ULTRA 3000 DEFINITION SPECIFICATION

ULTRA 3000

SINGLE ORIFICE DEFINITION

GOULD MODBUS CONFIGURATION

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Revision A

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DANIEL

DANIEL INDUSTRIES, INC.
ULTRA 3000 DEFINITION SPECIFICATION
SINGLE ORIFICE

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1.0 INTRODUCTION/REVISIONS

The Ultra 3000 AGA3 Definitions have been designed for use with orifice meters and implement the required features of natural gas flow computers.

Note that this application must still be developed, and changes to this specification may occur; however, the end result will be that a data acquisition system using RTU Gould Modbus will be able to communicate with the Ultra 3000. Any changes to the intermediate functions or menus will be recorded in the released definition specification.

P2 REVISIONS

a. Change from one Type I to two Type II IOU.
b. Additional I/O was included, and the RTD input was deleted.
c. Pressure control will be implemented rather than flow control.
d. Addition of registers per Reviewer request.
e. Register numbering format was changed due to programmer recommendations.

P3 REVISIONS

a. The definition will consist of one Type I, and one Type II IOU's.
b. 36SD (Smart DP/P) data will be included.
c. Both serial ports will have the same data.
d. The default for the analog output for the Type I board is changed to Valve Positioning.

P4 REVISIONS

a. RTD for Type I board will remain.
b. Communications parameters changed to reflect RTU protocol.

FINAL REVISIONS

a. Additional I/O was included in data sets.
b. Modbus Register assignments modified to reflect final version.

1.1 SCOPE OF SPECIFICATION

The Ultra 3000 involves a three-tiered approach to design. This task-oriented approach involves:

- Definition -- The flow engineer defines a specific application. This includes the number of tubes, assignment of inputs to functions, choosing a flow calculation method, etc.

- Configuration -- The field technician chooses a definition which has been previously defined by a flow engineer. He then is able to calibrate inputs, set pipe sizes, collect, data, etc.

- Tool Generation Programs -- When necessary, a software engineer will be asked to create a new tool or protocol driver.

This specification provides specific information on a Ultra 3000 system which supports one of nine standard orifice definitions. Basic reference information on the Ultra 3000 system can be found in the Field Engineer's Manual and the Field Technician's Manual. A detailed description of the terminology (definitions,tools, ladders) and general procedure for generating a new definition are provided in the Flow Engineer's Manual. The Field Technician's Manual covers definitions and concepts necessary for installing, configuring, and using the Ultra 3000.

This specification includes sections on :

- Flow rate equations per API Chapter 14.3 Part 3
- Gas Chromatograph Interface Capability (not configured for this definition)
- Valve Positioning Capability
- Default Security Codes
- Default Audit Logs 1 and 2 Lists
- EFM Display List
- Definition Specific Sub-Menus
- Default Alarm List
- Diagnostics Menu Representing Default Calibration Parameters

- Modbus RTU Register List

1.2 AGA3 DEFINITION/CONFIGURATION FEATURES

The primary features of the Ultra 3000 AGA3 Definition software are as follows:

- Provides Modbus Communications for remote access
- Serves as a single orifice meter definition using AGA3 1992
- Supports AGA-8 1992 (both detail and gross methods)
- Accepts standard transducer assignments, including 36SD smart sensor for Static Pressure and Differential Pressure plus 500 OHM RTD input for Temperature
- Allows the user access to all auxiliary analog inputs and their scales
- Supports a serial interface with the Daniel Chromatograph (not configured for this definition), but will default to the use of operator entered gas quality values
- Performs valve positioning using an analog output to control pressure (single analog outputs can be switched between valve positioning and flow rate)
- Provides an analog output proportional to station flow rate
- Provides two pulse outputs based on station volume

1.3 AGA3 SINGLE ORIFICE DEFINITION

The AGA3 Single Orifice Definition uses flow rate equations from API Chapter 14.3 which are included in this specification.

1.3.1 DEFINITION HARDWARE REQUIREMENTS

This orifice definition uses the IOU Type 1 and Type 2 Card. The following hardware is required to support the custom definition, unless the inputs are using fixed values.

INPUTS	OUTPUTS	NAME	REQUIREMENT	I/O TYPE & QTY.	
1		Pres1/Diff. Pres1	36SD	1	1
1		Flw Temp1	500 OHM RTD		
10		Aux Analog Inputs	1-5 volts	2	1
8		Aux Digital Inputs	Contact Closures		
	2	Volume Pulse Outputs	Pullup Resistor Req'd		
	6	Aux Digital Outputs	Contact Closures		
	1	Flw Rt Out	1-5 volts		
	1	Valve Control	1-5 volts		
	1	Erate Rt Out	1-5 volts		

1.3.2 DEFINITION FIELD WIRING MAP

NAME	REQUIREMENT	INPUTS	OUTPUTS	IOU BOARD #
Pres1	36SD			1
Diff Pres1	36SD			1
Flw Temp1	RTD			1
Aux Anlg 1	1-5 volts	Analog Input #1		1
Aux Anlg 2	1-5 volts	Analog Input #2		1
Aux Anlg 3	1-5 volts	Analog Input #1		2
Aux Anlg 4	1-5 volts	Analog Input #2		2
Aux Anlg 5	1-5 volts	Analog Input #3		2
Aux Anlg 6	1-5 volts	Analog Input #4		2
Aux Anlg 7	1-5 volts	Analog Input #5		2
Aux Anlg 8	1-5 volts	Analog Input #6		2
Aux Anlg 9	1-5 volts	Analog Input #7		2
Aux Anlg 10	1-5 volts	Analog Input #8		2
Din1	Contact Closure	Digital Input #1		1
Din2	Contact Closure	Digital Input #2		1
DIn3	Contact Closure	Digital Input #3		1
DIn4	Contact Closure	Digital Input #4		1
DIn5	Contact Closure	Digital Input #1		2
DIn6	Contact Closure	Digital Input #2		2
DIn7	Contact Closure	Digital Input #3		2
DIn8	Contact Closure	Digital Input #4		2

1.3.2 DEFINITION FIELD WIRING MAP, CONTINUED

NAME	REQUIREMENT	INPUTS	OUTPUTS	IOU BOARD #
VP 1	Contact Closure		Digital Output #1	1
VP 2	Contact Closure		Digital Output #2	1
Aux Dig Out3	Contact Closure		Digital Output #3	1
Aux Dig Out4	Contact Closure		Digital Output #4	1
Aux Dig Out5	Contact Closure		Digital Output #1	2
Aux Dig Out6	Contact Closure		Digital Output #2	2
Aux Dig Out7	Contact Closure		Digital Output #3	2
Aux Dig Out8	Contact Closure		Digital Output #4	2
Valve Pos	1-5 volts		Analog Output #1	1
Flw Rt Out	1-5 volts		Analog Output #1	2
Erate Rt Out	1-5 volts		Analog Output #2	2

1.4 CALCULATIONS

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

- Analog input sampling and average rate calculation
- Corrected flow rate and volume and calculation

These processes are usually run independently without regard for the state of the other. When the volume calculation process begins a new cycle, it signals the sampling process for new inputs 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 FLOW RATE EQUATIONS

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

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

$$Q_v = 7709.61 * C_d * E_v * Y * d^2 * \qquad \text{Eqn. 3-6b}$$

$$\text{sqrt}(P_{f1} * h_w * Z_s / (G_r * Z_{f1} * T_f))$$

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_{f1}	=	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_{f1}	=	flowing compressibility at P_{f1} & 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 Ultra 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 calculation, and does not replace the specific gravity value the operator entered into the Ultra.

The quantity, sqrt($P_{f1} * h_w$), is stored as a separate entity, FLOW EXTN, in the Ultra and is stored in the data log by default. This is in accordance with the COGM document on electronic flow meters.

1.4.2 ENERGY RATE EQUATION

The Ultra calculates volumetric energy rate using the following equation:

Erate = 1.0E-06 * Qb * Energy

where,

1.0E-06 = conversion factor to convert energy from BTU to Dekatherm

Qb = volumetric flow rate in standard cubic feet per hour at base conditions

Energy = energy in BTUs at 14.73 PSIA and 60 DEGF

Erate = volumetric energy rate in Dekatherms at base conditions

1.4.3 RATE AND VOLUME CALCULATION

The Ultra calculates rates, volumes, and compressibility on a periodic basis, once a minute.

At the beginning of the calculation cycle, the analog input averages accumulated during the preceding I/O ladder are transferred to the CALC LADDER. 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 ladder. During each cycle, the Ultra updates all of the running averages for the log. For Analog Inputs in the log, "flow averages" are kept based on flowing conditions. The meter is considered to be flowing if the differential pressure for that meter is above the cut-off value. Averaging is not performed during "no flow" conditions; this results in zero values for logging purposes.

1.5 GAS CHROMATOGRAPH INTERFACE (Not supported in this definition)

The Ultra 3000 supports retrieval of gas composition and gas quality from the Model 2251 Danalyzer Gas Chromatograph Controller. The Ultra polls the chromatograph if one of its serial ports has been configured for 'GC' protocol. It uses the communications parameters (baud rate, RTS delay, etc…) that are configured for that serial port.

To enable the gas chromatograph interface, three pieces of information must be programmed into the Ultra. These are the MODBUS communication address of the chromatograph, GC selected as one of the serial communications ports; and the chromatograph stream number of the data are required. The first two are configured with the Ultra 'Ports' Menu. The stream number is configured with the online Config Menu.

The Ultra initiates a poll of the GC about once every four minutes. If the poll is not successful, the poll will be retried every 4 seconds until the poll succeeds. Each poll of the GC is made up of a series of MODBUS queries for chromatograph data. If any query fails, the poll sequence is aborted.

The first poll to the GC is for the time of the current analysis. This time stamp is saved for comparison later. Next, the current stream number is read. Next a poll is issued for the BTU content and specific gravity, followed by a poll for the 11 component values supported by the Model 2251. The final poll retrieves the chromatograph alarms and the analysis time stamp again. If the alarms denoted by the chromatograph's MODBUS registers 3046 and 3047 are non-zero, or the analysis time does not match that of the first poll, the sequence is aborted. Otherwise, the data is processed and used in the Ultra.

The data read from the GC and the associated MODBUS register numbers are:

C6+	7001
Propane	7002
I-Butane	7003
Butane	7004
Neo-Pentane	7005
I-Pentane	7006
Pentane	7007
Nitrogen	7008
Methane	7009
CO2	7010
Ethane	7011
Specific Gravity	7035 (Real Gas Relative Density)
BTU Content	7033

If the retrieved value for Nitrogen exceeds 50 percent, the data is discarded and no further processing is done. The most common cause of a value greater than 50 percent for Nitrogen is the reassignment of MODBUS register numbers done when Neo-Pentane is deleted from the Model 2251 configuration. If this component must be deleted, a dummy component should be inserted in its place to preserve the register assignments as shown. This is the only check the Ultra does on the retrieved data before storing.

Since the AGA-8 equations do not support Neo-Pentane or C6+ as a single component, the retrieved data is partially processed before storing the data in the Ultra. If Neo-Pentane is present, it is considered to be Iso-Pentane (which is the most chemically similar component supported by AGA-8) and added to that component's value. Any C6+ component reported is separated into the following fractions:

Hexane	0.47466
Heptane	0.3534
Octane	0.17194

These fractions are the default values used by Model 2251 in the calculation of the reported value for BTU content.

GC communications will not be available with this application. The above text is for reference only.

1.6 VALVE POSITIONING

The Ultra 3000 provides pressure control based on pressure and also supports differential pressure over-range protection. The Ultra controls the pressure by means of an analog output (1-5 VDC) connected to a control valve. The valve positioning function can be configured to operate in various ways based on the value of the following configuration variables:

Valve positioning mode (VP Mode)	NONE [0]=none (disabled) FLW RT [1]=pressure control only UpPrOR [2]=pressure w/upstream pressure over-ride DnPrOR[3]=pressure w/downstream pressure over-ride
Pres setpoint	desired pressure in PSIG
Deadband	in % of setpoint
Small step	valve positioning step for fine control
Large step	valve positioning step for fast control
Fine control error limit	in % of setpoint
Over-ride pressure	in PSIG
Differential pressure over-range limit	in InH2O
Preset valve position	valve position for DP over-ride
Update time in seconds	valve positioning update time

If the function is disabled or the Maintenance Mode (Maint Mode ENABLE[1]) is enabled, no control is done. To fix the valve position to a specific value, place the output in the fixed mode and enter the desired fixed value. This value will be maintained regardless of any configuration variables. If the function is enabled, and the valve position has not been fixed by the operator, the valve positioning function runs each I/O ladder sample time after the analog inputs have been sampled.

1.6.1 DIFFERENTIAL PRESSURE OVER-RANGE PROTECTION

The differential pressure over-range protection feature is enabled by entering a non-zero value for the DP over-range limit. When enabled, this feature takes precedence over other valve positioning modes.

Each I/O cycle, the DP on the primary meter run is compared to the over-range limit. If the DP is below the over-range limit, valve positioning continues based on the selected mode. If the DP exceeds the limit, the valve position is set to the preset valve position, and the valve positioning function is aborted. Normal valve positioning resumes with the next analog sample cycle, that shows a DP below the over-range limit.

Certain combinations of parameters will cause the valve position to oscillate when this feature is enabled.

1.6.2 PRESSURE CONTROL (VP MODE = FLW RT [1])

The Ultra attempts to cause the measured pressure to match a user entered pressure setpoint. Each I/O cycle, a timer is incremented. If this timer is less than the programmed update time, the function is postponed for another cycle. After the update time has elapsed, the current pressure is compared to the setpoint. If the difference (error) is greater than a fine control threshold, a large step is applied to the valve position. Otherwise, if the error is greater than a user programmed deadband, a small step is applied to the valve position. If the error does not exceed the deadband, no change is made to the valve position. The following example illustrates this.

Flow setpoint	500 PSIG
Small step	0.1 %
Deadband	1 %
Large step	0.3 %
Fine control	
Error limit	5 %

If the observed pressure is below 475 PSIG, 0.3 percent will be added to the valve position (above 525, 0.3 percent will be subtracted). Otherwise, if the pressure is below 495 PSIG, 0.1 percent will be added to the valve position (above 505, 0.1 percent will be subtracted). If the observed pressure is between 495 and 505 PSIG, no control will be performed.

1.6.3 PRESSURE CONTROL WITH PRESSURE OVER-RIDE (VP MODE = 2 0R 3)

Each I/O cycle, the instantaneous value of the pressure is compared to the over-ride pressure value. If the pressure is less than the over-ride value, normal pressure control continues. If the pressure exceeds the over-ride value, the small step is added to the valve position for mode 2 or subtracted from the valve position for mode 3.

1.6.4 FLOW RATE OUTPUT

Ultra provides an analog output proportional to a station volumetric flow rate. This output is provided for use by external equipment which require an analog indication of the measured flow rate. The flow rate outputs are updated once each calculation cycle. The user is free to rescale this output.

1.6.5 VOLUME PULSE OUTPUT

Ultra provides two separate pulse outputs based on station volume. Each has a volume per pulse entry and a pulse period entry for configuration. For each output, 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.

2.0 FIXED MENU DEFAULTS

2.1 SECURITY CODES

Defines the list of users and their security codes for the current configuration.

USER ID	LEVEL
Field Engr	255
Super Tech	200
Field Tech	100
Observer	0

2.2 EFM PARAMETERS

Allows the user to define and/or modify the following configuration parameters for the EFM.

EFM PARAMETERS	SECURITY CLEARANCE	
	READ	WRITE
EFM Parameters	0	100
EFM Security Codes	255	255
EFM Communication Ports	0	100
User Data Log	100	255
EFM Display List	0	255
Log Clear Security Level		255
User Data Log Interval	None	
Contract Hour	7	
Configuration Description	Default Configuration	
Display Inactivity Timeout	60	
Display Scroll Mode:	Blank Screen	
Display Scroll Interval		

2.3 PORTS

Configurable serial and parallel ports:

SERIAL

PORT NO.	COMM ID.	USE
1	**1**	**MODBUS RTU GOULD**
PARAMETERS	**DEFAULT**	
Baud Rate	9600	
Parity	None	
Data Bits	8	
Start Bits	1	
Stop Bits	1	
RTS Required	YES	
RTS Up Delay	200	
RTS Down Delay	10	
CTS Required	NO	
CTS True Abort RTS Up	YES	
CTS False Abort RTS Down	NO	
CTS for Carrier Detect	NO	
CTS Timeout	0	

SERIAL

PORT NO.	COMM ID.	USE
2	**1**	**MODBUS RTU GOULD**
PARAMETERS	**DEFAULT**	
Baud Rate	9600	
Parity	None	
Data Bits	8	
Start Bits	1	
Stop Bits	1	
RTS Required	YES	
RTS Up Delay	200	
RTS Down Delay	10	
CTS Required	NO	
CTS True Abort RTS Up	YES	
CTS False Abort RTS Down	NO	
CTS for Carrier Detect	NO	
CTS Timeout	0	

PARALLEL DEFAULTS

PORT NO.	COMM ID.	USE
1	**1**	**LOCAL**

2.4 AUDIT 1 DATA LOG - 24 HOUR

The following items are included on the data log. Audit data logs 1 and 2 are set to 24-hour and 1-hour log intervals, respectively. The default contract hour is 7:00 am. When a graph is selected the scale range must be entered.

LABEL	DECIMAL PLACES	DIGITS	GRAPH NO.
Log1 Dp1	2	6	0
Log1 Pres1	1	6	0
Log1 Temp1	1	4	0
Log1FlwTm1	2	6	0
Log1 Extn1	2	6	0
Log1 Vol1	0	6	0
Log1 Eng1	0	6	0

2.5 AUDIT 2 DATA LOG - 1 HOUR

LABEL	DECIMAL PLACES	DIGITS	GRAPH NO.
Log2 Dp1	2	6	1
Log2 Pres1	1	6	1
Log2 Temp1	1	4	1
Log2FlwTm1	2	6	0
Log2 Extn1	2	6	0
Log2 Vol1	0	6	2
Log2 Eng1	0	6	0

SCALE RANGE
Point Name: Log2 Pres1 Low Scale: 0.0 High Scale: 1000.0

2.6 USER DATA LOG - NONE

2.7 EFM DISPLAY LIST

The DISPLAY List provides for viewing the selected setup parameters and data points from the field user data set unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu.

POINT NAME	UNITS
F/L Prs1	
Metr Pres1	PSIG
F/L Tmp1	
Flw Temp1	DEGF
F/L Dp1	
Diff Pres1	INH2O
Real Grav	
BTU	BTU/SCF
F/L Aux1	
Aux Anlg 1	
F/L Aux2	
Aux Anlg 2	
F/L Aux3	
Aux Anlg 3	
F/L Aux4	
Aux Anlg 4	
F/L Aux5	
Aux Anlg 5	
F/L Aux6	
Aux Anlg 6	
F/L Aux7	
Aux Anlg 7	
F/L Aux8	
Aux Anlg 8	
F/L Aux9	
Aux Anlg 9	
F/L Aux10	
Aux Anlg 10	

EFM DISPLAY LIST, CONTINUED

POINT NAME	UNITS
Flow Rate1	MCF/HR
Tot Vol 1	MCF
Today Vol1	MCF
Ysday Vol1	MCF
Erate 1	DTH/HR
Tot Enrgy1	DTHERM
Tdy Enrgy1	DTHERM
Ysy Enrgy1	DTHERM

3.0 DEFINITION SPECIFIC LABELS

Descriptive labels are shown here for reference only. The column labeled DP in the table indicates the number of digits displayed past the decimal point.

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
Erate Rt out	DKT/HR	0	1	Analog energy flow rate
Flw Rt Out	MCF/HR	1	0.0	Analog flow rate
Valve Pos	%	1	50.0	Current valve position
Version		1	1.0	Software version
Sys Error		0	0	System alarm
Atms Pres	PSIA	2	14.73	Atmospheric pressure
Pres Base	PSIA	2	14.73	Pressure base
Temp Base	DEG F	1	60.0	Temperature base
Orif Mtrl	(None)	0	STAIN[1]	Orifice material
Pipe Mtrl	(None)	0	CARBON[0]	Pipe material
Tref Orif	DEGF	1	68.0	Reference temperature of orifice plate
Tref Pipe	DEGF	1	68.0	Reference temperature of pipe
Spec Heat		2	1.30	Specific heat ratio
SG Select		0	REAL[1]	Input specific gravity 0=ideal, 1=real
Zs1 Entry	(None)	6	1.000000	Compressibility of gas used for ideal specific gravity
AGA8 Mthd		0	DETAIL[0]	AGA-8 Method 0=detail 1=GR, CO2, BTU 2=GR, CO2, N2

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
Zs		6	1.000000	Standard compressibility
Zb		6	1.000000	Base compressibility
Mol Wt		4	16.8000	Calculated by AGA-8
B		6	0.000000	AGA-8 2nd virial coeff.
C		6	0.000000	AGA-8 3rd virial coeff.
D		6	0.000000	AGA-8 reduced density
K3		6	0.000000	AGA-8 mixture size parameter
Real Grav	(None)	4	0.6000	Current Specific Gravity
BTU	(None)	2	1000.00	Current BTU
Methane	MOL%	4	95.0000	Methane MOL%
Nitrogen	MOL%	4	0.0000	Nitrogen MOL%
CO2	MOL%	4	0.0000	Carbon dioxide MOL%
Ethane	MOL%	4	5.0000	Ethane MOL%
Propane	MOL%	4	0.0000	Propane MOL%
H2O	MOL%	4	0.0000	Water MOL%
H2S	MOL%	4	0.0000	Hydrogen Sulphide MOL%
Hydrogen	MOL%	4	0.0000	Hydrogen MOL%
CO	MOL%	4	0.0000	Carbon Monoxide MOL%
Oxygen	MOL%	4	0.0000	Oxygen MOL%
I-Butane	MOL%	4	0.0000	I-Butane MOL%
Butane	MOL%	4	0.0000	Butane MOL%
I-Pentane	MOL%	4	0.0000	I-Pentane MOL%

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
Pentane	MOL%	4	0.0000	Pentane MOL%
Hexane	MOL%	4	0.0000	Hexane MOL%
Heptane	MOL%	4	0.0000	Heptane MOL%
Octane	MOL%	4	0.0000	Octane MOL%
Nonane	MOL%	4	0.0000	Nonane MOL%
Decane	MOL%	4	0.0000	Decane MOL%
Helium	MOL%	4	0.0000	Helium MOL%
Argon	MOL%	4	0.0000	Argon MOL%
Chrom Addr	(None)	0	1	Chromatograph address
Chrom Strm	(None)	0	1	Chromatograph stream
VPP 1	MCF	1	100.0	Volume per pulse 1
PP 1	SEC	0	4	Pulse period 1
VPP 2	MCF	1	100.0	Volume per pulse 2
PP 2	SEC	0	4	Pulse period 2
VP Mode	(None)	0	NONE[0]	Valve positioning option 0=disabled 1=pressure control 2=upstream pressure override 3=downstream pressure override
Pres Setpt	PSIG	0	0.0	Pressure setpoint
Deadband	PCT	1	2.0	Control deadband %
Small Step	PCT	2	0.05	Fine valve step %
Large Step	PCT	1	0.5	Coarse valve step %
Fine Cntrl	PCT	0	5	Error limit control %

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
Ovrd Pres	PSIG	0	0.0	Pres override limit
Preset Pos	PCT	0	50	Valve position for DP override
Dp Limit	InH2O	0	0	DP override limit 0=disabled
Update Tim	SEC	0	10.0	Valve position update time
Orif Diam1	IN	3	4.000	Meter 1 orifice diameter
Pipe Diam1	IN	3	8.071	Meter 1 pipe diameter
Tap Lctn 1	IN	0	UPSTRM[1]	Tap location 0=downstream 1=upstream
Zflow Lim1	InH2O	2	0.50	Low flow cutoff in InH2O
Corr Od1	IN	4	0	Temp corrected orifice diameter
Corr Pd1	IN	4	0	Temp corrected pipe diameter 1
Corr Beta	(None)	5	0.00000	Temp corrected beta ratio
Ev 1	(None)	5	1.00000	Velocity of approach factor
Cd 1	(None)	6	0.600000	Coefficient of discharge
Zf 1	(None)	6	1.000000	Flowing compressibility
Y 1	(None)	6	1.000000	Expansion factor
Flw Extn1	(None)	3	0.000	sqrt(Hw*Pf)
Flw Time 1	MIN	2	0.00	Flow time
Flow Rate1	MCF/HR	1	0.0	Hourly flow rate
Dly FlwRt1	MCF/D	1	0.0	Daily flow rate

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
Log Vol 1	MCF	0	0	Logged accumulated volume
Today Vol1	MCF	0	0	Daily accumulated volume
Ysday Vol1	MCF	0	0	Ysday's accumulated volume
Tot Vol 1	MCF	0	0	Total accumulated volume (Rolls over @ 10,000,000)
Erate 1	DTH/HR	1	0.0	Energy flow rate
Log Enrgy1	DTH	0	0	Logged accumulated energy
Tdy Enrgy1	DTH	0	0	Today's accumulated energy
Ysy Enrgy1	DTH	0	0	Ysday's accumulated energy
Tot Enrgy1	DTH	0	0	Total accumulated energy (Rolls over @ 10,000,000)
Factor	COUNTS	0	4095	Span counts for scaled integers
Prs1 LScal	PSIG	2	0.00	Static Pres @ 0 Counts
Prs1 HScal	PSIG	2	1000.00	Static Pres @ Factor Counts
Tmp1 LScal	DEGF	2	0.00	Temp. @ 0 Counts
Tmp1 HScal	DEGF	2	150.00	Temp. @ Factor Counts
DP1 LScal	InH2O	2	0.00	DP @ 0 Counts
DP1 HScal	InH2O	2	150.00	DP @ Factor Counts
Rat1 LScal	MCF/HR	2	0.00	Flow Rate @ 0 Counts
Rat1 HScal	MCF/HR	2	5000.00	Flow Rate @ Factor Counts

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
ERateLScal	DTH/HR	2	0.00	Energy Rate @ 0 Counts
ERateHScal	DTH/HR	2	5000.00	Energy Rate @ Factor Counts

4.0 DEFINITION SPECIFIC SUBMENUS

The following submenus are found: Access → Edit → Menus

4.1 ALARMS

The ALARMS SUBMENU allows the user to view alarms and to edit and/or view the alarm limits.

PROMPT	DEFAULT	SECURITY CLEARANCE	
		READ	WRITE
Maint Mode	0	0	N/A
CutOffAlm	0	0	N/A
Zf Zero	0	0	N/A
Sys Error	0	0	N/A
Prs1 LoAlm	0	0	N/A
Prs1 HiAlm	0	0	N/A
Tmp1 LoAlm	0	0	N/A
Tmp1 HiAlm	0	0	N/A
Dp1 LoAlm	0	0	N/A
Dp1 HiAlm	0	0	N/A
Batt LoAlm	0	0	N/A
Aux1 LoAlm	0	0	N/A
Aux1 HiAlm	0	0	N/A
Aux2 LoAlm	0	0	N/A
Aux2 HiAlm	0	0	N/A
Aux3 LoAlm	0	0	N/A
Aux3 HiAlm	0	0	N/A
Aux4 LoAlm	0	0	N/A
Au x4 HiAlm	0	0	N/A
Aux5 LoAlm	0	0	N/A
Aux5 HiAlm	0	0	N/A
Aux6 LoAlm	0	0	N/A
Aux6 HiAlm	0	0	N/A
Aux7 LoAlm	0	0	N/A
Aux7 HiAlm	0	0	N/A
Aux8 LoAlm	0	0	N/A
Aux8 HiAlm	0	0	N/A
Rate1LoAlm	0	0	N/A
Rate1HiAlm	0	0	N/A

ALARMS, CONTINUED

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
ERate LoAlm	0		0	N/A
ERate HiAlm	0		0	N/A
Prs1 LoLmt	0.0	PSIG	100	100
Prs1 HiLmt	1010.0	PSIG	100	100
Tmp1 LoLmt	0.0	DEGF	100	100
Tmp1 HiLmt	151.5	DEGF	100	100
Dp1 LoLmt	0.00	INH2O	100	100
Dp1 HiLmt	151.50	INH2O	100	100
Batt LoLmt	5.50	BATT	100	100
Aux1 LoLmt	-1.00	PCT	100	100
Aux1 HiLmt	101.00	PCT	100	100
Aux2 LoLmt	-1.00	PCT	100	100
Aux2 HiLmt	101.00	PCT	100	100
Aux3 LoLmt	-1.00	PCT	100	100
Aux3 HiLmt	101.00	PCT	100	100
Aux4 LoLmt	-1.00	PCT	100	100
Aux4 HiLmt	101.00	PCT	100	100
Aux5 LoLmt	-1.00	PCT	100	100
Aux5 HiLmt	101.00	PCT	100	100
Aux6 LoLmt	-1.00	PCT	100	100
Aux6 HiLmt	101.00	PCT	100	100
Aux7 LoLmt	-1.00	PCT	100	100
Aux7 HiLmt	101.00	PCT	100	100
Aux8 LoLmt	-1.00	PCT	100	100
Aux8 HiLmt	101.00	PCT	100	100
Aux9 LoLmt	-1.00	PCT	100	100
Aux9 HiLmt	101.00	PCT	100	100
Aux10LoLmt	-1.00	PCT	100	100
Aux10HiLmt	101.00	PCT	100	100
Rate1LoLmt	0.0	MCF/HR	100	100
Rate1HiLmt	5000.0	MCF/HR	100	100
ERateLoLmt	0.0	DTH/HR	100	100
ERateHiLmt	5000.0	DTH/HR	100	100

4.1.1 LOGGED ALARMS

The Logged Alarms can be viewed via the View Logs sub-menu of the Main Menu of the Electronic Flow Meter Definition and Configuration System. The number of transitions until logging begins have been defaulted to 5 for all logged alarms. Other alarms, such as, CutOffAlm, Zf Zero, etc. do not generate alarm log entries.

LOGGED ALARMS
Prs1 LoAlm
Prs1 HiAlm
Tmp LoAlm
Tmp1 HiAlm
Dp1 LoAlm
Dp1 HiAlm
Batt LoAlm
Aux1 LoAlm
Aux1 HiAlm
Aux2 LoAlm
Aux2 HiAlm
Aux3 LoAlm
Aux3 HiAlm
Aux4 LoAlm
Aux4 HiAlm
Aux5 LoAlm
Aux5 HiAlm
Aux6 LoAlm
Aux6 HiAlm
Aux7 LoAlm
Aux7 HiAlm
Aux8 LoAlm
Aux8 HiAlm
Aux9 LoAlm
Aux9 HiAlm
Aux10LoAlm
Aux10HiAlm
Rate1LoAlm
Rate1HiAlm
ERateLoAlm
ERateHiAlm

4.2 ANALOGS

The ANALOGS submenu of this definition provides for toggling between LIVE and FIXED values of the following analogs.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Metr Pres1	0.0	PSIG	0	N/A
Flw Temp1	-50.0	DEGF	0	N/A
Diff Pres1	0.00	INH2O	0	N/A
Aux Anlg 1	0.00	PCT	0	N/A
Aux Anlg 2	0.00	PCT	0	N/A
Aux Anlg 3	0.00	PCT	0	N/A
Aux Anlg 4	0.00	PCT	0	N/A
Aux Anlg 5	0.00	PCT	0	N/A
Aux Anlg 6	0.00	PCT	0	N/A
Aux Anlg 7	0.00	PCT	0	N/A
Aux Anlg 8	0.00	PCT	0	N/A
Aux Anlg 9	0.00	PCT	0	N/A
Aux Anlg10	0.00	PCT	0	N/A
Battery	13.60	BATT	0	N/A
Flow Rate1	0.0	MCF/HR	0	N/A
Erate	0.0	DTH/HR	0	N/A
Valve Pos	0.0	PCT	0	N/A
Inst Prs1	####.#	PSIG	100	N/A
Inst Tmp1	###.#	DEGF	100	N/A
Inst Dp1	###.##	INH2O	100	N/A
Inst Aux1	###.##	PCT	100	N/A
Inst Aux2	###.##	PCT	100	N/A
Inst Aux3	###.##	PCT	100	N/A
Inst Aux4	###.##	PCT	100	N/A
Inst Aux5	###.##	PCT	100	N/A
Inst Aux6	###.##	PCT	100	N/A
Inst Aux7	###.##	PCT	100	N/A
Inst Aux8	###.##	PCT	100	N/A
Inst Aux9	###.##	PCT	100	N/A
Inst Aux10	###.##	PCT	100	N/A
Inst Batt	##.##	BATT	100	N/A

- represents live values

ANALOGS, CONTINUED

The ANALOGS submenu of this definition provides for toggling between LIVE and FIXED values of the following analogs.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Pct FRate	0.00	PCT	100	N/A
Pct ERate	0.00	PCT	100	N/A
F/L Prs1	LIVE[0]	PSIG	100	100
Man Pres1	485.27		100	100
F/L Tmp1	LIVE[0]	DEGF	100	100
Man Temp1	109.0		100	100
F/L Dp1	LIVE[0]	INH2O	100	100
Man Dp1	20.00		100	100
F/L Aux1	LIVE[0]	PCT	100	100
Man Aux1	0.00		100	100
F/L Aux2	LIVE[0]	PCT	100	100
Man Aux2	0.00		100	100
F/L Aux3	LIVE[0]	PCT	100	100
Man Aux3	0.00		100	100
F/L Aux4	LIVE[0]	PCT	100	100
Man Aux4	0.00		100	100
F/L Aux5	LIVE[0]	PCT	100	100
Man Aux5	0.00		100	100
F/L Aux6	LIVE[0]	PCT	100	100
Man Aux6	0.00		100	100
F/L Aux7	LIVE[0]	PCT	100	100
Man Aux7	0.00		100	100
F/L Aux8	LIVE[0]	PCT	100	100
Man Aux8	0.00		100	100
F/L Aux9	LIVE[0]	PCT	100	100
Man Aux9	0.00		100	100
F/L Aux10	LIVE[0]	PCT	100	100
Man Aux10	0.00		100	100
F/L FRout	LIVE[0]	PCT	0	100
Man FRout	0.00		0	100
F/L ERout	LIVE[0]	PCT	0	100
Man ERout	0.00		0	100
Maint Mode	DISABL[0]		100	100

4.3 SCALES

The high- and low-scale values for the analogs shown in the following table can be modified in the SCALES submenu.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
M Pres1/Lo	0.0	PSIG	100	100
M Pres1/Hi	1000.0	PSIG	100	100
M Temp1/Lo	0.0	DEGF	100	100
M Temp1/Hi	150.0	DEGF	100	100
D Pres1/Lo	0.00	INH2O	100	100
D Pres1/Hi	150.00	INH2O	100	100
Aux 1 Lo	0.00	PCT	100	100
Aux 1 Hi	100.00	PCT	100	100
Aux 2 Lo	0.00	PCT	100	100
Aux 2 Hi	100.00	PCT	100	100
Aux 3 Lo	0.00	PCT	100	100
Aux 3 Hi	100.00	PCT	100	100
Aux 4 Lo	0.00	PCT	100	100
Aux 4 Hi	100.00	PCT	100	100
Aux 5 Lo	0.00	PCT	100	100
Aux 5 Hi	100.00	PCT	100	100
Aux 6 Lo	0.00	PCT	100	100
Aux 6 Hi	100.00	PCT	100	100
Aux 7 Lo	0.00	PCT	100	100
Aux 7 Hi	100.00	PCT	100	100
Aux 8 Lo	0.00	PCT	100	100
Aux 8 Hi	100.00	PCT	100	100
Aux 9 Lo	0.00	PCT	100	100
Aux 9 Hi	100.00	PCT	100	100
Aux10 Lo	0.00	PCT	100	100
Aux10 Hi	100.00	PCT	100	100

SCALES, CONTINUED

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Battery Lo	0.00	BATT	100	100
Battery Hi	15.83	BATT	100	100
Flw Rt Low	0.0	MCF/HR	0	100
Flw Rt Hi	5000.0	MCF/HR	0	100
EngyRt Low	0.0	DTH/HR	0	100
EngyRt Hi	5000.0	DTH/HR	0	100

4.4 DIGITALS

The DIGITALS submenu provides for viewing and/or editing the digital inputs and outputs.

PROMPT	DEFAULT	SECURITY CLEARANCE	
		READ	WRITE
DIn1	0	0	N/A
DIn2	0	0	N/A
DIn3	0	0	N/A
DIn4	0	0	N/A
DIn5	0	0	N/A
DIn6	0	0	N/A
DIn7	0	0	N/A
DIn8	0	0	N/A
PP 1	10	100	100
pplowlim1	4	100	100
max_puls1	100	100	100
VP 1	0	0	N/A
PP 2	10	100	100
pplowlim2	4	100	100
max_puls2	100	100	100
VP 2	0	0	N/A
Dout3	OFF[0]	0	100
Dout4	OFF[0]	0	100
Dout5	OFF[0]	0	100
Dout6	OFF[0]	0	100
Dout7	OFF[0]	0	100
Dout8	OFF[0]	0	100

DIGITALS, CONTINUED

PROMPT	DEFAULT	SECURITY CLEARANCE	
		READ	WRITE
F/L VP1	LIVE[0]	100	100
Man VP1	OFF[0]	100	100
F/L VP2	LIVE[0]	100	100
Man VP2	OFF[0]	100	100

4.5 CONFIG

The following default parameters can be changed in the CONFIG submenu.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Orif Diam1	4.000	IN	0	100
Pipe Diam1	8.071	IN	0	100
Zflow Lim1	0.50	INH2O	0	100
Tap Lctn 1	UPSTRM[1]		0	100
Atms Pres	14.73	PSIA	0	100
Pres Base	14.73	PSIA	0	100
Temp Base	60.0	DEGF	0	100
AGA8 Mthd	DETAIL[0]		0	100
SG Select	REAL[1]		0	100
Real Grav	0.6000		0	100
Zs1 Entry	1.000000		0	100
Orif Mtrl	STAIN[1]		0	100
Pipe Mtrl	CARBON[0]		0	100
Tref Orif	68.0	DEGF	0	100
Tref Pipe	68.0	DEGF	0	100
Chrom Strm	1		0	100
Version	2.00		0	N/A
Factor	4095	COUNTS	0	100
Prs1 LScal	0.00	PSIG	0	100
Prs1 HScal	1000.00	PSIG	0	100
Tmp1 LScal	0.00	DEGF	0	100
Tmp1 HScal	150.00	DEGF	0	100
DP1 LScal	0.00	InH2O	0	100
DP1 HScal	150.00	InH2O	0	100
Rat1 LScal	0.00	MCF/HR	0	100
Rat1 HScal	5000.00	MCF/HR	0	100
ERateLScal	0.00	DTH/HR	0	100
ERateHScal	5000.00	DTH/HR	0	100

4.6 CONTROL

The CONTROL submenu provides for entering the control values for the pulse outputs.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
VPP 1	100.0		0	100
PP 1	4		0	100
VPP 2	100.0		0	100
PP 2	4		0	100
VP Mode	NONE[0]		0	100
Pres Setpt	0	PSIG	0	100
Deadband	2.0	PCT	0	100
Small Step	0.05	PCT	0	100
Large Step	0.5	PCT	0	100
Fine Cntrl	5	PCT	0	100
Ovrd Pres	0	PSIG	0	100
DP Limit	0	INH2O	0	100
Preset Pos	50	PCT	0	100
Update Tim	10	SEC	0	100
Valve Pos	0.0	PCT	0	N/A
F/L VP Out	FIXED[1]		0	100
FixdVP Val	50	PCT	0	100
Inst Rate	0.0	MCF/HR	0	N/A
Flow Rate1	0.0	MCF/HR	0	N/A
Diff Pres1	0.00	INH2O	0	N/A
Metr Pres1	0.0	PSIG	0	N/A
Maint Mode	DISABL[0]		0	100

4.7 CALCULATED DATA

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

PROMPT	SAMPLE VALUES	SECURITY CLEARANCE	
		READ	WRITE
Flow Rate1	426.4 MCF/HR	0	N/A
Ev 1	1.03162	100	N/A
Cd 1	0.603111	100	N/A
Y 1	0.999521	100	N/A
Flw Extn 1	100.000	0	N/A
AGA8 Mthd	DETAIL[0]	100	255
Zs	0.997811	0	N/A
Zb	0.997811	0	N/A
Zf 1	0.948103	0	N/A
B	-0.0517398	100	N/A
K3	0.100912	100	N/A
Mol Wt	16.7444	100	N/A

4.8 LIVE GAS DATA

Data retrieved from the Gas Chromatograph can be read in this menu.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Chrom Strm	1		100	100
BTU	0.00	BTU	100	N/A
CO2	0.0000	MOL%	100	N/A
Ethane	0.0000	MOL%	100	N/A
I-Butane	0.0000	MOL%	100	N/A
I-Pentane	0.0000	MOL%	100	N/A
Methane	0.0000	MOL%	100	N/A
Nitrogen	0.0000	MOL%	100	N/A
N-Butane	0.0000	MOL%	100	N/A
N-Heptane	0.0000	MOL%	100	N/A
N-Hexane	0.0000	MOL%	100	N/A
N-Octane	0.0000	MOL%	100	N/A
N-Pentane	0.0000	MOL%	100	N/A
Propane	0.0000	MOL%	100	N/A
Spec Grav	0.0000		100	N/A
GC Fail	0		100	N/A
F/L GC	FIXED [1]		100	100
GC timeout	120 SEC		100	100

4.9 FIXED GAS DATA

Entries for gas specific parameters can be edited in this submenu.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Spec Grav	0.6000		0	100
BTU	1000.00	BTU/SCF	0	100
CO2	0.0000	MOL%	100	100
Nitrogen	0.0000	MOL%	100	100
Spec Heat	1.30		100	100
Methane	95.0000	MOL%	100	100
Ethane	5.0000	MOL%	100	100
Propane	0.0000	MOL%	100	100
Water	0.0000	MOL%	100	100
H2S	0.0000	MOL%	100	100
Hydrogen	0.0000	MOL%	100	100
CO	0.0000	MOL%	100	100
Oxygen	0.0000	MOL%	100	100
I-Butane	0.0000	MOL%	100	100
N-Butane	0.0000	MOL%	100	100
I-Pentane	0.0000	MOL%	100	100
N-Pentane	0.0000	MOL%	100	100
N-Hexane	0.0000	MOL%	100	100
N-Heptane	0.0000	MOL%	100	100
N-Octane	0.0000	MOL%	100	100
N-Nonane	0.0000	MOL%	100	100
N-Decane	0.0000	MOL%	100	100
Helium	0.0000	MOL%	100	100
Argon	0.0000	MOL%	100	100

4.10 RATES AND VOLUMES

The RATES AND VOLUMES can be monitored on this screen.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Flow Rate1	0.0	MCF/HR	0	N/A
Dly FlwRt1	0.0	MCF/D	0	N/A
Today Vol1	0	MCF	0	N/A
Ysday Vol1	0	MCF	0	N/A
Tot Vol 1	0	MCF	0	N/A
Erate 1	0.0	DTH/HR	0	N/A
Tdy Enrgy1	0	DTHERM	0	N/A
Ysy Enrgy1	0	DTHERM	0	N/A
Tot Enrgy1	0	DTHERM	0	N/A

4.11 DIAGNOSTICS

The DIAGNOSTICS SUBMENU allows the user to edit and /or view the calibration parameters.

PROMPT		DEFAULTS		SECURITY CLEARANCE	
				READ	WRITE
Inst Prs1		####.#	PSIG	100	N/A
RawLS Prs1		10000	COUNTS	100	100
RawHS Prs1		50000	COUNTS	100	100
Tol Prs1		25		100	100
CalPtsPrs1		0		100	100
AsFndPrs1	ARRAY			100	N/A
AsLeftPrs1	ARRAY			100	N/A
RAsLftPrs1	ARRAY			100	N/A
OfstUsPrs1	NO [0]			100	100
OfAsFdPrs1		0	PSIG	100	100
OfAsLfPrs1		0	PSIG	100	100
Inst Tmp1		###.#	DEGF	100	N/A
RawLS Tmp1		39173	COUNTS	100	100
RawHS Tmp1		44436	COUNTS	100	100
Tol Tmp1		25		100	100
CalPtsTmp1		0		100	100
AsFndTmp1	ARRAY			100	N/A
AsLeftTmp1	ARRAY			100	N/A
RAsLftTmp1	ARRAY			100	N/A
OfstUsTmp1	NO [0]			100	100
OfAsFdTmp1		0	DEGF	100	100
OfAsLfTmp1		0	DEGF	100	100
Inst Dp1		###.##	INH2O	100	N/A
RawLS Dp1		10000	COUNTS	100	100
RawHS Dp1		50000	COUNTS	100	100
Tol Dp1		25		100	100
CalPtsDp1		0		100	100

DIAGNOSTICS, CONTINUED

PROMPT		DEFAULTS		SECURITY CODES	
				READ	WRITE
AsFndDp1	ARRAY			100	N/A
AsLeftDp1	ARRAY			100	N/A
RAsLftDp1	ARRAY			100	N/A
OfstUsDp1	NO [0]			100	100
OfAsFdDp1		0	INH2O	100	100
OfAsLfDp1		0	INH2O	100	100
Inst Aux1		###.##	PCT	100	N/A
RawLS Aux1		36056	COUNTS	100	100
RawHS Aux1		49214	COUNTS	100	100
Tol Aux1		25		100	100
CalPtsAux1		0		100	100
AsFndAux1	ARRAY			100	N/A
AsLeftAux1	ARRAY			100	N/A
RAsLftAux1	ARRAY			100	N/A
OfstUSAux1	NO [0]			100	100
OfAsFdAux1		0	PCT	100	100
OfAsLfAux1		0	PCT	100	100
Inst Aux2		###.##	PCT	100	N/A
RawLS Aux2		36056	COUNTS	100	100
RawHS Aux2		49214	COUNTS	100	100
Tol Aux2		25		100	100
CalPtsAux2		0		100	100
AsFndAux2	ARRAY			100	N/A
AsLeftAux2	ARRAY			100	N/A
RAsLftAux2	ARRAY			100	N/A
OfstUsAux2	NO [0]			100	100
OfAsFdAux2		0	PCT	100	100
OfAsLfAux2		0	PCT	100	100

DIAGNOSTICS, CONTINUED

PROMPT		DEFAULTS		SECURITY CODES	
				READ	WRITE
Inst Aux3		###.##	PCT	100	N/A
RawLS Aux3		12484	COUNTS	100	100
RawHS Aux3		62420	COUNTS	100	100
Tol Aux3		25		100	100
CalPtsAux3		0		100	100
AsFndAux3	ARRAY			100	N/A
AsLeftAux3	ARRAY			100	N/A
RAsLftAux3	ARRAY			100	N/A
OfstUSAux3	NO [0]			100	100
OfAsFdAux3		0	PCT	100	100
OfAsLfAux3		0	PCT	100	100
Inst Aux4		###.##	PCT	100	N/A
RawLS Aux4		12484	COUNTS	100	100
RawHS Aux4		62420	COUNTS	100	100
Tol Aux4		25		100	100
CalPtsAux4		0		100	100
AsFndAux4	ARRAY			100	N/A
AsLeftAux4	ARRAY			100	N/A
RAsLftAux4	ARRAY			100	N/A
OfstUsAux4	NO [0]			100	100
OfAsFdAux4		0	PCT	100	100
OfAsLfAux4		0	PCT	100	100
Inst Aux5		###.##	PCT	100	N/A
RawLS Aux5		12484	COUNTS	100	100
RawHS Aux5		62420	COUNTS	100	100
Tol Aux5		25		100	100
CalPtsAux5		0		100	100
AsFndAux5	ARRAY			100	N/A
AsLeftAux5	ARRAY			100	N/A
RAsLftAux5	ARRAY			100	N/A
OfstUsAux5	NO [0]			100	100
OfAsFdAux5		0	PCT	100	100
OfAsLfAux5		0	PCT	100	100

DIAGNOSTICS, CONTINUED

PROMPT		DEFAULTS		SECURITY CODES	
				READ	WRITE
Inst Aux6		###.##	PCT	100	N/A
RawLS Aux6		12484	COUNTS	100	100
RawHS Aux6		62420	COUNTS	100	100
Tol Aux6		25		100	100
CalPtsAux6		0		100	100
AsFndAux6	ARRAY			100	N/A
AsLeftAux6	ARRAY			100	N/A
RAsLftAux6	ARRAY			100	N/A
OfstUSAux6	NO [0]			100	100
OfAsFdAux6		0	PCT	100	100
OfAsLfAux6		0	PCT	100	100
Inst Aux7		###.##	PCT	100	N/A
RawLS Aux7		12484	COUNTS	100	100
RawHS Aux7		62420	COUNTS	100	100
Tol Aux7		25		100	100
CalPtsAux7		0		100	100
AsFndAux7	ARRAY			100	N/A
AsLeftAux7	ARRAY			100	N/A
RAsLftAux7	ARRAY			100	N/A
OfstUsAux7	NO [0]			100	100
OfAsFdAux7		0	PCT	100	100
OfAsLfAux7		0	PCT	100	100
Inst Aux8		###.##	PCT	100	N/A
RawLS Aux8		12484	COUNTS	100	100
RawHS Aux8		62420	COUNTS	100	100
Tol Aux8		25		100	100
CalPtsAux8		0		100	100
AsFndAux8	ARRAY			100	N/A
AsLeftAux8	ARRAY			100	N/A
RAsLftAux8	ARRAY			100	N/A
OfstUsAux8	NO [0]			100	100
OfAsFdAux8		0	PCT	100	100
OfAsLfAux8		0	PCT	100	100

DIAGNOSTICS, CONTINUED

PROMPT		DEFAULTS		SECURITY CODES	
				READ	WRITE
Inst Aux9		###.##	PCT	100	N/A
RawLS Aux9		12484	COUNTS	100	100
RawHS Aux9		62420	COUNTS	100	100
Tol Aux9		25		100	100
CalPtsAux9		0		100	100
AsFndAux9	ARRAY			100	N/A
AsLeftAux9	ARRAY			100	N/A
RAsLftAux9	ARRAY			100	N/A
OfstUsAux9	NO [0]			100	100
OfAsFdAux9		0	PCT	100	100
OfAsLfAux9		0	PCT	100	100
Inst Aux10		###.##	PCT	100	N/A
RawLSAux10		12484	COUNTS	100	100
RawHSAux10		62420	COUNTS	100	100
Tol Aux10		25		100	100
CalPtsAu10		0		100	100
AsFndAu10	ARRAY			100	N/A
AsLeftAu10	ARRAY			100	N/A
RAsLftAu10	ARRAY			100	N/A
OfstUsAu10	NO [0]			100	100
OfAsFdAu10		0	PCT	100	100
OfAsLfAu10		0	PCT	100	100
Inst Batt		##.##	BATT	100	N/A
RawLS Batt		0	COUNTS	100	100
RawHS Batt		255	COUNTS	100	100
To1 Batt		25	BATT	100	100
CalPtsBatt		0		100	100
AsFndBatt	ARRAY			100	N/A
AsLeftBatt	ARRAY			100	N/A
RAsLftBatt	ARRAY			100	N/A
OfstUsBatt	NO [0]			100	100
OfAsFdBatt		0	BATT	100	100
OfAsLfBatt		0	BATT	100	100

4.12 GOULD MODBUS

This definition utilizes Gould Modbus RTU protocol on both serial port #1 and #2. The Gould Modbus RTU Protocol differs from the standard Daniel Modbus Protocol in that the boolean registers which were defined at locations 1001 through 3000 can be addressed using function codes 1, 2, 5, and 15 at addresses 0 through 1999. The short integers which were defined at locations 3001 through 5000 can be addressed using function codes 3, 6, and 16 at addresses zero through 1999.

Addressing of registers is as follows:

FUNCTION CODE	GOULD MODBUS REGISTER ASSIGNMENTS	ULTRA 3000 REGISTER ASSIGNMENTS
1 - Read Coil Status	0-1999	1001-3000
2 - Read Input Status	0-1999	1001-3000
3 - Read Holding Registers	0-1999	3001-5000
5 - Force Single Coil	0-1999	1001-3000
6 - Preset Single Register	0-1999	3001-5000
15 - Force Multiple Coils	0-1999	1001-3000
16 - Preset Multiple Registers	0-1999	3001-5000

Using any of the function codes listed in the table above with a Gould Modbus register number greater then 1999 will result in the function being processed the same as with the standard Daniel Modbus Protocol.

Modbus registers defined in the 3001 through 5000 register range and addressed using function codes 3, 6, and 16 at addresses 0 through 1999 will be processed as follows:

Floating Point:

Read (Function Code 3) - The floating point value will be converted to a 16-bit signed integer value in the range -32767 to +32767.

Write (Function Codes 6 or 16) - The 16-bit signed integer value is converted to a signed floating point number in the range -32767.0 to +32767.0 and stored in the appropriate location.

Long Interger:

Read (Function Code 3) - The long integer value is treated as 2 16-bit unsigned integers. If the request is for an even numbered register (0010), the low order 16 bits (range 0-65535) of the long integer will be returned. If the request is for an odd numbered register (0011), the high order 16 bits (range 0-65535) or the long integer will be returned.

Write (Function Code 6 or 16) - The 16-bit unsigned value is converted to a 32-bit unsigned long integer value in the range 0-65535. The long integer may be assigned to either an even or odd register address.

Signed/Unsigned 16-Bit Integer:

Read (Function Code 3) - The integer value will be returned as a 16-bit integer.

Write (Function Code 6 or 16) - The integer value will be stored as a 16-bit integer.

Boolean:

Read (Function Code 3) - A boolean “true” will be returned as a 16-bit integer value of 1. A boolean “false” will be returned as a 16-bit integer value of 0.

Write (Function Code 6 or 16) - A non-zero 16-bit integer value will cause the boolean to be set to “true”. A zero 16-bit integer value will cause the boolean to be set to “false”.

4.12.1 SCALED FLOATING POINT VALUES

Some floating point values will be converted to scaled signed 16-bit integers by using the following equation:

$$MODBUS = \frac{VARIABLE - ZS}{FS - ZS} * FACTOR$$

where, MODBUS is the scaled integer stored in the modbus register
VARIABLE is the actual value of the analog input or rate
FACTOR is a user configurable integer (maximum value 32767)
ZS is the zero scale value from the table below
FS is the full scale value from the table below

VARIABLE	SCALING		DEFAULT VALUE
	ZERO	FULL	
Factor			4095
Metr Pres1	0.0	1000.0	
Flw Temp1	0.0	150.0	
Diff Pres1	0.0	150.0	
Flow Rate1	0.0	5000.0	
Erate 1	0.0	5000.0	

Note: The data above is taken from the scale values for the analogs inputs in section 4.3. The parameter factor is taken from section 4.5.

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5.0 GOULD MODBUS RTU REGISTER LIST

The register numbering format is such that it will allow for future expansion. Additionally, the registers below are available for serial port 1 and serial port 2. The following register data items can be accessed (read/write) using Modbus function codes 1, 2, 5, and 15.

GOULD MODBUS REGISTER NUMBER	ULTRA 3000 MODBUS REGISTER NUMBER	DATA NAME	DATA TYPE	ACCESS (READ/ WRITE)
0	1001	DIn1	Boolean	R
1	1002	DIn2	Boolean	R
2	1003	DIn3	Boolean	R
3	1004	DIn4	Boolean	R
4	1005	DIn5	Boolean	R
5	1006	DIn6	Boolean	R
6	1007	DIn7	Boolean	R
7	1008	DIn8	Boolean	R
8	1009	VP1	Boolean	R
9	1010	VP2	Boolean	R
10	1011	Dout3	Boolean	R/W
11	1012	Dout4	Boolean	R/W
12	1013	Dout5	Boolean	R/W
13	1014	Dout6	Boolean	R/W
14	1015	Dout7	Boolean	R/W
15	1016	Dout8	Boolean	R/W
16	1017	F/L VP1	Boolean	R/W
17	1018	Man VP1	Boolean	R/W
18	1019	F/L VP2	Boolean	R/W

GOULD MODBUS REGISTER NUMBER	ULTRA 3000 MODBUS REGISTER NUMBER	DATA NAME	DATA TYPE	ACCESS (READ/ WRITE)
19	1020	Man VP2	Boolean	R/W

GOULD MODBUS RTU REGISTER LIST, CONTINUED

The following register data items can be accessed (read/write) using Modbus function codes 3, 6, and 16.

GOULD MODBUS REGISTER NUMBER	ULTRA 3000 MODBUS REGISTER NUMBER	DATA NAME	DATA TYPE	ACCESS (READ/ WRITE)
0	3001	Metr Pres1	Scaled Integer	R
1	3002	Flw Temp1	Scaled Integer	R
2	3003	Diff Pres1	Scaled Integer	R
3	3004	Flow Rate1	Scaled Integer	R
4	3005	Erate1	Scaled Integer	R
5	3006	Tot Vol 1	Long Integer	R
6	3007	Tot Vol 1	Long Integer	R
7	3008	Tot Enrgy1	Long Integer	R
8	3009	Tot Enrgy1	Long Integer	R
9	3010	Pres Setpnt	Floating Point	R/W

6.0 AGA8 NOMINAL RANGES FOR THE DETAIL AND GROSS CHARACTERIZATION METHODS

QUANTITY	RANGE		
Relative Density	0.56	to	0.87
Gross Heating Value	477	to	1150 Btu/Scf
Methane Mole%	45.2	to	98.3
Nitrogen Mole%	0.3	to	53.6
Carbon Dioxide Mole%	0.04	to	28.94
Ethane Mole%	0.24	to	9.53
Propane Mole%	0.02	to	3.57
Butanes Mole%	0.01	to	1.08
Pentanes Mole%	0.002	to	0.279
Hexanes Plus Mole%	0.0005	to	0.1004
Helium Mole%	0.0	to	0.158
Hydrogen Mole%	0.0		
Carbon Monoxide Mole%	0.0		
Argon Mole%	0.0		
Oxygen Mole%	0.0		
Water Mole%	0.0	to	0.05
Hydrogen Sulfide Mole%	0.0	to	0.02

Gross Method - Temperatures from 32.0 to 130.0 DegF
Pressures from atmospheric to 1200 Psia

Detail Method - Temperatures from -200.0 to 760 DegF
Pressures from atmospheric to 40,000 Psia

Reference - AGA8 Nov 1992 Manual

AGA3 NOMINAL RANGES
Orifice Diameters greater than 0.45 inches
Pipe Diameters 2.0 inches and greater
Pipe Reynolds numbers greater than or equal to 4000
Beta ratios of 0.10 to 0.75
Temperatures -50.0 to 350.0 DegF
Pressures 0.0 to 5000.0 Psig
Differential Pressures 0.0 to 750.0 InH2O

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WARRANTY CLAIM REQUIREMENTS

To make a warranty claim, you, the Purchaser, must:

1. Provide Daniel with proof of the Date of Purchase and proof of the Date of Shipment of the product in question.

2. Return the product to Daniel within twelve (12) months of the date of original shipment of the product, or within eighteen (18) months of the date of original shipment of the product to destinations outside of the United States. The Purchaser must prepay any shipping charges. In addition, the Purchaser is responsible for insuring any product shipped for return, and assumes the risk of loss of the product during shipment.

3. To obtain Warranty service or to locate the nearest Daniel office, sales, or service center call (281) 897-2900, Fax (281) 897-2901, or contact:

   Daniel Measurement Services
   19203 Hempstead Highway
   Houston, Texas 77065

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

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

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

DANIEL INDUSTRIES, INC.
CUSTOMER PROBLEM REPORT

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

COMPANY NAME: _____

TECHNICAL CONTACT:_____ PHONE: _____

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

INVOICE ADDRESS: _____

_____

_____

SHIPPING ADDRESS: _____

_____

_____

RETURN SHIPPING METHOD: _____

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

DESCRIPTION OF PROBLEM: _____

_____

_____

WHAT WAS HAPPENING AT TIME OF FAILURE? _____

_____

ADDITIONAL COMMENTS: _____

_____

_____

REPORT PREPARED BY:_____ TITLE: _____

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

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

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

The sales and service offices of Daniel Industries, Inc. are located throughout the United States and in major countries overseas. Please contact Daniel Measurement Services at 19203 Hempstead Highway, Houston, Texas 77065, or phone (281) 897-2900 for the location of the sales or service office nearest you. Daniel Measurement Services offers both on-call and contract maintenance service designed to provide single-source responsibility for all Daniel Measurement and Control products.

DANIEL