

MODEL 2470 SOLARFLOW PLUS

**DANIEL MEASUREMENT AND CONTROL
HOUSTON, TEXAS**

"AGA-3 DUAL"

**HHDT EPROM 8-2470-178
LC EPROM 8-2470-173
LD EPROM 8-2470-172**

**Part Number: 3-9003-009
REVISION Q**

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DANIEL

**DANIEL INDUSTRIES, INC.
Model 2470 SolarFlow Plus
ENRON AGA-3 Dual Meter Run
Application Manual**

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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 or applications for which the SolarFlow Plus is intended. The Hand Held Data Terminal (HHDT) provided with a SolarFlow Plus unit is compatible with the same application or applications.

Basic reference information on the Model 2470 SolarFlow Plus system is provided in the System Reference Manual (Daniel part number 3-9000-451). The System Reference Manual includes sections on system hardware, software, installation, and operating procedures for both the SolarFlow Plus computer and the HHDT.

Information on each application of the Model 2470 SolarFlow Plus is provided in a separate application manual. The application manual also provides references to the System Reference Manual whenever more detailed information is available in the reference manual. The application manual together with the System Reference manual, provides a complete information package for a specific installation of the Model 2470 SolarFlow Plus system.

This application manual provides specific information on a Model 2470 SolarFlow Plus unit and the associated HHDT configured for the ENRON dual-meter AGA-3 application. Because an individual configuration of a SolarFlow Plus unit may differ in some respects from the basic system, information provided by the basic reference manual and this application manual may also differ. When differences are noted, the information contained in the application manual takes precedence.

This applications manual includes sections on:

- Calculation modules for the ENRON 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 menus for the HHDT
- Default user report listing
- Channel assignments for the unit
- Default data log list
- Default security codes

1.2 SOLARFLOW PLUS AND HHDT EPROMS FOR THE ENRON AGA-3 DUAL-METER APPLICATION

The Model 2470 SolarFlow Plus unit configured for the ENRON AGA-3 dual-meter application is fitted with the following EPROMs.

LC EPROM, Daniel part number 8-2470-173

LD EPROM, Daniel part number 8-2470-172

The Hand Held Data Terminal is fitted with:

HHDT EPROM, Daniel part number 8-2470-178

1.3 INSTALLATION CONFIGURATION FOR THE ENRON DUAL METER RUN AGA-3 APPLICATION WITH ONE DP TRANSMITTER PER METER TUBE

The SolarFlow Plus ENRON dual-meter run AGA-3 application is designed for installations with two orifice-meter tubes. The application has:

- One differential pressure (DP) transmitter per tube
- One static pressure transmitter per tube
- A common temperature transmitter
- A common specific gravity input

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

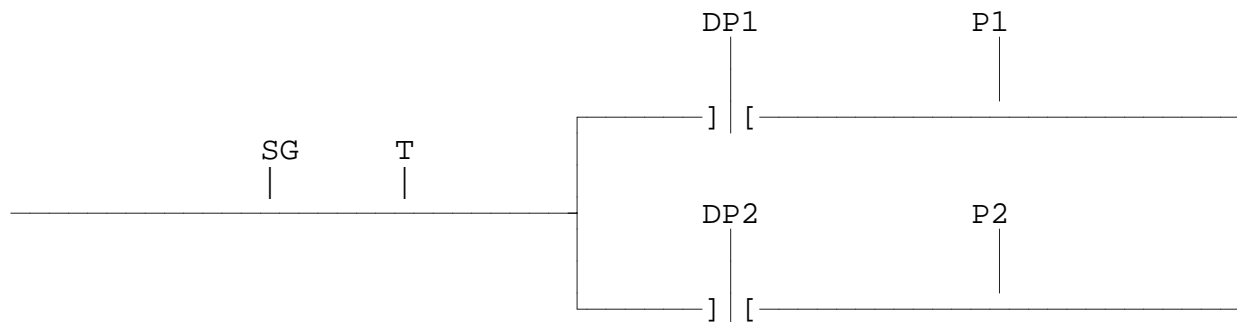


Figure 1. Installation Configuration for the ENRON AGA-3 Dual Meter SolarFlow Plus Application with One Differential Pressure Transmitter per Tube

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2.0 ENRON DUAL AGA-3 (AGA-3 DUAL) CALCULATION MODULE

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:

$$Q_h = C_f \cdot \sqrt{h_w \cdot P_f}$$

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:

$$C_f = \frac{(F_b \cdot F_g \cdot F_{pv} \cdot F_{tf} \cdot F_{ry})}{1000}$$

Where:

- F_b = basic orifice factor
- F_g = specific gravity factor
- F_{pv} = supercompressibility factor
- F_{tf} = flowing temperature factor
- F_{ry} = result of multiplying: $F_{pb}, F_{tb}, F_r, Y, F_a$

Where:

- F_{pb} = pressure base factor
- F_{tb} = temperature base factor
- F_r = Reynolds number factor
- Y = expansion factor
- F_a = orifice thermal expansion factor

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

The calculation methods of Channels 59, 63, 70, and 74 have been modified especially for ENRON. They represent the average extension factors for the last hour or last day over the flowing time period. The Extension Factor is defined as the square root of the product of differential pressure and static pressure, i.e.

$$E.F. = \sqrt{DP \cdot PRES}$$

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, $(h_w \cdot P_f)^5$, 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.

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3.0 FIELD WIRING CONNECTIONS

NOTE: Before connecting analog inputs to the SolarFlow Plus unit, make sure slide switch settings are in accordance with section 3.3.3.

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 table below.

NOTE: Configurations for this application include the static pressure and DP transmitters associated with meter 1 installed within the Model 2470 enclosure with all other transmitters installed externally, or with all transmitters installed externally. The following information furnishes necessary details for wiring both internal and external transmitters.

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

CH	TRANSMITTER TYPE	WIRE COLOR	TB1 PIN NO.	SIGNAL TYPE
20	INTERNAL, static pressure, Meter tube No.1 (factory installed)	White (Blue) ⁽¹⁾ Green (Black) ⁽¹⁾ Black (Red) ⁽¹⁾	23 25 26	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
20	EXTERNAL, static pressure, 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), Meter tube No.1 (factory installed)	Violet Black Gray	27 30 29	Signal in + Analog ground 8 to 10 VDC
<i>or</i>				
21	EXTERNAL, DP, Meter tube 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, common 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 ⁽²⁾	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 ⁽²⁾	EXTERNAL, 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
25	External common specific gravity ⁽³⁾ (to be installed by user)	⁽⁴⁾	43 46	Signal in + Analog ground
26	None, jumper pin 47 to 50	Black Black	47 50	Signal in + Analog ground

- NOTES:**
- (1) SolarFlow Plus units fitted with Statham 36PG series static pressure transmitters are wired with the Blue, Black, and Red wires.
 - (2) If SolarFlow Plus is configured as a single meter run, install a jumper wire from pin 35 to 38 for channel 23 and a jumper wire from pin 39 to pin 42 for channel 24.
 - (3) Live SG is optional; see Status Input Channel No.9.
 - (4) The wire for connecting the specific gravity transmitter is user supplied.
 - (5) Any analog inputs not used must have their respective "Signal in" terminal jumpered to their "Analog ground" terminal.
-

3.2 STATUS INPUT SIGNAL CONNECTIONS

This application supports two status input conditions that are activated by means of a dry contact closure between the status input channel and common. The following details the pin-out arrangement for the status inputs.

CH	DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
1	Status 1		60 51	Spare input Common
2	Status 2		61 52	Spare input Common
3	Status 3		62 53	Spare input Common
4	Status 4		63 54	Spare input Common
9	Fixed SG option	FIXED	64 59	Status in (Open) indicates FIXED specific gravity to be used Common (Shorted) indicates LIVE specific gravity to be used
10	Single or Dual Pressure Transmitter	DUAL TRAN	65 58	Status in (Open) indicates use of dual pressure inputs Common (Shorted) indicates use of a single pressure input*
16	Status 5		66 57	Spare input Common
17	Status 6		67 56	Spare input Common
18	Status 7		68 55	Spare input Common

* When a single pressure transmitter is chosen, the front panel LCD displays this as 023 AUX PRES while the HHDT will continue to display this as 023 METER PRES 2.

3.3 OUTPUT SIGNAL CONNECTIONS

NOTE: All output signals from SolarFlow Plus units in hazardous locations must be isolated using 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 as follows in the discussion of the CONFIG submenu of the SETUP UNIT menu.

3.3.1 Form-A Relay Output

Form-A relay outputs are shown in the following table.

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

3.3.2 TTL-Level Signal Termination Board Pin Numbers

TTL-level signals for output channels 5, 6, and 7 are available at the termination board pin numbers shown in the table below.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
5	Volume pulse output	FlowOut	78 76	TTL output Common
6	Volume pulse output	Sampler	79 77	TTL output Common
7	Open Tube 2	Tube Sw2	80 75	TTL output Common

3.3.3 Analog Output Connections

This application provides two 1- to 5 VDC analog outputs for corrected station flow rate in MCF/DAY.

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	SIGNAL TYPE
27	Flow rate output	Flw Rt Out	3 4	Analog out Ground
28	PID Setpoint	Setpoint	1 2	Analog out Ground

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 section 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 dual DP transmitters using orifice meters
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
S4-4	OFF	Relay K2 activated by Channel 8

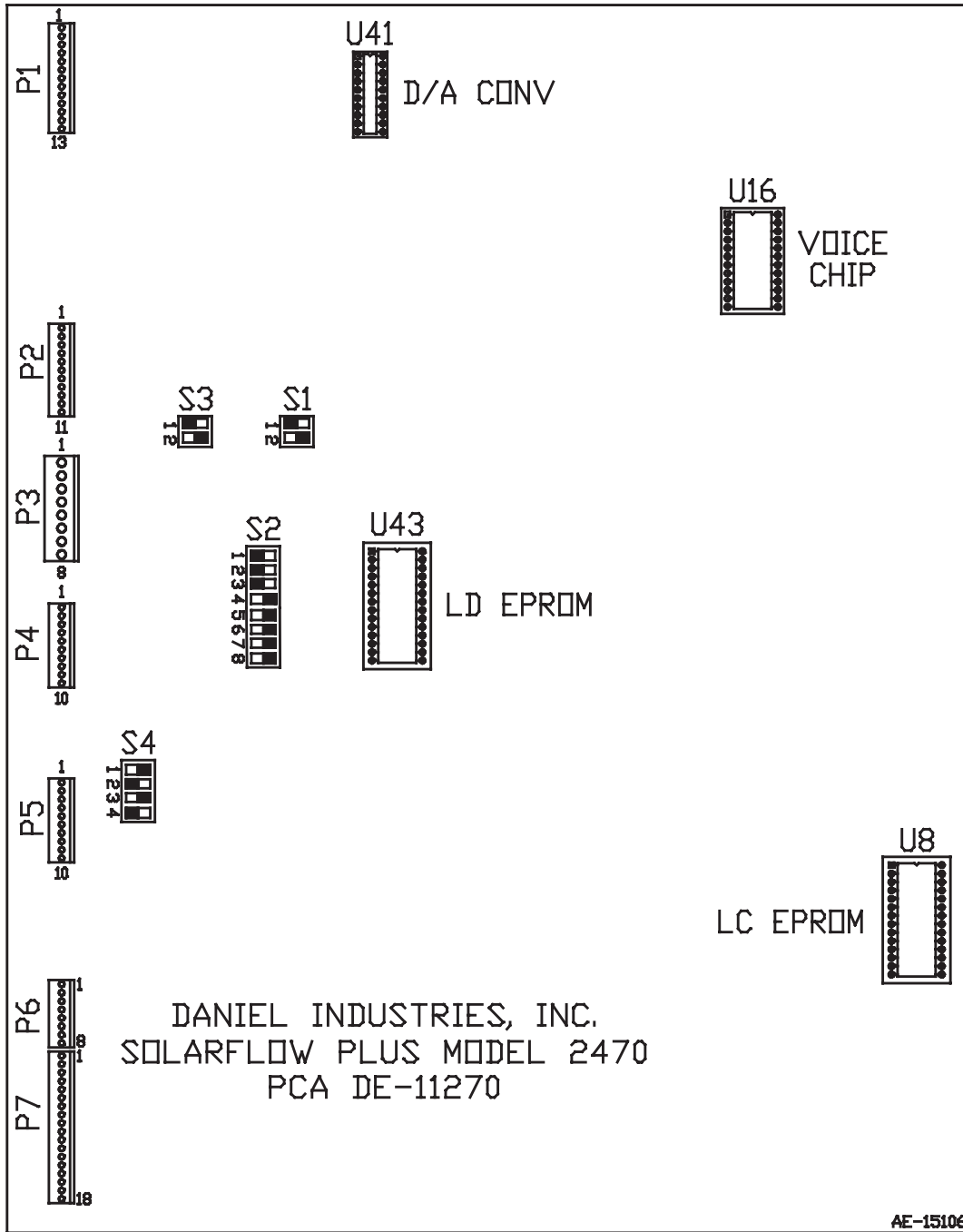


Figure 2. Model 2470 Slide Switch Locations
(PC Board Assembly Part No. 3-2470-000)

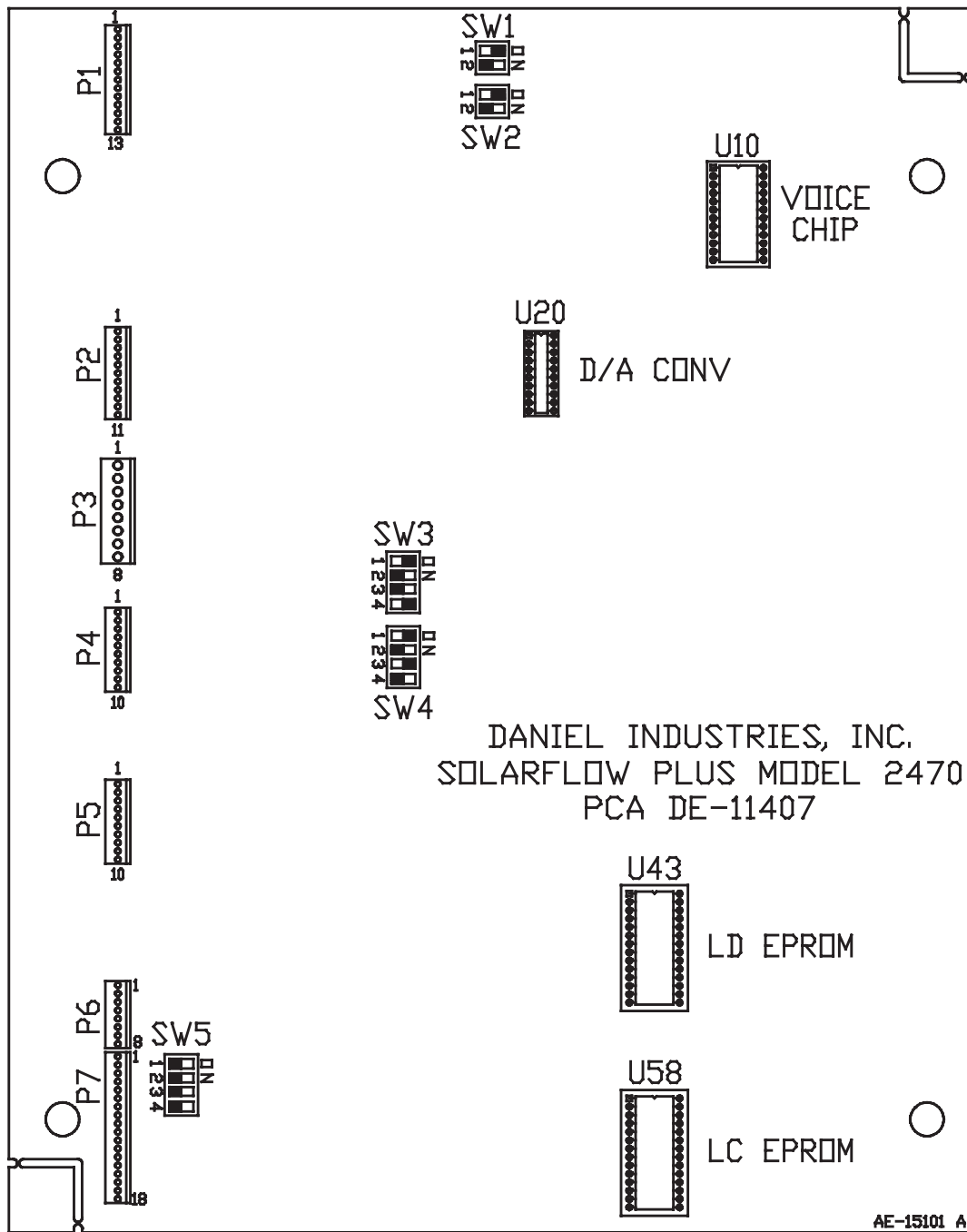


Figure 3. Model 2470 Slide Switch Locations
(PC Board Assembly Part No. 3-2470-008)

3.4.1 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 dual 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

4.0 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the ENRON dual-meter run AGA-3 application that can be changed in the SETUP LOCATION menu are shown in the table below 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 section 5.10.1 of the Model 2470 System Reference Manual.

NOTE: After approximately five minutes of inactivity (nothing keyed in on the keypad), the HHDT times out and turns itself off. **The HHDT must be disconnected from the SolarFlow Plus unit and reconnected before communications can be reestablished.**

HHDT PROMPT	DEFAULT	DESIRED	
LOCATION NAME	BLANK LOCATION	_____	(Max. 15 A/N Chr)
LOCATION ID	0	_____	(Max. 10 A/N Chr)
DATE	010180 MMDDYY	_____	
WEEK DAY	1 (1-7)	_____	
TIME	0000 HHMM	_____	
SEC CODE	120	_____	
USER REP ⁽¹⁾	20	_____	
PCOMM RATE ⁽²⁾	1200 BPS	_____	

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

(2) Refer to section 5.10.1.8 in the Model 2470 System Reference Manual for a complete discussion of the PCOMM RATE 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 ENRON AGA-3 application of SolarFlow Plus that can be changed in the four submenus of the SETUP UNIT menu using the HHDT are tabulated below. 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.

6.1 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	_____	(Max. 15 A/N Chr)
UNIT ID	BLANK ID	_____	(Max. 10 A/N Chr)
CONTRACT HOUR	7	_____	(0 to 23)
RESET CMOD ⁽¹⁾	NO	_____	

NOTE: (1) The RESET CMOD (Reset Calculations Module) is discussed in detail in section 5.10.2.1.6 in the Model 2470 System Reference Manual.

6.2 INPUTS SUBMENU

The INPUTS submenu of the SETUP UNIT menu of the HHDT provides for switching between LIVE and FIXED values of the analog inputs shown as follows. When the HHDT is used to fix a live input value (A/D value) the actual floating point value is not used. Instead, the SolarFlow Plus, taking into account all calibration and scaling, back calculates the raw unscaled binary value the A/D converter would have produced if the fixed floating point value had been the actual live value measured. This raw value is then used in place of the actual reading from the A/D converter.

The raw binary value does not have infinite precision and therefore cannot exactly represent every possible floating point value. The raw value will be very close to the desired fixed value; within +/- 0.0032%. This may cause slight differences between two runs with separately calibrated live inputs but identically fixed live values. This effect is the result of a trade-off within SolarFlow Plus where emphasis is put on the accuracy and speed of live calculations rather than operation with fixed live values. Refer to section 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
DIFF PRES1	xxxxx INH2O
METR TEMP	xxxxx DEGF
METR PRES2	xxxxx PSIG
DIFF PRES2	xxxxx INH2O
SPEC GRAV	xxxxx
ANLOGIN1	xxxxx

6.3 OUTPUTS SUBMENU

The OUTPUTS submenu of the SETUP UNIT menu of the HHDT provides a means of setting both the digital and analog output channel values. Operation of the HHDT with the OUTPUTS submenu is similar to the way it is used with the INPUTS submenu.

HHDT PROMPT	DEFAULT
SET POINT	0 MCF/D
CNTRL 1	OFF
CNTRL 2	OFF
CNTRL 3	OFF
CNTRL 4	OFF
CNTRL 5	OFF
CNTRL 6	OFF

6.4 SCALES SUBMENU

The high- and low-scale setpoints for the analog inputs shown in the following table can be modified in the SCALES submenu of the SETUP UNIT menu of the HHDT. Refer to section 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	1000	PSIG	_____
D PRES1/LO	0	INH2O	_____
D PRES1/HI	100	INH2O	_____
M TEMP1/LO	0	DEGF	_____
M TEMP1/HI	150	DEGF	_____
M PRES2/LO	0	PSIG	_____
M PRES2/HI	1000	PSIG	_____
D PRES2/LO	0	INH2O	_____
D PRES2/HI	100	INH2O	_____
S GRAV/LO	0.6		_____
S GRAV/HI	0.8		_____
ANAIN1/LO	1		_____
ANAIN1/HI	5		_____
F RT OUT/L	0	MCF/D	_____
F RT OUT/H	1000000	MCF/D	_____
SETPOINT/LO	0	MCF/D	_____
SETPOINT/HI	1000000	MCF/D	_____

6.5 CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu of the HHDT. Refer to section 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	_____
ATMS PRES	14.70	PSIA	_____
PRES BASE	14.73	PSIA	_____
TEMP BASE	60	DEGF	_____
N2	0.00	MOL%	_____
CO2	0.00	MOL%	_____
BTU	1000.0		_____
FIXED SG	0.600		_____
TAP LCTN	0		_____
			0 = DOWNSTREAM 1 = UPSTREAM
TAP TYPE	0		_____
			0 = FLANGE 1 = PIPE
LFlowLim	0.25	%	_____
VPP1 ⁽¹⁾	60.0	MCF	_____
			MCF/PULSE
PP1 ⁽²⁾	0	SEC	_____
			PULSE PERIOD
VPP2 ⁽¹⁾	60.0	MCF	_____
			MCF/PULSE
PP2 ⁽²⁾	0	MCF	_____
			PULSE PERIOD

0 = Closed

-
- NOTES:**
- (1) VPP1 and VPP2 are scaling factors for "Flowout" and "Sampler" 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 .1MCF per pulse.

 - (2) The pulse period can be modified using the HHDT. Setting PP1 or PP2 to zero stops and clears the respective pulse output (this is the default). When PP1 or PP2 is changed to a non-zero, pulsing of the respective digital output begins based on the volume accumulated from that point forward. 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.R.
-

6.6 FACTORS SUBMENU

The FACTORS submenu of the SETUP UNIT menu of the HHDT allows for switching between LIVE and FIXED values for the calculated factors shown in the following table. Refer to section 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
FRY FCTR 1	XXXX
FRY FCTR 2	XXXX
FG FCTR	XXXX
FPV FCTR 1	XXXX
FPV FCTR 2	XXXX
FTF FCTR	XXXX

6.7 SETPOINTS SUBMENU

The SETPOINTS submenu in the SETUP UNIT menu provides for setting the high and low limits for the tube switching and the various alarm limits.

SETPOINTS (SETUP UNIT)

HHDT PROMPT	DEFAULT	
M PRES H	1050	PSIG
F RATE L	0.0	MCF/D
F RATE H	50000.0	MCF/D
DP 1 MAX	90.0	INH2O (DP=0)
DP 1 MIN	10.0	INH2O (DP=0)
LOW BATT	10.8	

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7.0 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: INPUTS/OUTPUTS, SCALES, RATE/VOLS, CONFIG, FACTORS, SETPOINTS, FLW AVERAGES, and ENERGY.

INPUTS/OUTPUTS

- BATTERY
- METR PRES1
- DIFF PRES1
- METR TEMP
- METR PRES2
- DIFF PRES2
- SPEC GRAV
- ANLOGIN1
- SET POINT
- STATUS 1
- STATUS 2
- STATUS 3
- STATUS 4
- FIXED
- DUAL TRAN
- STATUS 5
- STATUS 6
- STATUS 7
- CNTRL 1
- CNTRL 2
- CNTRL 3
- CNTRL 4
- CNTRL 5
- CNTRL 6

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
S GRAV/LO
S GRAV/HI
ANAIN1/LO
ANAIN1/HI
F RT OUT/L
F RT OUT/H
SETPOINT/L
SETPOINT/HI

RATE/VOLS

FLOW RATE 1
TODAY VOL1
FLW RATE 2
TODAY VOL2
FLW RATE
FLW RT OUT
TOTAL VOL
YSDAY VOL
U VOL 1Y
U VOL 1H
U VOL 2Y
U VOL 2H
LOG VOL 1
LOG VOL 2
VPP1
PP1
PC1

RATE/VOLS (Continued)

FLOWOUT
VPP2
PP2
PC2
SAMPLER

CONFIG

PIPE DIAM1
PIPE DIAM2
ORIF DIAM1
ORIF DIAM2
ATMS PRES
PRES BASE
TEMP BASE
N2
CO2
BTU
FIXED SG
TAP LCTN
TAP TYPE
LFLOW LIM

FACTORS

FB FCTR 1
FB FCTR 2
FRY FCTR 1
FRY FCTR 2
FG FCTR
FPV FCTR 1
FPV FCTR 2
FTF FCTR

SETPOINTS

M PRES H
F RATE L
F RATE H
DP 1 MAX
DP 1 MIN
LOW BATT

FLW AVERAGES

FLW PRS 1Y
FLW DIF 1Y
FLW TMP 1Y
FLW PRS 1H
FLW DIF 1H
FLW TMP 1H
FLW PRS 2Y
FLW DIF 2Y
FLW TMP 2Y
FLW PRS 2H
FLW DIF 2H
FLW TMP 2H

ENERGY

BTU RATE 1
BTU RATE 2
LOG MMBTU1
TDY MMBTU1
LOG MMBTU2
TDY MMBTU2

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 three sub-menus: PRES ALL, DIFF BIAS, and OTHERS. When entering one of these sub-menus, all of the values included under that selection are temporarily fixed. Other inputs remain live. Upon exit from the sub-menu, the values are "unfixed". This temporary "fixing" and "unfixing" does not affect inputs that have been "permanently fixed" using the SETUP UNIT menu. Refer to section 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, the HHDT will display "OVER-DEVIATION CALIBRATION REJECTED". 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 PRES ALL

The PRES ALL selection of the CALIBRATE UNIT menu provides for calibrating the pressure inputs listed below.

METR PRES1
DIFF PRES1
METR PRES2
DIFF PRES2

8.3 DIFF BIAS

The DIFF BIAS selection allows the user to calibrate the differential pressure transmitters listed below for the low bias effect due to a zero shift in the transmitter caused by calibrating at atmospheric conditions and operation at elevated pressures.

DIFF PRES1
DIFF PRES2

8.4 OTHERS

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

METR TEMP
LIVE SG
ANLOGIN1

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

METR PRES1
DIFF PRES1
METR TEMP
METR PRES2
DIFF PRES2
SPEC GRAV
ANLOGIN1

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10.0 ENRON AGA-3 DUAL CHANNEL ASSIGNMENTS**10.1 USER REPORT (CHANNEL ZERO)**

Channel 0 (zero) 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 NO.	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
20	METR PRES1	Meter No.1 flow pressure
23	METR PRES2	Meter No.2 flow pressure
21	DIFF PRES1	Meter No.1 differential pressure
24	DIFF PRES2	Meter No.2 differential pressure
22	METR TEMP1	Common flow temperature
91	FIXED SG	Fixed specific gravity
54	FLW RATE 1	Meter No.1 flow rate
65	FLW RATE 2	Meter No.2 flow rate
77	BTU RATE 1	Meter 1 energy rate
86	BTU RATE 2	Meter 2 energy rate
76	TOTAL VOL	Total station volume
84	YSDAY VOL	Yesterday's station volume
19	BATTERY	Voltage

10.2 CHANNEL ONE THROUGH 18 ASSIGNMENTS

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

CH. NO.	LABEL	0* LABEL	1 LABEL	DIR	DEFAULT	DESCRIPTION
1	STATUS 1	OFF	ON	Inp	--	Input 1
2	STATUS 2	OFF	ON	Inp	--	Input 2
3	STATUS 3	OFF	ON	Inp	--	Input 3
4	STATUS 4	OFF	ON	Inp	--	Input 4
5	FLOWOUT	OFF	ON	Out	Off	Volume pulse output
6	SAMPLER	OFF	ON	Out	Off	Sampler output
7	TUBESW2	NO	YES	Out	No	Open tube 2
8	CNTRL 1	OFF	ON	Out	Off	Output 1
9	FIXED	NO	YES	Inp	--	Used fixed specific gravity
10	DUAL TRAN	NO	YES	Inp	--	Use dual pressure transmitter
11	CNTRL 2	OFF	ON	Out	Off	Output 2
12	CNTRL 3	OFF	ON	Out	Off	Output 3
13	CNTRL 4	OFF	ON	Out	Off	Output 4
14	CNTRL 5	OFF	ON	Out	Off	Output 5
15	CNTRL 6	OFF	ON	Out	Off	Output 6
16	STATUS 5	OFF	ON	Inp		Input 5
17	STATUS 6	OFF	ON	Inp		Input 6
18	STATUS 7	OFF	ON	Inp		Input 7

* 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 9 is a status input labeled "FIXED" which is used to signify the use of a fixed or live specific gravity value in the calculations. If channel 9 shows its "1-label" value (in this case, "yes"), it means that you use the fixed value. If channel 9 shows its "0-Label" value, it means that you use the live value.

10.3 CHANNEL 19 THROUGH 28 ASSIGNMENTS

The following table lists assignments for channels 19 through 28 of the ENRON dual meter AGA-3 application. The column labeled **DP** in the table indicates the number of points displayed/logged past the decimal point.

CH. NO.	REF	LABEL	UNITS	DP	LOW SCALE	FULL SCALE	DESCRIPTION
19	--	BATTERY	VOLTS	1	3.2	16.0	--
20	P _f	METR PRES1	PSIG	0	0	1000	Flowing pressure, Meter No.1
21	H _w	DIFF PRES1	INH2O	1	0.0	100.0	Differential pressure (DP), Meter No.1
22	T _f	METR TEMP	DEGF	0	0	150	Meter No.1 flowing temperature
23*	P _f	METER PRES2	PSIG	0	0	1000	Flowing pressure, Meter No.2
24	H _w	DIFF PRES2	INH2O	1	0.0	100.0	DP, Meter No.2
25		SPEC GRAV	None	3	0.600	0.800	Specific gravity
26		ANLOGIN1	None	0	1	5	Auxiliary analog 1
27		FLW RT OUT	MCF/D	0	0	1000000	MCF/D rate out
28		SET POINT	MCF/D	0	0	1000000	PID set point

* When a single pressure transmitter is chosen, the front panel LCD displays this as 023 AUX PRES while the HHDT will continue to display this as 023 METER PRES 2.

10.4 CHANNEL 29 THROUGH 98 ASSIGNMENTS

The following table lists assignments for channels 29 through 98 of the ENRON dual meter AGA-3 application. The column labeled **DP** in the table indicates the number of points displayed/logged passed the decimal point.

CH. NO.	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
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	P _a	ATMS PRES	PSIA	2	14.70	Atmospheric pressure
34	P _b	PRES BASE	PSIA	2	14.73	Pressure base
35	T _b	TEMP BASE	DEGF	0	60	Temperature base
36		N2	MOL%	2	0.00	Nitrogen content
37		CO2	MOL%	2	0.00	Carbon dioxide content
38		TAP LCTN	None	0	0	Tap location: 0 = downstream 1 = upstream
39		TAP TYPE	None	0	0	Tap type 0 = flange 1 = pipe
40	F _b	FB FCTR1	None	1	1.0	Meter 1 orifice factor
41	F _b	FB FCTR2	None	1	1.0	Meter 2 orifice factor
42		FRY FCTR 1	None	4	1.0000	Meter 1 F _a , F _{pb} , F _{tb} , F _r , Y factors
43		FRY FCTR 2	None	4	1.0000	Meter 2 F _a , F _{pb} , F _{tb} , F _r , Y factors
44	g	FG FCTR	None	4	1.0000	Gravity factor
45	F _{pv}	FPV FCTR1	None	4	1.0000	Meter 1 supercompressibility factor
46	F _{pv}	FPV FCTR2	None	4	1.0000	Meter 2 supercompressibility factor
47		LOG MMBTU1	None	1	0.0	Meter 1 logged energy
48		TDY MMBTU1	None	1	0.0	Meter 1 energy since contract hour
49		LOG MMBTU2	None	1	0.0	Meter 2 logged energy

CH. NO.	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
50		TDY MMBTU2	None	1	0.0	Meter 2 energy since contract hr
51	F _{tf}	FTF FCTR	None	4	1.0000	Flowing temperature factor
52		BTU	None	1	1000.0	BTU content
53		LOG VOL 1	MCF	1	0.0	Meter No.1 volume
54		FLW RATE 1	MCF/D	1	0.0	Meter No.1 instantaneous volume per day
55		TODAY VOL1	MCF	1	0.0	Meter No.1 accumulated volume since contract hour
56		FLW PRS 1Y	PSIG	0	0	Meter 1 average flowing pressure yesterday
57		FLW DIF 1Y	INH2O	1	0.0	Meter 1 average DP yesterday
58		FLW TMP 1Y	DEGF	0	0	Meter 1 average flowing pressure, last hour
59		U VOL 1Y	CU FT	2	0.00	Meter 1 average ext. factor yesterday
60		FLW PRS 1H	PSIG	0	0.0	Meter 1 average flowing pressure, last hour
61		FLW DIF 1H	INH2O	1	0.0	Meter 1 average DP, last hour
62		FLW TMP 1H	DEGF	0	0	Meter 1 average flowing temperature, last hour
63		U VOL 1H	CU FT	2	0.00	Meter 1 average ext. factor last hour
64		LOG VOL 2	MCF	1	0.0	Meter No.2 logged volume
65		FLW RATE2	MCF/D	1	0.0	Meter No.2 instantaneous volume per day
66		TODAY VOL2	MCF	1	0.0	Meter 2 accumulated volume since contract hour
67		FLW PRS 2Y	PSIG	0	0	Meter 2 average flowing pressure yesterday
68		FLW DIF 2Y	INH2O	1	0.0	Meter 2 average DP yesterday

CH. NO.	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
69		FLW TMP 2Y	DEGF	0	0	Meter 2 average flowing pressure, last hour
70		U VOL 2Y	CU FT	2	0.00	Meter 2 average ext. factor yesterday
71		FLW PRS 2H	PSIG	0	0.0	Meter 2 average flowing pressure, last hour
72		FLW DIF 2H	INH2O	1	0.0	Meter 2 average DP, last hour
73		FLW TMP 2H	DEGF	0	0	Meter 2 average flowing temperature, last hour
74		U VOL 2H	CU FT	2	0.00	Meter 2 average ext. factor last hour
75		FLOW RATE	MCF/D	1	0.0	Total instantaneous volume per day
76		TOTAL VOL	MCF	1	0.0	Total accumulated volume
77		BTU RATE 1	MM/D	1	0.0	Meter 1 energy rate
78		LFLOW LIM	%	2	0.25	Low flow cutoff limit
79		VPP 1	MCF	1	60.0	Volume per pulse 1
80		PP1	SEC	0	0	Pulse period 1
81		PC 1	None	0	0	Total pulses 1
82		VPP 2	MCF	1	60.0	Volume per pulse 2
83		PP 2	SEC	0	0	Pulse period 2
84		YSDAY VOL	MCF	1	0.0	Yesterday's station volume
85		M PRES H	PSIG	0	1050	High alarm setpoint static pres
86		BTU RATE 2	MM/D	1	0.0	Meter 2 energy rate
87		F RATE L	MCF/D	1	0.0	Low alarm setpoint flow rate
88		F RATE H	MCF/D	1	0.0	High alarm setpoint flow rate
89		DP 1 MAX	INH2O	0	90	High setpoint to open tube 2
90		DP 1 MIN	INH2O	0	10	Low setpoint to close tube 2
91		FIXED SG	None	3	0.600	Fixed specific gravity
92		LOW BATT	VOLTS	1	10.8	Low alarm setpoint battery
94		VERSION	None	1	--	Version Number

CH. NO.	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
95		LOCATION	None	0	0	Location identification
96		DELAY OPT	SEC	0	0	Delay option
97		REPEAT OPT	None	0	0	Repeat option
98		MAINT OPT	None	0	0	Maintenance option

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11.0 DATA LOG LIST

The ENRON AGA-3 dual meter run application has data logs at 1-hour and 24-hour intervals.

11.1 ONE-HOUR LOG INTERVAL

The following items are included in the data log set to a time interval of one hour.

CH. NO.	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
61	FLW DIF 1H	0	4	Snapshot
60	FLW PRS 1H	0	6	Snapshot
62	FLW TMP 1H	0	4	Snapshot
63	U VOL 1H	0	6	Snapshot
53	LOG VOL 1	0	6	Snapshot and Zero
47	LOG MMBTU1	0	6	Snapshot and Zero
72	FLW DIF 2H	0	4	Snapshot
71	FLW PRS 2H	0	6	Snapshot
73	FLW TMP 2H	0	4	Snapshot
74	U VOL 2H	0	6	Snapshot
64	LOG VOL 2	0	6	Snapshot and Zero
49	LOG MMBTU2	0	6	Snapshot and Zero
--	FLW TME 1H	1	6	Snapshot
--	FLW TME 2H	1	6	Snapshot

11.2 TWENTY-FOUR HOUR LOG INTERVAL

The following items are included in the data log set to a time interval of twenty-four hours.

CH. NO.	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
57	FLW DIF 1Y	0	4	Snapshot
56	FLW PRS 1Y	0	6	Snapshot
58	FLW TMP 1Y	0	4	Snapshot
59	U VOL 1Y	0	6	Snapshot
55	TODAY VOL1	0	6	Snapshot
48	TDY MMBTU1	0	6	Snapshot
68	FLW DIF 2Y	0	4	Snapshot
67	FLW PRS 2Y	0	6	Snapshot
69	FLW TMP 2Y	0	4	Snapshot
70	U VOL 2Y	0	6	Snapshot
66	TODAY VOL2	0	6	Snapshot
50	TDY MMBTU2	0	6	Snapshot
--	FLW TME 1Y	1	6	Snapshot
--	FLW TME 2Y	1	6	Snapshot

12.0 ALARM LIST

Following is a description of alarms as logged in the HHDT event log.

ALARM NO.	DESCRIPTION
1	Meter Pressure 1 High
2	Meter Pressure 2 High
3	Flow Rate 1 Low
4	Flow Rate 1 High
5	Flow Rate 2 Low
6	Flow Rate 2 High
7	Battery Low

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TECHNICAL NOTE

Access of Data Log (Archives) Via Modbus

Both Hourly and Daily data log records are acquired using the following method. Refer to the Modbus Communications Register Assignments for the specific register numbers used.

The appropriate request value is written via a Modbus register write command (function code 16). SolarFlow Plus immediately becomes busy as it acquires the data log record associated with the given request value.

During the busy time, the SolarFlow Plus will ignore any Modbus commands. The busy time is typically about two seconds. Worst case busy time is seven seconds.

The newly acquired data log values are read from their dedicated Modbus registers (using function code 3).

Algorithm for Computation of Hourly Request Value:

Compute the number of hours between 1/1/1980 00:00 and the date/time of the desired log record. Call this difference 'H'.

The request number, 'N', is found by: $N = (H \text{ mod } 576) + 1$, where 'mod' is the modulo function.

-
- NOTES:**
- The stroke of New Year's on 1/1/1980 is assigned the number one.
 - Subsequent hours are numbered sequentially up to number 576. The next hour after 576 is one again; and so on...
-

Algorithm for Computation of Daily Request Value:

Compute the number of days between 1/1/1980 and the date of the desired log record. Call this difference 'H'.

The request number, 'N', is found by: $N = (H \text{ mod } 24) + 1$, where 'mod' is the modulo function.

-
- NOTES:**
- The daily log made on contract hour 1/1/1980 is assigned the number one.
 - Subsequent days are numbered sequentially up to number 24. The next day after 24 is one again; and so on...
-

TECHNICAL NOTE

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. For further details for this application, see ENG 352.

MODBUS FLOATING POINT INDEX ASSIGNMENTS

7001	Hourly History Request (1 - 576)
7002	Current number of events
7003	Hourly History Date
7004	Hourly History Time
7005	spare
7006	Hourly History DP 1 (Flw Time 1)
7007	Hourly History Pressure 1
7008	Hourly History Temperature 1
7009	Hourly History Uncorrected volume 1
7010	Hourly History Volume 1
7011	Hourly History Energy 1
7012	Hourly History DP 2 (Flw Time 2)
7013	Hourly History Pressure 2
7014	Hourly History Temperature 2
7015	Hourly History Uncorrected volume 2
7016	Hourly History Volume 2
7017	Hourly History Energy 2
7018	Hourly History AGA-3 Flow Time Run 2
7019	Hourly History AGA-3 Flow Time Run 1
7020	spare
7021	spare
7022	spare
7023	spare
7024	spare
7025	spare
7026	Daily History (1 - 24)
7027	Current number of events
7028	Daily History Date
7029	Daily History Time
7030	spare
7031	Daily History DP 1 (Flw Time 1)
7032	Daily History Pressure 1
7033	Daily History Temperature 1
7034	Daily History Uncorrected volume 1
7035	Daily History Volume 1
7036	Daily History Energy 1
7037	Daily History DP 2 (Flw Time 2)
7038	Daily History Pressure 2
7039	Daily History Temperature 2
7040	Daily History Uncorrected volume 2

7041 Daily History Volume 2
7042 Daily History Energy 2
7043 Daily History AGA-3 Flow Time Run 2
7044 Daily History AGA-3 Flow Time Run 1
7045 spare
7046 Previous day volume 1
7047 Previous day volume 2
7048 Current Flow rate output
7049 Current Setpoint output
7050 Current number of events
7051 Current Date
7052 Current Time
7053 Current Battery voltage
7054 Current Station flow rate
7055 Today's Station volume
7056 Yesterday's Station volume
7057 Current Flow Rate run 1
7058 Current Flow Rate run 2
7059 Current DP 1
7060 Current Pressure 1
7061 Current Temperature 1
7062 Current Uncorrected volume 1
7063 Today's accumulated Volume 1 since contract hour
7064 Today's accumulated Energy 1 since contract hour
7065 Current DP 2
7066 Current Pressure 2
7067 Current Temperature 2
7068 Current Uncorrected volume 2
7069 Today's accumulated Volume 2 since contract hour
7070 Today's accumulated Energy 2 since contract hour
7071 Current Auxiliary A/D 1
7072 Current Auxiliary A/D 2
7073 Current Auxiliary A/D 3
7074 Current Specific Gravity
7075 Current number of events
7076 Previous Hour Date
7077 Previous Hour Time
7078 spare
7079 Previous Hour DP 1 (Flw Time 1)
7080 Previous Hour Pressure 1
7081 Previous Hour Temperature 1
7082 Previous Hour Uncorrected volume 1

7083 Previous Hour Volume 1
7084 Previous Hour Energy 1
7085 Previous Hour DP 2 (Flw Time 2)
7086 Previous Hour Pressure 1
7087 Previous Hour Temperature 2
7088 Previous Hour Uncorrected volume 2
7089 Previous Hour Volume 2
7090 Previous Hour Energy 2
7091 Previous Hour AGA-3 Flow Time 2
7092 Previous Hour AGA-3 Flow Time 1
7093 spare
7094 spare
7095 Current number of events
7096 Previous Day Date
7097 Previous Day Time
7098 spare
7099 Previous Day DP 1 (Flw Time 1)
7100 Previous Day Pressure 1
7101 Previous Day Temperature 1
7102 Previous Day Uncorrected volume 1
7103 Previous Day Volume 1
7104 Previous Day Energy 1
7105 Previous Day DP 2 (Flw Time 2)
7106 Previous Day Pressure 2
7107 Previous Day Temperature 2
7108 Previous Day Uncorrected volume 2
7109 Previous Day Volume 2
7110 Previous Day Energy 2
7111 Previous Day Flow Time 2
7112 Previous Day Flow Time 1
7113 spare
7114 spare
7115 spare
7116 spare
7117 spare
7118 spare
7119 spare
7120 spare
7121 spare
7122 spare
7123 spare
7124 Current Flow rate output

7125	Current Setpoint output
7126	Current Fixed BTU
7127	Current Fixed Specific gravity
7128	Current Fixed CO2
7129	Current Fixed N2
7130	Current Pressure Base
7131	Current Temperature Base
7132	Current Atmospheric Base
7133	Current Contract hour
7134	Current Pipe Diameter 1
7135	Current Orifice Diameter 1
7136	Current Meter Factor 1
7137	Current Low flow (DP) cutoff
7138	Current Low Battery set point
7139	Current Pipe Diameter 2
7140	Current Orifice Diameter 2
7141	Current Meter Factor 2
7142	Current Zero flow (Turbine) cutoff
7143	Current Min setpoint for tube switch
7144	Current Max setpoint for tube switch
7145	Current High flow rate alarm setpoint
7146	Current Fb Factor 1
7147	Current Fry Factor 1
7148	Current Low flow rate alarm setpoint
7149	Current Ftf Factor 1
7150	Current Fg Factor 1
7151	Current High pressure alarm setpoint
7152	Current Volume per pulse output 2
7153	Current Fpv Factor 1
7154	Current Pulse period for output 2
7155	Current Volume per pulse output 1
7156	Current Pulse period for output 1
7157	Current Fb Factor 2
7158	Current Fry Factor 2
7159	Current Tap location
7160	Current Ftf Factor 2
7161	Current Fg Factor 2
7162	Current Tap Type
7163	reserved
7164	Current Fpv Factor 2
7165	reserved
7166	reserved

7167 spare
7168 spare
7169 spare
7170 spare
7171 spare
7172 spare
7173 spare
7174 spare
7175 Current Battery zeroscale
7176 Current Battery fullscale
7177 Current Differential pressure 1 zeroscale
7178 Current Differential pressure 1 fullscale
7179 Current Pressure 1 zeroscale
7180 Current Pressure 1 fullscale
7181 Current Temperature zeroscale
7182 Current Temperature fullscale
7183 Current Differential pressure 2 zeroscale
7184 Current Differential pressure 2 fullscale
7185 Current Pressure 2 zeroscale
7186 Current Pressure 2 fullscale
7187 spare
7188 spare
7189 spare
7190 spare
7191 spare
7192 spare
7193 spare
7194 spare
7195 spare
7196 spare
7197 spare
7198 spare
7199 spare
7200 spare

ENRON MODBUS BOOLEAN REGISTER ASSIGNMENTS

1001	Current status input 1
1002	Current status input 2
1003	Current status input 3
1004	Current status input 4
1005	Current Fixed gravity indicator
1006	Current Dual transmitter indicator
1007	Current status input 5
1008	Current status input 6
1009	Current status input 7
1010	Current flow out pulse output
1011	Current sampler output
1012	Current tube switching output
1013	Current control output 1
1014	Current control output 2
1015	Current control output 3
1016	Current control output 4
1017	Current control output 5
1018	Current control output 6
1019	reserved
1020	reserved
1021	reserved
1022	reserved
1023	reserved

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

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 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
