

MODEL 2470 SOLARFLOW PLUS

**DUAL STANDARD AGA-3
WITH
VALVE POSITIONING**

**LC EPROM 9-2460-236
LD EPROM 9-2460-235**

**Part Number 3-9003-045
Revision D**

APRIL 1999

DANIEL

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**DANIEL INDUSTRIES, INC.
MODEL 2470 SOLARFLOW PLUS
DUAL STANDARD AGA-3 WITH
VALVE POSITIONING**

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1.0 INTRODUCTION

1.1 SCOPE OF THIS MANUAL

A SolarFlow Plus unit delivered from the factory is fitted with a set of erasable, programmable, read-only memories (EPROMs) configured for the application(s) for which the SolarFlow Plus is intended. The Hand Held Data Terminal (HHDT) provided with SolarFlow Plus is **not** compatible with this particular valve positioning application. This application must be installed with Daniel Industries SFAccess Program, Part No. 3-2470-040. This manual provides specific information on a Model 2470 SolarFlow system configured for the dual-meter run, AGA-3 application with valve positioning. 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 the SolarFlow Plus computer and the HHDT. The System Reference manual, together with this application manual, provides information for this specific installation of the Model 2470 SolarFlow Plus system, although the SFAccess program on a PC is needed for the installation. This manual provides references to the System Reference Manual whenever more detailed information is provided in that manual.

This manual includes sections on:

- Calculation modules for the AGA-3 dual-meter run application
- 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, and MONITOR menu listings
- Default user report listing
- Channel assignments for the unit
- Default data log list

- Default security codes
- Default alarm list

1.2 INSTALLATION CONFIGURATION FOR THE DUAL METER RUN AGA-3 APPLICATION WITH VALVE POSITIONING

The SolarFlow Plus standard dual-meter run AGA-3 application is designed for installations with two orifice-meter tubes that have one differential pressure (DP) transmitter and one static pressure transmitter per tube, and common temperature transmitter and specific gravity inputs.

Figure 1 shows the installation configuration for the transmitters in the dual-meter AGA-3 application.

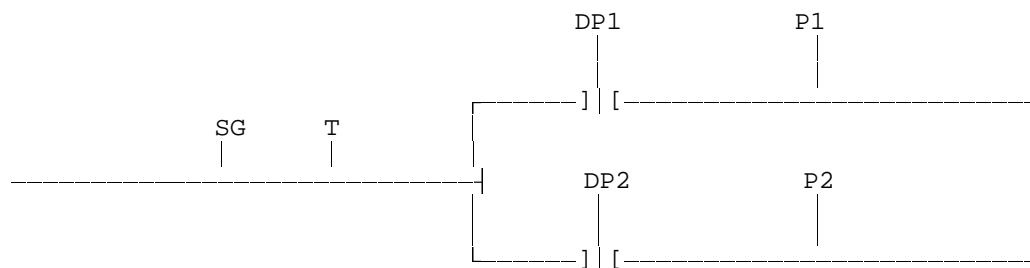


Figure 1. Installation Configuration for A Dual-Meter AGA-3 SolarFlow Plus Application with Valve Positioning

2.0 AGA-3 DUAL STANDARD (AGA3 DUAL STD) CALCULATION MODULE WITH VALVE POSITIONING

This manual supports a SolarFlow Plus computer configured to calculate orifice-meter measurements in accordance with the American Gas Association (AGA) Gas Measurement Committee Report No.3 (AGA-3), Orifice Metering of Natural Gas, (ANSI/API 2530 Second Edition, September 1985). Supercompressibility is calculated in accordance with AGA Standard NX-19 - Manual for the Determination of Supercompressibility Factors for Natural Gas.

2.1 FLOW RATE

In general, the equation for calculating flow rate is:

$$Q_h = C_f \sqrt{h_w (P_f)}$$

Where:

Q_h = corrected flow rate in thousands of standard cubic feet per hour (MCF/HR).

C_f = orifice flow constant calculated using the equation in 2.2

h_w = differential pressure in inches of water.

P_f = static pressure in pounds per square inch, absolute (PSIA).

2.2 ORIFICE FLOW CONSTANT (C_f)

The equation for calculating the orifice flow constant (C_f) is:

$$C_f = (F_b \cdot F_{pb} \cdot F_{tb} \cdot F_g \cdot F_{pv} \cdot F_r \cdot Y \cdot F_{tf} \cdot F_a) / 1000$$

Where:

F_b = basic orifice factor (Reference equation 61, ANSI/API 2530).

F_{pb} = pressure base factor (Reference equation 66, ANSI/API 2530).

F_{tb} = temperature base factor (Reference equation 67, ANSI/API 2530).

F_g = specific gravity factor (Reference equation 69, ANSI/API 2530).

F_{pv} = supercompressibility factor (Reference equation 72, ANSI/API 2530).

F_{pv} = calculations are limited to adjusted pressures of 0 (zero) to 2000 pounds per square inch, gauge and adjusted temperatures of -40 to 240 degrees Fahrenheit (°F).

F_r = Reynolds number factor (Reference equation 62, ANSI/API 2530).

Y = expansion factor (Reference equation 17 or 18, ANSI/API 2530).

F_{tf} = flowing temperature factor (Reference equation 68, ANSI/API 2530).

F_a = orifice thermal expansion factor (Reference equation E2 or E3, ANSI/API 2530).

2.3 CALCULATION CYCLES

During normal SolarFlow Plus operation, calculations are performed continuously. Each complete set of calculations is based on a calculation cycle. The time required to complete a calculation cycle depends on processor speed and the extent of data communication required by the application calculation module.

The SolarFlow Plus computer calculates the critical part of the flow rate calculation, extension factor,

$$\sqrt{h_w (P_f)}$$

every half second. The computer calculates the factors included in the flow constant (C_f), at an interval defined by the application program, typically every 15 to 25 seconds. The factors in C_f that are dependent upon sampled input values use the average of the 0.5-second samples in each calculation.

For example, if an application takes 20 seconds to calculate a new C_f value, a total of 40 extension factors are calculated during the C_f calculation interval. In addition, 40 samples of each analog input are obtained and averaged during the same period of time. SolarFlow Plus sums up and averages the individual extension factors then multiplies the result by the latest calculated value of C_f to produce an updated value for flow rate.

At the end of each flow rate calculation cycle, SolarFlow Plus updates channel values that are dependent on the calculated value of flow rate, such as flow rate and total volume.

2.4 VALVE POSITIONING PARAMETERS

Valve positioning will be performed as follows under the specified options.

FIX AND HOLD

The valve position is set to the over-ride valve position value.

FLOW RATE ONLY

After a timer has elapsed (Update Time), the flow rate is checked to determine if it is within the Deadband of the Flowrate Setpoint.

- If the flow rate is within the Deadband of the Flowrate Setpoint, the valve position is not updated and the timer is reset.
- If the flow rate is less than the Flowrate Setpoint (minus the Deadband), the valve step size is added to the valve position and the timer is reset.
- If the flow rate is greater than the Flowrate Setpoint (plus the Deadband), the valve step size is subtracted from the valve position and the timer is reset.

FLOW RATE WITH PRESSURE OVER-RIDE (UPSTREAM TAP)

Channel 26 pressure is checked every 0.5 seconds to determine if it exceeds the Pressure Setpoint.

- If the pressure is less than the Pressure Setpoint and the flow rate is within the Deadband of the Flowrate Setpoint, the valve position is not updated.
- If the pressure is less than the Pressure Setpoint and the flow rate is less than the Flowrate Setpoint (minus the Deadband), the valve step size is added to the valve position.
- If the pressure is less than the Pressure Setpoint and the flow rate is greater than the Flowrate Setpoint (plus the Deadband), the valve step size is subtracted from the valve position.
- If the pressure is greater than the Pressure Setpoint, the valve step size is added to the valve position.

FLOW RATE WITH PRESSURE OVER-RIDE (DOWNSTREAM TAP)

Channel 26 pressure is checked every 0.5 seconds to determine if it exceeds the Pressure Setpoint.

- If the pressure is less than the Pressure Setpoint and the flow rate is within the Deadband of the Flowrate Setpoint, the valve position is not updated and the timer is reset.
- If the pressure is less than the Pressure Setpoint and the flow rate is less than the Flowrate Setpoint (minus the Deadband), the valve step size is added to the valve position.
- If the pressure is less than the Pressure Setpoint and the flow rate is greater than the Flowrate Setpoint (plus the Deadband), the valve step size is subtracted from the valve position.
- If the pressure is greater than the Pressure Setpoint, the valve step size is subtracted from the valve position.

PRESSURE ONLY (UPSTREAM TAP)

After a timer has elapsed (Update Time), the pressure is checked to determine if it is within the Deadband of the Flowrate Setpoint. Note that setting the value of UPDATE TIME (Channel 87) to 0.0 results in this check being made every 0.5 seconds.

- If the pressure is within the Deadband of the Pressure Setpoint, the valve position is not updated.
- If the pressure is less than the Pressure Setpoint (minus the Deadband), the valve step size is subtracted from the valve position.
- If the pressure is greater than the Pressure Setpoint (plus the Deadband), the valve step size is added to the valve position.

PRESSURE ONLY (DOWNSTREAM TAP)

After a timer has elapsed (Update Time), the pressure is checked to determine if it is within the Deadband of the Flowrate Setpoint. Note that setting the value of UPDATE TIME (Channel 87) to 0.0 results in this check being made every 0.5 seconds.

- If the pressure is within the Deadband of the Pressure Setpoint, the valve position is not updated.
- If the pressure is less than the Pressure Setpoint (minus the Deadband), the valve step size is added to the valve position.
- If the pressure is greater than the Pressure Setpoint (plus the Deadband), the valve step size is subtracted from the valve position.

DIFFERENTIAL PRESSURE PROTECTION

If Differential Pressure Protection is enabled, it takes precedence over all other valve positioning unless the "Fix and Hold" option has been selected.

- If the Differential Pressure Protection is enabled, the Differential Pressure is checked every 0.5 seconds to determine if it is within the under/over range limits.
- If the Differential Pressure is not within limits, the valve position is set to the Preset Valve Position.

If the Differential Pressure is within limits, the valve position is defined by the valve positioning option selected.

3.0 FIELD WIRING CONNECTIONS

Before connecting analog inputs to the SolarFlow Plus unit, verify that slide switch settings are in the correct positions. See paragraph 3.3.3. Section 4 of the Model 2470 SolarFlow Plus System Reference Manual provides detailed information on slide switch settings.

3.1 ANALOG INPUT CONNECTIONS

Analog inputs for the dual-meter AGA-3 application of the Model 2470 SolarFlow Plus are connected in accordance with the following table.

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.

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.

Channel	Transmitter Type	Wire Color	Pin No.	Signal Type	
20	INTERNAL, static pressure, tube No.1 (Factory Installed)	(Blue*) (Black*) (Red*)	White Green Black	23 26 25	Signal in + Analog gnd 8 to 10 VDC
OR					
20	EXTERNAL, static pressure tube No.1 (To be installed by user)	Blue Black Red Shield		23 26 25 24	Signal in + Analog gnd 8 to 10 VDC Earth gnd
21	EXTERNAL, static pressure Meter tube No.2 (To be installed by user)	Blue Black Red Shield		27 30 29 28	Signal in + Analog gnd 8 to 10 VDC Earth gnd
22	EXTERNAL, common temperature (To be installed by user)	Blue Black Red Shield		31 34 33 32	Signal in + Analog gnd 8 to 10 VDC Earth gnd

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23	INTERNAL, differential pressure (DP), meter tube No.1 (Factory installed)	Violet Black Gray	35 38 37	Signal in + Analog gnd 8 to 10 VDC
OR				
23	EXTERNAL, DP, meter tube No. 1 (To be installed by user)	Blue Black Red Shield	35 38 37 36	Signal in + Analog gnd 8 to 10 VDC Earth gnd
24	EXTERNAL, DP, meter tube No.2 (To be installed by user)	Blue Black Red Shield	39 42 41 40	Signal in + Analog gnd 8 to 10 VDC Earth gnd
25	EXTERNAL, common specific gravity ⁽¹⁾ (To be installed by user)	(2)	43 46 45	Signal in + Analog gnd 8 to 10 VDC
26	EXTERNAL, process pressure for valve positioning (To be installed by user)	(2)	47 50 49	Signal in + Analog gnd 8 to 10 VDC

* SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with blue, black, and red wires.

NOTES:

- (1) Since fixed values are normally desired for BTU and SG, digital input channel 1 is factory-wired to ground. When live values are desired, remove the wire between pins 59 and 60 on the rear termination board and connect the live input. The fixed value for the specific gravity is entered in the CONFIG submenu of the SETUP UNIT menu by keying in the desired value. Refer to the System Wiring Diagram.
- (2) The wire for connecting the specific gravity transmitter is user supplied.

3.2 STATUS INPUT SIGNAL CONNECTIONS

This application supports one status input that is activated by means of a dry contact closure between the status input pin number and common. Following are the details of the pin-out arrangement for the status input.

Channel	Signal Description	(Label)	Pin No.	Signal Type
1	Use live or fixed Specific Gravity Value	(FIXED)	60	Status In (OPEN) indicates, use LIVE SG
			59	Common (SHORTED) indicates, Use FIXED SG

3.3 OUTPUT SIGNAL CONNECTIONS

Note that 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 (VPP1 and VPP2) and pulse period (PP1 and PP2) are included in the discussion of the CONFIG submenu of the SETUP UNIT menu.

There is one 1-5VDC analog output available on channel 27 in this application that can be used for valve positioning.

3.3.1 FORM-A RELAY OUTPUT

Output from the Form-A relays are shown in the following table.

Channel	Signal Description	(Label)	Pin No.	Signal Type
5	Volume pulse output	(VP1)	15 16	Form-A relay
6	Volume Pulse output	(VP2)	17 18	Form A relay

3.3.2 TTL LEVEL SIGNAL OUTPUTS

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

Channel	Signal Description	(Label)	Pin No.	Signal Type
5	Volume pulse output 1	(VP1)	78 76	TTL Output Common
6	Volume Pulse output 2	(VP2)	79 77	TTL Output Common

3.3.3 ANALOG OUTPUT CONNECTIONS

This application provides one 1-5 VDC analog output for valve positioning.

Channel	Signal Description	(Label)	Pin No.	Signal Type
27	Valve Positioning	(VALVE POS)	3 4	Analog output Analog ground

3.3.4 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 2 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 3 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 3.3.4.1.* 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 2.)

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 single DP transmitter using an orifice meter
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

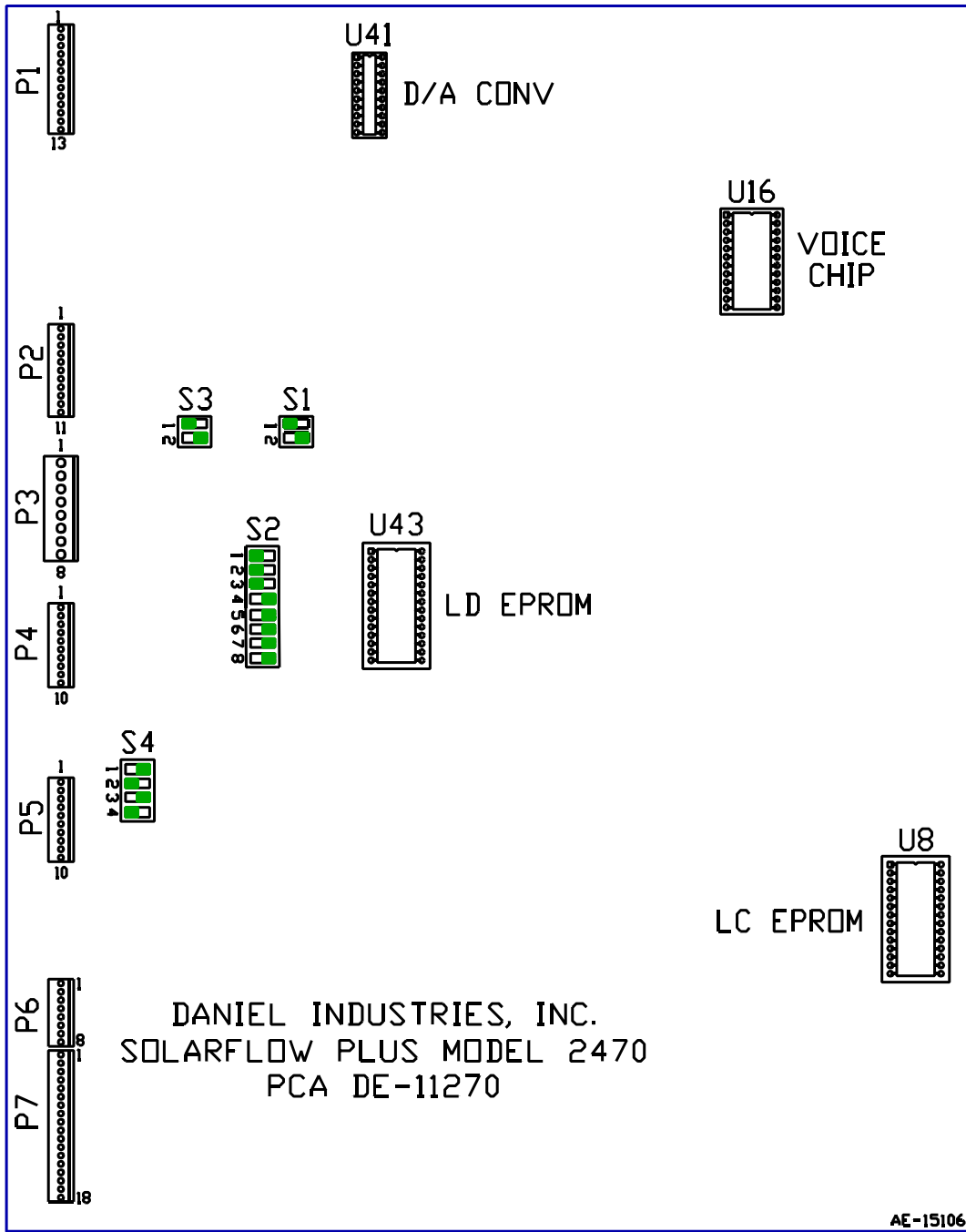


Figure 2. Model 2470 Slide Switch Locations
(PC Board Assembly Part No. 3-2470-000)

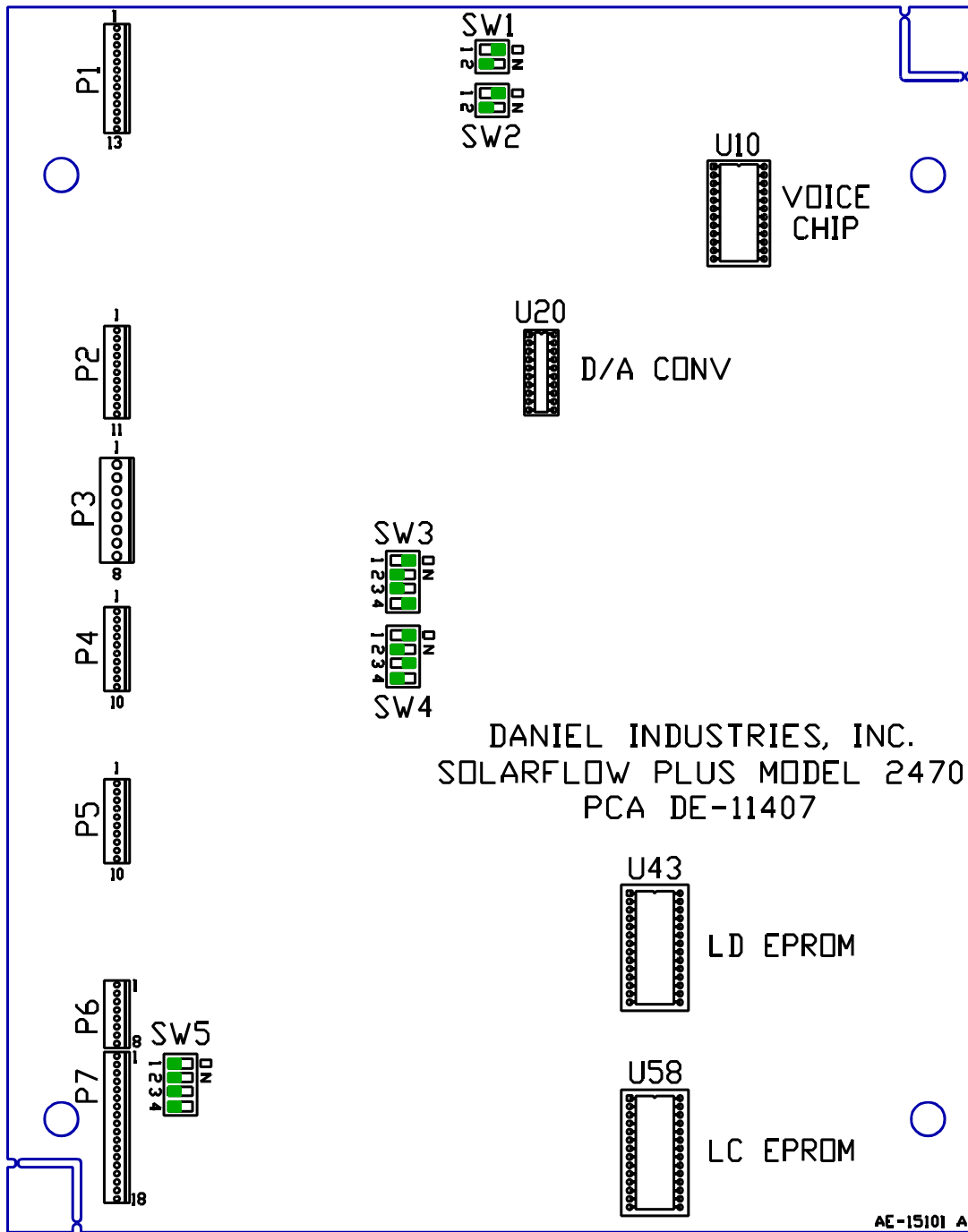


Figure 3. Model 2470 Slide Switch Locations
(PC Board Assembly Part No. 3-2470-008)

3.3.4.1 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 3 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 3.)

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 an orifice meter
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
SW4-3	OFF	Relay K2 activated by Channel 8

4.0 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the dual-meter run AGA-3 application that can be changed in the SETUP LOCATION menu are shown in the following table described by the 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.

HHDT Prompt	Default	Desired
LOCATION NAME	BLANK LOCATION	_____
LOCATION ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE	120	_____
USER REP ⁽¹⁾	20	_____
PCOMM RATE ⁽²⁾	300 BPS	_____
RTS DELAY ⁽³⁾	0 1/100 SEC	_____

NOTES:

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

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

(3) 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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5.0 SECURITY CODE LIST

The default security code list for this application is: 120, 101, 111, 121, 131, 141, 102, 112, 122, 132, 142.

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6.0 SETUP UNIT MENU

The parameters for the dual-meter AGA-3 application of SolarFlow Plus that can be changed in the four submenus of the SETUP UNIT menu are tabulated as follows. The parameters are tabulated by the prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

6.1 GENERAL SUBMENU

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

HHDT Prompt	Default	Desired
UNIT NAME	BLANK UNIT	_____
UNIT ID	BLANK-ID	_____
CONTRCT HR	7	_____
LOG INTRVL	1	_____
LOG DEFINE ⁽¹⁾	020A60 (ChTLD)	_____
RESET CMOD ⁽²⁾	OFF	_____

NOTES:

- (1) Before making changes in the LOG DEFINE Submenu, collect all data logs in SolarFlow Plus memory. All data logs in SolarFlow Plus memory are automatically erased and can no longer be recovered any time a change is made in the LOG DEFINE menu. Refer to paragraph 11.3 for a description of the LOG DEFINE prompt.
- (2) The RESET CMOD (Reset Calculations Module) prompt selects the calculation module for an alternate SolarFlow Plus application in installations with more than one installation configuration. For example, this SolarFlow Plus installation might serve an AGA-3 dual tube standard application as well as the AGA-3 stacked meter application. The user might initially set up the SolarFlow Plus unit for the AGA-3 dual meter application, then decide to change the unit to the AGA-3 stacked meter application. To do so, RESET CMOD is set to ON. When invoking the SETUP UNIT Menu subsequently, the operator is prompted to select the application desired. RESET CMOD is discussed in detail in paragraph 5.10.2.1.6 in the Model 2470 SolarFlow Plus System Reference Manual.

6.2 INPUTS SUBMENU

The INPUTS submenu of the SETUP UNIT menu provides for toggling between LIVE and FIXED values of the analog inputs shown below. Refer to paragraph 5.10.2.2 in the Model 2470 System Reference Manual for additional information about the INPUTS submenu.

HHDT Prompt	Default
METR PRES1	xxxxx PSIG
METR PRES2	xxxxx PSIG
METR TEMP	xxxxx DEGF
DIFF PRES1	xxxxx INH2O
DIFF PRES2	xxxxx INH2O
LIVE SG	xxxxx

6.3 SCALES SUBMENU

The high- and low-scale setpoints for the analog inputs shown in the table below 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 PSIG	_____
M PRES1/HI	1500 PSIG	_____
M PRES2/LO	0 PSIG	_____
M PRES2/HI	1500 PSIG	_____
M TEMP/LO	0 DEGF	_____
M TEMP/HI	150 DEGF	_____
D PRES1/LO	0 INH2O	_____
D PRES1/HI	150 INH2O	_____
D PRES2/LO	0 INH2O	_____
D PRES2/HI	150 INH2O	_____
LIVE SG/LO	0.6	_____
LIVE SG/HI	0.8	_____

6.4 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	Default	Desired
PIPE DIAM1	8.071 IN	_____
PIPE DIAM2	8.071 IN	_____
ORIF DIAM1	4.000 IN	_____
ORIF DIAM2	4.000 IN	_____
ZFLOW LIM	2.00 %	_____
ATMS PRES	14.73 PSIA	_____
PRES BASE	14.73 PSIA	_____
TEMP BASE	60 DEGF	_____
ORIF MTRL	0	_____
		0 = STEEL 1 = MONEL
FIXED SG	0.570	_____
FIXED CO2	0.00 MOL%	_____
FIXED N2	0.00 MOL%	_____
TAP LCTN	0	_____
		0 = DOWNSTREAM 1 = UPSTREAM
TAP TYPE	0	_____
		0 = FLANGE 1 = PIPE
VPP1 ⁽¹⁾	60.0 MCF	_____
		MCF/PULSE
PP1 ⁽²⁾	0 SEC	_____
		PULSE PERIOD
VPP2 ⁽¹⁾	60.0 MCF	_____
		MCF/PULSE
PP2 ⁽²⁾	0 SEC	_____
		MCF/PULSE

NOTES:

- (1) VPP1 and VPP2 are not the same as the outputs on channel 5 (VP1) and channel 6 (VP2). VP1 and VP2 are output pulses representing corrected station volume. VPP1 and VPP2 are scaling factors for VP1 and VP2 in thousands of cubic feet per pulse (MCF per pulse). The number of cubic feet per pulse can be modified using the HHDT. As indicated in the table, the scaling factor in MCF per pulse is 60.0. To accommodate an external totalizer that advances in increments of 100 standard cubic feet (SCF) per pulse, the default value of VPP1 and VPP2 would be reset to 0.1MCF per pulse.
- (2) The pulse period can be modified using the HHDT. As indicated in the table, no pulses are generated by PP1 and PP2 since the pulse period is set at zero (0) seconds. The value can be changed to provide a pulse to drive an external device. For example, resetting PP1 or PP2 to 1 would generate a pulse 1 second in duration. The value for PP1 or PP2 must be an integer equal to 1 or greater. Fractions of a second are not permitted.

6.5 FACTORS SUBMENU

The FACTORS submenu of the SETUP UNIT menu of the HHDT provides for toggling between LIVE and FIXED values for the calculated factors shown in the following table. Refer to paragraph 5.10.2.5 in the Model 2470 System Reference Manual for additional information about the FACTORS submenu.

HHDT Prompt	Default
FB FCTR 1	XXXX
FB FCTR 2	XXXX
FPB FCTR	XXXX
FTB FCTR	XXXX
FG FCTR	XXXX
FPV FCTR 1	XXXX
FPV FCTR 2	XXXX
FR FCTR 1	XXXX
FR FCTR 2	XXXX
Y FCTR 1	XXXX
Y FCTR 2	XXXX
FTF FCTR	XXXX
FA FCTR	XXXX

7.0 DISPLAY MENU

The DISPLAY Menu 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 five selections: INPUTS, SCALES, RATE/VOLS, CONFIG, and FACTORS.

INPUTS

- BATTERY
- METR PRES1
- METR PRES2
- METR TEMP
- DIFF PRES1
- DIFF PRES2
- LIVE SG

SCALES

- M PRES1/LO
- M PRES1/HI
- M PRES2/LO
- M PRES2/HI
- M TEMP/LO
- M TEMP/HI
- D PRES1/LO
- D PRES1/HI
- D PRES2/LO
- D PRES2/HI
- LIVE SG/LO
- LIVE SG/HI

RATE/VOLS

- FLOW RATE 1
- TOT VOL 1
- FLOW RATE 2
- TOT VOL 2
- FLOW RATE
- TOT VOL
- TODAY VOL
- YSDAY VOL
- VP1
- PC1

VP2
PC2

CONFIG

PIPE DIAM1
PIPE DIAM2
ORIF DIAM1
ORIF DIAM2
ZFLOW LIM
ATMS PRES
PRES BASE
TEMP BASE
TAP LCTN
TAP TYPE
ORIF MTRL
FIXED
FIXED SG
FIXED CO2
FIXED N2
VPP1
PP1
VPP2
PP2

FACTORS

FB FCTR 1
FB FCTR 2
FPB FCTR
FTB FCTR
FG FCTR
FPV FCTR 1
FPV FCTR 2
FR FCTR 1
FR FCTR 2
Y FCTR 1
Y FCTR 2
FTF FCTR
FA FCTR

8.0 CALIBRATE UNIT MENU

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 two selections: PRESSURES and OTHERS. Refer to paragraph 5.11 in the Model 2470 System Reference Manual for additional information on the CALIBRATE UNIT menu.

8.1 ACCEPTING AND REJECTING CALIBRATION

SolarFlow Plus has a built-in reference table that correlates the 1-to-5 volt analog inputs to a bit count. If the deviation between the "expected" (VALUE DISPLAYED) and the "actual" (user entered value) bit count is less than 25 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" bit count is greater than 25 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.

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

	ACTUAL (XMTR)	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:

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

8.2 PRESSURES

The PRESSURES selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed below. LOW BIAS is calibrated under the differential pressure entry.

METR PRES1
METR PRES2
DIFF PRES1
DIFF PRES2

8.3 OTHERS

The analog inputs listed below are calibrated in the OTHERS selection of the CALIBRATE UNIT menu.

METR TEMP
LIVE SG

9.0 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 analog inputs listed below are available in the MONITOR menu in the dual-meter AGA-3 application. Refer to paragraph 5.13.8 in the Model 2470 System Reference Manual for additional information on the MONITOR menu.

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

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10.0 AGA-3 DUAL STD CHANNEL ASSIGNMENTS

10.1 USER REPORT (CHANNEL ZERO)

Channel zero (0) is a predefined report list containing a report header and the channel data shown in the table below. 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
20	METR PRES1	Live pressure meter No.1 in PSIG
23	DIFF PRES1	Live DP, Run No.1, 1 value in inches of water
22	METR TEMP	Live temperature in degrees Fahrenheit (°F)
21	METR PRES2	Live pressure meter No.2 in PSIG
24	DIFF PRES2	Live DP, Run No.1, 2 value in inches of water
25	LIVE SG	Live value for specific gravity
60	FLOW RATE1	Flow rate for meter No.1
58	TOT VOL1	Total volume for meter No.1
63	FLOW RATE2	Flow rate for meter No.2
61	TOT VOL2	Total volume for meter No.2
67	TODAY VOL	Today's volume in MCF
68	YSDAY VOL	Yesterday's volume in MCF

10.2 CHANNEL ONE THROUGH 18 ASSIGNMENTS

Assignments for the dual meter AGA-3 application channels one through 18 are tabulated as follows.

Chl	Label	Input/Output	0-Label	1-Label	Default	Description
1*	FIXED	Inp	ES	NO	--	Fixed Gravity in use
2 through 4 are reserved for later use						
5	VP 1	Out	OFF	ON	OFF	Volume pulse output 1
6	VP 2	Out	OFF	ON	OFF	Volume pulse output 2
7 through 18 are reserved for later use						

* The "0-Label" for a status input, "Inp", lists the condition of the input when it is shorted to common. The "1-Label" lists the condition of the input when it is left open. For example, Channel 1 is a status input labeled "FIXED" which is used to signify the use of a fixed or live specific gravity value in the calculations. The "0-Label" is "YES" which means "use the FIXED value" The "1-Label" is "NO" which means do not use the FIXED value, use the LIVE value.

10.3 CHANNEL 19 THROUGH 90 ASSIGNMENTS

Assignments for the single and dual meter run AGA-3 channels 19 through 106 are tabulated as follows. The column labeled DP in the table indicates the number of points displayed/logged past the decimal point.

Channel	Ref	Label	Units	DP	Default	Description
19	--	BATTERY	VOLTS	1	-	Scale 3.2-16
20	Pf	METR PRES1	PSIG	0	-	Meter 1 flowing pressure Scale 0 to 1500
21	Pf	METR PRES2	PSIG	0	-	Meter 2 flowing pressure Scale 0 to 1500
22	Tf	METR TEMP	DEG F	0	-	Flowing temperature Scale 0 to 150
23	Hw	DIFF PRES1	InH2O	1	-	Meter 1 DP Scale 0 to 150.0
24	Hw	DIFF PRES2	InH2O	1	-	Meter 2 DP Scale 0 to 150.0
25	G	LIVE SG	(None)	3	-	Live specific gravity Scale 0.600 to 0.800
26		PRES PV VP	PSIG	0	0.0	Process pressure variable used for positioning
27		VALVE POS	%	1	0.0	Valve Position (Analog Output)
28 Reserved						

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29	D	PIPE DIAM1	In	3	8.071	Meter No.1 pipe diameter
30	D	PIPE DIAM2	In	3	8.071	Meter No.2 pipe diameter
31	d	ORIF DIAM1	In	3	4.000	Meter No.1 orifice diameter
32	d	ORIF DIAM2	In	3	4.000	Meter No.2 orifice diameter
33	Pa	ATMS PRES	PSIA	2	14.73	Atmospheric pressure
34	Pb	PRES BASE	PSIA	2	14.73	Pressure base
35	Tb	TEMP BASE	DEG F	0	60	Temperature base
36	G	FIXED SG	(None)	3	0.570	Alternate specific gravity
37		FIXED CO2	MOL%	2	0.00	Carbon dioxide inert for Fpv calc
38		FIXED N2	MOL%	2	0.00	Nitrogen inert for Fpv calc
39		TAP LCTN	(None)	0	0	Tap location: 0 = Downstream 1 = Upstream
40		TAP TYPE	(None)	0	0	Tap type: 0 = Flange 1 = Pipe
41	Fb	FB FCTR1	(None)	1	1.0	Meter No.1 orifice factor
42	Fb	FB FCTR2	(None)	1	1.0	Meter No.2 orifice factor
43	Fpb	FPB FCTR	(None)	4	1.0000	Pressure base factor
44	Ftb	FTB FCTR	(None)	4	1.0000	Temperature base factor
45	Fg	FG FCTR	(None)	4	1.0000	Gravity factor
46	Fpv	FPV FCTR1	(None)	4	1.0000	Meter No.1 supercompressibility factor
47	Fpv	FPV FCTR2	(None)	4	1.0000	Meter No.2 supercompressibility factor
48		FPV MTHD	(None)	0	0	Fpv calculation method 0 = Standard 1 = Alternate
49		PADJ FCRT	(None)	3	0.000	NX-19 Press. Adj. factor
50		TADJ FCTR	(None)	3	0.000	NX-19 Temp. Adj. factor
51	Fr	FR FCTR 1	(None)	4	1.0000	Meter No.1 Reynolds number factor

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52	Fr	FR FCTR 2	(None)	4	1.0000	Meter No.2 Reynolds number factor
53	Y	Y FCTR 1	(None)	4	1.0000	Meter No.1 expansion factor
54	Y	Y FCTR 2	(None)	4	1.0000	Meter No.2 expansion factor
55	Ftf	FTF FCTR	(None)	4	1.0000	Flowing temperature factor
56	Fa	FA FCTR	(None)	4	1.0000	Thermal expansion factor
57		ORIF MTR1	(None)	0	0	Orifice material: 0 = Steel 1 = Monel
58	V	TOT VOL 1	MCF	1	0.0	Meter No.1 total accumulated volume
59		LOG VOL 1	MCF	1	0.0	Meter No.1 logged accumulated volume
60		FLOW RATE1	MCF/hr	1	0.0	Meter No.1 flow rate
61		TOT VOL 2	MCF	1	0.0	Meter 2 total accumulated volume
62	V	LOG VOL 2	MCF	1	0.0	Meter 2 logged accumulated volume
63		FLOW RATE2	MCF/hr	1	0.0	Meter 2 flow rate
64		TOT VOL	MCF	1	0.0	Meter 1 & 2 total accumulated volume
65		LOG VOL	MCF	1	0.0	Meter 1 & 2 logged accumulated volume
66	Qh	FLOW RATE	MCF/hr	1	0.0	Meter 1 & 2 flow rate
67		TODAY VOL	MCF	1	0.0	Today's volume
68		YSDAY VOL	MCF	1	0.0	Yesterday's volume
69		VPP 1	MCF	1	60.0	Volume per pulse 1
70		PP 1	SEC	1	0.0	Pulse period 1
71		PC 1	(None)	0	0	Total pulses 1
72		VPP 2	MCF	1	60.0	Volume per pulse 2
73		PP 2	SEC	1	0.0	Pulse period 2
74		PC 2	(None)	0	0	Total pulses 2
75		LPP 1	BBLS	1	0.1	Liq per pulse 1
76		TOT LIQ 1	BBLS	1	0.0	Total liquid 1
77		LOG LIQ 1	BBLS	1	0.0	Logged liquid 1
78		LPP 2	BBLS	1	0.1	Liq per pulse 2
79		TOT LIQ 2	BBLS	1	0.0	Total liquid 2
80	LOG LIQ 2	BBLS	1	0.0	Logged liquid 2	

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81		FLOW RATE1	MCF/D	1	0.0	Flow Rate 1 MCF/D
82		FLOW RATE2	MCF/D	1	0.0	Flow Rate 2 MCF/D
83		FLOW RATE	MCF/D	1	0.0	Flow Rate MCF/D
84		FLOW SETPT	MCF/H	1	50.0	Flow Rate Setpoint
85		DEAD BAND	%	0	2	Control deadband
86		VALVE STEP	%	1	2.0	Valve step size
87		UPDAT TIME	SEC	0	60	Valve position update time
88-89 Reserved						
90		ZFLOW LIM	%	2	2.00%	Low flow cutoff in percent of full scale
100		PRES SETPT	PSIG	0	10	Pressure setpoint for pressure control or pressure over-ride
101		VLV POS OT		0	0	Valve Positioning Option 0=none (disabled) 1=fix and hold 2=flowrate only 3=flowrate w/press. over-ride (upstrm tap) 4=flowrate w/press. over-ride (dwnstrm tap) 5=pressure only (upstrm tap) 6=pressure only (dwnstrm tap)
102		DP PRO OPT		0	0	Differential Pressure protection option 0 = Disable 1 = Enable
103		DP ORNG LI	In	1	100	DP Over-range limit
104		DP URNG LI	In	1	2	DP Under-range limit
105		PR VLV POS	%	1	50	Preset valve position
106		OV VLV POS	%	1	50	Over-ride valve position

11.0 DATA LOG LIST AND HEADER BLOCK

11.1 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 7:00am.

Channel Number	Channel Label	Decimal Places	Digits	Logging Type
20	METR PRES1	0	6	AVERAGE
23	DIFF PRES1	1	4	AVERAGE
22	METR TEMP	0	4	AVERAGE
21	METR PRES2	0	6	AVERAGE
24	DIFF PRES2	1	4	AVERAGE
59	LOG VOL1	1	6	SNAPSHOT & ZERO
62	LOG VOL2	1	6	SNAPSHOT & ZERO
67	TODAY VOL	1	8	SNAPSHOT
68	YSDAY VOL	1	8	SNAPSHOT

11.2 DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

- M PRES1/LO
- M PRES1/HI
- M PRES2/LO
- M PRES2/HI
- M TEMP/LO
- M TEMP/HI
- D PRES1/LO
- D PRES1/HI
- D PRES2/LO
- D PRES2/HI
- LIVE SG/LO
- LIVE SG/HI
- PIPE DIAM1
- PIPE DIAM2
- ORIF DIAM1

(Continued on the next page.)

Header Block Contents (Continued)

ORIF DIAM2
ORIF MTRL
ATMS PRES
PRES BASE
TEMP BASE
FIXED SG
FIXED CO2
FIXED N2
TAP LCTN
VPP 1
PP 1
VPP 2
PP 2

11.3 LOG DEFINE PROMPT

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

Ch: channel number, which is 020 in the example 020A61

T: type of log, which is A in the example 020A61.

T can be:

A for average over log interval.

S for snapshot

Z for snapshot and zero at logging time

L: number of digits to be logged, which is 6 in the example 020A61

D: number of decimal places to be displayed, which is 1 in the example 020A61.

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

* If your HHDT application uses the five-digit ChTLD prompt, do not use the leading zero (in this case, channel numbers must be two digits only).

12.0 ALARM DEFINITIONS

The following is a listing of the Alarm definitions for this application.

Number of Retries: 5 for alarms 1 through 8
 0 (none) for alarm 9

Alarm No.	Alarm Condition	Alarm Message	VARIABLE VALUES			
			F	X	Y	Z
1	C(19) < X	BATTERY LO	16.0	10.8	0	0
2	C(20) < X*S(20,F)					
	or					
3	C(20) > Y*S(20,F)	METR PRES1	1500	0	1.01	0
	C(21) < X*S(21,F)					
	or					
4	C(21) > Y*S(21,F)	METR PRES2	1500	0	1.01	0
	C(22) < X*S(22,F)					
	or					
5	C(22) > Y*S(22,F)	METR TEMP	150	0	1.01	0
	C(23) < X*S(23,F)					
	or					
6	C(23) > Y*S(23,F)	DIFF PRES1	1150.0	0	1.01	0
	C(24) < X*S(24,F)					
	or					
7	C(24) > Y*S(24,F)	DIFF PRES2	150.0	0	1.01	0
	C(66) < X					
	or					
8	C(66) > Y	FLOW RATE		0	99999999	0
	C(64) > Y	VOL HIGH		0	99999999	0
9	C(94) > X					
	and					
	C(94) < > Y	SYS ERROR		109999.0	120015.0	0

EXAMPLE:

Alarm # 2

Y = 1.01

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

F = 1500 PSIG

Therefore, the alarm setpoint for alarm #2 is $1.01(1500) = 1515$ PSIG.

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

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

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

To acknowledge an alarm condition displayed on the LCD of SolarFlow Plus, enter the ALARM menu of the HHDT and select the ACKNOWLEDGE sub-menu. Any existing un-acknowledged 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.

12.1 DOWNLOADING ALARMS WITH HOST COMMUNICATIONS SOFTWARE (HCS)

The SolarFlow Plus software has been modified to conform to Federal Communications Commission (FCC) regulations regarding automatic telephone dialing. This will not affect any operations unless Host Communications Software (HCS) is used to perform alarm call-outs.

FCC regulations require that an alarm call-out device such as SolarFlow Plus cannot call the same phone number repeatedly for the same alarm occurrence. This would happen only if an alarm were configured to use one phone number. If an alarm occurred, SolarFlow Plus would formerly dial the one phone number repeatedly until someone answered and properly acknowledged the alarm. In most applications two or more phone numbers are assigned to an alarm.

In order to comply with this FCC regulation, SolarFlow Plus will now detect when HCS downloads an Alarm/Phone Number list with only a single phone number assigned to an alarm. When this condition is detected, SolarFlow Plus erases the downloaded Alarm/Phone Number list. HCS will not detect this action. If SolarFlow Plus is contacted through HCS in the Terminal Access Mode, each alarm will read "NO ENTRY". The Alarm/Phone Number list will need to be downloaded again with at least two phone numbers assigned to an alarm at all times to conform to this FCC regulation.

HCS allows phone numbers to be active during different time periods and on various days of the week. The easiest way to comply with this FCC regulation is to make sure that the phone number list ends with two "24-hours-a day-7-days-a-week" phone numbers.

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13.0 RADIO COMMUNICATION

This software may be used for radio communication only with Daniel PC software that supports "Radio Packetized Logon". The "Radio Packetized Logon" is active in SolarFlow Plus whenever a radio interface is installed, no local HHDT cable is plugged in, and RTS DELAY is set to some non-zero value. Consult the manual for your Daniel PC software to determine whether it supports this feature.

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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 (281) 897-2900, Fax (281) 897-2901, or contact:

Daniel Measurement Services
19203 Hempstead Highway
Houston, Texas 77065

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

Daniel Measurement Services offers both on call and contract maintenance service designed to afford single source responsibility for all its products.

Daniel Industries, Inc. reserves the right to make changes at any time to any product to improve its design and to insure the best available product.

**DANIEL INDUSTRIES, INC.
CUSTOMER PROBLEM REPORT**

FOR FASTEST SERVICE, COMPLETE THIS FORM, AND RETURN IT ALONG WITH THE AFFECTED EQUIPMENT TO CUSTOMER SERVICE AT THE ADDRESS INDICATED BELOW.

COMPANY NAME: _____

TECHNICAL CONTACT: _____ PHONE: _____

REPAIR P. O. #: _____ IF WARRANTY, UNIT S/N: _____

INVOICE ADDRESS: _____

SHIPPING ADDRESS: _____

RETURN SHIPPING METHOD: _____

EQUIPMENT MODEL #: _____ S/N: _____ FAILURE DATE: _____

DESCRIPTION OF PROBLEM: _____

WHAT WAS HAPPENING AT TIME OF FAILURE? _____

ADDITIONAL COMMENTS: _____

REPORT PREPARED BY: _____ TITLE: _____

IF YOU REQUIRE TECHNICAL ASSISTANCE, PLEASE FAX OR WRITE THE MAIN CUSTOMER SERVICE DEPARTMENT AT:

DANIEL MEASUREMENT SERVICES
ATTN: CUSTOMER SERVICE
19203 HEMPSTEAD HIGHWAY
HOUSTON, TEXAS 77065

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

The sales and service offices of Daniel Industries, Inc. are located throughout the United States and in major countries overseas.
Please contact Daniel Measurement Services at 19203 Hempstead Highway, Houston, Texas 77065, or phone (281) 897-2900 for the location of the sales or service office nearest you.
Daniel Measurement Services 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.

DANIEL
