

MODEL 2480 SOLARFLOW PLUS

**DANIEL MEASUREMENT AND CONTROL
HOUSTON, TEXAS**

**ENHANCED SOLARFLOW PLUS
FOR TURBINE/PD INSTALLATIONS
APPLICATION MANUAL**

**HHDT EPROM 8-2480-152
2480 EPROM 8-2482-005**

**Part Number 3-9004-009
Revision D**

MARCH 1999

DANIEL

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**DANIEL INDUSTRIES, INC.
ENHANCED MODEL 2480 AGA-7 SOLARFLOW PLUS
SINGLE METER RUN
APPLICATION MANUAL**

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SECTION 1

1.0 INTRODUCTION

The Model 2480 Enhanced SolarFlow Plus software application has been designed to implement as many of the commonly required features of natural gas flow computers as possible. This application has been designed to be compatible with existing Model 2480 support programs with minimal changes to those programs. Even with the enhanced features, field upgrades of existing units will be simple and easy. There are minimal or no hardware changes. This enhanced software will calculate rates and volumes using equations shown in section 1.4.

1.1 SCOPE OF THIS MANUAL

A SolarFlow Plus unit delivered from the factory is fitted with an erasable, programmable, read-only memory (EPROM) configured for the application for which the SolarFlow Plus is intended. The Hand Held Data Terminal (HHDT) provided with SolarFlow Plus is compatible with all Model 2480 applications specified. This manual provides specific information on a Model 2480 SolarFlow Plus system that is configured for a turbine/PD meter application. Basic reference information on the Model 2480 SolarFlow Plus system is provided in the System Reference Manual (Daniel Part Number 3-9000-497). The System Reference Manual includes sections on system hardware, software, installation, and operating procedures for both the SolarFlow Plus computer and the HHDT. The System Reference manual, together with this application manual, provide a complete information package for this specific installation of the Model 2480 SolarFlow Plus system. This manual references the System Reference Manual whenever more detailed information is provided in that manual.

This manual includes sections on:

- Calculation module for the turbine/PD meter 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, ALARM and MONITOR menus for the HHDT
- Default user report listing
- Channel assignments for the unit
- Default data log list
- Default security codes
- Default alarm list

1.2 PRODUCT FEATURES

The primary features of the Enhanced Model 2480 SolarFlow Plus software are as follows:

- Serves as a single run turbine/PD meter application
- Provides volume and energy measurement
- Supports AGA-8 according to the new standard (both detail and gross methods)
- Provides one contact closure pulse output based on station volume

1.3 ENHANCED TURBINE/PD APPLICATION

The following enhanced application is included in this manual. The former closest equivalent application is also included for reference.

NEW APPLICATION

PREVIOUS ANALOGOUS APPLICATION

2480 SNGL AGA-7E

2480 AGA-7 SNGL 8-2482-001

Transducer assignments in the new application are identical to existing ones in the older application. This allows upgrading of current units in the field without rewiring the analog inputs.

1.4 CALCULATIONS

The calculations in the SolarFlow Plus are divided into two distinct processes. These are as follows:

- Analog input sampling and uncorrected rate calculation
- Volume and corrected flow rate calculation cycle

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

1.4.1 ANALOG INPUT SAMPLING AND UNCORRECTED RATE CALCULATION

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

The samples are added to eight running sums which will be converted to average values and placed in SolarFlow Plus Channels 19 - 26 at the beginning of the next calculation cycle. These eight values are simple arithmetic averages of the inputs for the cycle. In addition to these eight averages, "flow time" averages are kept for measured static pressure in PSIG, temperature, specific gravity (regardless of source), and BTU content (regardless of source).

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

Each 0.5 seconds, the uncorrected flow rate is updated. The uncorrected flow rate is:

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

where

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

Pulses = The number of pulses used in rate calculation

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

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

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

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

1.4.2 FLOW RATE EQUATIONS

The SolarFlow Plus calculates volumetric flow rate using the following equations:

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

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

$$V_c = V_u * CF$$

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

where :

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

All compressibility values are calculated in accordance with AGA Report No. 8, 1992. The operator may select the DETAIL (full analysis) or GROSS (short form) method for compressibility calculation. For equations consult AGA Report No. 8. All input gravity values used in the SolarFlow Plus are assumed to be for reference conditions of 14.73 PSIA and 60 °F. This assumption is consistent with calculation examples given in AGA Report No. 8. If the operator indicates that the input gravity is the ideal relative density, the ideal value is converted to G_r before the flow rate calculation is run. This value is internal to the flow rate calculation, and does not replace the specific gravity value in the SolarFlow Plus channels.

1.4.3 RATE AND VOLUME CALCULATION

The SolarFlow Plus recalculates rates, volumes, and compressibility on a continuous basis. The duration of this calculation cycle depends on the configuration chosen. The length of each cycle is fixed, to ensure that no calculation cycle crosses a log period boundary. The cycle periods for **DETAIL** (full analysis) and **GROSS** (short form) are as follows:

AGA-8 DETAIL	AGA-8 GROSS (SHORT FORM)
20 SEC	10 SEC

At the beginning of each cycle, the analog input averages accumulated during the preceding cycle are transferred to the SolarFlow Plus channels. A new flow calculation is then performed using these inputs. The flowing compressibility is calculated first, followed by the instantaneous flow rate. The rates and volumes are updated last.

1.4.4 LOGGING

The logging function is a part of the calculation cycle process. At the end of each cycle, the SolarFlow Plus updates all of the running averages for the log. For channels in the log definition designated as averages, "flow averages" are kept based on flowing conditions. Straight time averages are kept for an item if the meter run is shut-in for the entire log period.

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

1.5 VOLUME PULSE OUTPUT

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

1.6 ACCEPTING AND REJECTING CALIBRATION

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the output of the transmitter for analog inputs to the SolarFlow Plus unit. The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP, and AUX. Refer to section 5.11 in the Model 2480 System Reference Manual for additional information on the CALIBRATE UNIT menu.

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

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

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

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

1.7 LOG DEFINE PROMPT

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

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

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

- * Enhanced SolarFlow software must use six digit channel assignments due to the 150 total channels.

1.8 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.

1.9 USER LOGON EVENT

This application generates a "User logged on" record in the Event log only if the user performed an action (e.g. changed a measurement parameter, etc.) which generates another event. In other words, no event log entry is made when a user logs on and just reads current values.

1.10 HIGH SPEED CHANNEL READS

This application supports high speed channel reads with DSI protocol.

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SECTION 2**2.0 ENHANCED SOLARFLOW PLUS CHANNEL ASSIGNMENTS**

The enhanced SolarFlow Plus software features a comprehensive set of channels which should satisfy all of the expected applications with some room for future growth. The Model 2480 Enhanced SolarFlow Plus supports 150 channels. The first 28 channels have the same special meaning as in the past. The remaining channels are the calculation channels which contain all rates, volumes, calculated results and configuration entries. The channels not used by a particular configuration are reserved if that application has been selected, and are not available for other purposes.

This application has channel assignments which are compatible with the enhanced applications of Model 2470 SolarFlow Plus.

2.1 CHANNEL 1 THROUGH 18 ASSIGNMENTS

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

CH	LABEL	INPUT OUTPUT	0- LABEL	1- LABEL	DEFAULT	DESCRIP
001*	LIVE SG	INP	NO	YES	NO	Live gravity use
002 through 004 are reserved for later use						
005	VP 1	OUT	OFF	ON	OFF	Volume pulse output 1
006 through 018 reserved for later use						

* LIVE SG for channel 001 indicates pin 1 not jumpered to pin 2.

2.2 CHANNEL 19 THROUGH 240 ASSIGNMENTS

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

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
023	BATTERY	VOLTS	2	0.00	Scale 3.2 -16
Channels 20-26 as per applications					
027-028	Reserved			0	
029	VERSION		1	1.0	Software version
030	SYS ERROR		0	0	System alarm
031-032	Reserved			0	
033	ATMS PRES	PSIA	2	14.73	Atmospheric pressure
034	PRES BASE	PSIA	2	14.73	Pressure base
035	TEMP BASE	DEG F	0	60	Temperature base
036-041	Reserved			0	
042	SG SELECT		0	0	Input Specific Gravity 0=ideal, 1=real
043	AGA8 MTHD		0	0	AGA-8 Method 0=detail 1=GR, CO2, BTU 2=GR, CO2, N2
044	ZS		6	1.000000	Standard compressibility
045	ZB		6	1.000000	Base compressibility
046	MOL WT		4	16.8000	Calculated by AGA-8
047	B		6	0.000000	AGA-8 2nd virial coeff.

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
048	C		6	0.000000	AGA-8 3rd virial coeff.
049	D		6	0.000000	AGA-8 reduced density
050	K3		6	0.000000	AGA-8 mixture size parameter
051	SPEC GRAV	(None)	4	0.6000	Current SG
052	BTU	(None)	1	1000.0	Current BTU
053	METHANE	MOL%	3	95.000	Methane MOL%
054	N2	MOL%	3	0.000	Nitrogen MOL%
055	CO2	MOL%	3	0.000	Carbon dioxide MOL%
056	ETHANE	MOL%	3	5.000	Ethane MOL%
057	PROPANE	MOL%	3	0.000	Propane MOL%
058	H2O	MOL%	3	0.000	Water MOL%
059	H2S	MOL%	3	0.000	Hydrogen Sulphide MOL%
060	HYDROGEN	MOL%	3	0.000	Hydrogen MOL%
061	CO	MOL%	3	0.000	Carbon Monoxide MOL%
062	OXYGEN	MOL%	3	0.000	Oxygen MOL%
063	I-BUTANE	MOL%	3	0.000	I-butane MOL%
064	BUTANE	MOL%	3	0.000	Butane MOL%
065	I-PENTANE	MOL%	3	0.000	I-pentane MOL%
066	PENTANE	MOL%	3	0.000	Pentane MOL%
067	HEXANE	MOL%	3	0.000	Hexane MOL%
068	HEPTANE	MOL%	3	0.000	Heptane MOL%
069	OCTANE	MOL%	3	0.000	Octane MOL%
070	NONANE	MOL%	3	0.000	Nonane MOL%

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
071	DECANE	MOL%	3	0.000	Decane MOL%
072	HELIUM	MOL%	3	0.000	Helium MOL%
073	ARGON	MOL%	3	0.000	Argon MOL%
074-075	Reserved				
076	VPP 1	MCF	1	100.0	Volume per pulse 1
077	PP 1	SEC	0	1	Pulse period 1
78-104	Reserved				
105	ZFLOW LIM	SEC	0	15	Turbine zero flow cutoff time
106-128	Reserved			0	
129	ZF 1	(None)	6	1.000000	Flowing compressibility
130-131	Reserved			0	
132	FLW TIME 1	MIN	2	0.00	Flow time
133	FLOW RATE1	MCF/H	1	0.0	Hourly flow rate
134	FLOW RATE1	MCF/D	1	0.0	Daily flow rate
135	LOG VOL 1	MCF	1	0.0	Logged accumulated volume
136	TODAY VOL1	MCF	1	0.0	Daily accumulated volume
137	YSDAY VOL1	MCF	1	0.0	Ysday's accumulated volume
138	TOT VOL 1	MCF	1	0.0	Total accumulated volume (Rolls over @ 10,000,000)
139	ERATE 1	DTH/H	1	0.0	Energy flow rate
140	LOG ENRGY1	DTH	1	0.0	Logged accumulated energy

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
141	TDY ENRGY1	DTH	1	0.0	Today's accumulated energy
142	YSY ENRGY1	DTH	1	0.0	Ysday's accumulated energy
143	TOT ENRGY1	DTH	1	0.0	Total accumulated energy (Rolls over @ 10,000,000)
144	UNCR RATE1	ACF/H	1	0.0	Uncorrected flow rate
145	LOG UVOL1	ACF	1	0.0	Logged uncorrected volume
146	TDY UVOL1	ACF	1	0.0	Today's uncorrected volume
147	YSY UVOL1	ACF	1	0.0	Ysday's uncorrected volume
148	TOT UVOL1	ACF	1	0.0	Total uncorrected volume (Rolls over @ 10,000,000)
149	METR FCTR1	PPCF	2	100.00	Meter factor in pulses per actual cubit foot
150-240	Reserved				

* All totals roll over at 10,000,000 so adjust your units accordingly.

SECTION 3

3.0 SINGLE TURBINE/PD APPLICATION

Section 3 covers the individual requirements for the single turbine/PD application configured to calculate volume and flow rate using equations from section 1.4. The single turbine/PD application supports measurement on a single meter tube. Channel 1 is a digital input that indicates whether an analog input is used for live specific gravity. To select fixed specific gravity, this input should be jumpered to ground; for live specific gravity, this input should be left open.

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

3.1 FIELD WIRING CONNECTIONS - INPUT CONNECTIONS**3.1.1 ANALOG INPUT CONNECTIONS**

Analog inputs for the single-meter AGA-7 application of the Model 2480 SolarFlow Plus are connected in accordance with the following table.

The following table shows the Solarflow Plus channels assigned for connecting analog inputs to the unit. Drawing number DE-11284 in Appendix C of the model 2480 System Reference Manual provides field wiring detail for connecting the inputs. Figure 3-1 illustrates the terminal board connections for this application.

CH	TRANSMITTER TYPE	WIRE COLOR	TB2 PIN NO.	TB2 PIN LABEL
19	Auxiliary 1-5 VDC single ended analog input. Used for logging purposes only.	- ¹	1	AUX
		- ¹	3	GND
20	Daniel Model 224 millivolt static pressure transmitter. (Factory wired, if installed inside SolarFlow Plus enclosure.)	Yellow	10	PWR +
		Green	11	SIG +
		White	12	SIG -
		Black	13	PWR -
- OR -				
20	Statham series 36, 1-5 VDC static pressure transmitter. (Factory wired, if installed inside SolarFlow Plus enclosure.)	Blue	7	SP
		Red	8	+12 V
		Black	9	GND
21	External, RTD temperature transducer. (To be installed by user. Cable supplied with connector.)	- ²	14	TEMP
		- ³	15	GND
		- ³	16	GND
22	External, Specific Gravity transmitter. (To be installed by user.)	- ¹	4	DP1
		- ¹	6	GND

- See NOTES, next page -

NOTES: Footnotes for preceding table:

¹ Interconnect wiring to be supplied by user.

² Amber with Black tracer or Red.

³ Amber or White.



IMPORTANT: If the specific gravity input is FIXED rather than LIVE, digital channel No.1 should be held at ground level (0 volts) by installing a jumper wire between pins 1 and 2 of TB1 on the rear termination board of the model 2480 SolarFlow Plus. The value for the specific gravity input is entered in the GAS DATA submenu of the SETUP UNIT menu by keying in the desired value for the parameter, SPEC GRAV.

3.1.2 PD/TURBINE METER INPUT CONNECTIONS

INPUT DESCRIPTION	WIRE COLOR	TB1 PIN NO.	TB1 PIN LABEL
PD/Turbine Meter, maximum frequency of 50 Hz. (For pulse inputs up to a maximum frequency of 5 KHz, see section 6.5 of the Model 2480 SolarFlow Plus System Reference Manual, part number 3-9000-497, regarding the Daniel Model 1882 Preamplifier.)	- ¹	17	GND
	- ¹	18	PD

NOTES: Footnotes for preceding table:

¹ Interconnect wiring to be supplied by user.

3.1.3 STATUS INPUT CONNECTIONS

This application supports one status input that is activated by means of a dry contact closure between the status input channel and common. When TB1 pins 1 and 2 are connected together (shorted), a FIXED specific gravity will be used. When pins 1 and 2 are not connected (open), a live specific gravity will be used. The following details the pin-out arrangement for the status input.

CH	DESCRIPTION (LABEL)	TB1 PIN NO.	TB1 PIN LABEL	SIGNAL TYPE
1	Fixed SG option (FIXED)	2	IN 1	status in
		1	GND	common

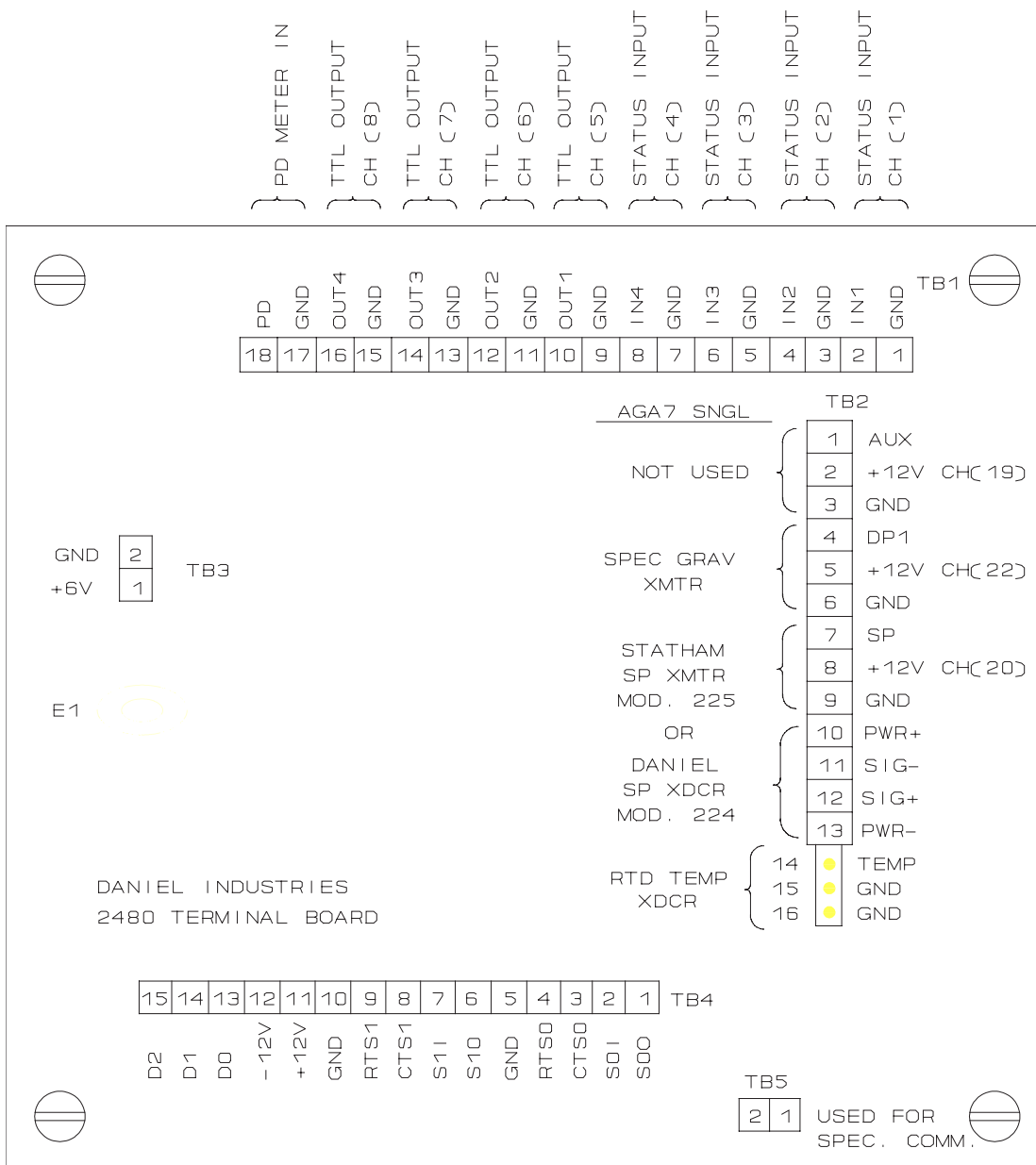


Figure 3-1. Terminal Board Connections

3.2 OUTPUT SIGNAL CONNECTIONS

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 one TTL output for corrected station volume on channel 5. The volume per pulse and the pulse period of the output may be changed using the HHDT. Prompts for changing the volume per pulse (VPP1) and pulse period (PP1) are included in the discussion of the CONTROL submenu of the SETUP UNIT menu.

3.2.1 TTL LEVEL SIGNAL OUTPUTS

TTL level output for channel FIVE (5) is available at the terminal board TB1 shown in the following table.

CH	DESCRIPTION (LABEL)	TB1 PIN NO.	TB1 PIN LABEL	SIGNAL TYPE
5	Volume pulse output 1 (VP1)	10	OUT 1	TTL output
		9	GND	common

3.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the single-meter run AGA-7E application that can be changed in the SETUP LOCATION menu are shown in the following table described by the HHDT prompt for the parameter, the factory-installed default value, and a blank space for entering the desired value if different from the factory default. Additional information on the SETUP LOCATION menu is provided in section 5.10.1 of the Model 2480 System Reference Manual.

HHDT PROMPT	DEFAULT	DESIRED
LOC NAME	BLANK LOCATION	_____
LOC ID	0	_____
DATE	010180 MMDDYY	_____
WEEK DAY	1 (1-7)	_____
TIME	0000 HHMM	_____
SEC CODE ⁽¹⁾	120	_____
USER REP ⁽²⁾	****	_____
PCOMM RATE ⁽³⁾	300 BPS	_____
RTS DELAY ⁽⁴⁾	0 1/100 SEC	_____

-
- NOTE:**
- (1) Refer to section 5.10.1.6 in the Model 2480 System Reference Manual for a complete discussion of the SEC CODE prompt.
 - (2) Refer to section 5.10.1.7 in the Model 2480 System Reference Manual for a complete discussion of the USER REP prompt.
 - (3) Refer to section 5.10.1.8 in the Model 2480 System Reference Manual for a complete discussion of the PCOMM RATE prompt.
 - (4) Refer to section 5.10.1.9 in the Model 2480 System Reference Manual for a complete discussion of the RTS DELAY prompt.
-

3.4 SECURITY CODE LIST

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

3.5 SETUP UNIT MENU

The parameters for the single-meter AGA-7E application of SolarFlow Plus that can be changed in the seven submenus of the SETUP UNIT menu using the HHDT are tabulated as follows. The parameters are tabulated by the HHDT prompt for the parameter, the factory-installed default, and a blank space for entering the desired value if different from the factory default.

3.5.1 GENERAL SUBMENU

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

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

-
- NOTE:**
- (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 section 1.7 for a description of the LOG DEFINE prompt.
 - (2) The calculations module in Model 2480 is established upon initial startup. Refer to section 5.10.2 in the System Reference Manual.
-

3.5.2 ANALOGS SUBMENU

The ANALOGS submenu of the SETUP UNIT menu of the enhanced single orifice application provides for toggling between LIVE and FIXED values of the following analogs. The AUX1 key on the HHDT toggles the input between the fixed and live values. A fixed value is shown by an asterisk (*) following the analog value in the display. For additional information, refer to section 5.2.11 of the Model 2480 System Reference Manual.

HHDT PROMPT	DEFAULT
METR PRES	0.0 PSIG
METR TEMP	0.0 DEGF
LIVE SG	0.0000
AUX	0.0
BATTERY	0.00 VOLTS

3.5.3 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 of the HHDT. Refer to section 5.10.2.3 in the Model 2480 System Reference Manual for additional information.

HHDT PROMPT	DEFAULT	DESIRED
M PRESS/LO	0 PSIG	_____
M PRESS/HI	1000 PSIG	_____
M TEMP/LO	0 DEGF	_____
M TEMP/HI	150 DEGF	_____
LIVE SG/LO	.6000	_____
LIVE SG/HI	.8000	_____
AUX/LO	0	_____
AUX/HI	100	_____

3.5.4 CONFIG SUBMENU

The following default parameters can be changed in the CONFIG submenu of the SETUP UNIT menu. Refer to section 5.10.2.4 in the Model 2480 System Reference Manual for additional information about the CONFIG submenu.

HHDT PROMPT	SAMPLE VALUES	DESIRED
METR FCTR1	100.0 PPCF	
ZFLOW LIM1	15 SECS	
ATMS PRES	14.73 PSIA	
PRES BASE	14.73 PSIA	
TEMP BASE	60 DEG F	
AGA8 MTHD	0	
SG SELECT	0	
VERSION	2.1	

3.5.5 GAS DATA

The enhanced Model 2480 SolarFlow Plus software can accept Gas Data information that can be downloaded from the HHDT or SFACCESS software. Data cannot be accepted directly from an analyzer.

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.600		_____
BTU	1000.00		_____
CO2	0.000	MOL%	_____
N2	0.000	MOL%	_____
METHANE	95.000	MOL%	_____
ETHANE	5.000	MOL%	_____
PROPANE	0.000	MOL%	_____
H2O	0.000	MOL%	_____
H2S	0.000	MOL%	_____
HYDROGEN	0.000	MOL%	_____
CO	0.000	MOL%	_____
OXYGEN	0.000	MOL%	_____
I-BUTANE	0.000	MOL%	_____
BUTANE	0.000	MOL%	_____
I-PENTANE	0.000	MOL%	_____
PENTANE	0.000	MOL%	_____
HEXANE	0.000	MOL%	_____
HEPTANE	0.000	MOL%	_____
OCTANE	0.000	MOL%	_____
NONANE	0.000	MOL%	_____
DECANE	0.000	MOL%	_____
HELIUM	0.000	MOL%	_____
ARGON	0.000	MOL%	_____

3.5.6 CONTROL SUBMENU

The CONTROL submenu of the SETUP UNIT menu provides for entering the control values for the volume pulse outputs.

HHDT PROMPT	SAMPLE VALUES	DESIRED
VPP1	100.0 MCF	_____
PP1	1 SEC	_____

VPP1 is not the same as the output on channel 5 (VP1). VP1 is an output pulse representing corrected station volume. VPP1 is a scaling factor for VP1 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 0.1. To accommodate an external totalizer that advances in increments of 1000 standard cubic feet (SCF) per pulse, the default value of VPP1 would be reset to 1 MCF per pulse.

The pulse period can be modified using the HHDT. The value can be changed to provide a pulse to drive an external device. For example, setting PP1 to 1 would generate a pulse period of 1 second in duration (0.5 second high followed by 0.5 second low). The value for PP1 must be an integer equal to 1 or greater. Fractions of a second are not permitted.

3.5.7 CALCULATED DATA

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

HHDT PROMPT	SAMPLE VALUES		DESIRED
FLOW RATE1	0.0	MCFH	_____
UNCR RATE1	0.0	ACF/H	_____
AGA8 MTHD	1		_____
ZB	1.038190		_____
ZF 1	0.927767		_____
B - AGA8	0.033417		_____
C - AGA8	0.002236		_____
D - AGA8	0.266296		_____
K - AGA8	0.100912		_____
MOL WT.	16.7444		_____

3.6 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 the following selections: ANALOGS, SCALES, DISCRETES, CONFIG, GAS DATA, CALC DATA and RATE/VOLS.

3.6.1 ANALOGS

- METR PRES
- METR TEMP
- LIVE SG
- AUX
- BATTERY

3.6.2 SCALES

- M PRES/LO
- M PRES/HI
- M TEMP/LO
- M TEMP/HI
- LIVE SG/LO
- LIVE SG/HI
- AUX LO
- AUX HI

3.6.3 CONFIG

- METR FCTR1
- ZFLOW LIM
- ATMS PRES
- PRES BASE
- TEMP BASE
- AGA8 MTHD
- SG SELECT
- VERSION

3.6.4 GAS DATA

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

3.6.5 CONTROL

VPP 1
PP1

3.6.6 CALC DATA

FLOW RATE1
UNCR RATE1
AGA8 MTHD
ZB
ZF 1
B - AGA8
C - AGA8
D - AGA8
K - AGA8
MOL WT.

3.6.7 RATE/VOLS

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

3.7 CALIBRATE UNIT MENU

The CALIBRATE UNIT menu provides for calibrating the SolarFlow Plus input circuitry to match the outputs of the transmitters for analog inputs to the SolarFlow Plus unit. The CALIBRATE UNIT menu has three selections: PRESSURES, TEMP and OTHERS. Refer to section 5.11 in the Model 2480 System Reference Manual for additional information on the CALIBRATE UNIT menu.

3.7.1 PRESSURE

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

METR PRES

3.7.2 TEMPERATURE

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

3.7.3 OTHERS

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

LIVE SG
AUX

3.8 MONITOR MENU

The MONITOR menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs listed are available in the MONITOR menu in the single orifice application. Refer to section 5.13.8 in the Model 2480 System Reference Manual for additional information on the MONITOR menu.

METR PRES
METR TEMP
LIVE SG
AUX

3.9 USER REPORT (CHANNEL 0)

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

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
020	METR PRES1	Live pressure meter No.1 in PSIG
021	METR TEMP1	Live temperature in degrees Fahrenheit (°F)
022	LIVE SG	Live value for specific gravity
144	UNCR RATE1	Uncorrected flow rate
133	FLOW RATE1	Hourly flow rate for meter No.1
138	TOT VOL 1	Total accumulated volume for meter No. 1
148	TOT UVOL 1	Total uncorrected volume for meter No. 1
136	TODAY VOL1	Daily accumulated volume
137	YSDAY VOL1	Yesterday's accumulated volume

3.10 DATA LOG LIST CONTENTS

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

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
020	METR PRES	1	6	AVERAGE
021	METR TEMP	1	4	AVERAGE
132	FLW TIME	1	6	SNAPSHOT & ZERO
145	LOG UVOL 1	1	6	SNAPSHOT & ZERO
135	LOG VOL	1	6	SNAPSHOT & ZERO

3.11 DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

- M PRES/LO
- M PRES/HI
- M TEMP/LO
- M TEMP/HI
- LIVE SG/LO
- LIVE SG/HI
- AUX LO
- AUX HI
- METR FCTR1
- ZFLOW LIM
- ATMS PRES
- PRES BASE
- TEMP BASE
- AGA8 MTHD
- SG SELECT
- VERSION

(Continued on the next page)

Header Block Contents (Continued)

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

3.12 ALARM DEFINITIONS

When using the HHDT in the ALARMS menu to set-up alarm conditions, the HHDT displays the terms "LOW", "HIGH", and "ALT". The parameter that is modified by the operator is ALT, which is equivalent to the "Z" value shown in the following alarm conditions list. The values for LOW and HIGH are not applicable to this application. Any values displayed under these prompts are meaningless. If the user desires to change a setpoint for a specific alarm, the ALT parameter is the only parameter applicable.

The following is a listing of the Alarm definitions for the AGA-7E single meter run application.

The number of retries for the alarms are:

- 5 for alarms 1 through 11
- 0 for alarm 12

ALARM #	ALARM CONDITION	VARIABLE VALUES		ALARM MESSAGES
		F	Z ALT	
1	C(19)<Z*S(19,F)		0	AUX LOW
2	C(19)>Z*S(19,F)		1.01	AUX HIGH
3	C(20)<Z*S(20,F)		0	PRES LOW
4	C(20)>Z*S(20,F)	1000	1.01	PRES HIGH
5	C(21)<Z*S(21,F)	1000	0	TEMP LOW
6	C(21)>Z*S(21,F)	150	1.01	TEMP HIGH
7	C(22)<Z*S(22,F)	150	0	LIVE SG LOW
8	C(22)>Z*S(22,F)	.6000	1.01	LIVE SG HIGH
9	C(133)<Z	.8000	0	FLOW LOW
10	C(133)>Z		999999.0	FLOW HIGH
11	C(23)<Z*		6.0	BATT LOW
12	C(30)< > 0.0			SYS FAIL

* This battery alarm voltage may be changed (5.976 VDC is normal alarm standard).

3.12.1 CALCULATING ALARM SETPOINTS

Alarm setpoints are calculated using the equation shown under the Alarm Condition column in the table shown above. For example, to calculate the setpoint for Alarm #4, the equation shown is:

$$\text{Setpoint} = Z * S(20,F)$$

Where:

$$Z = 1.01$$

$$F = 1000$$

$S(20,F) =$ The full scale value for channel 20, which is the meter pressure transmitter. The Model 2480 automatically generates this value based on the full scale value entered in the SETUP UNIT menu.

Therefore:

$$\text{The setpoint for Alarm \#4 is} = 1.01 * 1000 = 1010.0$$

When the ALARM menu is entered using the HHDT the user may modify the Z value shown in the above alarm conditions by changing the value for ALT. This enables the user to adjust the alarm limit to match the requirements.

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.

3.12.2 OTHER SYSTEM CONDITIONS

There are system conditions, not strictly alarms, that will show up on the data log of the SolarFlow Plus. These system conditions may or may not require corrective action. A typical data log from the Model 2480 will be in the format shown as follows.

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

The print-out will list each log item along with the respective date and time of the log item followed by a series of parameters which were defined to be included in the data log. In addition to the defined items three other sets of data are supplied with each log interval. On the line after the Date and Time, three labels are defined as follows:

- a. U-Range which will list any of the analog inputs that were in an Under-Range condition any time during the log interval.
- b. O-Range which will list any of the analog inputs that were in an Over-Range condition any time during the log interval.
- c. Misc. which will list system conditions that have occurred during the log interval.

A series of eight decimal points (.....) are shown under the respective data log interval Date and Time. If none of the analog inputs were in an under or over range condition, decimal points will be displayed. If any of the factory defined analog inputs are out of range, a number will replace one of the decimal points. For example, if Channels 20 and 21 were Under Range the following would be displayed.

```

Date      Time
U-Range   O-Range

MM/DD/YY HH:MM
.23.....
```

The "2" replacing the second decimal point indicates channel 20 is Under-Range. The "3" in place of the third decimal point indicates channel 21 is Under-Range and so-on. This same sequence applies to the Over-Range conditions.

The following table lists the applicable analog input for each of the decimal points under the "U-Range" and "O-Range" identifiers.

2480 AGA-7E SNGL

ANALOG INPUT

1	AUX, Channel 19
2	METER PRESSURE, CHANNEL 20
3	METER TEMPERATURE, CHANNEL 21
4	LIVE GRAVITY, CHANNEL 22
5	BATTERY, CHANNEL 23
6-8	Not Used

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

The data log will show the Misc. dots as follows:

```

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

The enhanced version of these miscellaneous bits is as follows:

DOT NO.	SYSTEM CONDITIONS	WEIGHT IN CH 30
8	System Failure	1.0
7	Cold Start	2.0
6	Warm Start	4.0
5	Designates Daily Log	8.0
4	Chromatograph Communications Failure	16.0
3	Reserved	32.0
2	Floating Point Error	64.0
1	Reserved	128.0

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

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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

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DANIEL
