

MODEL 2480 SOLARFLOW PLUS

**DANIEL MEASUREMENT AND CONTROL
HOUSTON, TEXAS**

ENHANCED SOLARFLOW PLUS

APPLICATION MANUAL

**HHDT EPROM 8-2480-152
2480 EPROM 8-2481-005**

**Part Number 3-9004-008
Revision D**

FEBRUARY 1999

DANIEL

Year 2000 Warranty

The Company represents and warrants that computer programs in any medium, software, firmware and combinations thereof ("Deliverables") manufactured by the Company and incorporated into or supplied by the Company for use with goods manufactured by the Company will, under normal use and care:

- i) recognize and accept dates falling on or after 1 January 2000;
- ii) recognize and accept the year 2000 and every succeeding fourth year as leap years;
- iii) recognize and accept 29 February in the year 2000 and every succeeding fourth year;
- iv) record, store, process, sequence, present and output calendar dates and data related to dates falling on or after 1 January 2000, in the same manner and with the same functionality as they do on or before 31 December 1999 and without errors or omissions; and
- v) lose no functionality with respect to the introduction into them of dates or data related to dates falling on or after 1 January 2000;

provided that, in the case of any non-conforming Deliverables that are returned to the Company promptly following discovery of the non-conformity, the Company will, at its option and cost, repair or replace such Deliverable or refund to the Purchaser the purchase price therefor. This shall be the Purchaser's sole and exclusive remedy for breach of the foregoing warranty.

Notwithstanding the foregoing, the Company shall not, under any circumstances whatsoever, be liable for any defects or errors caused by: materials or workmanship made, furnished or specified by the Purchaser; non-compliance with the Company's installation or operation requirements; failure to install any revisions and/or upgrades to the Deliverables deemed mandatory by the Company; any modifications to Deliverables not previously authorized by the Company in writing; the use by the Purchaser of any non-authorized spare or replacement parts in connection with the goods used in conjunction with the Deliverables; or the use of the Deliverables with any hardware or software not supplied by the Company. The Purchaser shall at all times remain solely responsible for the adequacy and accuracy of all information supplied by it. Any third party content in Deliverables shall carry only the warranty extended by the original manufacturer.

THE FOREGOING CONSTITUTES THE COMPANY'S SOLE AND EXCLUSIVE WARRANTY IN RELATION TO THE PERFORMANCE OF THE DELIVERABLES AS IT RELATES TO THE CHANGE FROM YEAR 1999 TO YEAR 2000 OR THE OCCURRENCE OF LEAP YEARS THEREAFTER, AND THE PURCHASER'S EXCLUSIVE REMEDY FOR BREACH THEREOF. IN NO EVENT WILL THE COMPANY BE LIABLE FOR INDIRECT, CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES, INCLUDING LOSS OF USE, BUSINESS INTERRUPTION OR LOSS OF PROFITS, IRRESPECTIVE OF WHETHER THE COMPANY HAD NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

The foregoing warranty shall remain valid until the later of December 31, 2000 or one year after the date that the Deliverable was shipped.

**DANIEL INDUSTRIES, INC.
MODEL 2480 SOLARFLOW PLUS
ENHANCED SINGLE METER RUN AGA-3 WITH STACKED DP'S
APPLICATION MANUAL**

NOTICE

DANIEL INDUSTRIES, INC. AND DANIEL MEASUREMENT AND CONTROL ("DANIEL") SHALL NOT BE LIABLE FOR TECHNICAL OR EDITORIAL ERRORS IN THIS MANUAL OR OMISSIONS FROM THIS MANUAL. **DANIEL MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THIS MANUAL AND, IN NO EVENT, SHALL DANIEL BE LIABLE FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PRODUCTION, LOSS OF PROFITS, ETC.**

PRODUCT NAMES USED HEREIN ARE FOR MANUFACTURER OR SUPPLIER IDENTIFICATION ONLY AND MAY BE TRADEMARKS/REGISTERED TRADEMARKS OF THESE COMPANIES.

COPYRIGHT © 1999
BY DANIEL MEASUREMENT AND CONTROL
HOUSTON, TEXAS, U.S.A.

All rights reserved. No part of this work may be reproduced or copied in any form or by any means - graphic, electronic or mechanical - without first receiving the written permission of Daniel Measurement and Control, Houston, Texas, U.S.A.

WARRANTY

Daniel Measurement and Control ("Daniel") warrants all equipment manufactured by it to be free from defects in workmanship and material, provided that such equipment was properly selected for the service intended, properly installed, and not misused. Equipment which is returned, transportation prepaid to Daniel within twelve (12) months of the date of shipment (eighteen (18) months from date of shipment for destinations outside of the United States), which is found after inspection by Daniel to be defective in workmanship or material, will be repaired or replaced at Daniel's sole option, free of charge, and return-shipped at lowest cost transportation. All transportation charges and export fees will be billed to the customer. Warranties on devices purchased from third party manufacturers not bearing a Daniel label shall have the warranty provided by the third party manufacturer.

Extended warranty - Models 2470, 2480 and 2500 are warranted for a maximum of twenty-four (24) months. The Danalyzer valves are warranted for the life of the instrument and the columns for five years.

The warranties specified herein are in lieu of any and all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

Daniel shall be liable only for loss or damage directly caused by its sole negligence. Daniel's liability for any loss or damage arising out of, connected with, or resulting from any breach hereof shall in no case exceed the price allocable to the equipment or unit thereof which gives rise to the claim. Daniel's liability shall terminate one year after the delivery of the equipment except for overseas deliveries and extended warranty products as noted above.

In no event, whether as a result of breach of warranty or alleged negligence, shall Daniel be liable for special or consequential damages, including, but not limited to, loss of profits or revenue; loss of equipment or any associated equipment; cost of capital; cost of substitute equipment, facilities or services; downtime costs; or claims of customers of the purchaser for such damages.

TABLE OF CONTENTS

Section	Page
SECTION 1	
1.0 INTRODUCTION	1-1
1.1 SCOPE OF THIS MANUAL	1-1
1.2 PRODUCT FEATURES	1-3
1.3 ENHANCED APPLICATIONS	1-3
1.4 CALCULATIONS	1-4
1.4.1 Analog Input Sampling	1-4
1.4.2 Flow Rate Equations	1-5
1.4.3 Rate and Volume Calculation	1-6
1.4.4 Logging	1-7
1.5 VOLUME PULSE OUTPUT	1-7
1.6 ACCEPTING AND REJECTING CALIBRATION	1-8
1.7 LOG DEFINE PROMPT	1-9
1.8 RADIO COMMUNICATION	1-10
1.9 USER LOGON EVENT	1-10
1.10 HIGH SPEED CHANNEL READS	1-10
SECTION 2	
2.0 ENHANCED SOLARFLOW PLUS CHANNEL ASSIGNMENTS	2-1
2.1 CHANNEL ONE THROUGH 18 ASSIGNMENTS	2-2
2.2 CHANNEL 19 THROUGH 150 ASSIGNMENTS	2-3
SECTION 3	
3.0 SINGLE ORIFICE APPLICATION	3-1
3.1 FIELD WIRING CONNECTIONS	3-1
3.2 OUTPUT SIGNAL CONNECTIONS	3-4
3.2.1 TTL Level Signal Outputs	3-4
3.3 SETUP LOCATION MENU	3-5
3.4 SECURITY CODE LIST	3-6
3.5 SETUP UNIT MENU	3-6

3.5.1	General Submenu	3-7
3.5.2	Analogs Submenu	3-8
3.5.3	Scales Submenu	3-8
3.5.4	Config Submenu	3-9
3.5.5	Gas Data	3-10
3.5.6	Control Submenu	3-11
3.5.7	Calculated Data	3-12
3.6	DISPLAY MENU	3-13
3.6.1	Analogs	3-13
3.6.2	Scales	3-13
3.6.3	Config	3-13
3.6.4	Gas Data	3-14
3.6.5	Control	3-14
3.6.6	Calc Data	3-15
3.6.7	Rate/Vols	3-15
3.7	CALIBRATE UNIT MENU	3-16
3.7.1	Pressures	3-16
3.7.2	Temp	3-16
3.7.3	Aux	3-16
3.8	MONITOR MENU	3-16
3.9	USER REPORT (CHANNEL 0)	3-17
3.10	DATA LOG LIST CONTENTS	3-17
3.11	DATA LOG HEADER BLOCK CONTENTS	3-18
3.12	ALARM DEFINITIONS	3-20
3.12.1	Calculating Alarm Setpoints	3-21
3.12.2	Other System Conditions	3-22

SECTION 4

4.0	SINGLE ORIFICE APPLICATION WITH STACKED DIFFERENTIAL PRESSURE TRANSMITTERS	4-1
4.1	FIELD WIRING CONNECTIONS	4-1
4.2	OUTPUT SIGNAL CONNECTIONS	4-4
4.2.1	TTL Level Signal Outputs	4-4
4.3	SETUP LOCATION MENU	4-5
4.4	SECURITY CODE LIST	4-6
4.5	SETUP UNIT MENU	4-6
4.5.1	General Submenu	4-6
4.5.2	Analogs Submenu	4-7
4.5.3	Scales Submenu	4-7

4.5.4	Config Submenu	4-8
4.5.5	Gas Data	4-9
4.5.6	Control Submenu	4-10
4.5.7	Calculated Data	4-11
4.6	DISPLAY MENU	4-12
4.6.1	Analogs	4-12
4.6.2	Scales	4-12
4.6.3	Config	4-12
4.6.4	Gas Data	4-13
4.6.5	Control	4-14
4.6.6	Calc Data	4-14
4.6.7	Rate/Vols	4-14
4.7	CALIBRATE UNIT MENU	4-15
4.7.1	Pressures	4-15
4.7.2	Temp	4-15
4.8	MONITOR MENU	4-15
4.9	USER REPORT (CHANNEL 0)	4-16
4.10	DATA LOG LIST CONTENTS	4-16
4.11	DATA LOG HEADER BLOCK CONTENTS	4-17
4.12	ALARM DEFINITIONS	4-18
4.12.1	Calculating Alarm Setpoints	4-19
4.12.2	Other System Conditions	4-20

LIST OF ILLUSTRATIONS

Figure 3-1.	Terminal Board Connections	3-3
Figure 4-1.	Terminal Board Connections	4-3

This page intentionally left blank.

SECTION 1

1.0 INTRODUCTION

The Model 2480 Enhanced SolarFlow Plus software applications have been designed to implement as many of the commonly required features of natural gas flow computers as possible. These applications have been designed to be compatible with existing Model 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 no hardware changes. This enhanced software will calculate volumetric flow rate using equations 3-6b and 3-7 from API Chapter 14.3, part 3.

1.1 SCOPE OF THIS MANUAL

A SolarFlow Plus unit delivered from the factory is fitted with a erasable, programmable, read-only memory (EPROM) configured for the application for which the SolarFlow Plus is intended. The Hand Held Data Terminal (HHDT) provided with SolarFlow Plus is compatible with all Model 2480 applications specified. This manual provides specific information on a Model 2480 SolarFlow Plus system which can be configured for one of two orifice meter applications. 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, provides a complete information package for nine specific installations 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 modules for two different orifice meter applications
- Field wiring connections for applicable inputs and outputs
- SETUP LOCATION menu parameters for the Hand Held Data Terminal (HHDT)
- SETUP UNIT menu parameters for the HHDT
- DISPLAY, CALIBRATE UNIT, ALARM and MONITOR menus for the HHDT
- Default user report listing
- Channel assignments for the unit
- Default data log list
- Default security codes
- Default alarm list

1.2 PRODUCT FEATURES

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

- Serves as a single run orifice meter application with single or stacked DP transducers using the new flow equations
- Supports AGA-8 according to the new standard (both detail and gross methods)
- Provides one contact closure pulse output based on station volume

Both of these applications are supported in a single EPROM set which is supported by a single HHDT. The features that are common to both applications are discussed generally. Features that apply to specific applications such as analog inputs, alarms, User Report lists, etc. will be located in the section dedicated to that particular application.

1.3 ENHANCED APPLICATIONS

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

NEW APPLICATION	PREVIOUS ANALOGOUS APPLICATION	
2480 ORIF SNGL	2480 AGA-3 SNGL	8-2481-001
2480 ORIF SSNGL	2480 AGA-3 SSNGL	8-2481-001

Both of these applications are implemented in a single EPROM set which is supported by a single HHDT. Each has the features listed previously. Where a new application corresponds to a previous application, the transducer assignments are identical to existing ones to allow upgrading of current units in the field without rewiring the analog inputs.

1.4 CALCULATIONS

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

- Analog input sampling
- Rate and volume calculation cycle

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

1.4.1 ANALOG INPUT SAMPLING

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

The samples are added to five running sums which will be converted to average values and placed in SolarFlow Plus Channels 19 - 23 at the beginning of the next calculation cycle. These five values are simple arithmetic averages of the inputs for the cycle. In addition to these five averages, "flow time" averages are kept for four inputs to be used in the flow calculation. These four values are flow averages for differential pressure, measured static pressure in PSIG, temperature, and flow extension.

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

1.4.2 FLOW RATE EQUATIONS

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

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

$$Q_v = 7709.61 * C_d * E_v * Y * d^2 * \text{sqrt}(P_{fl} * h_w * Z_s / (G_r * Z_{fl} * T_f)) \quad \text{Eqn. 3-6b}$$

where :

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

Standard conditions = 14.73 PSIA and 519.67 Rankine

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

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

The quantity, $\sqrt{P_{fi} * h_w}$, is stored as a separate entity in the SolarFlow Plus channel, FLOW EXTN, and is stored in the data log by default. This is in accordance with the COGM document on electronic flow meters.

1.4.3 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 period for the AGA-8 Detail version is 20 seconds and the cycle period for the AGA-8 Gross (or short form) is 10 seconds.

At the beginning of each cycle, the analog input averages accumulated during the preceding cycle are transferred to the SolarFlow Plus channels. Using these inputs, a new flow calculation is done. 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 for the meter run. 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.

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. It is expected that these channels will be capable of handling all the needs of API Chapter 14.3. The 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.

Both applications have identical channel assignments except for the analog inputs and these channels are compatible with the enhanced applications of Model 2470 SolarFlow Plus.

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

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

2.1 CHANNEL ONE THROUGH 18 ASSIGNMENTS

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

CH	LABEL	INPUT OUTPUT	0- LABEL	1- LABEL	DEFAULT	DESCRIP
001 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						

2.2 CHANNEL 19 THROUGH 150 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
Channels 19-22 as per applications					
023	BATTERY	VOLTS	2	0.00	Scale 2.42 - 12.12
024-028	Reserved				
029	VERSION		1	1.0	Software version
030	SYS ERROR		0	0	System alarm
031	RESERVED		0	0	
032	COMP DPRES	InH2O	1	0.0	Composite DP if stacked
033	ATMS PRES	PSIA	2	14.73	Atmospheric pressure
034	PRES BASE	PSIA	2	14.73	Pressure base
035	TEMP BASE	DEG F	0	60	Temperature base
036	ORIF MTRL	(None)	0	1	Orifice material 0=carbon steel 1=stainless steel 2=monel
037	PIPE MTRL	(None)	0	0	Pipe material 0=carbon steel 1=stainless steel 2=monel
038	TREF ORIF	DEG F	1	68.0	Reference temp of orifice plate
039	TREF PIPE	DEG F	1	68.0	Reference temp of pipe

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

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
060	HYDROGEN	MOL%	3	0.000	Hydrogen MOL%
061	CO	MOL%	3	0.000	Carbon Monoxide MOL%
062	OXYGEN	MOL%	3	0.000	Oxygen MOL%
063	I-BUTANE	MOL%	3	0.000	I-butane MOL%
064	BUTANE	MOL%	3	0.000	Butane MOL%
065	I-PENTANE	MOL%	3	0.000	I-pentane MOL%
066	PENTANE	MOL%	3	0.000	Pentane MOL%
067	HEXANE	MOL%	3	0.000	Hexane MOL%
068	HEPTANE	MOL%	3	0.000	Heptane MOL%
069	OCTANE	MOL%	3	0.000	Octane MOL%
070	NONANE	MOL%	3	0.000	Nonane MOL%
071	DECANE	MOL%	3	0.000	Decane MOL%
072	HELIUM	MOL%	3	0.000	Helium MOL%
073	ARGON	MOL%	3	0.000	Argon MOL%
074-075	Reserved				
076	VPP 1	MCF	1	100.0	Volume per pulse 1
077	PP 1	SEC	0	1	Pulse period 1
078-119 RESERVED					
120	ORIF DIAM1	IN	3	4.000	Meter 1 orifice diameter
121	PIPE DIAM1	IN	3	8.071	Meter 1 pipe diameter
122	TAP LCTN1	(None)	0	0	Tap location 0=downstream 1=upstream

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
123	ZFLOW LIM1	InH2O	2	0.50	Low flow cutoff in InH2O
124	CORR OD1	IN	4	0	Temp corrected orifice diameter 1
125	CORR PD1	IN	4	0	Temp corrected pipe
126	CORR BETA1	(None)	5	0.00000	Temp corrected Beta ratio
127	EV1	(None)	5	1.00000	Velocity of approach factor
128	CD 1	(None)	6	0.600000	Coefficient of discharge
129	ZF 1	(None)	6	1.000000	Flowing compressibility
130	Y FCTR 1	(None)	6	1.000000	Expansion factor
131	FLW EXTN 1	(None)	3	0.000	$\sqrt{H_w * P_f}$
132	FLW TIME 1	MIN	2	0.00	Flow time
133	FLOW RATE1	MCF/H	1	0.0	Hourly flow rate
134	FLOW RATE1	MCF/D	1	0.0	Daily flow rate
135	LOG VOL 1	MCF	1	0.0	Logged accumulated volume
136	TODAY VOL1	MCF	1	0.0	Daily accumulated volume
137	YSDAY VOL1	MCF	1	0.0	Ysday's accumulated volume
138	TOT VOL 1	MCF	1	0.0	Total accumulated volume (Rolls over @ 10,000,000)
139	ERATE 1	DTH/H	1	0.0	Energy flow rate
140	LOG ENRGY1	DTH	1	0.0	Logged accumulated energy
141	TDY ENRGY1	DTH	1	0.0	Today's accumulated energy

CH	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
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)
144-150 RESERVED					

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

This page intentionally left blank.

SECTION 3

3.0 SINGLE ORIFICE APPLICATION

Section 3 covers the individual requirements for the single orifice application configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The single orifice application supports measurement on a single meter tube. Analog inputs use Channels 19 through 22. Any unused analog input should be jumpered to ground.

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

3.1 FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed. No changes should be required unless the previously used application has been significantly different. Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2480 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

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

A field wiring diagram is provided in the Model 2480 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters. Figure 3-1 illustrates the terminal board connections for this application.

The following table shows the SolarFlow Plus channels assigned for connecting analog inputs to the unit.

CH	TRANSMITTER TYPE	WIRE COLOR	TB2 PIN NO.	TB2 PIN LABEL
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.)	*	14	TEMP
		#	15	GND
		#	16	GND
22	External, DP transmitter, (To be installed by user.)	Blue	4	DP1
		Black	5	+12V
		Red	6	GND

* Amber with Black tracer or Red

Amber or White

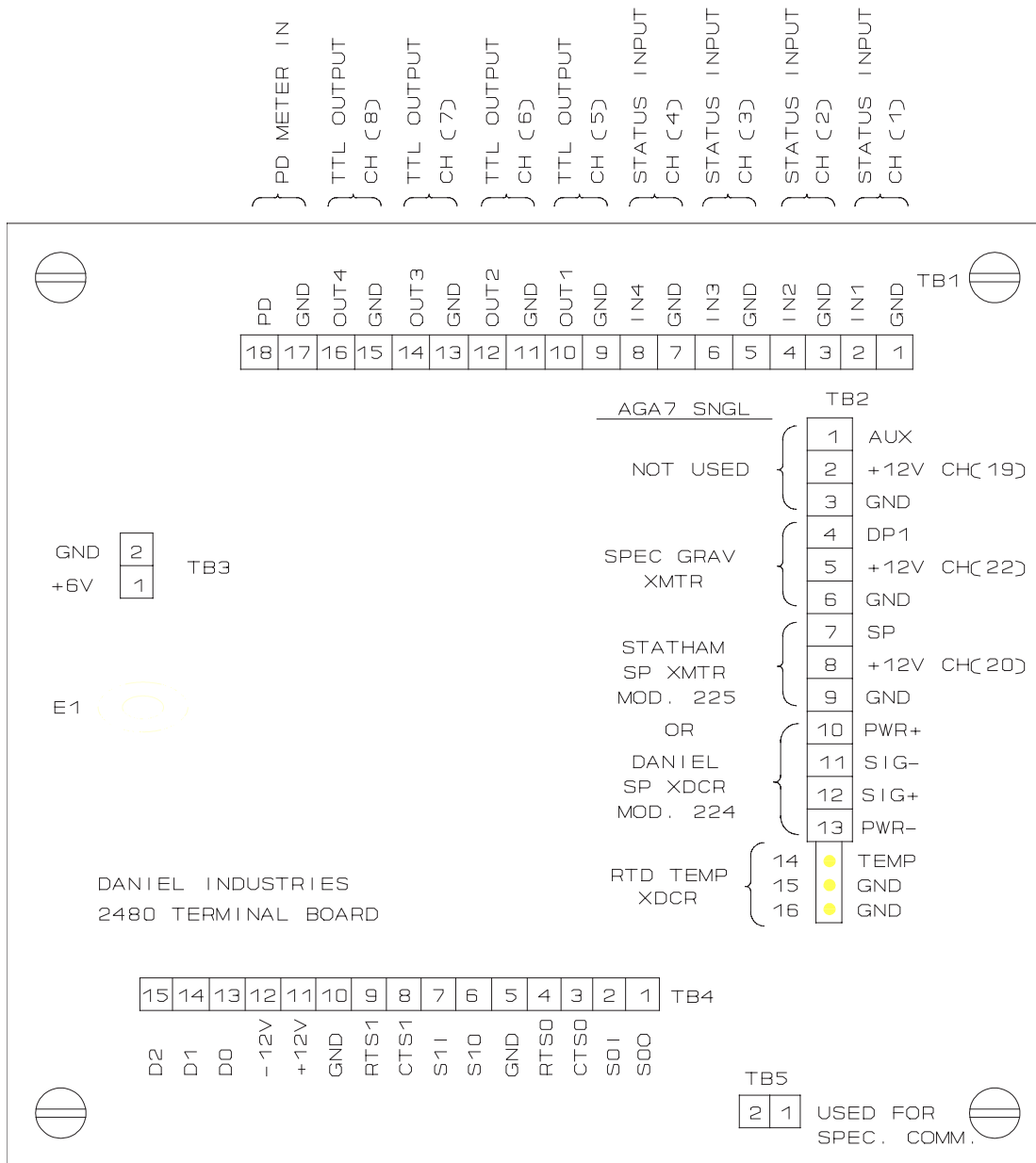


Figure 3-1. Terminal Board Connections

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 CONFIG 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 NO.	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	TB1 LABEL	SIGNAL TYPE
5	Volume pulse output 1	VP1	10 9	OUT1 GND	TTL Output Common

3.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the single-meter run AGA-3 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-3 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	XXXXXX PSIG
METR TEMP	XXXXXX DEGF
DIFF PRESS	XXXXXX InH2O
BATTERY	XXXXXX VOLTS
AUX	XXXXXX InH2O

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	_____
D PRESS/LO	0 InH2O	_____
D PRESS/HI	150 InH2O	_____
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
ORIF DIAM1	4.000	IN IN	_____
PIPE DIAM1	8.071	INH2O	_____
ZFLOW LIM1	0.50		_____
TAP LCTN 1	0	PSIA	_____
ATMS PRES	14.73	PSIA	_____
PRES BASE	14.73	DEG F	_____
TEMP BASE	60		_____
AGA8 MTHD	0		_____
SG SELECT	0		_____
ORIF MTRL	1		_____
PIPE MTRL	0	DEG F	_____
TREF ORIF	68.0	DEG F	_____
TREF PIPE	68.0		_____
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	0.0	MOL%	_____
N2	0.0	MOL%	_____
VISCOSITY	0.0000069	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.00	MOL%	_____
ETHANE	5.00	MOL%	_____
PROPANE	0.00	MOL%	_____
H2O	0.00	MOL%	_____
H2S	0.00	MOL%	_____
HYDROGEN	0.00	MOL%	_____
CO	0.00	MOL%	_____
OXYGEN	0.00	MOL%	_____
I-BUTANE	0.00	MOL%	_____
BUTANE	0.00	MOL%	_____
I-PENTANE	0.00	MOL%	_____
PENTANE	0.00	MOL%	_____
HEXANE	0.00	MOL%	_____
HEPTANE	0.00	MOL%	_____
OCTANE	0.00	MOL%	_____
NONANE	0.00	MOL%	_____
DECANE	0.00	MOL%	_____
HELIUM	0.00	MOL%	_____
ARGON	0.00	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. As indicated in the table, no pulses are generated by PP1 when 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 to 1 would generate a pulse one second in duration. 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	_____
EV 1	1.03164		_____
CD 1	0.603166		_____
Y 1	0.999892		_____
FLW EXTN 1	94.841		_____
AGA8 MTHD	1		_____
ZS	1.038190		_____
ZB	1.038190		_____
ZF 1	0.927767		_____
B - AGA8	0.033417		_____
C - AGA8	0.002236		_____
D - AGA8	0.266296		_____
K - AGA8	0.100912		_____
MOL WT.	16.7444		_____

3.6 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 seven selections: ANALOGS, SCALES, CONFIG, GAS DATA, CALC DATA and RATE/VOLS.

3.6.1 ANALOGS

- METR PRES
- METR TEMP
- DIFF PRES
- BATTERY
- AUX

3.6.2 SCALES

- M PRES/LO
- M PRES/HI
- M TEMP/LO
- M TEMP/HI
- D PRESS/LO
- D PRESS/HI
- AUX/LO
- AUX/HI

3.6.3 CONFIG

- ORIF DIAM1
- PIPE DIAM1
- ZFLOW LIM1
- TAP LCTN 1
- ATMS PRES
- PRES BASE
- TEMP BASE
- AGA8 MTHD
- SG SELECT
- ORIF MTRL

PIPE MTRL
TREF ORIF
TREF PIPE
VERSION

3.6.4 GAS DATA

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

3.6.5 CONTROL

VPP 1
PP1

3.6.6 CALC DATA

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

3.6.7 RATE/VOLS

FLOW RATE1 (MCFH)
FLOW RATE1 (MCFD)
TODAY VOL1
YSDAY VOL1
TOT VOL 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 AUX. Refer to section 5.11 in the Model 2480 System Reference Manual for additional information on the CALIBRATE UNIT menu.

3.7.1 PRESSURES

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

METR PRES
DIFF PRESS

3.7.2 TEMP

The analog input METR TEMP is calibrated in the TEMP submenu of the CALIBRATE UNIT menu.

3.7.3 AUX

The analog input AUX is calibrated in the AUX submenu of the CALIBRATE UNIT menu.

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
DIFF PRESS
AUX

3.9 USER REPORT (CHANNEL 0)

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

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
023	BATTERY	Battery charge in volts
020	METR PRES	Live pressure in PSIG
021	FLOW TEMP	Live temperature in degrees Fahrenheit (°F)
022	DIFF PRES	Live DP, value in inches of water
133	FLOW RATE	Flow rate
138	TOT VOL	Total volume
136	TODAY VOL	Today's volume in MCF
137	YSDAY VOL	Yesterday's volume in MCF

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
022	DIFF PRES	2	6	AVERAGE
020	METR PRES	1	6	AVERAGE
021	FLOW TEMP	2	6	AVERAGE
132	FLOW TIME	1	4	SNAPSHOT & ZERO
131	FLOW EXTN	3	6	AVERAGE
135	LOG VOL	1	8	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
D PRESS/LO
D PRESS/HI
ORIF DIAM1
PIPE DIAM1
ZFLOW LIM1
TAP LCTN 1
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD
SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF
TREF PIPE
SPEC GRAV
BTU
CO2
N2
VISCOSITY
SPEC HEAT
METHANE
ETHANE
PROPANE
H2O
H2S
HYDROGEN
CO
OXYGEN

I-BUTANE
BUTANE
I-PENTANE
PENTANE
HEXANE
HEPTANE
OCTANE
NONANE
DECANE
HELIUM
ARGON

3.12 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-3 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)	1000	0	PRES LOW
4	C(20)>Z*S(20,F)	1000	1.01	PRES HIGH
5	C(21)<Z*S(21,F)	150	0	TEMP LOW
6	C(21)>Z*S(21,F)	150	1.01	TEMP HIGH
7	C(22)<Z*S(22,F)	150.0	0	DIFF LOW
8	C(22)>Z*S(22,F)	150.0	1.01	DIFF HIGH
9	C(133)<Z		0	FLOW LOW
10	C(133)>Z		999999.0	FLOW HIGH
11	C(23)<Z		6.0	BATT LOW
12	C(30)>Z			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 ORIF SNGL

ANALOG INPUT

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

The "Misc." section is applicable for system conditions that were present during the log interval. The conditions defined as "1" through "8" are detailed as follows:

- 1 - Calibration over-deviation
- 2 - Fpv adjusted pressure out of range
- 3 - Fpv adjusted temperature out of range
- 4 - not used
- 5 - Designates daily log
- 6 - Warm start was enacted during interval
- 7 - Cold start was enacted during interval
- 8 - System fault

SECTION 4

4.0 SINGLE ORIFICE APPLICATION WITH STACKED DIFFERENTIAL PRESSURE TRANSMITTERS

Section 4 covers the individual requirements for the single orifice application with stacked DPs configured to calculate volumetric flow rate using equations from API Chapter 14.3, Part 3. The single orifice application supports measurement on a single meter tube. Analog inputs use Channels 19 through 22. Any unused analog input should be jumpered to ground.

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

4.1 FIELD WIRING CONNECTIONS

Before exchanging your EPROM set for working installations, make sure that all previous data is recorded as needed. No changes should be required unless the previously used application has been significantly different. Configurations for this application include the static pressure and DP transmitter(s) associated with meter 1 installed within the Model 2480 enclosure with all other transmitters installed externally, or with *all* transmitters installed externally.

The wiring configuration for analog inputs for the single orifice application with stacked differential pressure transmitters is shown in this section.

A field wiring diagram is provided in the Model 2480 System Reference Manual. The following information furnishes necessary details for wiring both internal and external transmitters. Figure 4-1 illustrates the terminal board connections for this application.

The following table shows the SolarFlow Plus channels assigned for connecting analog inputs to the unit.

CH	TRANSMITTER TYPE	WIRE COLOR	TB2 PIN NO.	TB2 PIN LABEL
19	EXTERNAL, Low range DP transmitter, (To be installed by the user.)	Blue	1	AUX
		Red	2	+12V
		Black	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.)	*	14	TEMP
		#	15	GND
		#	16	GND
22	EXTERNAL, DP transmitter, (To be installed by user.)	Blue	4	DP1
		Red	5	+12V
		Black	6	GND

* Amber with Black tracer or Red

Amber or White

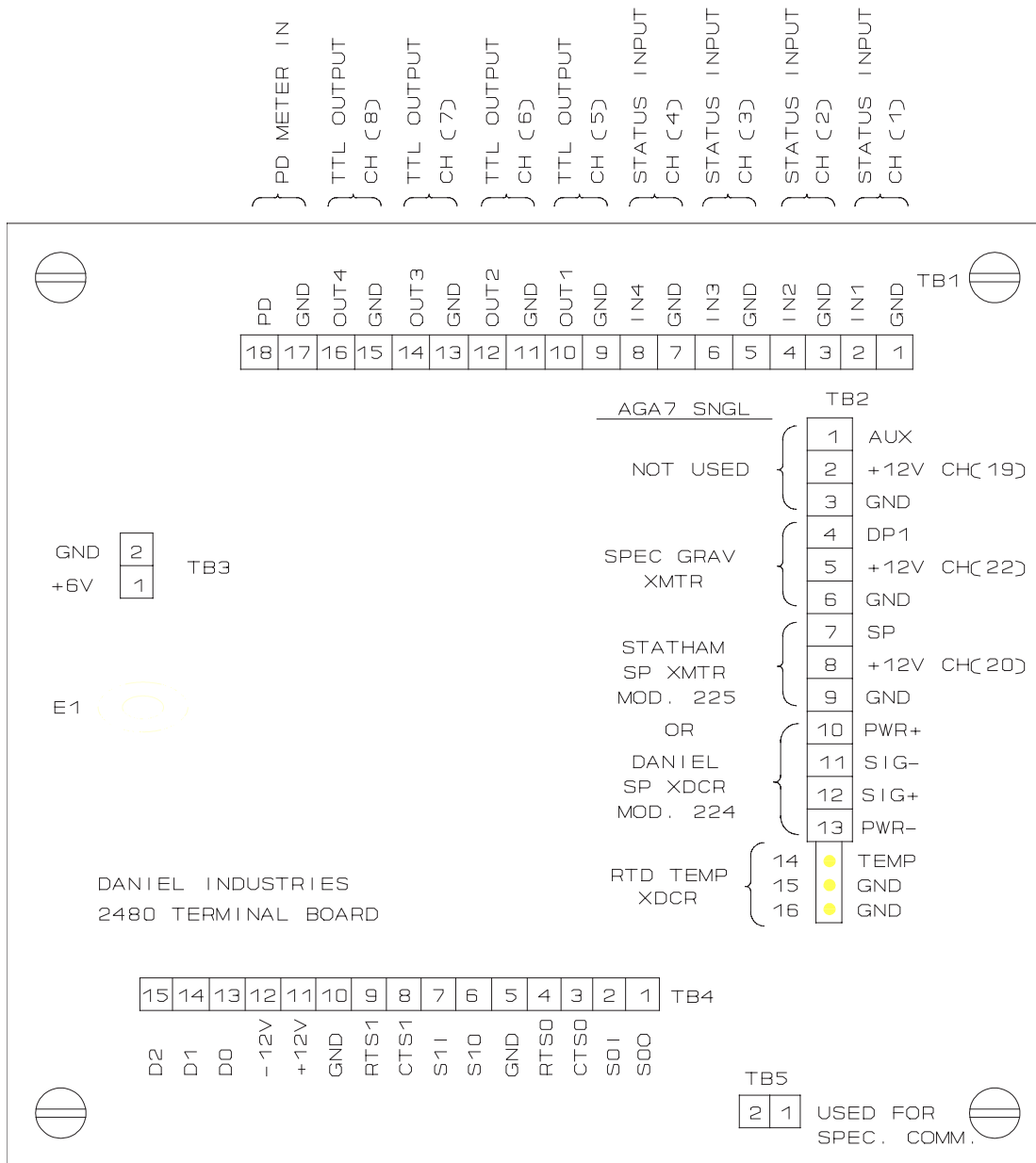


Figure 4-1. Terminal Board Connections

4.2 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 CONFIG submenu of the SETUP UNIT menu.

4.2.1 TTL LEVEL SIGNAL OUTPUTS

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

CH NO.	DESCRIPTION	LABEL	TB1 PIN NO.	TB1 PIN LABEL	SIGNAL TYPE
5	Volume pulse output 1	VP1	10 9	OUT1 GND	TTL Output Common

4.3 SETUP LOCATION MENU

The SolarFlow Plus operating parameters for the single-meter run AGA-3 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.
-

4.4 SECURITY CODE LIST

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

4.5 SETUP UNIT MENU

The parameters for the single-meter AGA-3 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.

4.5.1 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.
-

4.5.2 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	XXXXX PSIG
METR TEMP	XXXXX DEGF
DIFF PRESL	XXXXX INH20
DIFF PRESH	XXXXX INH20

4.5.3 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 PRES/LO	0 PSIG	_____
M PRES/HI	1000 PSIG	_____
M TEMP/LO	0 DEGF	_____
M TEMP/HI	150 DEGF	_____
D PRESL/LO	0.0 INH20	_____
D PRESL/HI	30.0 INH20	_____
D PRESH/LO	0.0 INH20	_____
D PRESH/HI	150.0 INH20	_____

4.5.4 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
ORIF DIAM1	4.000	IN IN	_____
PIPE DIAM1	8.071	INH2O	_____
ZFLOW LIM1	0.50		_____
TAP LCTN 1	0	PSIA	_____
ATMS PRES	14.73	PSIA	_____
PRES BASE	14.73	DEG F	_____
TEMP BASE	60		_____
AGA8 MTHD	0		_____
SG SELECT	0		_____
ORIF MTRL	1		_____
PIPE MTRL	0	DEG F	_____
TREF ORIF	68.0	DEG F	_____
TREF PIPE	68.0		_____
VERSION	2.1		_____

4.5.5 GAS DATA

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

HHDT PROMPT	SAMPLE VALUES		DESIRED
SPEC GRAV	0.600		_____
BTU	1000.00		_____
CO2	0.0	MOL%	_____
N2	0.0	MOL%	_____
VISCOSITY	0.0000069	#/FTS	_____
SPEC HEAT	1.30		_____
METHANE	95.00	MOL%	_____
ETHANE	5.00	MOL%	_____
PROPANE	0.00	MOL%	_____
H2O	0.00	MOL%	_____
H2S	0.00	MOL%	_____
HYDROGEN	0.00	MOL%	_____
CO	0.00	MOL%	_____
OXYGEN	0.00	MOL%	_____
I-BUTANE	0.00	MOL%	_____
BUTANE	0.00	MOL%	_____
I-PENTANE	0.00	MOL%	_____
PENTANE	0.00	MOL%	_____
HEXANE	0.00	MOL%	_____
HEPTANE	0.00	MOL%	_____
OCTANE	0.00	MOL%	_____
NONANE	0.00	MOL%	_____
DECANE	0.00	MOL%	_____
HELIUM	0.00	MOL%	_____
ARGON	0.00	MOL%	_____

4.5.6 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. As indicated in the table, no pulses are generated by PP1 when 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 to 1 would generate a pulse one second in duration. The value for PP1 must be an integer equal to 1 or greater. Fractions of a second are not permitted.

4.5.7 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.

HHD PROMPT	SAMPLE VALUES	DESIRED
FLOW RATE1	0.0 MCFH	_____
EV 1	1.03164	_____
CD 1	0.603166	_____
Y 1	0.999892	_____
FLW EXTN 1	94.841	_____
AGA8 MTHD	1	_____
ZS	1.038190	_____
ZB	1.038190	_____
ZF 1	0.927767	_____
B - AGA8	0.033417	_____
C - AGA8	0.002236	_____
D - AGA8	0.266296	_____
K - AGA8	0.100912	_____
MOL WT.	16.7444	_____

4.6 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 seven selections: ANALOGS, SCALES, CONFIG, GAS DATA, CALC DATA and RATE/VOLS.

4.6.1 ANALOGS

METR PRES
METR TEMP
DIFF PRESL
DIFF PRESH

4.6.2 SCALES

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

4.6.3 CONFIG

ORIF DIAM1
PIPE DIAM1
ZFLOW LIM1
TAP LCTN 1
ATMS PRES
PRES BASE
TEMP BASE
AGA8 MTHD

SG SELECT
ORIF MTRL
PIPE MTRL
TREF ORIF
TREF PIPE
VERSION

4.6.4 GAS DATA

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

4.6.5 CONTROL

VPP 1
PP1

4.6.6 CALC DATA

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

4.6.7 RATE/VOLS

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

4.7 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 two selections: PRESSURES and TEMP. Refer to section 5.11 in the Model 2480 System Reference Manual for additional information on the CALIBRATE UNIT menu.

4.7.1 PRESSURES

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

METR PRES
DIFF PRESL
DIFF PRESH

4.7.2 TEMP

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

METR TEMP

4.8 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
DIFF PRESL
DIFF PRESH

4.9 USER REPORT (CHANNEL 0)

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

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
Header	--	Time, date, and location data
023	BATTERY	Battery charge in volts
020	METR PRES	Live pressure in PSIG
021	FLOW TEMP	Live temperature in degrees Fahrenheit (°F)
032	COMP DPRES	Composite DP, value in inches of water
133	FLOW RATE	Flow rate
138	TOT VOL	Total volume
136	TODAY VOL	Today's volume in MCF
137	YSDAY VOL	Yesterday's volume in MCF

4.10 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
032	COMP DPRES	2	6	AVERAGE
020	METR PRES	1	6	AVERAGE
021	FLOW TEMP	2	6	AVERAGE
132	FLOW TIME	1	4	SNAPSHOT & ZERO
131	FLOW EXTN	3	6	AVERAGE
135	LOG VOL	1	8	SNAPSHOT & ZERO

4.11 DATA LOG HEADER BLOCK CONTENTS

The data log header block includes the following items:

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

4.12 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-3 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)	1000	0	PRES LOW
4	C(20)>Z*S(20,F)	1000	1.01	PRES HIGH
5	C(21)<Z*S(21,F)	150	0	TEMP LOW
6	C(21)>Z*S(21,F)	150	1.01	TEMP HIGH
7	C(22)<Z*S(22,F)	150.0	0	DIFF LOW
8	C(22)>Z*S(22,F)	150.0	1.01	DIFF HIGH
9	C(133)<Z		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 is normally fixed at 5.976 VDC but can be changed.

4.12.1 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.

4.12.2 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 ORIFICE SSNGL

ANALOG INPUT

- | | |
|-----|-----------------------------------|
| 1 | LOW RANGE DP, Channel 19 |
| 2 | METER PRESSURE, CHANNEL 20 |
| 3 | METER TEMPERATURE, CHANNEL 21 |
| 4 | DIFFERENTIAL PRESSURE, CHANNEL 22 |
| 5 | BATTERY, CHANNEL 23 |
| 6-8 | Not Used |

The "Misc." section is applicable for system conditions that were present during the log interval. The conditions defined as "1" through "8" are detailed as follows:

- 1 - Calibration over-deviation
- 2 - Fpv adjusted pressure out of range
- 3 - Fpv adjusted temperature out of range
- 4 - not used
- 5 - Designates daily log
- 6 - Warm start was enacted during interval
- 7 - Cold start was enacted during interval
- 8 - System fault

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
