT LOW	0 MCFD	_____
FLW RT HI	100000 MCFD	_____
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

DUAL ORIFICE APPLICATION (1P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

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	1.000 IN	_____
PIPE DIAM1	4.000 IN	_____
TAP LCTN 1	0	_____
ORIF DIAM2	1.000 IN	_____
PIPE DIAM2	4.000 IN	_____
TAP LCTN 2	0	_____
DP CUTOFF	0.25 InH2O	_____
ATMS PRES	14.70 PSIA	_____
PRES BASE	14.73 PSIA	_____
TEMP BASE	60 DEG F	_____
AGA8 MTHD	0	_____
FW MODE	0	_____
H2O CNTENT	0 LB/MM	_____
CLOSE LOGS	0	_____

DUAL ORIFICE APPLICATION (IPIT)
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4.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

**DUAL ORIFICE APPLICATION (1P1T)
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4.4.7 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 1.6 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	_____
TS ENABLE	0		_____
OPEN 2	80.0	InH2O	_____
CLOSE 2	20.0	InH2O	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFD	_____
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	%	_____

DUAL ORIFICE APPLICATION (IPIT)
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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.

HHD PROMPT	SAMPLE VALUES		DESIRED
FLOW RATE1	1942.6	MCFD	_____
CORR OD 1	0.9997	IN	_____
CORR PD 1	3.9992	IN	_____
CORR BETA1	0.24998		_____
EV 1	1.03164		_____
CD 1	0.603166		_____
ZF 1	0.947718		_____
Y 1	0.999892		_____
FLOW RATE2	1593.0	MCFD	_____
CORR OD 2	0.9997	IN	_____
CORR PD 2	3.9992	IN	_____
CORR BETA2	0.24998		_____
EV 2	1.00196		_____
CD 2	0.59755		_____
ZF 2	0.86544		_____
Y 2	0.97811		_____
STN FLW RT	3536.1	MCFD	_____
FW MODE	0		_____
H2O CNTENT	0	LB/MM	_____
FW FACTOR	1.00000		_____
AGA8 MTHD	0		_____
ZS	0.997825		_____
ZB	0.997835		_____
B - AGA8	-0.057429		_____
C - AGA8	0.000000		_____
D - AGA8	0.273477		_____
K - AGA8	0.100591		_____
MOL WT.	16.7444		_____

DUAL ORIFICE APPLICATION (1P1T)
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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

FLOW PRES1
DIFF PRES1
FLOW TEMP1
DIFF PRES2
SPARE 1
FLW RT OUT
VALVE POS

4.5.2 SCALES

M PRES1/LO
M PRES1/HI
D PRES1/LO
D PRES1/HI
M TEMP1/LO
M TEMP1/HI
D PRES2/LO
D PRES2/HI
SPARE 1/LO
SPARE 1/HI
FLW RT LOW
FLW RT HI
VLV POS LO
VLV POS HI

4.5.3 DISCRETES

OPEN 2
CLOSE 2

4.5.4 CONFIG

ORIF DIAM1
PIPE DIAM1
TAP LCTN 1
ORIF DIAM2
PIPE DIAM2
TAP LCTN 2
DP CUTOFF
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
FW MODE
H2O CNTENT
CLOSE LOGS

DUAL ORIFICE APPLICATION (1P1T)
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4.5.5 GAS DATA

Digital gas chromatograph inputs are not used in this application.

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

4.5.6 CONTROL

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

DUAL ORIFICE APPLICATION (1P1T)
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4.5.7 CALC DATA

FLOW RATE1
CORR OD 1
CORR PD 1
CORR BETA1
EV 1
CD 1
ZF 1
Y 1
FLOW RATE2
CORR OD 2
CORR PD 2
CORR BETA2
EV 2
CD 2
ZF 2
Y 2
STN FLW RT
FW MODE
H2O CNTENT
FW FACTOR
AGA8 MTHD
ZS
ZB
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

4.5.8 RATE/VOLS

FLOW RATE1 (MCF/H)
FLOW RATE1 (MCF/D)
TODAY VOL1
YSDAY VOL1
TOT VOL 1
ERATE 1
TDY ENRGY1
YSY ENRGY1
TOT ENRGY1
FLOW RATE2 (MCF/H)
FLOW RATE2 (MCF/D)
TODAY VOL2
YSDAY VOL2
TOT VOL 2
ERATE 2
TDY ENRGY2
YSY ENRGY2
TOT ENRGY2
STN FLW RT
ST TDY VOL
ST YSY VOL
ST TOT VOL
STN ERATE
TDY ENERGY
YSY ENERGY
TOT ENERGY

DUAL ORIFICE APPLICATION (1P1T) ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

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 four selections: PRESSURES, DP BIAS, TEMP and SPARES. 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:

- FLOW PRES1
- DIFF PRES1
- DIFF PRES2

4.6.2 DP BIAS

- DIFF PRES1
- DIFF PRES2

4.6.3 TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the FLOW TEMP1 selection.

4.6.4 SPARES

The analog inputs listed as follows are calibrated in the SPARES submenunu of the CALIBRATE UNIT MENU:

- SPARE 1

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 double orifice application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

FLOW PRES1
 DIFF PRES1
 FLOW TEMP1
 DIFF PRES2
 SPARE 1

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	FLOW PRES1	Live pressure meter No.1 in PSIG
022	FLOW TEMP1	Live temperature in degrees Fahrenheit (°F)
021	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
138	FLOW RATE1	Flow rate for meter No.1
142	TOT VOL 1	Total volume for meter No.1
178	FLOW RATE2	Flow rate for meter No.2
182	TOT VOL 2	Total volume for meter No.2
213	ST TDY VOL	Today's volume in MCFD
214	YSDAY VOL	Yesterday's volume in MCFD

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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
021	DIFF PRES1	1	4	AVERAGE
131	FLOW PRES1	1	6	AVERAGE
132	FLOW TEMP1	1	4	AVERAGE
134	FLW EXTN 1	2	6	SNAPSHOT & ZERO
139	LOG VOL1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	1	4	AVERAGE
171	FLOW PRES2	1	6	AVERAGE
172	FLOW TEMP2	1	4	AVERAGE
174	FLW EXTN 2	2	6	SNAPSHOT & ZERO
179	LOG VOL 2	1	6	SNAPSHOT & ZERO
184	LOG ENRGY2	1	6	SNAPSHOT & ZERO
074	LOG TIME	1	6	SNAPSHOT & ZERO

4.10 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

(Continued on the next page)

DUAL ORIFICE APPLICATION (IPIT)
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Header Block Contents (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

DUAL ORIFICE APPLICATION (1P1T)
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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 19, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTER LO	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5	C(23) < X	FLOW PRES2 low	0	
6	C(24) < X	DIFF PRES2 low	0	
7*	C(25) < X	FLOW TEMP2 low	0	
8*	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14	C(23) > Y	FLOW PRES2 high		1000
15	C(24) > Y	DIFF PRES2 high		100
16*	C(25) > Y	FLOW TEMP2 high		150
17*	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000

DUAL ORIFICE APPLICATION (IPIT)
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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
19	C(139) > Y	FLOW RATE2 high		100000
20	C(30) < > X	SYS ERROR	0	

* This alarm should be disabled in this application.

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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.

DUAL ORIFICE APPLICATION (2P1T) ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

5.0 DUAL ORIFICE APPLICATION (2P1T)

Section 3 covers the individual requirements for the ENRON dual orifice enhanced application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. This dual orifice application (ENRON AGA3 2P1T) supports measurement on two meter tubes with dual static pressures and a common temperature. Optional capabilities such as valve positioning, tube switching, etc. are listed as part of the setup. This application supports MODBUS communications. If you do not need some of these capabilities, they may be skipped when entering the setup parameters with the Handheld Data Terminal (HHDT). 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 1.9. 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.

DUAL ORIFICE APPLICATION (2PIT)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure Meter Tube No. 1(factory installed)	White (Blue ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
20	EXTERNAL, static pressure Meter Tube No.1 (to be installed by user)	Blue Black Red Shield	23 26 25 24	Signal in + Analog ground 8 to 10 VDC Earth ground
21	INTERNAL, differential pressure (DP) No. 1 (factory installed)	Blue Black Red	27 30 29	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
21	EXTERNAL, differential pressure (DP) No. 1 (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 Meter Tube No. 1 (to be installed by user)	Blue Black Red Shield	31 34 33 32	Signal in + Analog ground 8 to 10 VDC Earth ground
23	EXTERNAL, static pressure Meter Tube No.2 (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, differential (DP) Meter Tube 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

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25	EXTERNAL, Meter temperature No. 2 (To be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	Spare No. 1		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the blue, black, and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
 - (3) Jumper any unused analog input to analog ground.
-

DUAL ORIFICE APPLICATION (2PIT)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS

5.2 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 76	TTL output Common
6	Volume pulse output 2	VP 2	79 70	TTL output Common

DUAL ORIFICE APPLICATION (2P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

5.2.1 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

5.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced dual orifice plate application (ENRON AGA3 2PIT) 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 Section 1 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⁾	300 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.
-

DUAL ORIFICE APPLICATION (2P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

5.4 SETUP UNIT MENU

The parameters for the enhanced dual orifice plate application (2P1T) 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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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 the enhanced dual orifice (2P1T) 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
FLOW PRES1	xxxxx PSIG
DIFF PRES1	xxxxx InH2O
FLOW TEMP1	xxxxx DEG F
FLOW PRES2	xxxxx PSIG
DIFF PRES2	xxxxx InH2O
SPARE 1	xxxxx MCFD
FLW RT OUT	xxxxx %
VALVE POS	

DUAL ORIFICE APPLICATION (2P1T)
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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
M PRES1/LO	0.0 PSIG	_____
M PRES1/HI	1000.0 PSIG	_____
D PRES1/LO	0.0 InH2O	_____
D PRES1/HI	100.0 InH2O	_____
M TEMP1/LO	0.0 DEG F	_____
M TEMP1/HI	150.0 DEG F	_____
M PRES2/LO	0.0 PSIG	_____
M PRES2/HI	1000.0 PSIG	_____
D PRES2/LO	0.0 InH2O	_____
D PRES2/HI	100.0 InH2O	_____
SPARE 1/LO	0.0 0.0	_____
SPARE 1/HI	100.0 100.0	_____
FLW RT LOW	0 MCFD	_____
FLW RT HI	100000 MCFD	_____
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

DUAL ORIFICE APPLICATION (2P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

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	1.000 IN	_____
PIPE DIAM1	4.000 IN	_____
TAP LCTN 1	0	_____
ORIF DIAM2	1.000 IN	_____
PIPE DIAM2	4.000 IN	_____
TAP LCTN 2	0	_____
DP CUTOFF	0.25 InH2O	_____
ATMS PRES	14.70 PSIA	_____
PRES BASE	14.73 PSIA	_____
TEMP BASE	60 DEG F	_____
AGA8 MTHD	0	_____
FW MODE	0	_____
H2O CNTENT	0 LB/MM	_____
CLOSE LOGS	0	_____

DUAL ORIFICE APPLICATION (2PIT)
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5.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

DUAL ORIFICE APPLICATION (2P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

5.4.7 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 Section 1 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	_____
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	MCFD	_____
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	%	_____

DUAL ORIFICE APPLICATION (2PIT)
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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		DESIRED
FLOW RATE1	1942.6	MCFD	_____
CORR OD 1	0.9997	IN	_____
CORR PD 1	3.9992	IN	_____
CORR BETA1	0.24998		_____
EV 1	1.03164		_____
CD 1	0.603166		_____
ZF 1	0.947718		_____
Y 1	0.999892		_____
FLOW RATE2	1593.0	MCFD	_____
CORR OD 2	0.9997	IN	_____
CORR PD 2	3.9992	IN	_____
CORR BETA2	0.24998		_____
EV 2	1.00196		_____
CD 2	0.59755		_____
ZF 2	0.86544		_____
Y 2	0.97811		_____
STN FLW RT	3535.6	MCFD	_____
FW MODE	0		_____
H2O CNTENT	0	LB/MM	_____
FW FACTOR	1.00000		_____
AGA8 MTHD	0		_____
ZS	0.997825		_____
ZB	0.997835		_____
B - AGA8	-0.057429		_____
C - AGA8	0.000000		_____
D - AGA8	0.273477		_____
K - AGA8	0.100591		_____
MOL WT.	16.7444		_____

DUAL ORIFICE APPLICATION (2P1T)
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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

FLOW PRES1
DIFF PRES1
FLOW TEMP1
FLOW PRES2
DIFF PRES2
SPARE 1
FLW RT OUT
VALVE POS

5.5.2 SCALES

M PRES1/LO
M PRES1/HI
D PRES1/LO
D PRES1/HI
M TEMP1/LO
M TEMP1/HI
M PRES2/LO
M PRES2/HI
D PRES2/LO
D PRES2/HI
SPARE 1/LO
SPARE 1/HI
FLW RT LOW
FLW RT HI
VLV POS LO
VLV POS HI

5.5.3 DISCRETES

OPEN 2 SP
CLOSE 2 SP

5.5.4 CONFIG

ORIF DIAM1
PIPE DIAM1
TAP LCTN 1
ORIF DIAM2
PIPE DIAM2
TAP LCTN 2
DP CUTOFF
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
FW MODE
H2O CNTENT
CLOSE LOGS

DUAL ORIFICE APPLICATION (2P1T)
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5.5.5 GAS DATA

Digital gas chromatograph inputs are not used in this application.

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

5.5.6 CONTROL

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

DUAL ORIFICE APPLICATION (2P1T)
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5.5.7 CALC DATA

FLOW RATE1
CORR OD 1
CORR PD 1
CORR BETA1
EV 1
CD 1
ZF 1
Y 1
FLOW RATE2
CORR OD 2
CORR PD 2
CORR BETA2
EV 2
CD 2
ZF 2
Y 2
STN FLW RT
FW MODE
H2O CNTENT
FW FACTOR
AGA8 MTHD
ZS
ZB
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

5.5.8 RATE/VOLS

FLOW RATE1 (MCF/H)
FLOW RATE1 (MCF/D)
TODAY VOL1
YSDAY VOL1
TOT VOL 1
ERATE 1
TDY ENRGY1
YSY ENRGY1
TOT ENRGY1
FLOW RATE2 (MCF/H)
FLOW RATE2 (MCF/D)
TODAY VOL2
YSDAY VOL2
TOT VOL 2
ERATE 2
TDY ENRGY2
YSY ENRGY2
TOT ENRGY2
STN FLW RT (MCF/H)
STN FLW RT (MCF/D)
ST TDY VOL
ST YSY VOL
ST TOT VOL
STN ERATE
TDY ENERGY
YSY ENERGY
TOT ENERGY

DUAL ORIFICE APPLICATION (2P1T)
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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 four selections: PRESSURES, DP BIAS, TEMP and SPARES. 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:

FLOW PRES1
FLOW PRES2
DIFF PRES1
DIFF PRES2

5.6.2 DP BIAS

DIFF PRES1
DIFF PRES2

5.6.3 TEMPERATURE

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the FLOW TEMP1 selection.

5.6.4 SPARES

The analog inputs listed as follows are calibrated in the SPARES submenunu of the CALIBRATE UNIT MENU:

SPARE 1

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 double orifice application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

FLOW PRES1
 DIFF PRES1
 FLOW TEMP1
 FLOW PRES2
 DIFF PRES2
 SPARE 1

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	FLOW PRES1	Live pressure meter No.1 in PSIG
022	FLOW TEMP1	Live temperature in degrees Fahrenheit (°F)
021	DIFF PRES1	Live DP, Run No.1, value in inches of water
023	FLOW PRES2	Live pressure meter No.2 in PSIG
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
138	FLOW RATE1	Flow rate for meter No.1
142	TOT VOL 1	Total volume for meter No.1
178	FLOW RATE2	Flow rate for meter No.2
182	TOT VOL 2	Total volume for meter No.2
213	ST TDY VOL	Today's volume in MCFD
214	YSDAY VOL	Yesterday's volume in MCFD

**DUAL ORIFICE APPLICATION (2P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____**

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
021	DIFF PRES1	1	4	AVERAGE
131	FLOW PRES1	1	6	AVERAGE
132	FLOW TEMP1	1	4	AVERAGE
134	FLW EXTN 1	2	6	SNAPSHOT & ZERO
139	LOG VOL1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	1	4	AVERAGE
171	FLOW PRES2	1	6	AVERAGE
172	FLOW TEMP2	1	4	AVERAGE
174	FLW EXTN 2	2	6	SNAPSHOT & ZERO
179	LOG VOL 2	1	6	SNAPSHOT & ZERO
184	LOG ENRGY2	1	6	SNAPSHOT & ZERO
074	LOG TIME	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 PRESS/LO
D PRESS/HI
ORIF DIAM1
PIPE DIAM1
ZFLOW LIM1
TAP LCTN 1
ATMS PRES
PRES BASE
TEMP BASE

(Continued on the next page)

DUAL ORIFICE APPLICATION (2PIT)
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Header Block Contents (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

DUAL ORIFICE APPLICATION (2P1T)
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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 19, 0 (none) for alarm 10

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTER LO	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5	C(23) < X	FLOW PRES2 low	0	
6	C(24) < X	DIFF PRES2 low	0	
7*	C(25) < X	FLOW TEMP2 low	0	
8*	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14	C(23) > Y	FLOW PRES2 high		1000
15	C(24) > Y	DIFF PRES2 high		100
16*	C(25) > Y	FLOW TEMP2 high		150
17*	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000

DUAL ORIFICE APPLICATION (2PIT)
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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
19	C(139) > Y	FLOW RATE2 high		100000
20	C(30) < > X	SYS ERROR	0	

* This alarm should be disabled in this application.

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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 APPLICATION (2P2T)

Section 6 covers the individual requirements for the ENRON 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 (ENRON AGA3 2P2T) supports measurement on two meter tubes with separate temperatures and pressures. MODBUS communications are available with this application. Optional capabilities such as valve positioning, tube switching, 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). 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 1.9. 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.

DUAL ORIFICE APPLICATION (2P2T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS

CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure (factory installed)	White (Blue ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
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	INTERNAL, differential pressure (DP) No.1 (factory installed)	Violet Black Gray	27 30 29	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
21	EXTERNAL, differential (DP) No.1 (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, Meter No.1 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	EXTERNAL, static pressure Meter Tube No.2 (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

DUAL ORIFICE APPLICATION (2P2T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

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

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 35PG static pressure transmitters are wired with the blue, black and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
-

6.2 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 76	TTL Output Common
6	Volume pulse output 2	VP 2	79 77	TTL Output Common
7	Valve control open	OPEN 2	80 75	TTL Output Common
8	Valve control close	CLOSE 2	81 74	TTL Output Common

DUAL ORIFICE APPLICATION (2P2T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

6.2.1 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

6.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced dual orifice separate temperature application (ENRON AGA3 2P2T) 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⁾	300 BPS	_____
RTS DELAY ⁽⁴⁾	0 1/100s	_____

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- 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.
-

DUAL ORIFICE APPLICATION (2P2T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

6.4 SETUP UNIT MENU

The parameters for the enhanced dual orifice separate temperature application (2P2T) 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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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
FLOW PRES1	xxxxx PSIG
DIFF PRES1	xxxxx InH2O
FLOW TEMP1	xxxxx DEG F
FLOW PRES2	xxxxx PSIG
DIFF PRES2	xxxxx INH2O
FLOW TEMP2	xxxxx DEG F
SPARE 1	xxxxx %
FLW RT OUT	xxxxx MCFD
VALVE POS	xxxxx %

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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
M PRES1/LO	0.0	PSIG	_____
M PRES1/HI	1000.0	PSIG	_____
D PRES1/LO	0.0	InH2O	_____
D PRES1/HI	100.0	InH2O	_____
M TEMP1/LO	0.0	DEG F	_____
M TEMP1/HI	150.0	DEG F	_____
M PRES2/LO	0.0	PSIG	_____
M PRES2/HI	1000.0	PSIG	_____
D PRES2/LO	0.0	InH2O	_____
D PRES2/HI	150.0	InH2O	_____
M TEMP2/LO	0.0	DEG F	_____
M TEMP2/HI	150.0	DEG F	_____
SPARE 1 LO	0.0		_____
SPARE 1 HI	100.0		_____
FLW RT LOW	0	MCFD	_____
FLW RT HI	100000.0	MCFD	_____
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

DUAL ORIFICE APPLICATION (2P2T)
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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	1.000 IN	_____
PIPE DIAM1	4.000 IN	_____
TAP LCTN 1	0	_____
ORIF DIAM2	1.000 IN	_____
PIPE DIAM2	4.000 IN	_____
TAP LCTN 2	0	_____
DP CUTOFF	0.25 InH2O	_____
ATMS PRES	14.70 PSIA	_____
PRES BASE	14.73 PSIA	_____
TEMP BASE	60 DEG F	_____
AGA8 MTHD	0	_____
FW MODE	0	_____
H2O CNTENT	0 LB/MM	_____
CLOSE LOGS	0	_____

DUAL ORIFICE APPLICATION (2P2T)
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6.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

DUAL ORIFICE APPLICATION (2P2T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

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 1.5 and 1.6 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	_____
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	MCFD	_____
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	%	_____

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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	
FLOW RATE1	1942.6	MCFD
CORR OD1	4.0000	IN
CORR PD1	8.0710	IN
CORR BETA1		
EV 1	1.03164	
CD 1	0.603166	
ZF 1	0.927767	
Y 1	0.999892	
FLW EXTN 1	94.841	
FLOW RATE2	1593.0	MCFD
CORR OD2	4.0000	IN
CORR PD2	8.0710	IN
CORR BETA2		MCFD
EV 2	1.03164	
CD 2	0.603166	
ZF 2	0.927767	
Y2	0.999892	
FLW EXTN 2	94.841	
STN FLW RT	3535.6	MCFD
AGA8 MTHD	0.0	
ZS	0.997811	
ZB	0.997811	
B - AGA8	-0.040383	
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

FLOW PRES1
DIFF PRES1
FLOW TEMP1
FLOW PRES2
DIFF PRES2
FLOW TEMP2
SPARE 1
FLW RT OUT
VALVE POS

6.5.2 SCALES

M PRES1/LO	SPARE 1 HI
M PRES1/HI	FLW RT LOW
D PRES1/LO	FLT RT HI
D PRES1/HI	VLV POS LO
M TEMP1/LO	VLV POS HI
M TEMP1/HI	
M PRES2/LO	
M PRES2/HI	
D PRES2/LO	
D PRES2/HI	
M TEMP2/LO	
M TEMP2/HI	
SPARE 1 LO	

6.5.3 DISCRETES

VP 1
VP 2
OPEN 2
CLOSE 2

6.5.4 CONFIG

ORIF DIAM1
PIPE DIAM1
TAP LCTN 1
ORIF DIAM2
PIPE DIAM2
TAP LCTN 2
DP CUTOFF
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF
TREF PIPE
CLOSE LOGS

6.5.5 GAS DATA

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

6.5.6 CONTROL

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

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6.5.7 CALC DATA

FLOW RATE1
CORR OD1
CORR PD1
CORR BETA1
EV 1
CD 1
ZF 1
Y 1
FLW EXTN 1
FLOW RATE2
CORR OD2
CORR PD2
CORR BETA2
EV 2
CD 2
ZF 2
Y2
FLW EXTN 2
STN FLW RT
AGA8 MTHD
ZS
ZB
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
ERATE 1
TDY ENRGY1
YSY ENRGY1
TOT ENRGY1
FLOW RATE2 (MCFH)
FLOW RATE2 (MCFD)
TODAY VOL2
YSDAY VOL2
TOT VOL 2
ERATE 2
TDY ENRGY2
YSY ENRGY2
TOT ENRGY2
STN FLW RT (MCFH)
STN FLW RT (MCFD)
ST TDY VOL
ST YSY VOL
ST TOT VOL
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:

FLOW PRES1
FLOW PRES2
DIFF PRES1
DIFF PRES2.

6.6.2 TEMPERATURE

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

FLOW TEMP1
FLOW TEMP2.

6.6.3 SPARES

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

SPARE 1.

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.

FLOW PRES1
DIFF PRES1
FLOW TEMP1
FLOW PRES2
DIFF PRES2
FLOW TEMP2
SPARE 1

DUAL ORIFICE APPLICATION (2P2T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

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	FLOW PRES1	Live pressure meter No.1 in PSIG
022	FLW TEMP1	Live temperature in degrees Fahrenheit (°F)
021	DIFF PRES1	Live DP, Run No.1, value in inches of water
023	FLOW PRES2	Live pressure meter No.2 in PSIG
025	FLW TEMP2	Live temperature in degrees Fahrenheit (°F)
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
138	FLOW RATE1	Daily flow rate for meter No. 1
142	TOT VOL 1	Total volume for meter No.1
178	FLOW RATE2	Daily flow rate for meter No.2
182	TOT VOL 2	Total accumulated volume, 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
021	DIFF PRES1	1	4	AVERAGE
131	FLOW PRES1	1	6	AVERAGE
132	FLOW TEMP1	1	4	AVERAGE
134	FLW EXTN 1	2	6	SNAPSHOT & ZERO
139	LOG VOL1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	1	4	AVERAGE
171	FLOW PRES2	1	6	AVERAGE
172	FLOW TEMP2	1	4	AVERAGE
174	FLW EXTN 2	2	6	SNAPSHOT & ZERO
179	LOG VOL 2	1	6	SNAPSHOT & ZERO
184	LOG ENRGY2	1	6	SNAPSHOT & ZERO
074	LOG TIME	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
D PRES1/LO
D PRES1/HI
M TEMP1/LO
M TEMP1/HI
M PRES2/LO
M PRES2/HI
D PRES2/LO
D PRES2/HI
M TEMP2/LO
M TEMP2/HI
ORIF DIAM1
PIPE DIAM1
TAP LCTN 1
ORIF DIAM2
PIPE DIAM2
TAP LCTN 2
DP CUTOFF
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)

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

DUAL ORIFICE APPLICATION (2P2T)
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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 19, 0 (none) for alarm 20

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTERY low	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5	C(23) < X	FLOW PRES2 low	0	
6	C(24) < X	DIFF PRES2 low	0	
7	C(25) < X	FLOW TEMP2 low	0	
8	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14	C(23) > Y	FLOW PRES2 high		1000
15	C(24) > Y	DIFF PRES2 high		100
16	C(25) > Y	FLOW TEMP2 high		150
17	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000
19	C(139) > Y	LOG VOL 1 high		100000

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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
20	C(30) < > X	SYS ERROR	0	

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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.

SINGLE TURBINE / PD APPLICATION (SNGL) ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS

7.0 SINGLE TURBINE/PD APPLICATION (SNGL)

Section 7 covers the individual requirements for the ENRON single enhanced turbine/PD application (ENRON AGA7 SNGL) configured to calculate volume and flow rate using equations from API Chapter 14.3, Part 3. The single turbine/PD application supports measurement on one meter tube with one pressure and one temperature transmitter. Optional capabilities such as valve positioning, tube switching, 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). This application uses FIXED inputs for BTU and specific gravity. 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 1.9. No changes should be required unless the previously used application has been significantly different.

The wiring configuration for the single turbine/PD analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual.

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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 ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
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	SPARE 2	Violet Black Gray	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, Meter No.1 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	EXTERNAL, static pressure Meter Tube No.2 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	SPARE 3	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

**SINGLE TURBINE / PD APPLICATION (SNGL)
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CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
25	EXTERNAL, Meter temperature No.2 (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	SPARE 1		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 35PG static pressure transmitters are wired with the blue, black and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
-

7.2 **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, 6, 7, and 8 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 76	TTL Output Common
6	Volume pulse output 2	VP 2	79 77	TTL Output Common
7	Valve control open	OPEN 2	80 75	TTL Output Common
8	Valve control close	CLOSE 2	81 74	TTL Output Common

**SINGLE TURBINE / PD APPLICATION (SNGL)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____**

7.2.2 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

7.2.3 TURBINE/PD INPUT CONNECTIONS

For wiring detail, refer to Drawing DE-11330, sheet 3, in the Model 2470 Reference Manual (Daniel Part No. 3-9000-451). The applicable ports are "PD #1" or "TURBIN #1" for meter number one and "PD #2" and "TURBIN #2" for meter number two.

7.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced single turbine/PD application (ENRON AGA7 SNGL) 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 Section 1 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⁾	300 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.
-

**SINGLE TURBINE / PD APPLICATION (SNGL)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS** _____

7.4 SETUP UNIT MENU

The parameters for the enhanced single turbine/PD application (SNGL) 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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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.

7.4.2 ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu for the ENRON enhanced single turbine/PD application (SNGL) 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
FLOW PRES1	xxxxx PSIG
FLOW TEMP1	xxxxx DEG F
SPARE 1	
SPARE 2	
SPARE 3	
FLW RT OUT	xxxxx MCFH
VALVE POS	xxxxx %

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7.4.3 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
M PRES1/LO	0.0	PSIG	_____
M PRES1/HI	1000.0	PSIG	_____
M TEMP1/LO	0.0	DEG F	_____
M TEMP1/HI	150.0	DEG F	_____
SPARE 1/LO	0.0		_____
SPARE 1/HI	100.0		_____
SPARE 2/LO	0.0		_____
SPARE 2/HI	100.0		_____
SPARE 3/LO	0.0		_____
SPARE 3/HI	100.0		_____
FLW RT LOW	0	MCFD	_____
FLW RT HI	100000	MCFD	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____

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7.4.4 DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	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
METR FCTR1	1.00	PPCF	_____
ZFLOW LIM	15	SECS	_____
ATMS PRES	14.70	PSIA	_____
PRES BASE	14.73	PSIA	_____
TEMP BASE	60	DEG F	_____
AGA8 MTHD	0		_____
FW MODE	0		_____
H2O CNTENT	0	LB/MM	_____
CLOSE LOGS	0		_____

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7.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

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7.4.7 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 Section 1 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	_____
VP MODE	0	_____
FLW SETPNT	0.0 MCFD	_____
DEADBAND	2.0 %	_____
SMALL STEP	0.05 %	_____
LARGE STEP	0.5 %	_____
FINE CNTRL	5 %	_____
PRES CHAN#	20	_____
OVRD PRESS	0 PSIG	_____
AFR LIMIT	0 MACFD	_____
PRESET POS	100 %	_____
UPDATE TIM	10 SECS	_____
VALVE POS	50.0 %	_____

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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		DESIRED
FLOW RATE1	2500.0	MCFD	_____
ZF 1	1.000000		_____
CORR FCTR1	55.62		_____
UNCR RATE1	0.0	MACFD	_____
FW MODE	0		_____
H2O CNTENT	0	LB/MM	_____
FW FACTOR	1.00000		_____
AGA8 MTHD	0		_____
ZS	0.997811		_____
ZB	0.997811		_____
B - AGA8	-0.040383		_____
C - AGA8	0.002236		_____
D - AGA8	0.266296		_____
K - AGA8	0.100912		_____
MOL WT.	16.7444		_____

7.5 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.

7.5.1 ANALOGS

FLOW PRES1
FLOW TEMP1
SPARE 1
SPARE 2
SPARE 3
FLW RT OUT
VALVE POS

7.5.2 SCALES

M PRES1/LO	FLW RT LOW
M PRES1/HI	FLW RT HI
M TEMP1/LO	VLV POS LO
M TEMP1/HI	VLV POS HI
SPARE 1/LO	
SPARE 1/HI	
SPARE 2/LO	
SPARE 2/HI	
SPARE 3/LO	
SPARE 3/HI	

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7.5.3 DISCRETES

VP 1
VP 2

7.5.4 CONFIG

METR FCTR1
ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
FW MODE
H2O CNTENT
CLOSE LOGS

7.5.5 GAS DATA

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

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7.5.6 CONTROL

VPP 1
PP 1
VPP 2
PP 2
VP MODE
FLW SETPNT
DEADBAND
SMALL STEP
LARGE STEP
FINE CNTRL
PRES CHAN#
OVRD PRESS
AFR LIMIT
PRESET POS
UPDATE TIM
VALVE POS

7.5.7 CALC DATA

FLOW RATE1
ZF 1
CORR FCTR1
UNCR RATE1
FLOW RATE2
FW MODE
H2O CNTENT
FW FACTOR
AGA8 MTHD
ZS
ZB
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

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7.5.8 RATE/VOLS

FLOW RATE1 (MCFH)
FLOW RATE1 (MCFD)
UNCR RATE1
TDY UVOL 1
YSY UVOL 1
TOT UVOL 1
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 SPARES. 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 PRESSURE selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

FLOW PRES1

7.6.2 TEMPERATURES

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the temperature as follows:

FLOW TEMP1

7.6.3 SPARES

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

SPARE 1
SPARE 2
SPARE 3

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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. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

FLOW PRES1
FLOW TEMP1
SPARE 1

7.8 USER REPORT (CHANNEL 0)

The User Report (Channel 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 User 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)
148	UNCR RATE1	Uncorrected flow rate, meter No.1
138	FLOW RATE1	Hourly flow rate for meter No.1
142	TOT VOL 1	Total accumulated volume for meter No. 1
140	TODAY VOL1	Today's volume
141	YSDAY VOL1	Yesterday's volume

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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
136	FLW TIME 1	2	6	SNAPSHOT & ZERO
020	FLOW PRES1	1	6	AVERAGE
022	FLOW TEMP1	1	4	AVERAGE
149	LOG UVOL 1	1	6	SNAPSHOT & ZERO
139	LOG VOL 1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
074	LOG TIME	1	6	SNAPSHOT & ZERO

7.10 DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

M PRES1/LO
M PRES1/HI
M TEMP1/LO
M TEMP1/HI
M PRES2/LO
M PRES2/HI
M TEMP2/LO
M TEMP2/HI
LIVE SG/LO
LIVE SG/HI
BTU LO
BTU HI
METR FCTR1
METR FCTR2

(Continued on the next page)

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Header Block Contents (Continued)

ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
SPEC GRAV
BTU
CO2
N2
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

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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 19, 0 (none) for alarm 20

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTERY low	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3*	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5*	C(23) < X	FLOW PRES2 low	0	
6*	C(24) < X	DIFF PRES2 low	0	
7*	C(25) < X	FLOW TEMP2 low	0	
8*	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10*	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12*	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14*	C(23) > Y	FLOW PRES2 high		1000
15*	C(24) > Y	DIFF PRES2 high		100
16*	C(25) > Y	FLOW TEMP2 high		150
17*	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000
19*	C(139) > Y	FLOW RATE2 high		100000

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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
20	C(30) < > X	SYS ERROR	0	

* This alarm should be disabled in this application.

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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.

8.0 DUAL TURBINE/PD APPLICATION (1P1T)

Section 8 covers the individual requirements for the ENRON dual enhanced turbine/PD application (ENRON AGA7 1P1T) configured to calculate volume and flow rate using equations from API Chapter 14.3, Part 3. The dual turbine/PD application supports measurement on two meter tubes with a common pressure and a common temperature transmitter. Optional capabilities such as valve positioning, tube switching, 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). This application uses FIXED inputs for BTU and specific gravity. 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.

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 1.9. No changes should be required unless the previously used application has been significantly different.

The wiring configuration for the dual turbine/PD common temperature analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual.

**DUAL TURBINE / PD APPLICATION (IPIT)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS**

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 ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
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	SPARE 2	Violet Black Gray	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, Meter No.1 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	EXTERNAL, static pressure Meter Tube No.2 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	SPARE 3	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

DUAL TURBINE / PD APPLICATION (1P1T)
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CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
25	EXTERNAL, Meter temperature No.2 (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	SPARE 1		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 35PG static pressure transmitters are wired with the blue, black and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
-

8.2 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, 6, 7, and 8 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 76	TTL Output Common
6	Volume pulse output 2	VP 2	79 77	TTL Output Common
7	Valve control open	OPEN 2	80 75	TTL Output Common
8	Valve control close	CLOSE 2	81 74	TTL Output Common

DUAL TURBINE / PD APPLICATION (IPIT)
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8.2.1 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

8.2.2 TURBINE/PD INPUT CONNECTIONS

For wiring detail, refer to Drawing DE-11330, sheet 3, in the Model 2470 Reference Manual (Daniel Part No. 3-9000-451). The applicable ports are "PD #1" or "TURBIN #1" for meter number one and "PD #2" and "TURBIN #2" for meter number two.

8.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced dual turbine/PD application (ENRON AGA7 1P1T) 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 Section 1 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⁾	300 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.
-

DUAL TURBINE / PD APPLICATION (1P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

8.4 SETUP UNIT MENU

The parameters for the enhanced dual turbine/PD application (1P1T) 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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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 for the ENRON enhanced dual turbine/PD application (1P1T) 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
FLOW PRES1	xxxxx PSIG
FLOW TEMP1	xxxxx DEG F
SPARE 1	
SPARE 2	
SPARE 3	
FLW RT OUT	xxxxx MCFH
VALVE POS	xxxxx %

DUAL TURBINE / PD APPLICATION (IPIT)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

8.4.3 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
M PRES1/LO	0.0 PSIG	_____
M PRES1/HI	1000.0 PSIG	_____
M TEMP1/LO	0.0 DEG F	_____
M TEMP1/HI	150.0 DEG F	_____
SPARE 1/LO	0.0	_____
SPARE 1/HI	100.0	_____
SPARE 2/LO	0.0	_____
SPARE 2/HI	100.0	_____
SPARE 3/LO	0.0	_____
SPARE 3/HI	100.0	_____
FLW RT LOW	0 MCFD	_____
FLW RT HI	100000 MCFD	_____
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

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
METR FCTR1	1.00	PPCF	_____
METR FCTR2	1.00	PPCF	_____
ZFLOW LIM	15	SECS	_____
ATMS PRES	14.70	PSIA	_____
PRES BASE	14.73	PSIA	_____
TEMP BASE	60	DEG F	_____
AGA8 MTHD	0		_____
FW MODE	0		_____
H2O CNTENT	0	LB/MM	_____
CLOSE LOGS	0		_____

DUAL TURBINE / PD APPLICATION (IPIT)
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8.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

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8.4.7 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 Section 1 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	_____
TS ENABLE	0		_____
OPEN 2 SP	4000	MACFD	_____
CLOSE 2 SP	1000	MACFD	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFD	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
AFR LIMIT	0	MACFD	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

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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		DESIRED
FLOW RATE1	2500.0	MCFD	_____
ZF 1	1.000000		_____
CORR FCTR1	55.62		_____
UNCR RATE1	0.0	MACFD	_____
FLOW RATE2	0.0	MCFD	_____
ZF 2	1.00000		_____
CORR FCTR2	66.48		_____
UNCR RATE2	3500.0	MACFD	_____
STN FLW RT	5000.0	MCFD	_____
STN UNC RT	6500.0	MACFD	_____
FW MODE	0		_____
H2O CNTENT	0	LB/MM	_____
FW FACTOR	1.00000		_____
AGA8 MTHD	0		_____
ZS	0.997811		_____
ZB	0.997811		_____
B - AGA8	-0.040383		_____
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, CALC DATA and RATE/VOLS.

8.5.1 ANALOGS

FLOW PRES1
FLOW TEMP1
SPARE 1
SPARE 2
SPARE 3
FLW RT OUT
VALVE POS

8.5.2 SCALES

M PRES1/LO	FLW RT LOW
M PRES1/HI	FLW RT HI
M TEMP1/LO	VLV POS LO
M TEMP1/HI	VLV POS HI
SPARE 1/LO	
SPARE 1/HI	
SPARE 2/LO	
SPARE 2/HI	
SPARE 3/LO	
SPARE 3/HI	

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8.5.3 DISCRETES

VP 1
VP 2
OPEN 2
CLOSE 2

8.5.4 CONFIG

METR FCTR1
METR FCTR2
ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
FW MODE
H2O CNTENT
CLOSE LOGS

8.5.5 GAS DATA

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

DUAL TURBINE / PD APPLICATION (IPIT)
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8.5.6 CONTROL

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

8.5.7 CALC DATA

FLOW RATE1
ZF 1
CORR FCTR1
UNCR RATE1
FLOW RATE2
ZF 2
CORR FCTR2
UNCR RATE2
STN FLW RT
STN UNC RT
FW MODE
H2O CNTENT
FW FACTOR
AGA8 MTHD
ZS
ZB
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

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8.5.8 RATE/VOLS

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

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 SPARES. 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 PRESSURE selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

FLOW PRES1

8.6.2 TEMPERATURES

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the temperature as follows:

FLOW TEMP1

8.6.3 SPARES

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

SPARE 1
SPARE 2
SPARE 3

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. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

FLOW PRES1
FLOW TEMP1
SPARE 1
SPARE 2
SPARE 3

8.8 USER REPORT (CHANNEL 0)

The User Report (Channel 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 User 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)
148	UNCR RATE1	Uncorrected flow rate, meter No.1
138	FLOW RATE1	Hourly flow rate for meter No.1
142	TOT VOL 1	Total accumulated volume for meter No. 1
188	UNCR RATE2	Uncorrected flow rate, meter No.2
178	FLOW RATE2	Hourly flow rate for meter No.2
182	TOT VOL 2	Total accumulated volume for meter No.2
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

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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
136	FLW TIME 1	2	6	SNAPSHOT & ZERO
020	FLOW PRES1	1	6	AVERAGE
022	FLOW TEMP1	1	4	AVERAGE
149	LOG UVOL 1	1	6	SNAPSHOT & ZERO
139	LOG VOL 1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
176	FLW TIME 2	2	6	SNAPSHOT & ZERO
023	FLOW PRES2	1	6	AVERAGE
025	FLOW TEMP2	1	6	AVERAGE
189	LOG UVOL 2	1	6	SNAPSHOT & ZERO
179	LOG VOL 2	1	6	SNAPSHOT & ZERO
184	LOG ENRGY2	1	6	SNAPSHOT & ZERO
074	LOG TIME	1	6	SNAPSHOT & ZERO

8.10 DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

M PRES1/LO
M PRES1/HI
M TEMP1/LO
M TEMP1/HI
M PRES2/LO
M PRES2/HI
M TEMP2/LO
M TEMP2/HI
LIVE SG/LO
LIVE SG/HI
BTU LO
BTU HI
METR FCTR1
METR FCTR2

(Continued on the next page)

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Header Block Contents (Continued)

ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
SPEC GRAV
BTU
CO2
N2
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

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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 19, 0 (none) for alarm 20

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTERY low	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3*	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5*	C(23) < X	FLOW PRES2 low	0	
6*	C(24) < X	DIFF PRES2 low	0	
7*	C(25) < X	FLOW TEMP2 low	0	
8*	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12*	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14*	C(23) > Y	FLOW PRES2 high		1000
15*	C(24) > Y	DIFF PRES2 high		100
16*	C(25) > Y	FLOW TEMP2 high		150
17*	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000
19	C(139) > Y	FLOW RATE2 high		100000

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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
20	C(30) < > X	SYS ERROR	0	

* This alarm should be disabled in this application.

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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 DUAL TURBINE/PD APPLICATION (2P1T)

Section 9 covers the individual requirements for the ENRON dual enhanced turbine/PD application (ENRON AGA7 2P1T) configured to calculate volume and flow rate using equations from API Chapter 14.3, Part 3. The dual turbine/PD application supports measurement on two meter tubes with separate pressure and a common temperature transmitter. Optional capabilities such as valve positioning, tube switching, 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). This application uses FIXED inputs for BTU and specific gravity. 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.

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 1.9. No changes should be required unless the previously used application has been significantly different.

The wiring configuration for the dual turbine/PD common temperature analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual.

DUAL TURBINE / PD APPLICATION (2PIT)
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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 ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
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	SPARE 2	Violet Black Gray	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, Meter No.1 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	EXTERNAL, static pressure Meter Tube No.2 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	SPARE 3	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

DUAL TURBINE / PD APPLICATION (2PIT)
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CH	TRANSMITTER TYPE	WIRE COLOR	PIN NO.	SIGNAL TYPE
25	EXTERNAL, Meter temperature No.2 (to be installed by user)		43 46 45 44	Signal in + Analog ground 8 to 10 VDC Earth ground
26	SPARE 1		47 50 49 48	Signal in + Analog ground 8 to 10 VDC Earth ground

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 35PG static pressure transmitters are wired with the blue, black and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
-

9.2 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, 6, 7, and 8 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 76	TTL Output Common
6	Volume pulse output 2	VP 2	79 77	TTL Output Common
7	Valve control open	OPEN 2	80 75	TTL Output Common
8	Valve control close	CLOSE 2	81 74	TTL Output Common

DUAL TURBINE / PD APPLICATION (2PIT)
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9.2.1 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

9.2.2 TURBINE/PD INPUT CONNECTIONS

For wiring detail, refer to Drawing DE-11330, sheet 3, in the Model 2470 Reference Manual (Daniel Part No. 3-9000-451). The applicable ports are "PD #1" or "TURBIN #1" for meter number one and "PD #2" and "TURBIN #2" for meter number two.

9.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced dual turbine/PD application (ENRON AGA7 2P1T) 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 Section 1 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⁾	300 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.
-

DUAL TURBINE / PD APPLICATION (2P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS _____

9.4 SETUP UNIT MENU

The parameters for the enhanced dual turbine/PD application (2P1T) 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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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 for the ENRON enhanced dual turbine/PD application (2P1T) 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
FLOW PRES1	xxxxx PSIG
FLOW TEMP1	xxxxx DEG F
FLOW PRES2	xxxxx PSIG
SPARE 1	
SPARE 2	
SPARE 3	
FLW RT OUT	xxxxx MCFH
VALVE POS	xxxxx %

DUAL TURBINE / PD APPLICATION (2PIT)
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9.4.3 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
M PRES1/LO	0.0 PSIG	_____
M PRES1/HI	1000.0 PSIG	_____
M TEMP1/LO	0.0 DEG F	_____
M TEMP1/HI	150.0 DEG F	_____
M PRES2/LO	0.0 PSIG	_____
M PRES2/HI	1000.0 PSIG	_____
SPARE 1/LO	0.0	_____
SPARE 1/HI	100.0	_____
SPARE 2/LO	0.0	_____
SPARE 2/HI	100.0	_____
SPARE 3/LO	0.0	_____
SPARE 3/HI	100.0	_____
FLW RT LOW	0 MCFD	_____
FLW RT HI	100000 MCFD	_____
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

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
METR FCTR1	1.00	PPCF	_____
METR FCTR2	1.00	PPCF	_____
ZFLOW LIM	15	SECS	_____
ATMS PRES	14.70	PSIA	_____
PRES BASE	14.73	PSIA	_____
TEMP BASE	60	DEG F	_____
AGA8 MTHD	0		_____
FW MODE	0		_____
H2O CNTENT	0	LB/MM	_____
CLOSE LOGS	0		_____

DUAL TURBINE / PD APPLICATION (2PIT)
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9.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

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9.4.7 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 Section 1 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	_____
TS ENABLE	0		_____
OPEN 2 SP	4000	MACFD	_____
CLOSE 2 SP	1000	MACFD	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFD	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
AFR LIMIT	0	MACFD	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

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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		DESIRED
FLOW RATE1	2500.0	MCFD	_____
ZF 1	1.000000		_____
CORR FCTR1	55.62		_____
UNCR RATE1	0.0	MACFD	_____
FLOW RATE2	0.0	MCFD	_____
ZF 2	1.00000		_____
CORR FCTR2	66.48		_____
UNCR RATE2	3500.0	MACFD	_____
STN FLW RT	5000.0	MCFD	_____
STN UNC RT	6500.0	MACFD	_____
FW MODE	0		_____
H2O CNTENT	0	LB/MM	_____
FW FACTOR	1.00000		_____
AGA8 MTHD	0		_____
ZS	0.997811		_____
ZB	0.997811		_____
B - AGA8	-0.040383		_____
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 and RATE/VOLS.

9.5.1 ANALOGS

FLOW PRES1
FLOW TEMP1
FLOW PRES2
FLOW TEMP2
SPARE 1
SPARE 2
SPARE 3
FLW RT OUT
VALVE POS

9.5.2 SCALES

M PRES1/LO	FLW RT LOW
M PRES1/HI	FLW RT HI
M TEMP1/LO	VLV POS LO
M TEMP1/HI	VLV POS HI
M PRES2/LO	
M PRES2/HI	
M TEMP2/LO	
M TEMP2/HI	
SPARE 1/LO	
SPARE 1/HI	
SPARE 2/LO	
SPARE 2/HI	
SPARE 3/LO	
SPARE 3/HI	

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9.5.3 DISCRETES

VP 1
VP 2
OPEN 2
CLOSE 2

9.5.4 CONFIG

METR FCTR1
METR FCTR2
ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
FW MODE
H2O CNTENT
CLOSE LOGS

9.5.5 GAS DATA

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

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9.5.6 CONTROL

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

9.5.7 CALC DATA

FLOW RATE1
ZF 1
CORR FCTR1
UNCR RATE1
FLOW RATE2
ZF 2
CORR FCTR2
UNCR RATE2
STN FLW RT
STN UNC RT
FW MODE
H2O CNTENT
FW FACTOR
AGA8 MTHD
ZS
ZB
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

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9.5.8 RATE/VOLS

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

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 SPARES. 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 PRESSURE selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed as follows:

FLOW PRES1
FLOW PRES2

9.6.2 TEMPERATURES

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the temperatures as follows:

FLOW TEMP1

9.6.3 SPARES

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

SPARE 1
SPARE 2
SPARE 3

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. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

FLOW PRES1
FLOW TEMP1
FLOW PRES2
SPARE 1
SPARE 2
SPARE 3

9.8 USER REPORT (CHANNEL 0)

The User Report (Channel 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 User 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	FLOW PRES2	Live pressure meter No.2 in PSIG
148	UNCR RATE1	Uncorrected flow rate, meter No.1
138	FLOW RATE1	Hourly flow rate for meter No.1
142	TOT VOL 1	Total accumulated volume for meter No. 1
188	UNCR RATE2	Uncorrected flow rate, meter No.2
178	FLOW RATE2	Hourly flow rate for meter No.2
182	TOT VOL 2	Total accumulated volume for meter No.2
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

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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
136	FLW TIME 1	2	6	SNAPSHOT & ZERO
020	FLOW PRES1	1	6	AVERAGE
022	FLOW TEMP1	1	4	AVERAGE
149	LOG UVOL 1	1	6	SNAPSHOT & ZERO
139	LOG VOL 1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
176	FLW TIME 2	2	6	SNAPSHOT & ZERO
023	FLOW PRES2	1	6	AVERAGE
025	FLOW TEMP2	1	6	AVERAGE
189	LOG UVOL 2	1	6	SNAPSHOT & ZERO
179	LOG VOL 2	1	6	SNAPSHOT & ZERO
184	LOG ENRGY2	1	6	SNAPSHOT & ZERO
074	LOG TIME	1	6	SNAPSHOT & ZERO

9.10 DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

M PRES1/LO
M PRES1/HI
M TEMP1/LO
M TEMP1/HI
M PRES2/LO
M PRES2/HI
M TEMP2/LO
M TEMP2/HI
LIVE SG/LO
LIVE SG/HI
BTU LO
BTU HI
METR FCTR1
METR FCTR2

(Continued on the next page)

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Header Block Contents (Continued)

ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
SPEC GRAV
BTU
CO2
N2
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

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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 19, 0 (none) for alarm 20

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTERY low	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3*	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5	C(23) < X	FLOW PRES2 low	0	
6*	C(24) < X	DIFF PRES2 low	0	
7*	C(25) < X	FLOW TEMP2 low	0	
8*	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12*	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14	C(23) > Y	FLOW PRES2 high		1000
15*	C(24) > Y	DIFF PRES2 high		100
16*	C(25) > Y	FLOW TEMP2 high		150
17*	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000
19	C(139) > Y	FLOW RATE2 high		100000

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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
20	C(30) < > X	SYS ERROR	0	

* This alarm should be disabled in this application.

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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.

10.0 DUAL TURBINE/PD APPLICATION (2P2T)

Section 10 covers the individual requirements for the ENRON dual enhanced turbine/PD application (ENRON AGA7 2P2T) configured to calculate volume and flow rate using equations from API Chapter 14.3, Part 3. The dual turbine/PD application supports measurement on two meter tubes with separate pressure and temperature transmitters. Optional capabilities such as valve positioning, tube switching, 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). This application uses FIXED inputs for BTU and specific gravity. 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.

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 1.9. No changes should be required unless the previously used application has been significantly different.

The wiring configuration for the dual turbine/PD 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.

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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 ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
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	SPARE 2	Violet Black Gray	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, Meter No.1 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	EXTERNAL, static pressure Meter Tube No.2 (to be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog ground 8 to 10 VDC Earth ground
24	SPARE 3	Blue Black Red Shield	39 42 41 40	Signal in + Analog ground 8 to 10 VDC Earth ground

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

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 35PG static pressure transmitters are wired with the blue, black and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
-

10.2 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, 6, 7, and 8 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 76	TTL Output Common
6	Volume pulse output 2	VP 2	79 77	TTL Output Common
7	Valve control open	OPEN 2	80 75	TTL Output Common
8	Valve control close	CLOSE 2	81 74	TTL Output Common

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10.2.1 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

10.2.2 TURBINE/PD INPUT CONNECTIONS

For wiring detail, refer to Drawing DE-11330, sheet 3, in the Model 2470 Reference Manual (Daniel Part No. 3-9000-451). The applicable ports are "PD #1" or "TURBIN #1" for meter number one and "PD #2" and "TURBIN #2" for meter number two.

10.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced dual turbine/PD application (ENRON AGA7 2P2T) 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 Section 1 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⁾	300 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.
-

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10.4 SETUP UNIT MENU

The parameters for the enhanced dual turbine/PD application (2P2T) 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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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 for the ENRON enhanced dual turbine/PD application (2P2T) 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
FLOW PRES1	xxxxx PSIG
FLOW TEMP1	xxxxx DEG F
FLOW PRES2	xxxxx PSIG
FLOW TEMP2	xxxxx DEG F
SPARE 1	
SPARE 2	
SPARE 3	
FLW RT OUT	xxxxx MCFH
VALVE POS	xxxxx %

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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
M PRES1/LO	0.0	PSIG	_____
M PRES1/HI	1000.0	PSIG	_____
M TEMP1/LO	0.0	DEG F	_____
M TEMP1/HI	150.0	DEG F	_____
M PRES2/LO	0.0	PSIG	_____
M PRES2/HI	1000.0	PSIG	_____
M TEMP2/LO	0.0	DEG F	_____
M TEMP2/HI	150.0	DEG F	_____
SPARE 1/LO	0.0		_____
SPARE 1/HI	100.0		_____
SPARE 2/LO	0.0		_____
SPARE 2/HI	100.0		_____
SPARE 3/LO	0.0		_____
SPARE 3/HI	100.0		_____
FLW RT LOW	0	MCFD	_____
FLW RT HI	100000	MCFD	_____
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

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
METR FCTR1	1.00	PPCF	_____
METR FCTR2	1.00	PPCF	_____
ZFLOW LIM	15	SECS	_____
ATMS PRES	14.70	PSIA	_____
PRES BASE	14.73	PSIA	_____
TEMP BASE	60	DEG F	_____
AGA8 MTHD	0		_____
FW MODE	0		_____
H2O CNTENT	0	LB/MM	_____
CLOSE LOGS	0		_____

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10.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

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10.4.7 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 Section 1 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	_____
TS ENABLE	0		_____
OPEN 2 SP	4000	MACFD	_____
CLOSE 2 SP	20.0	InH2O	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFD	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
AFR LIMIT	0	MACFD	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

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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		DESIRED
FLOW RATE1	2500.0	MCFD	_____
ZF 1	1.000000		_____
CORR FCTR1	55.62		_____
UNCR RATE1	3000.0	MACFD	_____
FLOW RATE2	2500.0	MCFD	_____
ZF 2	1.000000		_____
CORR FCTR2	66.48		_____
UNCR RATE2	3500.0	MACFD	_____
STN FLW RT	5000.0	MCFD	_____
STN UNC RT	6000.0	MACFD	_____
FW MODE	0		_____
H2O CNTENT	0	LB/MM	_____
FW FACTOR	1.00000		_____
AGA8 MTHD	0		_____
ZS	0.997811		_____
ZB	0.997811		_____
B - AGA8	-0.040383		_____
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, CALC DATA and RATE/VOLS.

10.5.1 ANALOGS

FLOW PRES1
FLOW TEMP1
FLOW PRES2
FLOW TEMP2
SPARE 1
SPARE 2
SPARE 3
FLW RT OUT
VALVE POS

4.5.2 SCALES

M PRES1/LO	FLW RT LOW
M PRES1/HI	FLW RT HI
M TEMP1/LO	VLV POS LO
M TEMP1/HI	VLV POS HI
M PRES2/LO	
M PRES2/HI	
M TEMP2/LO	
M TEMP2/HI	
SPARE 1/LO	
SPARE 1/HI	
SPARE 2/LO	
SPARE 2/HI	
SPARE 3/LO	
SPARE 3/HI	

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10.5.3 DISCRETES

VP 1
VP 2
OPEN 2
CLOSE 2

10.5.4 CONFIG

METR FCTR1
METR FCTR2
ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
FW MODE
H2O CNTENT
CLOSE LOGS

10.5.5 GAS DATA

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

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10.5.6 CONTROL

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

10.5.7 CALC DATA

FLOW RATE1
ZF 1
CORR FCTR1
UNCR RATE1
FLOW RATE2
ZF 2
CORR FCTR2
UNCR RATE2
STN FLW RT
STN UNC RT
FW MODE
H2O CNTENT
FW FACTOR
AGA8 MTHD
ZS
ZB
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

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10.5.8 RATE/VOLS

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

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

FLOW PRES1
FLOW PRES2

10.6.2 TEMPERATURES

The TEMP selection of the CALIBRATE UNIT menu provides for calibrating the temperatures as follows:

FLOW TEMP1
FLOW TEMP2

10.6.3 SPARES

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

SPARE 1
SPARE 2
SPARE 3

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. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

FLOW PRES1
FLOW TEMP1
FLOW PRES2
FLOW TEMP2
SPARE 1
SPARE 2
SPARE 3

10.8 USER REPORT (CHANNEL 0)

The User Report (Channel 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 User 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	FLOW PRES2	Live pressure meter No.2 in PSIG
025	FLOW TEMP2	Live temperature in degrees Fahrenheit (°F)
148	UNCR RATE1	Uncorrected flow rate, meter No.1
138	FLOW RATE1	Hourly flow rate for meter No.1
142	TOT VOL 1	Total accumulated volume for meter No. 1
188	UNCR RATE2	Uncorrected flow rate, meter No.2
178	FLOW RATE2	Hourly flow rate for meter No.2
182	TOT VOL 2	Total accumulated volume for meter No.2
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

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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
136	FLW TIME 1	2	6	SNAPSHOT & ZERO
020	FLOW PRES1	1	6	AVERAGE
022	FLOW TEMP1	1	4	AVERAGE
149	LOG UVOL 1	1	6	SNAPSHOT & ZERO
139	LOG VOL 1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
176	FLW TIME 2	2	6	SNAPSHOT & ZERO
023	FLOW PRES2	1	6	AVERAGE
025	FLOW TEMP2	1	6	AVERAGE
189	LOG UVOL 2	1	6	SNAPSHOT & ZERO
179	LOG VOL 2	1	6	SNAPSHOT & ZERO
184	LOG ENRGY2	1	6	SNAPSHOT & ZERO
074	LOG TIME	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 TEMP1/LO
M TEMP1/HI
M PRES2/LO
M PRES2/HI
M TEMP2/LO
M TEMP2/HI
LIVE SG/LO
LIVE SG/HI
BTU LO
BTU HI
METR FCTR1
METR FCTR2

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Header Block Contents (Continued)

ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
SPEC GRAV
BTU
CO2
N2
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN
I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

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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 19, 0 (none) for alarm 20

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTERY low	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3*	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5	C(23) < X	FLOW PRES2 low	0	
6*	C(24) < X	DIFF PRES2 low	0	
7	C(25) < X	FLOW TEMP2 low	0	
8*	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12*	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14	C(23) > Y	FLOW PRES2 high		1000
15*	C(24) > Y	DIFF PRES2 high		100
16	C(25) > Y	FLOW TEMP2 high		150
17*	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000
19	C(139) > Y	FLOW RATE2 high		100000

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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
20	C(30) < > X	SYS ERROR	0	

* This alarm should be disabled in this application.

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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 DUAL TURBINE / ORIFICE APPLICATION (1P1T)

Section 12 covers the individual requirements for the ENRON enhanced dual turbine/orifice application (ENRON AGA7/3 1P1T) configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The dual turbine/orifice application (ENRON AGA7/3 1P1T) supports measurement on two meter tubes with a common temperature and pressure. MODBUS communications are available with this application. Optional capabilities such as valve positioning, tube switching, 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). 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.

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 1.9. 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 turbine/orifice analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual.

**DUAL TURBINE / ORIFICE APPLICATION (IPIT)
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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 ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
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	SPARE 2	Violet Black Gray	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, Meter No.1 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	EXTERNAL, static pressure Meter Tube No.2 (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

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

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 35PG static pressure transmitters are wired with the blue, black and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
-

11.2 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 76	TTL Output Common
6	Volume pulse output 2	VP 2	79 77	TTL Output Common
7	Valve control open	OPEN 2	80 75	TTL Output Common
8	Valve control close	CLOSE 2	81 74	TTL Output Common

DUAL TURBINE / ORIFICE APPLICATION (1P1T)
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11.2.1 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

11.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced dual turbine/orifice application (ENRON AGA7/3 1P1T) 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 Section 1 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⁾	300 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.
-

**DUAL TURBINE / ORIFICE APPLICATION (1P1T)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS** _____

11.4 SETUP UNIT MENU

The parameters for the enhanced dual turbine/orifice application (ENRON AGA7/3 1P1T) 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 seven submenus: GENERAL, ANALOGS, SCALES, 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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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 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
FLOW PRES1	xxxxx PSIG
FLOW TEMP1	xxxxx DEG F
DIFF PRES2	xxxxx InH2O
SPARE 1	
SPARE 2	
FLW RT OUT	xxxxx MCFD
VALVE POS	xxxxx %

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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
M PRES1/LO	0.0	PSIG	_____
M PRES1/HI	1000.0	PSIG	_____
M TEMP1/LO	0.0	DEG F	_____
M TEMP1/HI	150.0	DEG F	_____
D PRES2/LO	0.0	InH2O	_____
D PRES2/HI	100.0	InH2O	_____
SPARE 1 LO	0.0		_____
SPARE 1 HI	100.0		_____
SPARE 2 LO	0.0		_____
SPARE 2 HI	100.0		_____
FLW RT LOW	0	MCFD	_____
FLW RT HI	100000	MCFD	_____
VLV POS LO	0.0	%	_____
VLV POS HI	100.0	%	_____

**DUAL TURBINE / ORIFICE APPLICATION (1P1T)
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11.4.4 DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
OPEN 2	ON
CLOSE 2	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
METR FCTR1	1.00 PPCF	_____
ORIF DIAM2	1.000 IN IN	_____
PIPE DIAM2	4.000	_____
TAP LCTN 2	0 InH20	_____
DP CUTOFF	0.25 SECS	_____
ZFLOW LIM	15 PSIA	_____
ATMS PRES	14.70 PSIA	_____
PRES BASE	14.73 DEG F	_____
TEMP BASE	60	_____
AGA8 MTHD	0	_____
FW MODE	0	_____
H2O CNTENT	0	_____
CLOSE LOGS	0	_____

DUAL TURBINE / ORIFICE APPLICATION (1P1T)
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11.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

**DUAL TURBINE / ORIFICE APPLICATION (IPIT)
ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS**

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 1.5 and 1.6 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	_____
TS ENABLE	0		_____
OPEN 2 SP	4000	MACFD	_____
CLOSE 2 SP	20	InH2O	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFD	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
AFR LIMIT	0	MACFD	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

DUAL TURBINE / ORIFICE APPLICATION (1P1T)
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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	
FLOW RATE1	1942.6	MCFD
ZF 1	1.000000	
CORR FCTR1	34.99	
UNCR RATE1	0.0	MACFD
FLOW RATE2	1593.0	MCFD
CORR OD 2	4.0002	IN
CORR PD 2	8.0713	IN
CORR BETA2	0.49561	
EV 2	1.03164	
CD 2	0.603166	
ZF 2	0.903988	
Y 2	0.999892	
STN FLW RT	3535.6	MCFD
FW MODE	0	
H2O CNTENT	0	
FW FACTOR	1.00000	
AGA8 MTHD	0	
ZS	0.997811	
ZB	0.997811	
B - AGA8	-0.048334	
C - AGA8	0.999892	
D - AGA8	0.228810	
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, CONTROL, CALC DATA and RATE/VOLS.

12.5.1 ANALOGS

FLOW PRES1
FLOW TEMP1
DIFF PRES2
SPARE 1
SPARE 2
FLW RT OUT
VALVE POS

12.5.2 SCALES

M PRES1/LO	FLW RT LOW
M PRES1/HI	FLT RT HI
M TEMP1/LO	VLV POS LO
M TEMP1/HI	VLV POS HI
D PRES2/LO	
D PRES2/HI	
SPARE 1 LO	
SPARE 1 HI	
SPARE 2 LO	
SPARE 2 HI	

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11.5.3 CONFIG

METR FCTR1
ORIF DIAM2
PIPE DIAM2
TAP LCTN 2
DP CUTOFF
ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
FW MODE
H2O CNTENT
CLOSE LOGS

11.5.4 GAS DATA

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

11.5.5 CONTROL

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

11.5.6 CALC DATA

FLOW RATE1
ZF 1
CORR FCTR1
UNCR RATE1
FLOW RATE2
CORR OD2
CORR PD2
CORR BETA2
EV 2
CD 2
ZF 2
Y2
STN FLW RT
FW MODE
H2O CNTENT
FW FACTOR
AGA8 MTHD
ZS
ZB
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

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11.5.7 RATE/VOLS

FLOW RATE1 (MCFH)
FLOW RATE1 (MCFD)
UNCR RATE1
TDY UVOL 1
YSY UVOL 1
TOT UVOL 1
TODAY VOL1
YSDAY VOL1
TOT VOL 1
ERATE 1
TDY ENRGY1
YSY ENRGY1
TOT ENRGY1
FLOW RATE2 (MCFH)
FLOW RATE2 (MCFD)
TODAY VOL2
YSDAY VOL2
TOT VOL 2
ERATE 2
TDY ENRGY2
YSY ENRGY2
TOT ENRGY2
STN FLW RT (MCFH)
STN FLW RT (MCFD)
ST TDY VOL
ST YSY VOL
ST TOT VOL
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 four selections: PRESSURES, DP BIAS, TEMP and SPARES. 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:

FLOW PRES1
DIFF PRES2.

11.6.2 DP BIAS

DIFF PRES2

11.6.3 TEMPERATURE

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

FLOW TEMP1

11.6.3 SPARES

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

SPARE 1
SPARE 2.

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 this application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

FLOW PRES1
FLOW TEMP1
DIFF PRES2
SPARE 1
SPARE 2

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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	FLW TEMP1	Live temperature in degrees Fahrenheit (°F)
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
148	UNCR RATE1	Uncorrected flow rate, meter No.1
138	FLOW RATE1	Daily flow rate for meter No. 1
142	TOT VOL 1	Total volume for meter No.1
178	FLOW RATE2	Daily flow rate for meter No.2
182	TOT VOL 2	Total accumulated volume, meter No.2
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

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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
136	FLW TIME 1	2	6	SNAPSHOT & ZERO
020	FLOW PRES1	1	6	AVERAGE
022	FLOW TEMP1	1	4	AVERAGE
149	LOG UVOL 1	1	6	SNAPSHOT & ZERO
139	LOG VOL 1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	1	4	AVERAGE
171	FLOW PRES2	1	6	AVERAGE
172	FLOW TEMP2	1	4	AVERAGE
174	FLW EXTN 2	2	6	SNAPSHOT & ZERO
179	LOG VOL 2	1	6	SNAPSHOT & ZERO
184	LOG ENRGY2	1	6	SNAPSHOT & ZERO
074	LOG TIME	1	6	SNAPSHOT & ZERO

11.10 DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

M PRES1/LO
M PRES1/HI
D PRES1/LO
D PRES1/HI
M TEMP1/LO
M TEMP1/HI
M PRES2/LO
M PRES2/HI
D PRES2/LO
D PRES2/HI
M TEMP2/LO
M TEMP2/HI
ORIF DIAM1
PIPE DIAM1
TAP LCTN 1
ORIF DIAM2
PIPE DIAM2
TAP LCTN 2
DP CUTOFF
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)

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

**DUAL TURBINE / ORIFICE APPLICATION (IPIT)
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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 19, 0 (none) for alarm 20

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTERY low	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3*	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5*	C(23) < X	FLOW PRES2 low	0	
6	C(24) < X	DIFF PRES2 low	0	
7*	C(25) < X	FLOW TEMP2 low	0	
8*	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12*	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14*	C(23) > Y	FLOW PRES2 high		1000
15	C(24) > Y	DIFF PRES2 high		100
16*	C(25) > Y	FLOW TEMP2 high		150
17*	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000
19	C(139) > Y	LOG VOL 1 high		100000

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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
20	C(30) < > X	SYS ERROR	0	

* This alarm should be disabled in this application.

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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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ENRON ENHANCED MODEL 2470 SOLARFLOW PLUS

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12.0 DUAL TURBINE / ORIFICE APPLICATION (2P1T)

Section 12 covers the individual requirements for the ENRON enhanced dual turbine/orifice application (ENRON AGA7/3 2P1T) configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The dual turbine/orifice common temperature application (ENRON AGA7/3 2P1T) supports measurement on two meter tubes with a common temperature and separate pressures. MODBUS communications are available with this application. Optional capabilities such as valve positioning, tube switching, 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). 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.

12.1 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 1.9. 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 turbine/orifice analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual.

**DUAL TURBINE / ORIFICE APPLICATION (2PIT)
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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 ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
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	SPARE 2	Violet Black Gray	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, Meter No.1 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	EXTERNAL, static pressure Meter Tube No.2 (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

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

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 35PG static pressure transmitters are wired with the blue, black and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
-

**DUAL TURBINE / ORIFICE APPLICATION (2PIT)
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12.2 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 76	TTL Output Common
6	Volume pulse output 2	VP 2	79 77	TTL Output Common
7	Valve control open	OPEN 2	80 75	TTL Output Common
8	Valve control close	CLOSE 2	81 74	TTL Output Common

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12.2.1 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

**DUAL TURBINE / ORIFICE APPLICATION (2P1T)
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12.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced dual turbine/orifice application (ENRON AGA7/3 2P1T) 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 Section 1 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⁾	300 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.
-

**DUAL TURBINE / ORIFICE APPLICATION (2P1T)
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12.4 SETUP UNIT MENU

The parameters for the enhanced dual turbine/orifice application (ENRON AGA7/3 2P1T) 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 seven submenus: GENERAL, ANALOGS, SCALES, 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.

12.4.1 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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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.

12.4.2 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
FLOW PRES1	xxxxx PSIG
FLOW TEMP1	xxxxx DEG F
FLOW PRES2	xxxxx PSIG
DIFF PRES2	xxxxx InH2O
SPARE 1	
SPARE 2	
FLW RT OUT	xxxxx MCFD
VALVE POS	xxxxx %

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12.4.3 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
M PRES1/LO	0.0 PSIG	_____
M PRES1/HI	1000.0 PSIG	_____
M TEMP1/LO	0.0 DEG F	_____
M TEMP1/HI	150.0 DEG F	_____
M PRES2/LO	0.0 PSIG	_____
M PRES2/HI	1000.0 PSIG	_____
D PRES2/LO	0.0 InH2O	_____
D PRES2/HI	100.0 InH2O	_____
SPARE 1 LO	0.0	_____
SPARE 1 HI	100.0	_____
SPARE 2 LO	0.0	_____
SPARE 2 HI	100.0	_____
FLW RT LOW	0 MCFD	_____
FLW RT HI	100000 MCFD	_____
VLV POS LO	0.0 %	_____
VLV POS HI	100.0 %	_____

**DUAL TURBINE / ORIFICE APPLICATION (2PIT)
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12.4.4 DISCRETES SUBMENU

HHDT PROMPT	DEFAULT
VP 1	OFF
VP 2	OFF
OPEN 2	ON
CLOSE 2	OFF

12.4.5 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
METR FCTR1	1.00 PPCF	_____
ORIF DIAM2	1.000 IN IN	_____
PIPE DIAM2	4.000	_____
TAP LCTN 2	0 InH20	_____
DP CUTOFF	0.25 SECS	_____
ZFLOW LIM	15 PSIA	_____
ATMS PRES	14.70 PSIA	_____
PRES BASE	14.73 DEG F	_____
TEMP BASE	60	_____
AGA8 MTHD	0	_____
FW MODE	0	_____
H2O CNTENT	0	_____
CLOSE LOGS	0	_____

DUAL TURBINE / ORIFICE APPLICATION (2PIT)
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12.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

**DUAL TURBINE / ORIFICE APPLICATION (2PIT)
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12.4.7 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 Section 1 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	_____
TS ENABLE	0		_____
OPEN 2 SP	4000	MACFD	_____
CLOSE 2 SP	20	InH2O	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFD	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
AFR LIMIT	0	MACFD	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

DUAL TURBINE / ORIFICE APPLICATION (2PIT)
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12.4.8 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	1942.6	MCFD
ZF 1	1.000000	
CORR FCTR1	34.99	
UNCR RATE1	0.0	MACFD
FLOW RATE2	1593.0	MCFD
CORR OD 2	4.0002	IN
CORR PD 2	8.0713	IN
CORR BETA2	0.49561	
EV 2	1.03164	
CD 2	0.603166	
ZF 2	0.903988	
Y 2	0.999892	
STN FLW RT	3535.6	MCFD
FW MODE	0	
H2O CNTENT	0	
FW FACTOR	1.00000	
AGA8 MTHD	0	
ZS	0.997811	
ZB	0.997811	
B - AGA8	-0.048334	
C - AGA8	0.999892	
D - AGA8	0.228810	
K - AGA8	0.100912	
MOL WT.	16.7444	

12.5 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.

12.5.1 ANALOGS

FLOW PRES1
FLOW TEMP1
FLOW PRES2
DIFF PRES2
SPARE 1
SPARE 2
FLW RT OUT
VALVE POS

12.5.2 SCALES

M PRES1/LO	FLW RT LOW
M PRES1/HI	FLT RT HI
M TEMP1/LO	VLV POS LO
M TEMP1/HI	VLV POS HI
M PRES2/LO	
M PRES2/HI	
D PRES2/LO	
D PRES2/HI	
SPARE 1 LO	
SPARE 1 HI	
SPARE 2 LO	
SPARE 2 HI	

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12.5.3 CONFIG

METR FCTR1
ORIF DIAM2
PIPE DIAM2
TAP LCTN 2
DP CUTOFF
ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
FW MODE
H2O CNTENT
CLOSE LOGS

12.5.4 GAS DATA

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

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12.5.5 CONTROL

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

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12.5.6 CALC DATA

FLOW RATE1
ZF 1
CORR FCTR1
UNCR RATE1
FLOW RATE2
CORR OD2
CORR PD2
CORR BETA2
EV 2
CD 2
ZF 2
Y2
STN FLW RT
FW MODE
H2O CNTENT
FW FACTOR
AGA8 MTHD
ZS
ZB
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

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12.5.7 RATE/VOLS

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

12.6 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 four selections: PRESSURES, DP BIAS, TEMP and SPARES. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

12.6.1 PRESSURES

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

FLOW PRES1
FLOW PRES2
DIFF PRES2.

12.6.2 DP BIAS

DIFF PRES2

12.6.3 TEMPERATURE

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

FLOW TEMP1

12.6.4 SPARES

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

SPARE 1
SPARE 2.

12.7 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 this application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

FLOW PRES1
FLOW TEMP1
FLOW PRES2
DIFF PRES2
SPARE 1
SPARE 2

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12.8 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	FLW TEMP1	Live temperature in degrees Fahrenheit (°F)
023	FLOW PRES2	Live pressure meter No.2 in PSIG
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
148	UNCR RATE1	Uncorrected flow rate, meter No.1
138	FLOW RATE1	Daily flow rate for meter No. 1
142	TOT VOL 1	Total volume for meter No.1
178	FLOW RATE2	Daily flow rate for meter No.2
182	TOT VOL 2	Total accumulated volume, meter No.2
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

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12.9 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
136	FLW TIME 1	2	6	SNAPSHOT & ZERO
020	FLOW PRES1	1	6	AVERAGE
022	FLOW TEMP1	1	4	AVERAGE
149	LOG UVOL 1	1	6	SNAPSHOT & ZERO
139	LOG VOL 1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	1	4	AVERAGE
171	FLOW PRES2	1	6	AVERAGE
172	FLOW TEMP2	1	4	AVERAGE
174	FLW EXTN 2	2	6	SNAPSHOT & ZERO
179	LOG VOL 2	1	6	SNAPSHOT & ZERO
184	LOG ENRGY2	1	6	SNAPSHOT & ZERO
074	LOG TIME	1	6	SNAPSHOT & ZERO

12.10 DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

M PRES1/LO
M PRES1/HI
D PRES1/LO
D PRES1/HI
M TEMP1/LO
M TEMP1/HI
M PRES2/LO
M PRES2/HI
D PRES2/LO
D PRES2/HI
M TEMP2/LO
M TEMP2/HI
ORIF DIAM1
PIPE DIAM1
TAP LCTN 1
ORIF DIAM2
PIPE DIAM2
TAP LCTN 2
DP CUTOFF
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)

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

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12.11 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 19, 0 (none) for alarm 20

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTERY low	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3*	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5	C(23) < X	FLOW PRES2 low	0	
6	C(24) < X	DIFF PRES2 low	0	
7*	C(25) < X	FLOW TEMP2 low	0	
8*	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12*	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14*	C(23) > Y	FLOW PRES2 high		1000
15	C(24) > Y	DIFF PRES2 high		100
16*	C(25) > Y	FLOW TEMP2 high		150
17*	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000
19	C(139) > Y	LOG VOL 1 high		100000

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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
20	C(30) < > X	SYS ERROR	0	

* This alarm should be disabled in this application.

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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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13.0 DUAL TURBINE / ORIFICE APPLICATION (2P2T)

Section 13 covers the individual requirements for the ENRON enhanced dual turbine/orifice application (ENRON AGA7/3 2P2T) configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The dual turbine/orifice separate temperature application (ENRON AGA7/3 2P2T) supports measurement on two meter tubes with separate temperatures and pressures. MODBUS communications are available with this application. Optional capabilities such as valve positioning, tube switching, 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). 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.

13.1 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 1.9. 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 turbine/orifice analog inputs is shown in this section.

A field wiring diagram is provided in the Model 2470 System Reference Manual.

**DUAL TURBINE / ORIFICE APPLICATION (2P2T)
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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 ¹) Green (Black ¹) Black (Red ¹)	23 26 25	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
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	SPARE 2	Violet Black Gray	27 30 29 28	Signal in + Analog ground 8 to 10 VDC Earth ground
22	EXTERNAL, Meter No.1 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	EXTERNAL, static pressure Meter Tube No.2 (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

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

-
- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 35PG static pressure transmitters are wired with the blue, black and red wires.
 - (2) Wire for connecting the external transmitter inputs is user-supplied.
-

13.2 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 76	TTL Output Common
6	Volume pulse output 2	VP 2	79 77	TTL Output Common
7	Valve control open	OPEN 2	80 75	TTL Output Common
8	Valve control close	CLOSE 2	81 74	TTL Output Common

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13.2.1 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

**DUAL TURBINE / ORIFICE APPLICATION (2P2T)
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13.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON enhanced dual turbine/orifice application (ENRON AGA7/3 2P2T) 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 Section 1 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⁾	300 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.
-

DUAL TURBINE / ORIFICE APPLICATION (2P2T)
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13.4 SETUP UNIT MENU

The parameters for the enhanced dual turbine/orifice application (ENRON AGA7/3 2P2T) 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 seven submenus: GENERAL, ANALOGS, SCALES, 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.

13.4.1 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	_____
RESET CMOD ⁽¹⁾	OFF	_____

NOTES: (1) 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.

13.4.2 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
FLOW PRES1	xxxxx PSIG
FLOW TEMP1	xxxxx DEG F
FLOW PRES2	xxxxx PSIG
DIFF PRES2	xxxxx InH2O
FLOW TEMP2	xxxxx DEG F
SPARE 1	
SPARE 2	
FLW RT OUT	xxxxx MCFD
VALVE POS	xxxxx %

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13.4.3 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
M PRES1/LO	0.0 PSIG	_____
M PRES1/HI	1000.0 PSIG	_____
M TEMP1/LO	0.0 DEG F	_____
M TEMP1/HI	150.0 DEG F	_____
M PRES2/LO	0.0 PSIG	_____
M PRES2/HI	1000.0 PSIG	_____
D PRES2/LO	0.0 InH2O	_____
D PRES2/HI	100.0 InH2O	_____
M TEMP2/LO	0.0 DEG F	_____
M TEMP2/HI	150.0 DEG F	_____
SPARE 1 LO	0.0	_____
SPARE 1 HI	100.0	_____
SPARE 2 LO	0.0	_____
SPARE 2 HI	100.0	_____
FLW RT LOW	0 MCFD	_____
FLW RT HI	100000.0 MCFD	_____
VLV POS LO	0.0 %	_____
VLV POS HI	100.0 %	_____

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13.4.4 DISCRETES SUBMENU

The DISCRETES submenu is not used in this application.

13.4.5 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.

HHD PROMPT	SAMPLE VALUES	DESIRED
METR FCTR1	1.00 PPCF	_____
ORIF DIAM2	1.000 IN IN	_____
PIPE DIAM2	4.000	_____
TAP LCTN 2	0 InH20	_____
DP CUTOFF	0.25 SECS	_____
ZFLOW LIM	15 PSIA	_____
ATMS PRES	14.70 PSIA	_____
PRES BASE	14.73 DEG F	_____
TEMP BASE	60	_____
AGA8 MTHD	0	_____
FW MODE	0	_____
H2O CNTENT	0	_____
CLOSE LOGS	0	_____

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13.4.6 GAS DATA

This ENRON enhanced SolarFlow Plus software does not use live chromatograph input. A fixed specific gravity may be inserted as necessary with the HHDT. Gas data positions can be seen on the HHDT screen and fixed data may be inserted.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.5861		_____
BTU	1031.9		_____
CO2	0.916	MOL%	_____
N2	0.166	MOL%	_____
METHANE	95.515	#/FTS	_____
ETHANE	2.798		_____
PROPANE	0.351	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.093	MOL%	_____
BUTANE	0.077	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.084	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____

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13.4.7 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 Section 1 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	_____
TS ENABLE	0		_____
OPEN 2 SP	4000	MACFD	_____
CLOSE 2 SP	20	InH20	_____
TS DELAY	30	SECS	_____
TS VLV TIM	30	SECS	_____
VP MODE	0		_____
FLW SETPNT	0.0	MCFD	_____
DEADBAND	2.0	%	_____
SMALL STEP	0.05	%	_____
LARGE STEP	0.5	%	_____
FINE CNTRL	5	%	_____
PRES CHAN#	20		_____
OVRD PRESS	0	PSIG	_____
AFR LIMIT	0	MACFD	_____
PRESET POS	100	%	_____
UPDATE TIM	10	SECS	_____
VALVE POS	50.0	%	_____

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13.4.8 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	1942.6	MCFD
ZF 1	1.000000	
CORR FCTR1	34.99	
UNCR RATE1	0.0	MACFD
FLOW RATE2	1593.0	MCFD
CORR OD2	4.0002	IN
CORR PD2	8.0713	IN
CORR BETA2	0.49561	
EV 2	1.03164	
CD 2	0.603166	
ZF 2	0.903988	
Y 2	0.999892	
STN FLW RT	3535.6	MCFD
FW MODE	0	
H2O CNTENT	0	
FW FACTOR	1.00000	
AGA8 MTHD	0	
ZS	0.997811	
ZB	0.997811	
B - AGA8	-0.048334	
C - AGA8	0.999892	
D - AGA8	0.228810	
K - AGA8	0.100912	
MOL WT.	16.7444	

13.5 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.

13.5.1 ANALOGS

FLOW PRES1
FLOW TEMP1
FLOW PRES2
DIFF PRES2
FLOW TEMP2
SPARE 1
SPARE 2
FLW RT OUT
VALVE POS

13.5.2 SCALES

M PRES1/LO	FLW RT LOW
M PRES1/HI	FLT RT HI
M TEMP1/LO	VLV POS LO
M TEMP1/HI	VLV POS HI
M PRES2/LO	
M PRES2/HI	
D PRES2/LO	
D PRES2/HI	
M TEMP2/LO	
M TEMP2/HI	
SPARE 1 LO	
SPARE 1 HI	
SPARE 2 LO	
SPARS 2 HI	

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13.5.3 CONFIG

METR FCTR1
ORIF DIAM2
PIPE DIAM2
TAP LCTN 2
DP CUTOFF
ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
FW MODE
H2O CNTENT
CLOSE LOGS

13.5.4 GAS DATA

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

13.5.5 CONTROL

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

13.5.6 CALC DATA

FLOW RATE1
ZF 1
CORR FCTR1
UNCR RATE1
FLOW RATE2
CORR OD2
CORR PD2
CORR BETA2
EV 2
CD 2
ZF 2
Y2
STN FLW RT
FW MODE
H2O CNTENT
FW FACTOR
AGA8 MTHD
ZS
ZB
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

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13.5.7 RATE/VOLS

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

13.6 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 four selections: PRESSURES, DP BIAS, TEMP and SPARES. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

13.6.1 PRESSURES

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

FLOW PRES1
FLOW PRES2
DIFF PRES2.

13.6.2 DP BIAS

DIFF PRES2

13.6.3 TEMPERATURE

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

FLOW TEMP1
FLOW TEMP2

13.6.4 SPARES

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

SPARE 1
SPARE 2.

13.7 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 this application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

FLOW PRES1
FLOW TEMP1
FLOW PRES2
DIFF PRES2
FLOW TEMP2
SPARE 1
SPARE 2

13.8 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	FLW TEMP1	Live temperature in degrees Fahrenheit (°F)
023	FLOW PRES2	Live pressure meter No.2 in PSIG
025	FLW TEMP2	Live temperature in degrees Fahrenheit (°F)
024	DIFF PRES2	Live DP, Run No.2, value in inches of water
148	UNCR RATE1	Uncorrected flow rate, meter No.1
138	FLOW RATE1	Daily flow rate for meter No. 1
142	TOT VOL 1	Total volume for meter No.1
178	FLOW RATE2	Daily flow rate for meter No.2
182	TOT VOL 2	Total accumulated volume, meter No.2
213	ST TDY VOL	Station today's volume
214	YSDAY VOL	Station yesterday's volume

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13.9 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
136	FLW TIME 1	2	6	SNAPSHOT & ZERO
020	FLOW PRES1	1	6	AVERAGE
022	FLOW TEMP1	1	4	AVERAGE
149	LOG UVOL 1	1	6	SNAPSHOT & ZERO
139	LOG VOL 1	1	6	SNAPSHOT & ZERO
144	LOG ENRGY1	1	6	SNAPSHOT & ZERO
024	DIFF PRES2	1	4	AVERAGE
171	FLOW PRES2	1	6	AVERAGE
172	FLOW TEMP2	1	4	AVERAGE
174	FLW EXTN 2	2	6	SNAPSHOT & ZERO
179	LOG VOL 2	1	6	SNAPSHOT & ZERO
184	LOG ENRGY2	1	6	SNAPSHOT & ZERO
074	LOG TIME	1	6	SNAPSHOT & ZERO

13.10 DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

M PRES1/LO
M PRES1/HI
D PRES1/LO
D PRES1/HI
M TEMP1/LO
M TEMP1/HI
M PRES2/LO
M PRES2/HI
D PRES2/LO
D PRES2/HI
M TEMP2/LO
M TEMP2/HI
ORIF DIAM1
PIPE DIAM1
TAP LCTN 1
ORIF DIAM2
PIPE DIAM2
TAP LCTN 2
DP CUTOFF
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

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13.11 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 19, 0 (none) for alarm 20

ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
1	C(19) < X	BATTERY low	10.8	
2	C(20) < X	FLOW PRES1 low	0	
3*	C(21) < X	DIFF PRES1 low	0	
4	C(22) < X	FLOW TEMP1 low	0	
5	C(23) < X	FLOW PRES2 low	0	
6	C(24) < X	DIFF PRES2 low	0	
7	C(25) < X	FLOW TEMP2 low	0	
8*	C(26) < X	SPARE 1 low	0	
9	C(138) < X	FLOW RATE1 low	0	
10	C(178) < X	FLOW RATE2 low	0	
11	C(20) > Y	FLOW PRES1 high		1000
12*	C(21) > Y	DIFF PRES1 high		100
13	C(22) > Y	FLOW TEMP1 high		150
14	C(23) > Y	FLOW PRES2 high		1000
15	C(24) > Y	DIFF PRES2 high		100
16	C(25) > Y	FLOW TEMP2 high		150
17*	C(26) > Y	SPARE 1 high		100
18	C(138) > Y	FLOW RATE1 high		100000
19	C(139) > Y	LOG VOL 1 high		100000

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ALARM NO.	ALARM CONDITION	ALARM MESSAGE	X	Y
20	C(30) < > X	SYS ERROR	0	

* This alarm should be disabled in this application.

When the ALARM menu is entered using the HHDT the user may modify the X or Y values shown in the above alarm conditions by changing the values for LOW and HIGH. 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 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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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 (713) 467-6000, Fax (281) 897-2901, or contact:

Daniel Measurement and Control
P. O. Box 55435
Houston, Texas 77255

When contacting Daniel for product service, the purchaser is asked to provide information as indicated on the following "Customer Problem Report".

Daniel Measurement and Control 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 AND CONTROL
ATTN: CUSTOMER SERVICE
19203 HEMPSTEAD HIGHWAY
HOUSTON, TEXAS 77065

PHONE: (281) 897-2900
FAX: (281) 897-2901

THIS DIGITAL APPARATUS DOES NOT EXCEED THE CLASS A LIMITS FOR RADIO NOISE EMISSIONS FROM DIGITAL APPARATUS AS SET OUT IN THE RADIO INTERFERENCE REGULATIONS OF THE CANADIAN DEPARTMENT OF COMMUNICATIONS.

LE PRÉSENT APPAREIL NUMÉRIQUE N'ÉMET PAS DES BRUITS RADIOÉLECTRIQUES DÉPASSANT LES LIMITES APPLICABLES AUX APPAREILS NUMÉRIQUES DE CLASSE A PRESCRITES DANS LE RÉGLEMENT SUR LE BROUILLAGE RADIOÉLECTRIQUE ÉDICTÉ PAR LE MINISTÈRE DES COMMUNICATIONS DU CANADA.

The sales and service offices of Daniel Industries, Inc. are located throughout the United States and in major countries overseas.

Please contact Daniel Measurement and Control at P. O. Box 55435, Houston, Texas 77255, or phone (713) 467-6000 for the location of the sales or service office nearest you.

Daniel Measurement and Control offers both on-call and contract maintenance service designed to provide single-source responsibility for all Daniel Measurement and Control products.

Daniel Measurement and Control reserves the right to make changes to any of its products or services at any time without prior notification in order to improve that product or service and to supply the best product or service possible.

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