MODEL 2480
SOLARFLOW PLUS

DANIEL MEASUREMENT AND CONTROL
HOUSTON, TEXAS

(2481 P SNGL)
(2481 P SSNGL)
(2481 METP SNGL)
(2481 METP SSNGL)

HHDT EPROM 8-2480-150
2480 EPROM 8-2481-002

Part Number: 3-9004-004
Revision F

JUNE 1999

DANIEL

Year 2000 Warranty

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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;

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DANIEL MEASUREMENT AND CONTROL
MODEL 2480 SOLARFLOW PLUS
PREMIUM SINGLE-METER RUN AGA-3
APPLICATION MANUAL

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SECTION 1

1.0 INTRODUCTION

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(s) for which the SolarFlow Plus is intended. The Hand Held Data Terminal (HHDT) provided with SolarFlow Plus is compatible with the applications for which the Model 2480 SolarFlow Plus is configured. This manual provides specific information on a Model 2480 SolarFlow system using the AGA-3 application configured for a single-meter run, a single-meter run with stacked DP's, a single-meter run with metric inputs and outputs, and a single-meter run with stacked DP's using metric inputs and outputs. 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 a specific installation of the Model 2480 SolarFlow Plus system. This manual provides references to the System Reference Manual whenever more detailed information is provided in that manual.

This manual includes sections on:

- Calculation modules for the AGA-3 single-meter run application with and without stacked DP transmitters
- Field wiring connections for applicable inputs and outputs
- SETUP LOCATION menu parameters for the Hand Held Data Terminal (HHDT)
- SETUP UNIT menu parameters for the HHDT
- DISPLAY, CALIBRATE UNIT, and MONITOR menus for the HHDT
- Default user report listing

- Channel assignments for the unit
- Default data log list
- Default security codes
- Default alarm list

1.2 INSTALLATION CONFIGURATION FOR A SINGLE-METER RUN AGA-3 APPLICATION WITH ONE DP TRANSMITTER

The SolarFlow Plus standard single-meter run AGA-3 application is designed for installations with a single orifice-meter tube that has one differential pressure (DP) transmitter, one static pressure transducer, and one RTD temperature input.

Figure 1-1 shows the installation configuration for the inputs in the single-meter AGA-3 Application.

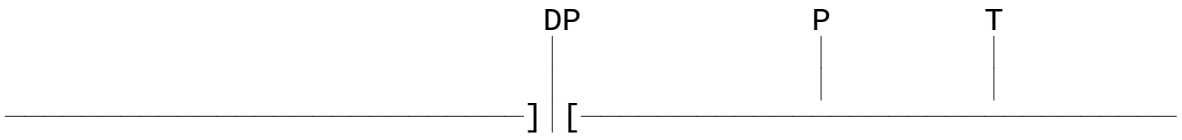

Figure 1-1. Installation Configuration for a Single-Meter AGA-3 SolarFlow Plus Application with One Differential Pressure Transmitter

1.3 INSTALLATION CONFIGURATION FOR A SINGLE METER RUN AGA-3 APPLICATION WITH TWO DP TRANSMITTERS

The SolarFlow Plus standard single-meter run AGA-3 application is designed for installations with a single orifice-meter tube that has two differential pressure (DP) transmitters, one static pressure transducer, and one RTD temperature input.

Figure 1-2 shows the installation configuration for the inputs in the single-meter AGA-3 Application.

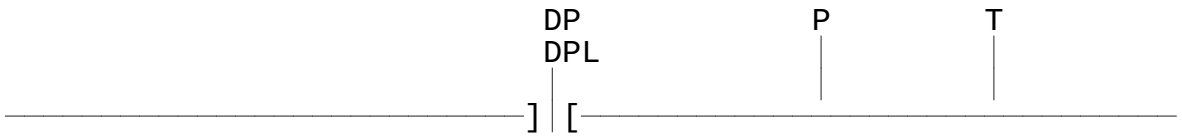

Figure 1-2. Installation Configuration for a Single-Meter AGA-3 SolarFlow Plus Application with Two Differential Pressure Transmitters

1.4 APPLICATION DESCRIPTION

The application supports orifice measurement of natural gas or other gases, using either single or stacked differential pressure transmitters, in accordance with the 1985 edition of AGA-3. Supercompressibility is computed using either American Gas Association Report NX-19 or by second order interpolation of operator entered matrix of compressibility values. The application supports measurement via a single orifice meter run. A pressure input is included for monitoring and logging, with fixed value input capability through the Hand Held Data Terminal (HHDT). Similarly, provisions are included for an RTD input to monitor temperature and one or two differential pressure transmitters.

This Model 2480 application supports four different configurations:

- AGA-3 Single Premium
- AGA-3 Single Premium with Stacked Differential Pressure inputs
- AGA-3 Metric Single Premium
- AGA-3 Metric Single Premium with Stacked Differential Pressure Inputs

The application is identical with the existing AGA-3 single meter run applications for Model 2480 with the addition of the capability to totalize volume on a "Premium Basis" with an alternate compressibility computation. This capability can also be used with metric inputs and outputs.

Five analog inputs and one to four auxiliary status inputs are available. Digital control outputs are Volume Pulse Output, Premium Level One Status, and Premium Level Two Status. For the two latter outputs, rate is at or above setpoint. One RS-232C serial port is provided for local parameter/data entry and/or remote communications with appropriate additional communications hardware.

As an alternate to the HHDT, Daniel’s Dos based PC program SFaccess may be used to locally communicate with the SolarFlow Plus. Modification to the SFaccess program to accommodate the channels listed in this manual is included within scope of current development.

SECTION 2

2.0 AGA-3 SINGLE (AGA-3 2481 PREM) CALCULATION MODULE

This manual supports a SolarFlow Plus computer configured to calculate orifice-meter measurements in accordance with the American Gas Association (AGA) Gas Measurement Committee Report No.3 (AGA-3), Orifice Metering of Natural Gas, (ANSI/API 2530 Second Edition, September 1985). Supercompressibility is calculated in accordance with AGA Standard NX-19 - Manual for the Determination of Supercompressibility Factors for Natural Gas. An alternate method of calculating supercompressibility is also available. See section 2.6.

2.1 FLOW RATE

In general, the equation for calculating flow rate is:

$$Q_h = C' \sqrt{h_w * P_f}$$

where:

- Q_h = corrected flow rate in thousands of standard cubic feet per hour (MCF/HR).
- C' = orifice flow constant calculated using the equation in 2.2
- h_w = differential pressure in inches of water.
- P_f = static pressure in pounds per square inch, absolute (PSIA).

2.2 ORIFICE FLOW CONSTANT (C′)

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

$$C' = \frac{(F_b * F_{pb} * F_{tb} * F_g * F_{pv} * F_r * Y * F_{tf} * F_a)}{SF}$$

where:

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

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

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

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

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

F_{pv} = calculations are limited to adjusted pressures of 0 (zero) to 2000 pounds per square inch, gauge and adjusted temperatures of -40 to 240 degrees Fahrenheit (°F). The supercompressibility factor may be computed from NX-19 or entered by the operator using the compressibility matrix

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

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

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

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

SF is the Scale Factor (i.e., if SF = 1000, rate is MCF/HR)

* An additional conversion factor in F_b allows for Metric applications.

2.3 WATER VAPOR FACTOR (F_w)

The format of the F_w factor is .xxxx and is available for logging purposes on Channel 62. The F_w factor may be viewed via the HHDT listed under the "DISPLAY" "FACTORS" submenu. This factor is calculated from the following formula:

$$W = \frac{e^{A}}{f_p} + e^{B}$$

where:

W = water content LBS/MMSCF

f_p = flowing static pressure psia

f_t = flowing temperature degrees F

A = K1 - [K2/(K3 + f_t)]

B = K4 - [K5/(K6 + f_t)]

K1 = 25.36794227

K2 = 7170.42747964

K3 = 389.5293906

K4 = 15.97666211

K5 = 7737.37631961

K6 = 483.28778105

$$F_w = 1 - \frac{K7 * K8}{1{,}000{,}000}$$

where:

K7 = (W -7)/18.015

K8 = 378.61*14.73/pressure base

2.4 CALCULATION CYCLES

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

The SolarFlow Plus computer calculates the critical part of the flow rate calculation, extension factor, $(h_w * P_f)^{.5}$, every half second. The computer calculates the factors included in the flow constant (C′), at an interval defined by the application program, typically every 15 to 25 seconds (10 to 15 seconds for a single orifice unit). The factors in C′ that are dependent upon sampled input values use the average of the 0.5-second samples in each calculation.

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

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

2.5 PREMIUM TOTALIZATION

For installations where it is desired to separate volume accumulation on a "Premium" basis, three separate sets of accumulators are provided. This feature allows separate volume totalizations for gas flowing at different instantaneous rates. Activation of this feature is accomplished by entering a non-zero setpoint for either or both premium levels.

Premium totalization is best illustrated by an example. Assume two premium levels. That is, three separate totals must be maintained: base, first level premium, and second level premium.

Conditions:

1. Total station flow is 90,000 SCFH.
2. Set point for premium level 1 is 60,000 SCFH.
3. Set point for premium level 2 is 80,000 SCFH.

Totalization is as follows:

1. Base Rate = 60,000 SCFH (all flow below first level set point).

2. Premium Level 1 Rate = 20,000 SCFH (all flow above the level 1 set point and below the level 2 set point but NOT including the Base Rate).

3. Premium Level 2 Rate = 10,000 SCFH (all flow above the level 2 set point but NOT including the Base Rate or level 2 rate).

To enable maximum flexibility channels are assigned for:

Total Volume	--	Non-resettable accumulator
Logged Volume	--	User selection of snapshot or snapshot and zero
Yesterday's Volume	--	Based on contract hour
Today's Volume	--	Based on contract hour

Separate channels are maintained for each of the outputs above for Base, Premium Level 1 and Premium Level 2.

2.6 SUPERCOMPRESSIBILITY

Channel 45 (FPV method) has a third operator selection. Choices now are:

0 = Standard NX-19 Computation (Default)
1 = Alternate
2 = Matrix

When matrix is selected, supercompressibility is based upon second order interpolation of operator entered matrix compressibility data. The basic equation is:

$$F_{pv} = \sqrt{\frac{Z_b}{Z_f}}$$

where,

F_{pv} = supercompressibility
Z_b = compressibility at base conditions (operator entered)
Z_f = compressibility at flowing conditions

NOTE: F_{pv} is forced to equal 1.0000 if Z_f is negative or zero.

The operator must enter nine values of compressibility. In matrix form this is illustrated:

	P1	**P2**	**P3**
T1	Z,P1-T1	Z,P2-T1	Z,P3-T1
T2	Z,P1-T2	Z,P2-T2	Z,P3-T2
T3	Z,P1-T3	Z,P2-T3	Z,P3-T3

P1, P2, P3 are pressure values (PSIA) and T1, T2, T3 are temperature values (Deg F). Terms (Z_n) are compressibility values for the measured gas at the corresponding pressure and temperature.

The interpolation algorithm allows computation outside the matrix. However, the user is cautioned to select values which approximate the normally expected range of operation.

2.7 METRIC IMPLEMENTATION

The metric versions of the application software execute the AGA-3 algorithm with appropriate unit conversions for display and reporting purposes. The engineering units used for display/reporting purposes are:

Pressure	KPA	kilopascals
Temperature	DEG C	degrees celsius
Differential Pressure	KPA	kilopascals
Pipe and Orifice Size	mm	millimeters
Volume	M3	cubic meters
Flow Rate	M3HR	cubic meters per hour

Calculations in the applications use the 1985 version of AGA-3. To use these equations, appropriate conversion factors are used. These are:

1 KPA	= 0.1450377	psi
1 psi	= 6.894757	KPA
I IN H2O	= 0.2488415	KPA
1 KPA	= 4.018622	IN H2O
1 inch	= 25.4	mm
1 mm	= 0.03937	inch
1 cubic foot	= 0.02831685	cubic meters
DEGF	= (DEG C * 1.8) + 32	

When a metric application is selected during initial startup the extension factor (square root of the product of static pressure and differential pressure) is maintained in metric units. The basic orifice factor is adjusted for units consistency as follows:

F_{bm} = F_b * (0.02831685 cubic meters/cubic foot)
* sqrt [(0.1450377 psi/KPA)
* (4.018622 IN H2O/KPA)]

= F_b * 0.02161842

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SECTION 3

3.0 FIELD WIRING CONNECTIONS

3.1 ANALOG INPUT CONNECTIONS

Analog inputs for the single-meter AGA-3 application of the Model 2480 SolarFlow Plus are connected in accordance with the following table.

A field wiring diagram (DE-11284) is provided in Appendix C of the Model 2480 System Reference Manual. Figure 3-1 illustrates 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 user; used only with stacked DP transmitters.)	Blue Red Black	1 2 3	AUX +12 V GND
20	Daniel Model 225 millivolt static pressure transmitter, (Factory wired, if installed inside SolarFlow Plus enclosure.)	Yellow Green White Black	10 11 12 13	PWR + SIG + SIG - PWR -
- or -				
20	Statham series 36, 1-5 VDC static pressure transmitter, (Factory wired, if installed inside SolarFlow Plus enclosure.)	Blue Red Black	7 8 9	SP +12 V GND
21	External, RTD temperature transducer, (To be installed by user; cable supplied with connector.)	* # #	14 15 16	TEMP GND GND
22	External DP transmitter, (To be installed by user.)	Blue Red Black	4 5 6	DP1 +12 V GND

* Amber with Black tracer or Red
\# Amber or White

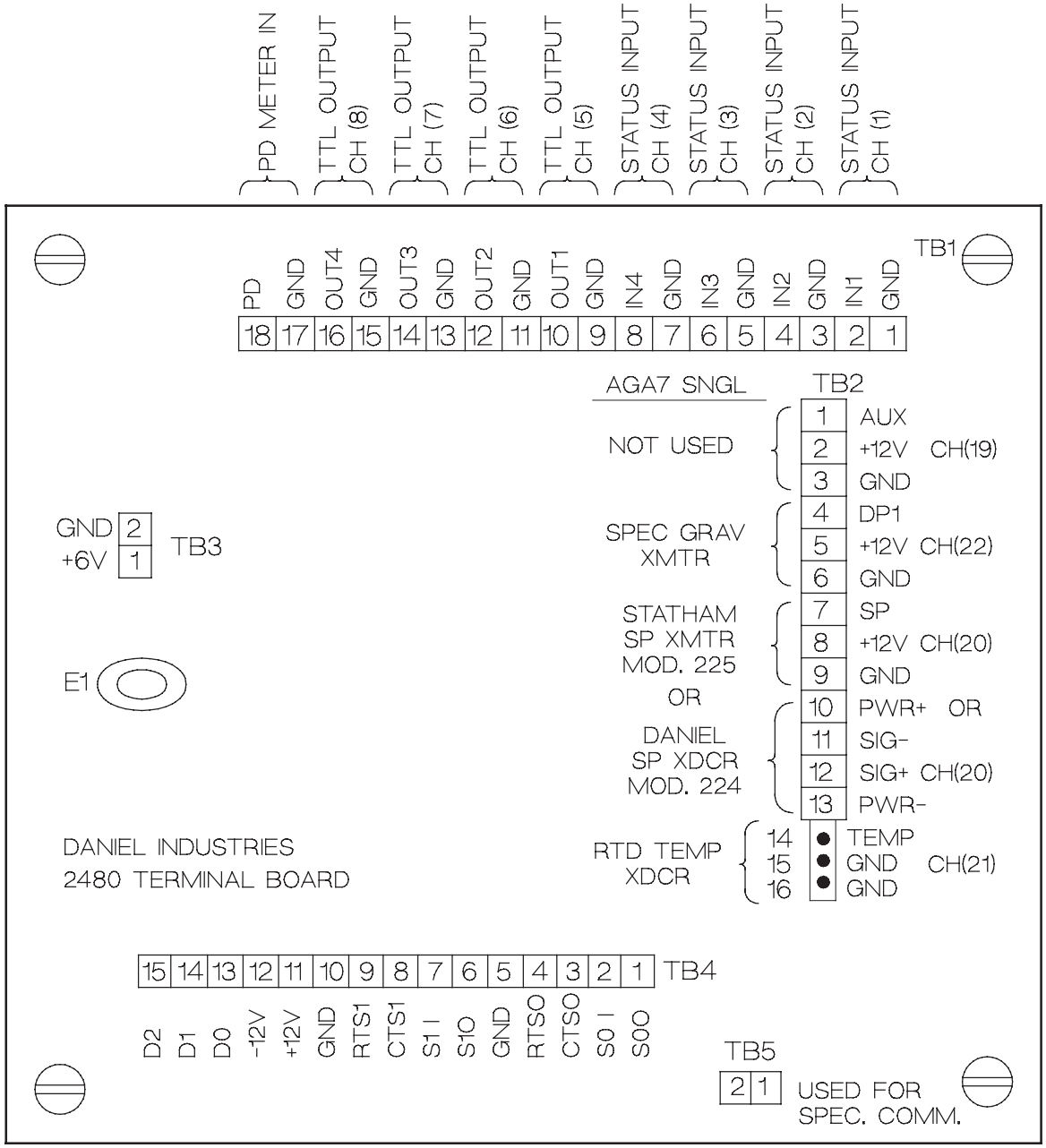

Figure 3-1. Terminal Board Connections

3.2 OUTPUT SIGNAL CONNECTIONS

NOTE: All output signals from a SolarFlow Plus unit installed in a hazardous location must be isolated by means of intrinsic safety barriers.

3.2.1 TTL Level Signal Outputs

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. Channels 6 and 7 may be used to trigger cut-offs when Premium One and Two volumes are exceeded.

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

CH	SIGNAL DESCRIPTION	LABEL	TB1 PIN NO.	TB1 LABEL	SIGNAL TYPE
5	Volume pulse output 1	VP1	10	OUT1	TTL Output
			9	GND	Common
6	Premium 1 Indicator	SP1	12	VP1	TTL Output
			11	GND	Common
7	Premium 2 Indicator	SP2	14	VP2	TTL Output
			13	GND	Common

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SECTION 4

4.0 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	_____
PCOMM RATE (2)	300 BPS	_____
RTS DELAY (3)	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 5.10.1.8 in the Model 2480 System Reference Manual for a complete discussion of the PCOMM RATE prompt.

(3) Refer to section 5.10.1.9 in the Model 2480 System Reference Manual for a complete discussion of the RTS DELAY prompt.

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SECTION 5

5.0 SECURITY CODE LIST

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

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SECTION 6

6.0 SETUP UNIT MENU

The parameters for the single-meter AGA-3 application of SolarFlow Plus that can be changed in the five 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.

6.1 GENERAL SUBMENU

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

HHDT PROMPT	DEFAULT	DESIRED
UNIT NAME	BLANK UNIT	_____
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 11.3 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.

6.2 INPUTS SUBMENU

The INPUTS submenu of the SETUP UNIT menu of the HHDT provides for switching between LIVE and FIXED values of the analog inputs shown as follows. Refer to section 5.10.2.2 in the Model 2480 System Reference Manual for additional information.

HHDT PROMPT	DEFAULT
METR PRES	XXXXX PSIG
METR TEMP	XXXXX DEGF
DIFF PRESL	XXXXX INH2O
DIFF PRES	XXXXX INH2O

6.3 SCALES SUBMENU

The high- and low-scale setpoints for the analog inputs shown in the table below can be modified in the SCALES submenu of the SETUP UNIT menu 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	INH20	_____
D PRESL/HI	30	INH20	_____
D PRES/LO	0	INH20	_____
D PRES/HI	150	INH20	_____

6.4 CONFIG SUBMENU

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

HHDT PROMPT	DEFAULT		DESIRED
PIPE DIAM	8.071	IN	_____
ORIF DIAM	4.000	IN	_____
ORIF MTRL	0		_____ 0 = STEEL 1 = MONEL
ZFLOW LIM	2.00	%	_____
ATMS PRES	14.73	PSIA	_____
PRES BASE	14.73	PSIA	_____
TEMP BASE	60	DEGF	_____
SPEC GRAV	0.600		_____
CO2	0.00	MOL%	_____
N2	0.00	MOL%	_____
TAP LCTN	0		_____ 0 = DOWNSTREAM 1 = UPSTREAM
TAP TYPE	0		_____ 0 = FLANGE 1 = PIPE
VPP 1(1)	0.1	MCF	_____ MCF/PULSE
PP 1(2)	0	SEC	_____ PULSE PERIOD
SCALE FCTR	1000.0		_____
HEAR RATIO	1.300		_____
VISCOSITY	0.0000069	#/FTS	_____
PREM SP1(3)	0.0	MCFH	_____
PREM SP2	0.0	MCFH	_____
%DEV	0	%RANG	_____

NOTE:

(1) VPP1 is not the same as the output on channel 5 (VP1). VP1 is a 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.

(2) The pulse period can be modified using the HHDT. As indicated in the table, no pulses are generated by PP1 since the pulse period is set at zero (0) seconds. The value can be changed to provide a pulse to drive an external device. For example, resetting PP1 to 1 would generate a pulse 1 second in duration. The value for PP1 must be an integer equal to 1 or greater. Fractions of a second are not permitted.

(3) The value of 0.0 disables this function.

6.5 FACTORS SUBMENU

The FACTORS submenu of the SETUP UNIT menu of the HHDT provides for switching between LIVE and FIXED values for the calculated factors shown in the table below. Refer to section 5.10.2.5 in the Model 2480 System Reference Manual for additional information.

HHDT PROMPT	DEFAULT
FB FCTR	XXXX
FPB FCTR	XXXX
FTB FCTR	XXXX
FG FCTR	XXXX
FPV FCTR	XXXX
FLOW Z	XXXX
FR FCTR	XXXX
Y FCTR	XXXX
FTF FCTR	XXXX
FA FCTR	XXXX
FW FCTR	XXXX

6.6 FPV CALCULATION SUBMENU

The FPV Calculation submenu allows calculations using the matrix compressibility method for adjusted temperatures and pressures. Supercompressibility is based on second order interpolation of operator-entered matrix compressibility data. Refer to section 2.5.

HHDT PROMPT	DEFAULT
FPV MTHD	0
PADJ FCTR	0
TADJ FCTR	0
BASE Z	1.0000
PRES LOW	0.0
PRES MED	0.0
PRES HI	0.0
TEMP LOW	0
TEMP MED	0
TEMP HI	0
Z,P1-T1	1.0000
Z,P2-T1	1.0000
Z,P3-T1	1.0000
Z,P1-T2	1.0000
Z,P2-T2	1.0000
Z,P3-T2	1.0000
Z,P1-T3	1.0000
Z,P2-T3	1.0000
Z,P3-T3	1.0000

SECTION 7

7.0 DISLAY 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 ten selections:

INPUTS
- BATTERY
- METR PRES
- METR TEMP
- DIFF PRESL (stacked DP inputs only)
- DIFF PRES

SCALES
- M PRES /LO
- M PRES /HI
- M TEMP/LO
- M TEMP/HI
- D PRESL/LO (stacked DP inputs only)
- D PRESL/HI
- D PRES/LO
- D PRES/HI

RATE/VOLS
- FLOW RATE
- TOT VOL
- TODAY VOL
- YSDAY VOL
- VP 1
- PC 1
- EXTN SUM Y
- EXTN SUM H

PREM VOLUMES
- PREM SP1
- PREM SP2
- P1 TOT VOL
- P1 TDY VOL
- P1 YSY VOL
- P2 TOT VOL
- P2 TDY VOL
- P2 YSY VOL
- BS TOT VOL
- BS TDY VOL
- BS YSY VOL

CONFIG
- PIPE DIAM
- ORIF DIAM
- ORIF MTRL
- ZFLOW LIM
- ATMS PRES
- PRES BASE
- TEMP BASE
- SPEC GRAV
- CO2
- N2
- TAP LCTN
- TAP TYPE
- VPP 1
- PP 1
- PREM SP1
- PREM SP2
- %DEV

FACTORS
- FB FCTR
- FPB FCTR
- FTB FCTR
- FG FCTR
- FPV FCTR
- FLOW Z
- FR FCTR
- Y FCTR
- FTF FCTR
- FA FCTR
- FW FCTR

FPV CALCULATION
- FPV MTHD
- PADJ FCTR
- TADJ FCTR
- BASE Z
- PRES LOW
- PRES MED
- PRES HI
- TEMP LOW
- TEMP MED
- TEMP HI
- Z,P1-T1
- Z,P2-T1
- Z,P3-T1
- Z,P1-T2
- Z,P2-T2
- Z,P3-T2
- Z,P1-T3
- Z,P2-T3
- Z,P3-T3

FLW AVERAGES
- AVG PRES Y
- FLW DIFF Y
- AVG TEMP Y
- AVG PRES H
- FLW DIFF H
- AVG TEMP H

MAX/MINIMUMS
- PRES MIN
- PRES MAX
- FRT MIN
- FRT MAX
- DIF MIN
- DIF MAX

INTEGRATOR EXT
- PRES EXT H
- FLOW EXT H
- TIME IDX H
- FLW TEMP H
- PRES EXT Y
- FLOW EXT Y
- TIME IDX Y
- FLW TEMP Y
- FLW PRES H
- FLW PRES Y
- FLW TIME H
- FLW TIME Y

SECTION 8

8.0 CALIBRATE UNIT MENU

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

8.1 PRESSURES

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

METR PRES
DIFF PRESL (Used with stacked DP(s) only)
DIFF PRES

8.2 OTHERS

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

METR TEMP

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SECTION 9

9.0 MONITOR MENU

The Monitor menu provides for witness testing analog inputs to the SolarFlow Plus unit. When the MONITOR menu is entered, all analog inputs are fixed at the values being transmitted to SolarFlow Plus when MONITOR is executed. The values remain fixed until the MONITOR menu is exited. The following analog inputs are available in the MONITOR menu in the single-meter AGA-3 application. Refer to section 5.13.8 in the Model 2480 System Reference Manual for additional information.

METR PRES
METR TEMP
DIFF PRESL (Used with stacked DP(s) only)
DIFF PRES

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SECTION 10

10.0 AGA-3 2480 SINGLE AND STACKED SINGLE CHANNEL ASSIGNMENTS

10.1 USER REPORT (CHANNEL ZERO)

The SolarFlow Plus has a front panel display that provides a predefined report list. The report list contains the channel data shown in the following table and is displayed in a scrolling format. The list is factory defined for the application and is not changeable by the user. Depending on the application, units may be in either English or metric system (in parentheses).

CHANNEL NUMBER	CHANNEL LABEL	DESCRIPTION
23	BATTERY	Battery voltage
20	METR PRES	Pressure in PSIG (KPA)
21	METR TEMP	Temperature in DEG F (DEG C)
29*	COMP DPRES	Composite DP in INH2O (KPA)
55	FLOW RATE	Flow rate in CFSFH (M3SFH)
53	TOT VOL	Total volume in CF*SF (M3*SF)
56	TODAY VOL	Today's volume in CF*SF (M3*SF)
57	YSDAY VOL	Yesterday's volume in CF*SF (M3*SF)
118	BS TOT VOL	Base volume in CF*SF (M3*SF)
110	P1 TOT VOL	Premium 1 vol in CF*SF (M3*SF)
114	P2 TOT VOL	Premium 2 vol in CF*SF (M3*SF)

* Used in stacked DP configuration only.

10.2 CHANNEL ONE THROUGH 18 ASSIGNMENTS

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

CH	LABEL	INPUT/ OUTPUT	0- LABEL	1- LABEL	DEFAULT	DESCRIPTION
001 through 004 are reserved for later use						
5	VP1	OUT	OFF	ON	OFF	Volume Pulse output 1
6	PREMIUM 1	OUT	OFF	ON	OFF	Premium level 1 indicator
7	PREMIUM 2	OUT	OFF	ON	OFF	Premium level 2 indicator
008 through 018 are unavailable						

10.3 CHANNEL 19 THROUGH 126 ASSIGNMENTS

Assignments for the single meter run AGA-3 channels 19 through 126 are tabulated as follows. The column labeled DP in the table indicates the number of points displayed past the decimal point. Channels 19 and 29 are used in the AGA-3 application only with stacked differential pressure meters. Units are English system. See section 13.0 for the Metric version.

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
19	H_w	DIFF PRESL	INH2O	1	--	Low range DP transmitter Scale 0-30.0
20	P_f	METR PRES	PSIG	0	--	Meter 1 flowing pressure Scale 0-1000
21	T_f	METR TEMP	DEG F	0	--	Scale 0-150
22	H_w	DIFF PRES	INH2O	1	--	High range DP transmitter Scale 0-150.0
23		BATTERY	VOLTS	2	--	Battery voltage Scale 2.43-12.1 VDC
Channels 24 through 28 are unavailable.						
29		COMP DPRES	INH2O	1	--	Composite DP
30	D	PIPE DIAM	IN	3	8.071	Pipe diameter
31	d	ORIF DIAM	IN	3	4.000	Orifice diameter
32	P_a	ATMS PRES	PSIA	2	14.73	Atmospheric pressure
33	P_b	PRES BASE	PSIA	2	14.73	Pressure base
34	T_b	TEMP BASE	DEG F	0	60	Temperature base
35	G	SPEC GRAV	(None)	3	0.600	Specific gravity
36		CO2	MOL%	2	0.00	Carbon dioxide inert for Fpv calculation
37		N2	MOL%	2	0.00	Nitrogen inert for Fpv calculation

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
38		TAP LCTN	(None)	0	0	Tap location: Downstream = 0 Upstream = 1
39		TAP TYPE	(None)	0	0	Tap type: Flange = 0 Pipe = 1
40	F_b	FB FCTR	(None)	1	1.0	Orifice factor
41	F_{pb}	FPB FCTR	(None)	4	1.0000	Pressure base factor
42	F_{tb}	FTB FCTR	(None)	4	1.0000	Temperature base factor
43	F_g	FG FCTR	(None)	4	1.0000	Gravity factor
44	F_{pv}	FPV FCTR	(None)	4	1.0000	Supercompressibility factor
45		FPV MTHD	(None)	0	0	Fpv Calculation Method 0 = Standard 1 = Alternate 2 = Matrix
46		PADJ FCTR	(None)	3	0.000	NX-19 pressure adjustment factor
47		TADJ FCTR	(None)	3	0.000	NX-19 temperature adjustment factor
48	F_r	FR FCTR	(None)	4	1.0000	Reynolds number factor
49	Y	Y FCTR	(None)	4	1.0000	Expansion factor
50	F_{tf}	FTF FCTR	(None)	4	1.0000	Flowing temperature factor
51	F_a	FA FCTR	(None)	4	1.0000	Thermal expansion factor
52		ORIF MTRL	(None)	0	0	Orifice material: 0 = steel 1 = monel

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
53		TOT VOL	CF*SF	1	0.0	Total accumulated volume
54		LOG VOL	CF*SF	1	0.0	Logged accumulated volume
55		FLOW RATE	CFSFH	1	0.0	Flow rate
56		TODAY VOL	CF*SF	1	0.0	Today's volume
57		YSDAY VOL	CF*SF	1	0.0	Yesterday's volume
58		ZFLOW LIM	%	2	2.00	Low flow cutoff limit
59		VPP 1	CF*SF	1	0.100	Volume per pulse 1
60		PP 1	SEC	1	0.0	Pulse period 1
61		PC 1	(None)	0	0	Total pulses 1
62	F_w	Fw Fctr	(None)	4	0.0000	Water vapor factor
63		AVG PRES Y	PSIG	0	0	Average pressure last day
64		FLW DIFF Y	INH2O	1	0.0	Average flowing differential last day
65		AVG TEMP Y	DEG F	0	0	Average temperature last day
66		EXTN SUM Y	(None)	1	0.0	Integrated extension last day
67		AVG PRES H	PSIG	0	0	Average pressure last hour
68		FLW DIFF H	INH2O	1	0.0	Average flowing differential last hour
69		AVG TEMP H	DEG F	0	0	Average temperature last hour
70		EXTN SUM H	(None)	1	0.0	Integrated extension last hour
71		PRES MIN	PSIG	0	0	Minimum pressure this log interval

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
72		FRT MIN	CFSFH	1	0.0	Minimum flowrate this log interval
73		DIFF MIN	INH2O	1	0.0	Minimum differential pressure this log interval
74		PRES MAX	PSIG	0	0	Maximum pressure this log interval
75		FRT MAX	CFSFH	1	0.0	Maximum flowrate this log interval
76		DIFF MAX	INH2O	1	0.0	Maximum differential pressure this log interval
77		PRES EXT H	(None)	0	--	Pressure extension last hour
78		FLOW EXT H	(None)	0	--	Flow extension last hour
79		TIME IDX H		0	--	Flow time index last hour

NOTE: The equations used to calculate the functions of channels 77, 78 and 79 are shown as follows.

$$CH\#\ 77 = PRES\ EXT\ H = 100 * \sum \left(\frac{PF * 100}{RANGE} \right) * \frac{SAMPLE}{3600}$$

$$CH\#\ 78 = FLOW\ EXT\ H = 100 * \sum \sqrt{\left(\frac{PF * 100}{RANGE} * \frac{DP * 100}{RANGE} \right)} * \frac{SAMPLE}{3600}$$

$$CH\#\ 79 = TIME\ IDXH = 1000 * \sum \left(\frac{SAMPLE}{3600} \right)$$

where:

SAMPLE = sampling interval in seconds

RANGE = calibrated range of the transducer

PF = static pressure (PSIA)

DP = differential pressure in inches of water

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
80		FLW TEMP H	DEGF	0	--	Average flowing temperature last hour
81		PRES EXT Y	(None)	0	--	Pressure extension last day
82		FLOW EXT Y	(None)	0	--	Flow extension last day
83		TIME IDX Y	(None)	0	--	Flow time index last day
84		FLW TEMP Y	(None)	0	--	Average flowing temperature last day
85		FLW PRES H	PSIG	0	--	Average flowing pressure last hour
86		FLW PRES Y	PSIG	0	--	Average flowing pressure yesterday
87		FLW TIME H	MIN	0	--	Flow time last hour
88		FLW TIME Y	MIN	0	--	Flow time yesterday
89 Reserved						
90		% DEV		0	0	0=Normal under/over range fault bits; see section 12.2.1
91	ZB	BASE Z	(None)	4	1.0000	Base compressibility
92		PREM SP1	CFSFH	0	0	Premium level 1 setpoint
93		PREM SP2	CFSFH	0	0	Premium level 2 setpoint

94	P1	PRES LOW	PSIA	0	0	Matrix pressure low
95	P2	PRES MED	PSIA	0	0	Matrix pressure medium
96	P3	PRES HI	PSIA	0	0	Matrix pressure high
97	T1	TEMP LOW	DEG F	0	0	Matrix temperature low
98	T2	TEMP MED	DEG F	0	0	Matrix temperature medium
99	T3	TEMP HIGH	DEG F	0	0	Matrix temperature high
100	Z1	Z,P1-T1	(None)	4	1.0000	Compressibility P1,T1
101	Z2	Z,P2-T1	(None)	4	1.0000	Compressibility P2,T1
102	Z3	Z,P3-T1	(None)	4	1.0000	Compressibility P3,T1
103	Z4	Z,P1-T2	(None)	4	1.0000	Compressibility P1,T2
104	Z5	Z,P2-T2	(None)	4	1.0000	Compressibility P2,T2
105	Z6	Z,P3-T2	(None)	4	1.0000	Compressibility P3,T2
106	Z7	Z,P1-T3	(None)	4	1.0000	Compressibility P1,T3
107	Z8	Z,P2-P3	(None)	4	1.0000	Compressibility P2,T3
108	Z9	Z,P3-P3	(None)	4	1.0000	Compressibility P3,T3
109	ZF	FLOW Z	(None)	4	1.0000	Flowing compressibility
110	P1	TOT VOL	CF*SF	1	0.0	Premium 1 total volume
111	P1	LOG VOL	CF*SF	1	0.0	Premium 1 logged volume
112	P1	TDY VOL	CF*SF	1	0.0	Premium 1 today volume
113	P1	YSY VOL	CF*SF	1	0.0	Premium 1 yesterday's volume
114	P2	TOT VOL	CF*SF	1	0.0	Premium 2 total volume
115	P2	LOG VOL	CF*SF	1	0.0	Premium 2 logged volume
116	P2	TDY VOL	CF*SF	1	0.0	Premium 2 today volume

117	P2	YSY VOL	CF*SF	1	0.0	Premium 2 yesterday's volume
118		BS TOT VOL	CF*SF	1	0.0	Base total volume
119		BS LOG VOL	CF*SF	1	0.0	Base logged volume
120		BS TDY VOL	CF*SF	1	0.0	Base today volume
121		BS YSY VOL	CF*SF	1	0.0	Base yesterday's volume
122	k	HEAT RATIO	(None)	3	1.300	Specific heat ratio
123	u	VISCOSITY	#/FT-S	7	0.0000069	Viscosity
124	SF	SCALE FCTR	(None)	0	1000	Volume/rate scale factor
125		TIME		0	0	Current Time in hhmmss format (read only)
126		DATE		0	0	Current Date in MMDDYY format (read only)

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SECTION 11

11.0 DATA LOG LIST AND HEADER BLOCK

This Data Log List and Header Block are identical in both the English and Metric versions.

11.1 DATA LOG LIST CONTENTS

The AGA-3 single meter application has one data log list, which is set to a one-hour interval with a contract hour at 7:00 AM. The following items are included on the data log.

CHANNEL NUMBER	CHANNEL LABEL	DECIMAL PLACES	DIGITS	LOGGING TYPE
21	METR TEMP	0	4	Average
20	METR PRES	0	6	Average
22	DIFF PRES	1	4	Average
54	LOG VOL	1	8	Snapshot and Zero
56	TODAY VOL	1	8	Snapshot
57	YSDAY VOL	1	8	Snapshot

11.2 DATA LOG HEADER BLOCK CONTENTS

M PRES/LO
M PRES/HI
M TEMP/LO
M TEMP/HI
D PRESL/LO
D PRESL/HI
D PRES/LO
D PRES/HI
PIPE DIAM1
ORIF DIAM1
ORIF MTRL
ZFLOWLIM
ATMS PRES
PRES BASE
TEMP BASE
FIXED SG
FIXED CO2
FIXED N2
TAP LCTN
TAP TYPE
FPV MTHD
PREM SP1
PREM SP1
%DEV

11.3 LOG DEFINE PROMPT

A maximum of ten items can be included in a data log. The up and down arrow keys scroll through the list of items. The insert and delete keys are also active.

LOG DEFINE adds, deletes, or modifies items in the Data Log List. A six-character entry (represented by the alphanumerical group ChTLD in the Default column for the HHDT prompt LOG DEFINE, section 6.1) defines an entry in the log. The characters "Ch" represent the channel number. For channels below 100, place a leading zero(s) in front of the channel number. "T" represents the type of log; "L" the number of digits to be logged; and "D" the number of decimal places logged. The type of log (T) can be an "A" for average over the log interval, "S" for snapshot at the logging time, or "Z" for snapshot and zero at the logging time. The number of digits to be logged (L) must be an even number. For example, if the character group ChTLD is 021A40 is entered in 6.1:

Ch: = 021, which is the channel number for METR TEMP

T: = A, means that the value logged is the average for METR TEMP over the log interval.

L: = 4, which is the number of digits to be logged

D: = 0 (zero), which means that METR TEMP is logged with no numbers after the decimal point.

NOTE: When a change is made to the LOG DEFINE sub-menu, previously recorded data logs are automatically erased and are no longer available for retrieval. For this reason, all data logs stored in SolarFlow Plus must be collected before making changes in the LOG DEFINE sub-menu.

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SECTION 12

12.0 ALARM DEFINITIONS

Following is a listing of the Alarm definitions for the AGA-3 single meter run English unit application.

NOTE: 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 number of retries for the alarms are:

5 for alarms 1 through 13
0 for alarm 14

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(55)<Z		0	FLOW LOW
10	C(55)>Z		999999.0	FLOW HIGH
11	C(53)<Z		0	VOL LOW
12	C(53)>Z		999999.0	VOL HIGH
13	BATT < 5.976*			BATT LOW
14				SYS FAIL

* This battery alarm is fixed at 5.976 VDC and cannot be changed.

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:

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:

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.

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.

```
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 print-out will list each log along with the respective date and time of the log 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 "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

12.2.1 REDEFINED OVER/UNDER-RANGE FAULT BITS

When Channel 90, %DEV, is zero, the under-range and over-range fault bits in the data log function normally. When %DEV is changed to some non-zero value, the meaning of the fault bits is changed such that the item labelled "under-range" indicates under or over-range and the item labelled "over-range" indicates a deviation during the log interval. The deviation is computed internally in the SolarFlow Plus by:

- averaging each analog input over the log interval
- computing the maximum of each input over the log interval
- computing the minimum of each input over the log interval
- computing the deviation, as a percentage of full scale, of both maximum and minimum from the average.

If the deviation is greater than or equal to the non-zero value the operator has configured into %DEV, then the deviation fault bit for that input is set.

SECTION 13

13.0 AGA-3 2480 SINGLE CHANNEL ASSIGNMENTS (METRIC)

Units are listed in the Metric system.

13.1 CHANNEL ONE THROUGH 18 ASSIGNMENTS (METRIC)

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

CH	LABEL	INPUT/ OUTPUT	0-LABEL	1-LABEL	DEFAULT	DESCRIPTION
001 through 004 are reserved for later use						
5	VP1	OUT	OFF	ON	OFF	Volume pulse output 1
6	PREMIUM 1	OUT	OFF	ON	OFF	Premium level 1 indicator
7	PREMIUM 2	OUT	OFF	ON	OFF	Premium level 2 indicator
008 through 018 are unavailable						

13.2 CHANNEL 19 THROUGH 124 ASSIGNMENTS (METRIC)

Assignments for the single meter run AGA-3 channels 19 through 124 are tabulated as follows. The column labeled DP in the table indicates the number of points displayed past the decimal point. Channels 19 and 29 are used in the AGA-3 application with stacked differential pressure meters. Units are Metric system. See section 10.0 for the English unit version.

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
19	H_w	DIFF PRESL	KPA	2	--	Low range DP transmitter Scale 0-7.47
20	P_f	METR PRES	KPA	0	--	Meter 1 flowing pressure Scale 0-6900
21	T_f	METR TEMP	DEG C	0	--	Scale -18 TO 66° C
22	H_w	DIFF PRES	KPA	2	--	High range DP transmitter Scale 0-37.3
23		BATTERY	VOLTS	2	--	Battery voltage Scale 2.43-12.1 VDC
Channels 24 through 28 are unavailable.						
29		COMP DPRES	KPA	2	--	Composite DP
30	D	PIPE DIAM	MM	1	200.0	Pipe diameter
31	d	ORIF DIAM	MM	1	75.0	Orifice diameter
32	P_a	ATMS PRES	KPA	3	101.325	Atmospheric pressure
33	P_b	PRES BASE	KPA	3	101.325	Pressure base
34	T_b	TEMP BASE	DEG C	0	15.0	Temperature base
35	G	SPEC GRAV	(None)	3	0.600	Specific gravity
36		CO2	MOL%	2	0.00	Carbon dioxide inert for Fpv calculation
37		N2	MOL%	2	0.00	Nitrogen inert for Fpv calculation

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
38		TAP LCTN	(None)	0	0	Tap location: Downstream = 0 Upstream = 1
39		TAP TYPE	(None)	0	0	Tap type: Flange = 0 Pipe = 1
40	F_b	FB FCTR	(None)	1	1.0	Orifice factor
41	F_{pb}	FPB FCTR	(None)	4	1.0000	Pressure base factor
42	F_{tb}	FTB FCTR	(None)	4	1.0000	Temperature base factor
43	F_g	FG FCTR	(None)	4	1.0000	Gravity factor
44	F_{pv}	FPV FCTR	(None)	4	1.0000	Supercompressibility factor
45		FPV MTHD	(None)	0	0	Fpv Calculation Method 0 = Standard 1 = Alternate 2 = Matrix
46		PADJ FCTR	(None)	3	0.000	NX-19 pressure adjustment factor
47		TADJ FCTR	(None)	3	0.000	NX-19 temperature adjustment factor
48	F_r	FR FCTR	(None)	4	1.0000	Reynolds number factor
49	Y	Y FCTR	(None)	4	1.0000	Expansion factor
50	F_{tf}	FTF FCTR	(None)	4	1.0000	Flowing temperature factor
51	F_a	FA FCTR	(None)	4	1.0000	Thermal expansion factor
52		ORIF MTRL	(None)	0	0	Orifice material: 0 = steel 1 = monel

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
53		TOT VOL	M3*SF	1	0.0	Total accumulated volume
54		LOG VOL	M3*SF	1	0.0	Logged accumulated volume
55		FLOW RATE	M3SFH	1	0.0	Flow rate
56		TODAY VOL	M3*SF	1	0.0	Today's volume
57		YSDAY VOL	M3*SF	1	0.0	Yesterday's volume
58		ZFLOW LIM	%	2	2.00	Low flow cutoff limit
59		VPP 1	M3*SF	1	10.0	Volume per pulse 1
60		PP 1	SEC	1	0.0	Pulse period 1
61		PC 1	(None)	0	0	Total pulses 1
62	F_w	FW FCTR	(None)	4	0.0000	Water vapor factor
63		AVG PRES Y	KPA	0	0	Average pressure last day
64		FLW DIFF Y	KPA	2	0.0	Average flowing differential last day
65		AVG TEMP Y	DEG C	2	0.0	Average temperature last day
66		EXTN SUM Y	(None)	1	0.0	Integrated extension last day
67		AVG PRES H	KPA	0	0	Average pressure last hour
68		FLW DIFF H	KPA	2	0.00	Average flowing differential last hour
69		AVG TEMP H	DEG C	2	0.00	Average temperature last hour
70		EXTN SUM H	(None)	1	0.0	Integrated extension last hour
71		PRES MIN	KPA	0	0	Minimum pressure this log interval

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
72		FRT MIN	M3SFH	1	0.00	Minimum flowrate this log interval
73		DIFF MIN	KPA	2	0.00	Minimum differential pressure this log interval
74		PRES MAX	KPA	0	0	Maximum pressure this log interval
75		FRT MAX	M3SFH	1	0.0	Maximum flowrate this log interval
76		DIFF MAX	KPA	2	0.00	Maximum differential pressure this log interval
77		PRES EXT H	(None)	0	--	Pressure extension last hour
78		FLOW EXT H	(None)	0	--	Flow extension last hour
79		TIME IDX H		0	--	Flow time index last hour
80		FLW TEMP H	DEG C	2	--	Average flowing temperature last hour
81		PRES EXT Y	(None)	0	--	Pressure extension last day
82		FLOW EXT Y	(None)	0	--	Flow extension last day
83		Time IDX Y	(None)	0	--	Flow time index last day
84		FLW TEMP Y	(None)	0	--	Average flowing temperature last day
85		FLW PRES H	KPA	0	--	Average flowing pressure last hour
86		FLW PRES Y	KPA	0	--	Average flowing pressure yesterday
87		FLW TIME H	MIN	0	--	Flow time last hour

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
88		FLW TIME Y	MIN	0	--	Flow time yesterday
89 reserved						
90		% DEV		0	0	0=normal under/over range fault bits; see section 12.2.1
91	ZB	BASE Z	(None)	4	1.0000	Base compressibility
92		PREM SP1	M3SFH	0	0	Premium level 1 setpoint
93		PREM SP2	M3SFH	0	0	Premium level 2 setpoint
94	P1	PRES LOW	KPA	0	0	Matrix pressure low
95	P2	PRES MED	KPA	0	0	Matrix pressure medium
96	P3	PRES HI	KPA	0	0	Matrix pressure high
97	T1	TEMP LOW	DEG C	0	0	Matrix temperature low
98	T2	TEMP MED	DEG C	0	0	Matrix temperature medium
99	T3	TEMP HIGH	DEG C	0	0	Matrix temperature high
100	Z1	Z,P1-T1	(None)	4	1.0000	Compressibility P1,T1
101	Z2	Z,P2-T1	(None)	4	1.0000	Compressibility P2,T1
102	Z3	Z,P3-T1	(None)	4	1.0000	Compressibility P3,T1
103	Z4	Z,P1-T2	(None)	4	1.0000	Compressibility P1,T2
104	Z5	Z,P2-T2	(None)	4	1.0000	Compressibility P2,T2
105	Z6	Z,P3-T2	(None)	4	1.0000	Compressibility P3,T2
106	Z7	Z,P1-T3	(None)	4	1.0000	Compressibility P1,T3
107	Z8	Z,P2-T3	(None)	4	1.0000	Compressibility P2,T3
108	Z9	Z,P3-T3	(None)	4	1.0000	Compressibility P3,T3
109	ZF	FLOW Z	(None)	4	1.0000	Flowing Compressibility

CH	REF	LABEL	UNITS	DP	DEFAULT	DESCRIPTION
110	P1	TOT VOL	M3*SF	1	0.0	Premium 1 total volume
111	P1	LOG VOL	M3*SF	1	0.0	Premium 1 logged volume
112	P1	TDY VOL	M3*SF	1	0.0	Premium 1 today volume
113	P1	YSY VOL	M3*SF	1	0.0	Premium 1 yesterday's volume
114	P2	TOT VOL	M3*SF	1	0.0	Premium 2 total volume
115	P2	LOG VOL	M3*SF	1	0.0	Premium 2 logged volume
116	P2	TDY VOL	M3*SF	1	0.0	Premium 2 today volume
117	P2	YSY VOL	M3*SF	1	0.0	Premium 2 yesterday's volume
118	BS	TOT VOL	M3*SF	1	0.0	Base total volume
119	BS	LOG VOL	M3*SF	1	0.0	Base logged volume
120	BS	TDY VOL	M3*SF	1	0.0	Base today volume
121	BS	YSY VOL	M3*SF	1	0.0	Base yesterday's volume
122	k	HEAT RATIO	(None)	3	1.300	Specific heat ratio
123	u	VISCOSITY	#/FT-S	5	0.01027	Viscosity
124	SF	SCALE FCTR	(None)	1	1.0	Volume/rate scale factor

NOTE: The equations used to calculate the functions of channels 77, 78 and 79 are identical to those delineated in section 10.3.

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SECTION 14

14.0 DATA LOG LIST AND HEADER BLOCK

The data Log List and Header Block Contents for the Metric version are identical to those shown in section 11.0.

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SECTION 15

15.0 ALARM DEFINITIONS (METRIC)

Following is a listing of the alarm definitions for the AGA-3 single meter run Metric unit application.

NOTE: 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 number of retries for the alarms are:

5 for alarms 1 through 13
0 for alarm 14

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)	6900	0	PRES LOW
4	C(20)>Z*S(20,F)	6900	1.01	PRES HIGH
5	C(21)<Z*S(21,F)	66	0	TEMP LOW
6	C(21)>Z*S(21,F)	66	1.01	TEMP HIGH
7	C(22)<Z*S(22,F)	37.3	0	DIFF LOW
8	C(22)>Z*S(22,F)	37.3	1.01	DIFF HIGH
9	C(55)<Z		0	FLOW LOW
10	C(55)>Z		999999.0	FLOW HIGH
11	C(53)<Z		0	VOL LOW
12	C(53)>Z		999999.0	VOL HIGH
13	BATT < 5.976*			BATT LOW
14				SYS FAIL

* This battery alarm is fixed at 5.976 VDC and cannot be changed.

15.1 CALCULATING ALARM SETPOINTS (METRIC)

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:

Setpoint = Z * S(20,F)

Where:

Z = 1.01
F = 6900
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:

The setpoint for Alarm #4 is = 1.01 * 6900 = 6969.0

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.

SECTION 16

16.0 RADIO COMMUNICATION

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

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SECTION 17

17.0 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.

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SECTION 18

18.0 HIGH SPEED CHANNEL READS

This application supports high speed channel reads with DSI protocol.

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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