FloBoss 107 – ROCNOC
User Manual

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About this Manual

This manual provides a basic overview of the Net Oil Computer, and briefly describes how to install and configure the program into an Emerson FB107 using ROCLINK 800 Configuration Interface Software.

For quick installation and configuration go to Chapter 3.2 & 3.3.

This manual is divided into the following chapters:

Chapter 1: Introduction

Briefly describes the Net Oil Computer program.

Chapter 2: Installing the Program

Procedure for installation of the ROCNOC programs into the FB107 using ROCLINK 800.

Chapter 3: NOC Configuration

Displays the NOC program screens and describes the parameters of each screen.

Chapter 4: Operation of ROCNOC

Overview of operation of the FB107 ROCNOC.

Chapter 5: Gas Flow

Options and features of gas flow for the FB107 ROCNOC.

Chapter 6: Diagnostics

Diagnostics features with the FB107 ROCNOC program.

Appendix A - Standards

Lists the standards used to develop the Net Oil Computer program.

Appendix B – AGA Configuration Guide

Guidelines used for the configuration of the AGA calculations.

Appendix C – Soft Points & TLP

Reference table for all available ROCNOC data points, as well as suggested Modbus register mapping

Appendix D – Directive 17 Compliance

Summary of AER Directive 17 compliance requirements for this application, cross-referencing Spartan ROCNOC system compliance

Chapter 1: Introduction

For quick installation and configuration go to Chapter 3.2 & 3.3.

The Net Oil Computer (NOC) uses a Micro Motion Mass Flow Meter as a flow sensor to calculate the net oil and water present in an emulsion stream. Water cut determination can be made by comparing the measured emulsion density to the reference densities of free oil and water. The system can also accept an input from a water cut analyzer.

The Net Oil Computer calculates the volume correction factor using the temperature effect on the densities of oil and water, as well as the pressure effect on the density of oil. Using the water cut and the volume correction factors, the emulsion flow is factored to determine the net oil and water at standard conditions. The program provides up to two net oil calculations.

The Proface touch screen display panel provides a user interface for starting and stopping tests and changing key parameters. The operator interface can stop and start tests monitor production numbers and enter meter factors from the display. The NOC program can also be run without a display.

1.1 Technical Overview

There have been 3 program versions used for the FB107 NOC software. All future supported software will be the 400 series, it is recommended that any 100 and 200 Series software systems be upgraded to 400 Series.

Series	Latest Version	# Liquid Runs	#Gas Compositions	Gas Composition Type	# History Points
100		40	1	Common	3 / well
200		15	15	Per well	3 / well
400	Contact Spartan Controls	15	15	Per well	120 total

The ROCNOC system has 2 operating modes available. The modes are “Well Test” or “LACT” (continuous test mode). In the Well Test mode the system will allow daily production to be tested for oil, water and gas production. The system has a database for each well containing oil density, water

density and well identifiers. The system uses a single editable gas composition for the 100 series software and individual gas compositions in the series 200 & 400 software. The well test mode prorates measurement to a 24 hour test. If the test is stopped prior or extended beyond 24 hours the production data will be prorated to a 24 hour test.

In LACT mode the well test will run continuously. Daily production numbers will be recorded based on the contract hour configured in the FB107.

Both well test and LACT mode allows measurement of either a 2 phase or 3 phase separator. The measurements can be made by Micro Motion Coriolis meters or Turbine meters for the liquid measurement. The gas measurement is made using an Emerson 205 MVS 3-1 transmitter or Rosemount 4088B Multivariable transmitter.

The system can provide water cut measurement by a number of methods. The common method is using a Micro Motion Coriolis meter density measurement for inferred water cut. Alternately a Drexelbrook BS&W monitor can be added in the range or 0-5% and an alternate technology such as a Phase Dynamics Microwave analyzer can be added for a high water cut range or can be used over the entire 0 to 100% water cut range.

If you are above the low monitor switch point and below the high monitor switch point, the NOC (density inferred) will calculate the water cut. See summary table below as an example:

Low Range	**High Range**	**Cut Method**
0%	Low Monitor Switch Point (Typically 5%)	Drexelbrook
Low Monitor Switch Point	High Monitor Switch Point	Net Oil Calculation
High Monitor Switch Point	100%	Phase Dynamics

1.2 Software Interface

The software used for configuration of the FB107 is the Emerson ROCLINK 800 program. The instructions provided in this manual are directed specifically to the use of the ROCLINK 800 program. There is an additional utility program available for use with the FB107 ROCNOC user programs, the FB107 ROCNOCWIN software. The software allows the user to make most configuration changes to the user program as done with ROCLINK 800. The FB107 ROCNOCWIN does not provide access to additional configurations setting not specific to the FB107 ROCNOC user program however does offer

a few additional utilities. It is recommended to use the ROCLINK 800 for all set up and configuration then use the ROCNOCWIN program utilities to assist in diagnostics when required.

Emerson ROCLINK800 Configuration Interface software is used to download the user program into a FB107. Five download files are used with the overall system. Older versions of software used 6 user programs where the license program was installed in user program 6. The license is now located in user program 4.

The programs used are as follows:

User Program	**Description**
ROCNOC1.BIN	Net Oil Program
ROCNOC2.BIN	Modbus Program
ROCNOC3PRN.BIN	Turbine & Printer program
ROCNOC3NPR.BIN	Turbine & No Printer program
ROCNOC4.BIN	API2540 & License program
ROCNOC5.BIN	Display Program (Proface or LCD)

Notes:

Printer: If a printer is not being used then ROCNOC3.BIN should have a NPR descriptor in the program name (ROCNOC3NPR.BIN). This will free up the serial port expected for use in the second card slot of the FB107.

Display: Most installation use a Proface display. The other option is using the Emerson LCD display. Two versions of User Program 5 are available for appropriate display.

US Units: Only 300 series programs support US units.

Chapter 2: Installing the NOC Program

2.1 Installation Procedure

The following outlines the recommended steps to download the NOC software.

Step 1.	**Clear All Existing User Programs** This command erases all user programs in memory. Select **Utilities** from the main screen and choose **User Programs**. Select **Clear**. Click **Yes** to confirm.
Step 2.	**Clear Flash Memory** This command erases all of the user configured parameters from the battery backed Flash Memory. Select **ROC** from the Main screen and choose **Flags**. In the System Flags screen set Clear Under Flash Memory. Click **Yes** to confirm.
Step 3.	**Resetting the Database** This function reloads the factory default values into the FB107. Select **ROC** from the Main Screen and choose **Flags**. In the System Flags screen, select the options next to Cold Start. Click **Yes** to confirm.
Step 4.	**Turn Off PID** This function turns off PID's in the FB107. If PID's are to be loaded add them after program downloading is completed Select **ROC** from the Main Screen and choose Information. In the Information screen, select the Points tab and set active PID's to 0.
Step 5.	**Download the Program** This step loads the program into the FB107 Memory. Select **Utilities** from the Main Menu and browse to the location for user program 1. Choose the file you wish to download and press **Download & Start**. Repeat this process for all 5 user programs.

Chapter 3: NOC Configuration

3.1 Configuration Options

The Net Oil Calculations are performed using well specific constants for oil and water density and shrinkage factors. Modbus or Analog Inputs are used to transmit density and temperature, and Modbus or a pulse input is used to transmit the flow rate. Accumulation is performed over the duration of the test for oil, water, and a user specified AGA. A pressure input is optionally provided for pressure compensation of oil density. Water cut can be directly monitored, with up to two monitoring ranges defined: a low range equipped with either an S&W or % analog monitor, and a high range that can be supplied with a % analog input.

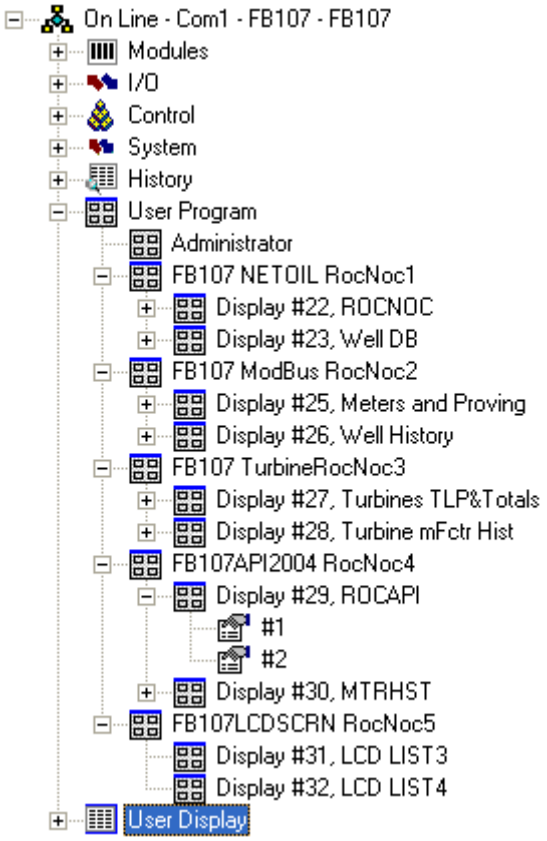
3.2 NOC Configuration Intro

The NOC program uses 8 user defined points: NOC Configuration, Well Configuration, Proving/Modbus Meters, Well History, Day Totals & Turbines, Turbine MF History, API Chapter 11, and Meter Factor History. The user defined points (or user data type) are accessed for configuring the display or the Modbus mapping. All confirmation parameters are available through the User Program sub menu.

The User Defined Points are summarized in the following table:

UDP Title	**# of points**	**UDP #**
NOC Configuration	49	22
Well Database Configuration	28	23
Mass Meter Drivers / Phase Dynamics	28	25
NOC Well History	16	26
Day Totals & Turbine Meter Variables	24	27
Turbine MF History	62	28
API Chapter 11 / License Variables	21	29
Micro Motion Meter Factor History	37	30
MVS/4088B Variables	54	40
Gas Meter Variables & Configuration Parameters	93	46

Configuration Menus –User Program & Sub Menus



3.3 FB107 ROCNOC Base Configuration

The following is the typical configuration settings for the FB107 when in use with the ROCNOC program. Note the settings may vary dependent on application.

Parameters	Description
Micro Motion Configuration	**Metric Units**: Volume = M3/min, Mass = Kg/min, Temperature = Deg C, Density = g/cc **Communications**: Address 1, 19.2K baud, 1SB, 8DB, No parity
Turbine Meter Configuration	FYI - The program expects **pulses / m3** (Metric)
I/O Setup (CPU card)	2 AI, 2 DO & 2PI / 250 OHM resistor-YES (on CPU card)
Advanced Settings (CPU card)	**Clock Speed**: 14.7456 MHz, I/O scan period 100ms
History Settings	Set History Points to 0 (unless required for AGA history)
Download User Programs Utilities / User Program Admin	Download user programs per Chapter 2 of this manual
Configuration Download File / Download	Download pre-configured file if available
Set Up User Program **Utilities / User Programs**	Refer to Chapter 3.1 of this manual Ensure all user programs are turned ON
Program setup for Micro Motion	Refer to Chapter 3.1 of this manual Set Modbus address = 1

	Enter Well database – As per site information provided Set Maximum wells - As Required by Site LACT Enable 0 = Well test, 1 = LACT **Note**: no updates will be displayed until a test is started
Program setup for Turbine	Refer to Chapter 3.2 of this manual Set Modbus address = 0 Enter Well database – As per site information provided **Note**: The oil & water density is required for the volume correction calculation for the turbine Map Turbine Input Configure Turbine Pulse input Set Maximum wells - As Required by Site LACT Enable 0 = Well test, 1 = LACT **Note**: no updates will be displayed until a test is started
I/O Configuration	Configure AI-RTD (A3), AI-BSW (A9), PI-Turbine Emulsion (A13), PI-Turbine Water (A14) if used
FB107 Units ROC / Device Information	Units – METRIC for Canada Contract Hour – Site Specific
FB107 AGA & PID ROC / Device Information	Set # of AGAs and PID to 0 if not being used
Display TLP Tools / Options	Display TLP – As Number. This setting is optional however many of the references used with the program refers to TPL as numbers.
Display Port	19,200, 1SB, No Parity, 8 DB Port Owner = ROC / Modbus Slave

Display Setup (Only when using Emerson LCD) ROC / Security	If editing is required on any of 4 user lists enable View & Edit. Preference is to use View Only when possible.
Configure / LCD User List / Standard (Only when using Emerson LCD)	Set up or use pre-configured user list 1-4. If using pre-configured list then download configuration is required
Modbus Access Configure / Modbus / Registers	Set up or use pre-configured Modbus map. If using pre-configured map then down load configuration is required. Indexing – typically set for PARAMETER Conversion – typically set for 69 but dependent on required byte order. Comm Port – Typically set for ALL COMM PORTS
Save Configuration ROC / Flags	Save the final configuration in Flags Tab Flash Memory SAVE CONFIGURATION

3.4 Standard User Program Configuration Screens (Micro Motion - Modbus)

Standard configuration of a ROCNOC is for use with a Micro Motion Coriolis meter using Modbus, RS485 communication to transmit process data. The following is a list of the basic configuration parameters when using a Micro Motion Coriolis meter with Modbus, RS485

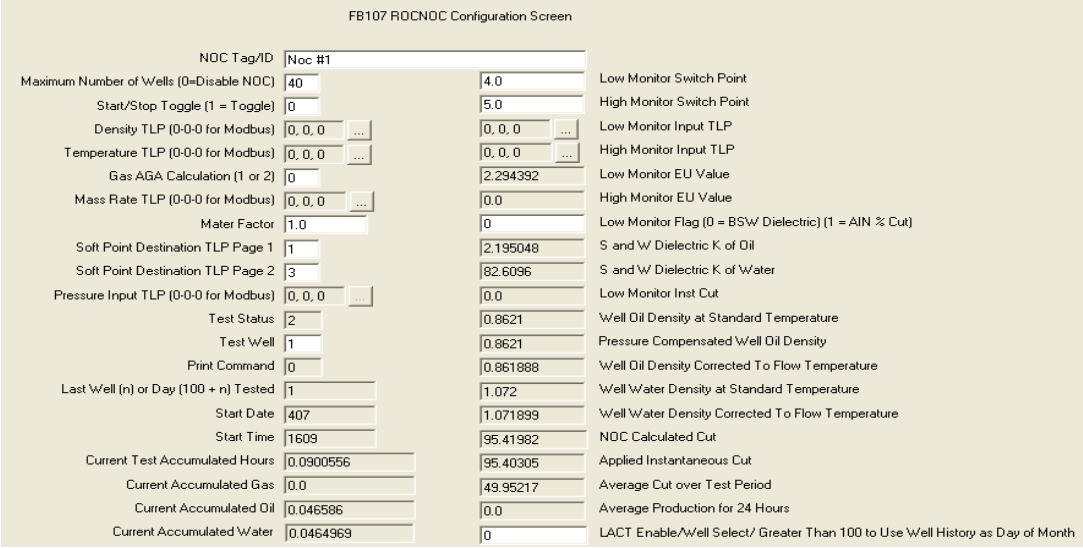
Micro Motion Transmitter Configuration:

Volume Units	m3 / min
Mass Units	kg / min
Density Units	g / cc
Temperature Units	Deg C
Modbus Address	1
Communications	19,200 Baud / 8 Data Bits / No Parity / 1 Stop Bit

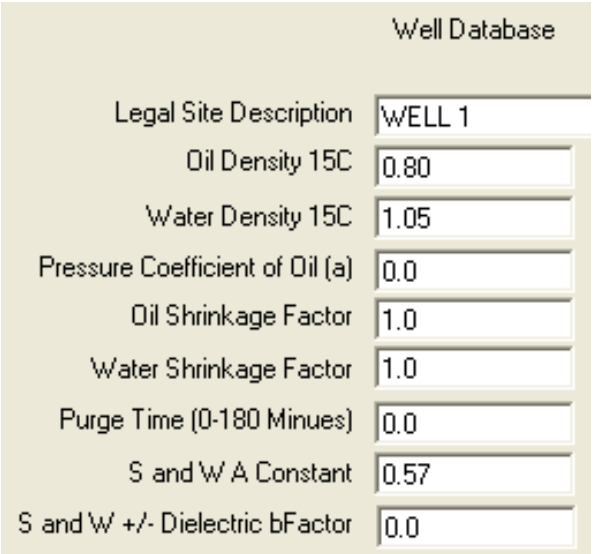
FB107: User Program Configuration Screens

User Program 1 > Display#22, ROCNOC

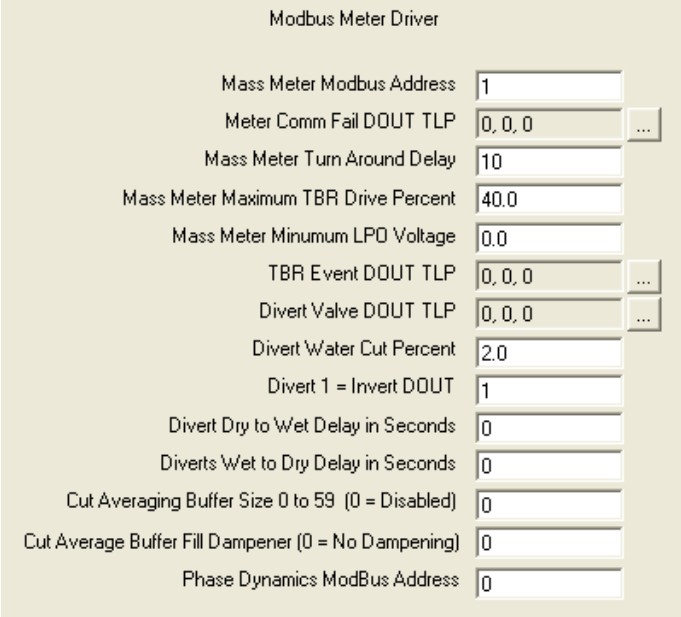
Note: Modbus communication is defined by setting Density, Mass frate, and Temperature TLPs to 0,0,0 as seen below



User Program 1 > Display#23 – Well DB



User Program 2 > Display#25 – Meters and Proving



3.5 User Program Configuration Screens (Analog)

If using analog and pulse inputs for flow, density, and temperature (such as with a Turbine flowmeter or Micro Motion with Analog/Pulse outputs), then refer to this section for basic configuration recommendations. The I/O used by the NOC system will vary depending on the options used in the program.

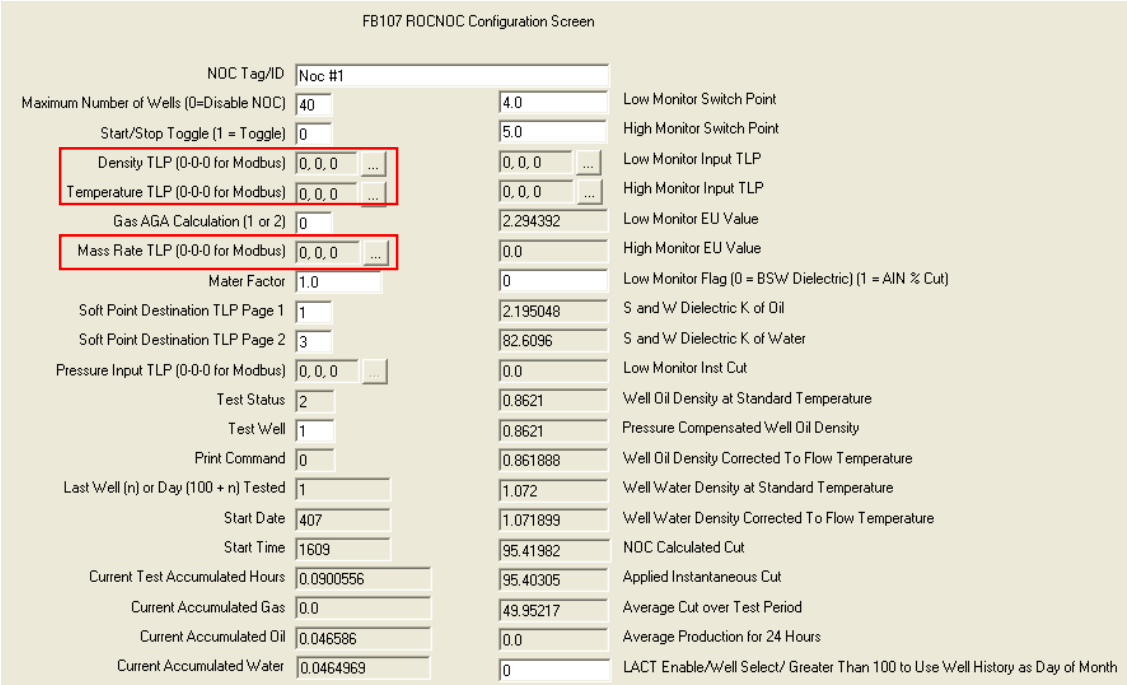
Using Micro Motion Transmitters

Micro Motion Transmitter Configuration:

Note: If using a pulse input for Coriolis meter the scaling has to be 60 pulses / kg

Volume Units	m3 / min
Mass Units	kg / min
Density Units	g / cc
Temperature Units	Deg C
Modbus Address	1
Communications	19,200 Baud / 8 Data Bits / No Parity / 1 Stop Bit

The mapping of most I/O points is done in the User Program. In User Programs select **FB107 NETOIL ROCNOC1** / **Display #22 ROCNOC / #1** menu. The NOC Configuration #1 & #2 allows configuration of each of the two NOCs. The inputs will be mapped in as a pulse for Mass flow and analogs for Density and Temperature if required, see highlighted area below



If using analog and pulse for the Density, Temperature and Mass rate inputs then scale the inputs to match the scaling from the Micro Motion transmitter and FB107. The TLP for the analog and pulse will have to be entered to match the input points.

Using Turbine Meters

The program is expecting scaling units to be in pulses/m3. Map the turbine per below in the NOC Configuration display.

Turbine:

Volume Units: Pulses/M3 (Metric)

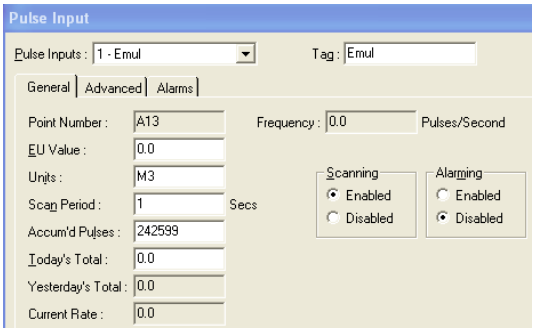
FB107 (with Turbine in use)

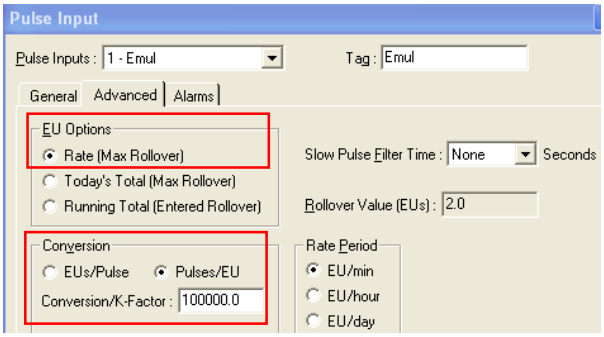
User Program 1 > Display#22, ROCNOC

FB107 ROCNOC Configuration Screen

NOC Tag/ID	Noc #1		
Maximum Number of Wells (0=Disable NOC)	40	4.0	Low Monitor Switch Point
Start/Stop Toggle (1 = Toggle)	0	5.0	High Monitor Switch Point
Density TLP (0-0-0 for Modbus)	0, 0, 0	0, 0, 0	Low Monitor Input TLP
Temperature TLP (0-0-0 for Modbus)	3, 2, 14	0, 0, 0	High Monitor Input TLP
Gas AGA Calculation (1 or 2)	0	2.294392	Low Monitor EU Value
Mass Rate TLP (0-0-0 for Modbus)	0, 0, 0	0.0	High Monitor EU Value
Mater Factor	1.0	0	Low Monitor Flag (0 = BSW Dielectric) (1 = AIN % Cut)
Soft Point Destination TLP Page 1	1	2.195048	S and W Dielectric K of Oil
Soft Point Destination TLP Page 2	3	82.6096	S and W Dielectric K of Water
Pressure Input TLP (0-0-0 for Modbus)	0, 0, 0	0.0	Low Monitor Inst Cut
Test Status	2	0.8621	Well Oil Density at Standard Temperature
Test Well	1	0.8621	Pressure Compensated Well Oil Density
Print Command	0	0.861888	Well Oil Density Corrected To Flow Temperature
Last Well (n) or Day (100 + n) Tested	1	1.072	Well Water Density at Standard Temperature
Start Date	407	1.071899	Well Water Density Corrected To Flow Temperature
Start Time	1609	95.41982	NOC Calculated Cut
Current Test Accumulated Hours	0.0900556	95.40305	Applied Instantaneous Cut
Current Accumulated Gas	0.0	49.95217	Average Cut over Test Period
Current Accumulated Oil	0.046586	0.0	Average Production for 24 Hours
Current Accumulated Water	0.0464969	0	LACT Enable/Well Select/ Greater Than 100 to Use Well History as Day of Month

Enter the turbine k-factor in the Conversion Factor field, illustrated as follows





3.6 Associated Hardware Configuration

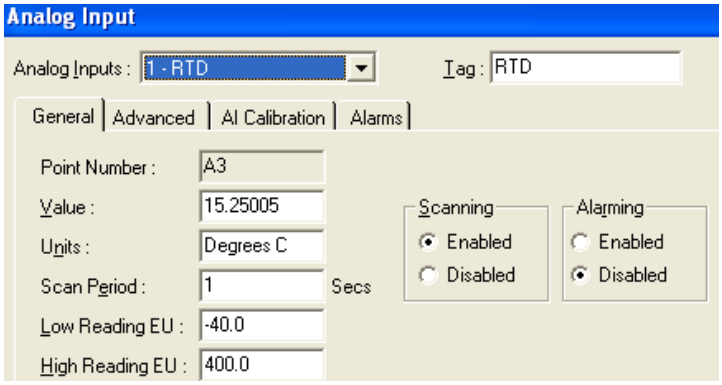
Drexelbrook

If a Drexelbrook BS&W monitor is used with the systems it should be configured to account for density changes due to temperature when used with a turbine meter. If used with a Micro Motion meter the system can correct to temperature and composition density changes. The Drexelbrook should be configured with a 5 second dampening time. Consult Spartan Controls for calibration information regarding the water cut monitor.

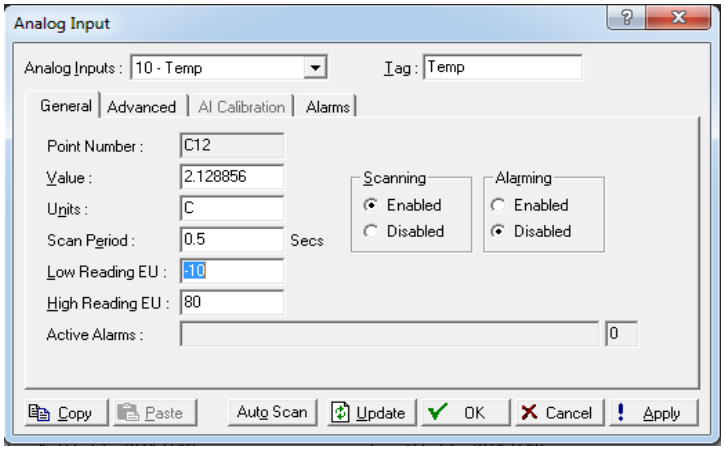
Temperature:

If using an external temperature measurement, either an RTD input or Analog Input must be configured, screens are illustrated below:

RTD Input

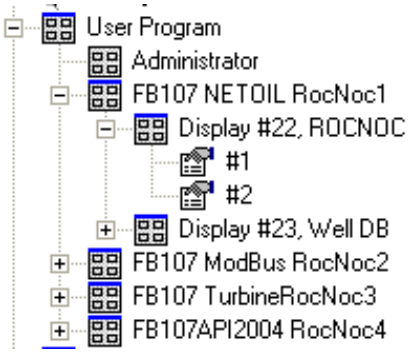


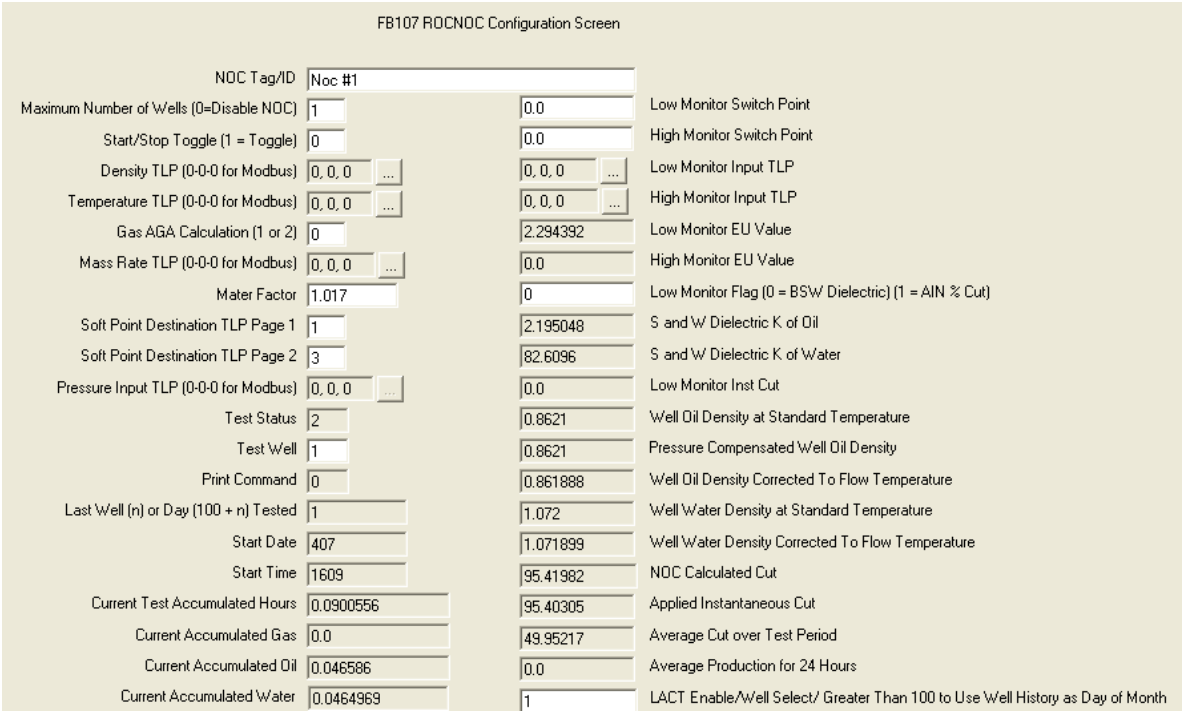
Analog Input



3.7 NOC Configuration Screen

In User Programs select **FB107 NETOIL ROCNOC1** / **Display #22 ROCNOC / #1** menu. The NOC Configuration #1 & #2 allows configuration of each of the two NOCs. This configuration must be complete for the well testing to function properly.





The parameters of this screen are described in the following table.

Parameters	Description
NOC Name	A 20 character identifier for the NOC.
Maximum # of Wells	The number of wells, 1 to 15, the NOC will be working with. It is used to reduce the number of wells a user scrolls through on the display. A value of 0 disables the NOC.
Start / Stop Toggle (1 = Toggle)	To start or stop a test enter a value of 1 into this location. While in test Start Toggle = 1 Then Logger Enabled = 0 (DEFAULT) Logger is NOT Enabled. **Other Functionality** Start Toggle > 1 BUT < 100 Then Logger Enabled Start Toggle = 100 does nothing Start Toggle = 101 Zero Net Oil Meter Totalizer Start Toggle = 102 Zero Net Water Meter Totalizer Start Toggle = 103 Zero Net Total Totalizer Start Toggle = 104 Zero Net Gas Meter Totalizer Start Toggle > 104 does nothing
Density TPL (0,0,0) for Modbus	This input is used for defining the Micro Motion density input for liquid measurement applications. The input can be mapped to an AI or by Modbus using TLP 0,0,0.
Temp TPL (0,0,0) for Modbus	This input is used for defining the temperature input for liquid measurement applications. The input can be mapped to an RTD, AI or by Modbus using TLP 0,0,0. When using a Modbus input the measurement will be supplied by the Micro Motion meter and will only have a temperature accuracy of +/-1C.

Gas AGA Calculation	This entry defines the number of AGA gas calculation required by the system. = 1 gas flow using well database = 2 gas flows using well database = 11 gas flow using AGA only = 12 gas flows using AGA only
Mass Rate TPL (0,0,0) for Modbus	This input is used for defining the Micro Motion mass flow input for liquid measurement applications. The input can be mapped to a PI or by Modbus using TLP 0,0,0. The system accepts the input by mass to allow for enhanced gas handling features.
Meter Factor	The Micromotion Mass Flow Transmitter produces a mass rate and density to the FB107 flow computer. A proving screen can be set up on the user defined display to allow either mass or volume meter proving to be accomplished.
Soft Point Destination TLP Page 1	Default = 1. This should not be changed. The index of a softpoint, 1 to 32, to which the NOC configuration values are written, or from which a test can be configured, started, or stopped.
Soft Point Destination TLP Page 2	Default = 3. This should not be changed. The index of a softpoint, 1 to 32, to which the NOC configuration values are written, or from which a test can be configured, started, or stopped.
Pressure Input TLP (0,0,0) for Modbus	This input is used for defining the pressure input for liquid measurement applications. The input can be mapped to an AI or by Modbus using TLP 0,0,0 if a pressure transmitter is wired into the Micro Motion transmitter. The pressure input is used to account for pressure effects on the liquid density when performing water cut calculations using the inferred density method.

Test Status	The status of the current well test. A value of 0 means the NOC is stopped or not testing a well, a value of 1 means the NOC is purging, and a value of 2 means the NOC is testing a well.
Test Well	The number of the well currently being tested or of the well last tested. The number of the well to test can be selected using the host software, user display or by soft point entry and is displayed here when the test is started. This entry is only used for Well Test mode not LACT mode. Changing a well number in LACT mode is made at the LACT Enable entry.
Print Command	A value used as a printer trigger. This trigger is set to 1 when a well test is stopped, automatically or by the user, and between 1 and 3 when the operator uses the LCD to print well test history. This trigger is set to 1 when a well test is stopped, automatically or by the user, and between 1 and 3 when the operator uses the LCD to print well test history. The values 1 to 3 correspond to the history of the last three well tests, 1 being the most recent.

Last Well	The number of the last well tested.
Start Date	The date of the start of the current or last well test. The values are in the format mmdd. For example, if the test started on March 31, 2010 at the date values would be 331.
Start Time	The time of the start of the current or last well test. The values are in the format hhmm. For example, if the test started at 11:43am, the time values would be 1143.

Current Test Accumulated Hours	The duration, in hours, of the current or last well tested. If a well is to be purged before being tested, the purge time left, in hours, is displayed.
Current Accumulated Gas	Accumulated gas for the current or last well test when Gas Accum AGA is non-zero. E3M3 (MSCF)
Current Accumulated Oil	Accumulated oil for the current or last well test in M3.
Current Accumulated Water	Accumulated water for the current or last well test in M3.
Low Monitor Switch Point	The range point of the low range water cut monitor. When a Drexelbrook is NOT installed this should be set for an entry of 0. With a Drexelbrook installed the point is typically 4.5%. The maximum low range monitor setting is 9.5%
High Monitor Switch Point	The point where the high range monitor takes over operation. There should be a 0.5% offset between the low and high switch point. This value is typically set for 5%.
Low Monitor Input TLP	The mapping point to the low monitor input. Typically 3,8,14 or AI (A9). If not configured, or not valid, enter 0.0
High Monitor Input TLP	The mapping point to the low monitor input. If an external high range water cut monitor is not being used enter 0,0,0 to disable the input. Entering a 0,0,0 will not affect the water cut operation of the Micro Motion density inferred water cut calculation. This entry is only used for additional water cut devices
Low Monitor EU Value	Engineering Unit (EU) value of water cut monitor input.
High Monitor EU Value	Engineering Unit (EU) value of water cut monitor input.

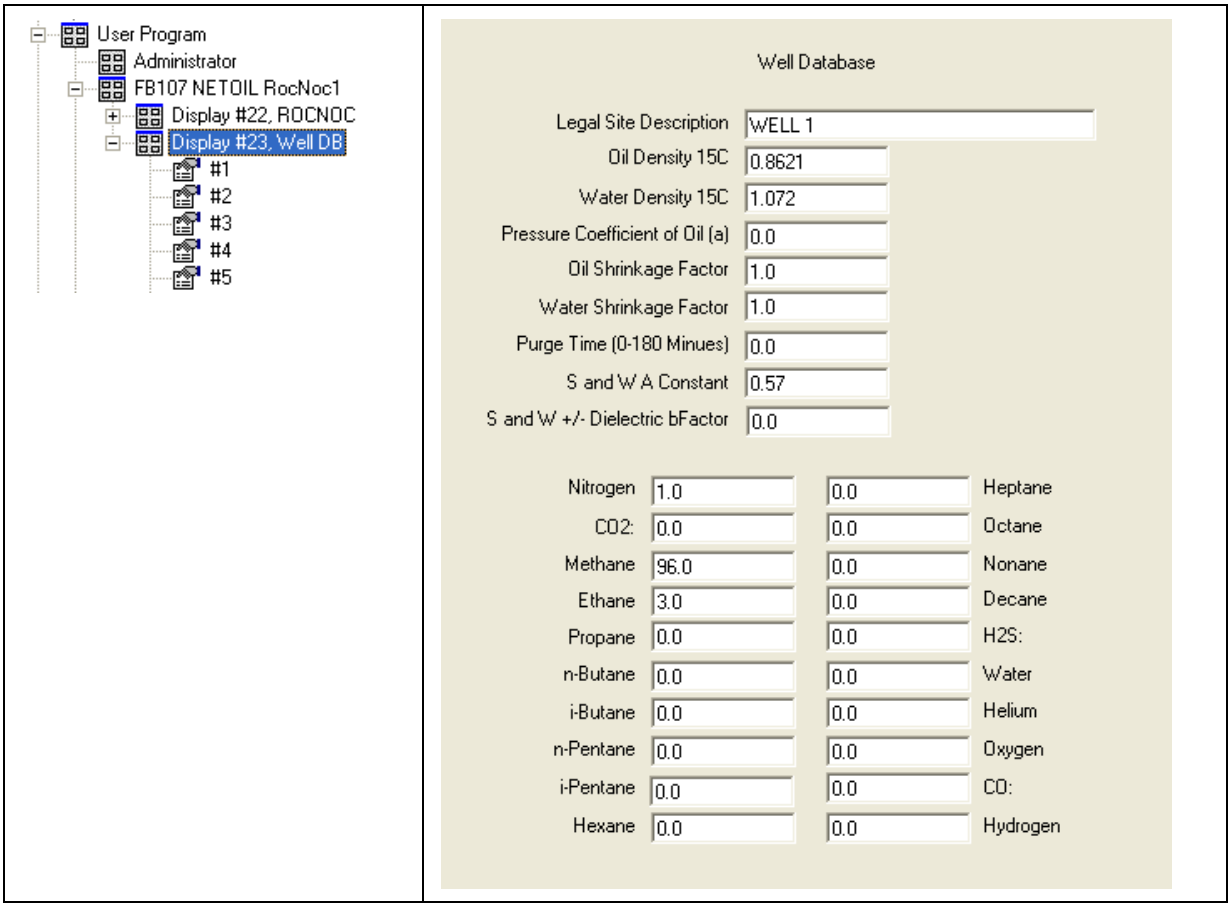
Low Monitor Flag (0 = BSW Dielectric) (1 = AIN % CUT)	Defines the low range monitor type. If set to 0, the program will assume an S&W device. (ie. Drexelbrook) If set to 1, the program will assume an analog device, with %water output.
S & W Dielectric K of Oil	The dielectric of oil at operating temperature. This is only used when the Low Monitor Input is enabled.
S & W Dielectric K of Water	The dielectric of water at operating temperature. This is only used when the Low Monitor Input is enabled.
Low Monitor Inst Cut	The instantaneous cut or percentage of water in mixture at operating temperature, expressed as a percentage, when the Low Monitor Input is enabled.
Well Oil Density at Standard Temperature	The oil density at 15C of the current well selected. This value is from the well database entry.
Pressure Compensated Well Oil Density	If a pressure transmitter is used this value will represent the oil density with pressure effect.
Well Oil Density Corrected to Flow Temperature	The oil density of the current well selected at flowing temperature. This value is from the well database entry at 15C then corrected to the current flowing temperature.
Well water Density at Standard Temperature	The water density at 15C of the current well selected. This value is from the well database entry.
Well Water Density Corrected to Flow Temperature	The water density of the current well selected at flowing temperature. This value is from the well database entry at 15C then corrected to the current flowing temperature.
NOC Calculated Cut	The instantaneous water cut using the density inferred water cut calculation.
Applied Instantaneous Cut	The instantaneous water cut used by the system. In most applications this will be either the Micro Motion or Drexelbrook water cut reading.
Average Cut Over Test Period	Average water cut of all water cut devices used in the water cut calculations.

Average Production For 24 Hours	Average production in M3 based on a 24 hour test. TLP 22,0,39 is the result of instantaneous FLOW RATE PER MINUTE CORRECTED TO 15C x METER FACTOR and PRORATING IT TO THE INSTANTANEOUS CORRECTED FLOW RATE PER DAY
LACT Enable/Well Select	There are 2 operating modes for the system “WELL TEST“ and “LACT”. A value of “0” for WELL TEST In this mode the test will prorate the test data based on a 24 hours period. This mode is intended for multiple well tests. The systems will save the last 3 tests from each well. A value of “1 to 40” for LACT The value > 1 represents the desired well # for the LACT test. In this mode the test will run for 24 hours and will store all the production numbers for that day. The day is based on the Contract Hour located in ROC see DEVICE INFORMATION. The test is intended for a single well and will run for an indefinite period. The last 3 days of test history is maintained. A value of 100 + well # for LACT (example well #1 = 101) Same operation as standard LACT except this option will maintain 3 months of test history. The history is saved in wells 1 to 31. The well # corresponds to the day of the month.

3.8 Well Configuration Screen

Select **FB107 NETOIL ROCNOC1** / **Display #23 WellDB #1**. The Well Configuration has 40 wells in version 1.XX software and 15 wells in version 2.XX & 4.XX software. This configuration must be complete for the well testing to function properly. The below illustrates version 2.XX software that contains both liquid and gas database for each well location. Version 1.XX software only contains a liquid database for the individual well locations. There is a single gas composition used for all wells in version 1.XX software.

Well Configuration Screen



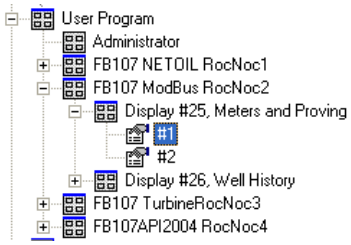
The parameters of this screen are described in the following table.

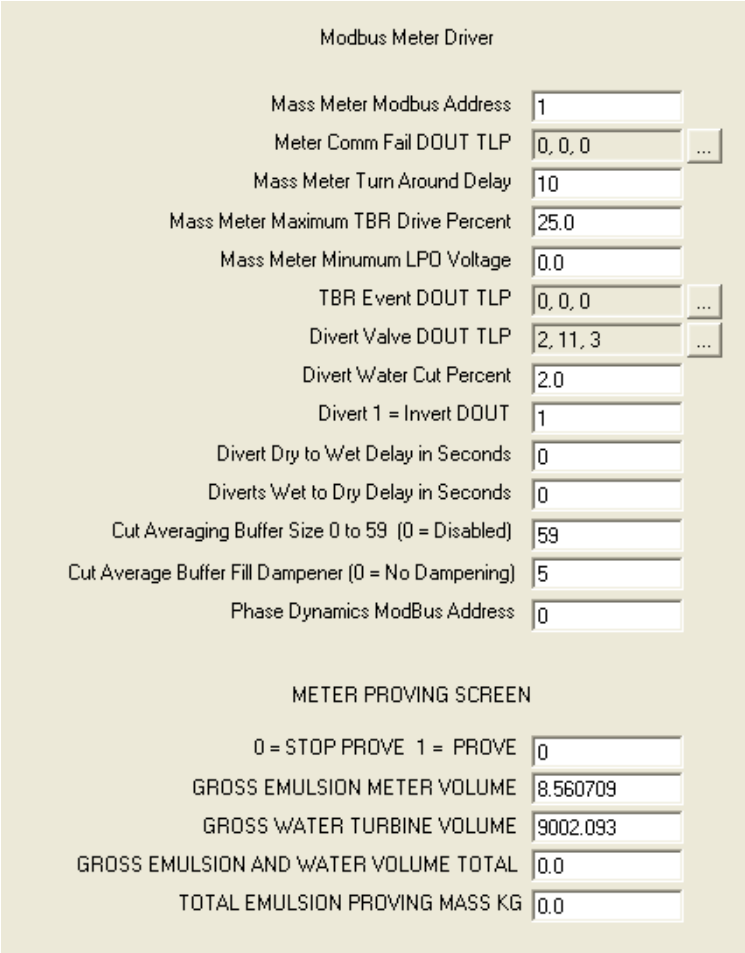
Parameters	Description
Legal Site Description	A 20 character identifier which can be used as an LSD or another description of the well. This identifier is displayed on the LCD when selecting a well to test.
Oil Density 15C	The measured oil density. Units: g/cc
Water Density 15C	The measured water density. Units: g/cc
Pressure Coefficient of Oil	The pressure coefficient of oil used in the pressure compensation of the oil density. Units: E_{-7} g/cc/kPA. Pressure Coeff of oil = $\frac{\text{standard density} - \text{operating density}}{\text{standard pressure} - \text{operating pressure}}$ Note: Typically, in test separator applications, the pressure coefficient is set to 0 because the difference in standard density and operating density is minimal and pressure compensation on density does not have to be performed.
Oil Shrinkage factor	The shrinkage factor of oil.
Water Shrinkage Factor	The shrinkage factor of water.
Purge Time (0-180 minutes)	The purge time before the well test is started. During this time the gas, oil and water measurement are not performed. The start date and time will be taken after the purge is complete. Once the purge is complete the testing will commence.
S&W A Constant	The S&W A constant. This value should not ever be changed unless advised by Spartan Controls. A change will impact the accuracy of the BS&W monitor if in use.
S&W +/- Dielectric Factor	The S&W B constant which is the change in % water per unit change in dielectric of the mixture. This entry is essentially an offset for the BS&W monitor.

3.9 Meters & Proving Configuration

Select **#1** from the **FB107 ModBus ROCNOC2** / **Display #25 Meters and Proving** menu in the User Program Directory. The NOC Configuration #1 & #2 allows configuration of each of the two NOCs. This configuration must be complete for the well testing to function properly.

Meters & Proving Configuration Screen





The parameters of this screen are described in the following table.

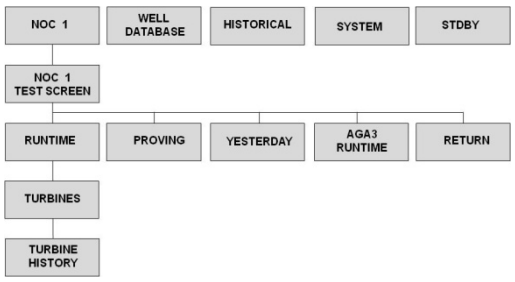
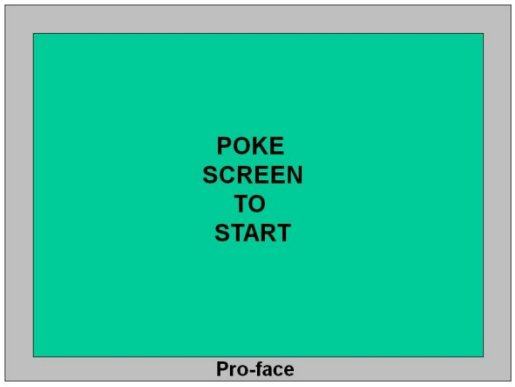
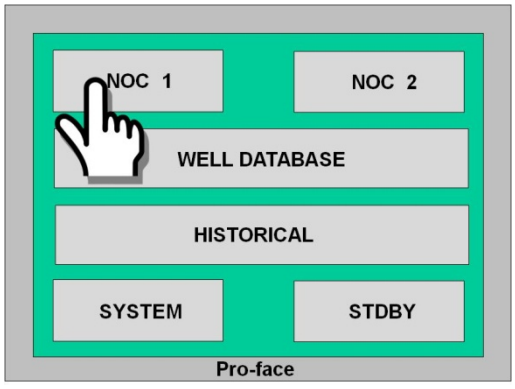
Parameters	Description
Mass Meter Modbus Address	Address of Micro Motion meter for Modbus communication. Use address 1 for meter 1 and address 2 if there is a second meter in use.
Meter Comm Fail DOUT TLP	Used to assign a discrete out based on a communications failure for diagnostic or alarm detection
Mass Meter Turn Around Delay	Communications delay for Micro Motion meter. Common and default setting is 10.
Mass Meter Maximum TBR Drive Percent	Setting used to prevent false volume calculations if entrained gas is carried though meter. If the drive gain is exceeded the volume calculation will be performed using the Micro Motion mass divided by the last good density before the drive gain event. It is recommended to get some run time in the meter to determine an optimum setting. Start at 50% then lower to a value approximately 10% over the stable operating drive gain for the installation.
Mass Meter Minimum LPO Voltage	Used in conjunction with TBR as an added option entry to detect the presence of entrained gas. This entry should not be required in most applications. The default entry is 0.
TBR Event DOUT TLP	Used to assign a discrete out based on a TBR event for diagnostic or alarm detection

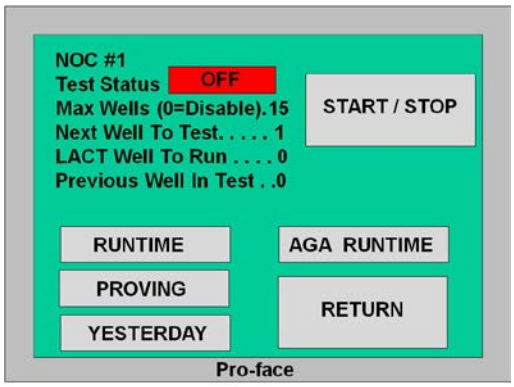
Divert Valve DOUT TLP	Discrete output mapping for divert valve based on high water cut
Divert Water Cut Percent	Water Cut Alarm Point for divert
Divert 1 = Invert DOUT	Setting to invert discrete output
Divert Dry to Wet Delay in Seconds	Delay time setting in seconds when wet product is present before discrete will activate
Divert Wet to Dry Delay in Seconds	Delay time setting in seconds when dry product is present before discrete will deactivate
Cut Average Buffer Size 0 to 59 (0 = Disable)	The Cut average option is used to control the discrete output for divert or shut down logic based on high water cut. Cut Monitor Averaging which is handled with a 60 value buffer that captures the last 60 instantaneous cuts when the flow rate exceeds 0.002 M3/Minute. The amount of averaging is tunable with configurable values of 0 to 59 AND a multiplier. The multiplier determines the update time of the buffer, 0 is fastest at filling buffer, and the higher the multiplier the slower the buffer is filled. A buffer size of 0 disables the cut averaging ALL TIMES FOR ONE NOC RUNNING ONLY! Cut Averaging configured as 29 AND a multiplier of 0 gives a 30 value average in 70 seconds Cut Averaging configured as 59 AND a multiplier of 0 gives a 60 value average in 140 seconds

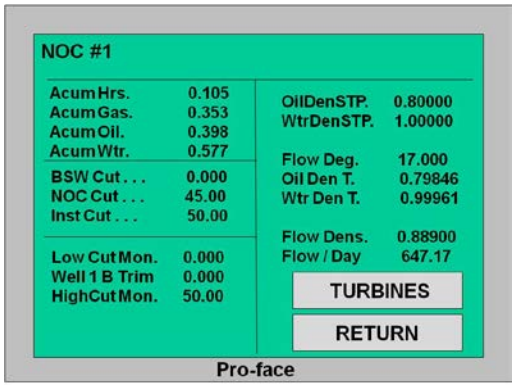
	Cut Averaging configured as 59 AND a multiplier of 1 gives a 60 value average in 264 seconds Cut Averaging configured as 59 AND a multiplier of 2 gives a 60 value average in 405 seconds
Cut Average Buffer Fill Dampener (0 = No Dampening)	Multiplier for Cut Average Buffer
Phase Dynamics Modbus Address	Modbus address for Phase Dynamics if in use. Desired address is 11
0 = Stop Prove 1 = Prove	Start / Stop control
Gross Emulsion Meter Volume	Emulsion Volume display
Gross water Turbine Volume	Water Turbine volume
Gross Emulsion and Water Volume Total	Total liquid volume from separator
Total Emulsion Proving Mass Kg	Mass reading from Micro Motion meter

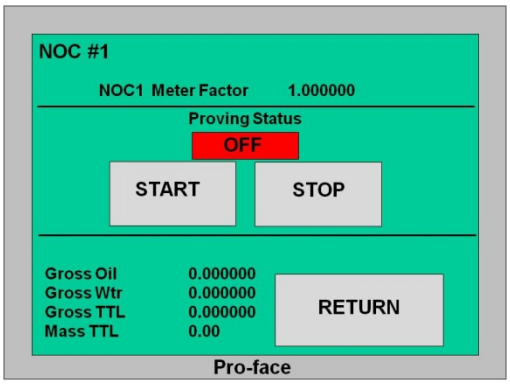
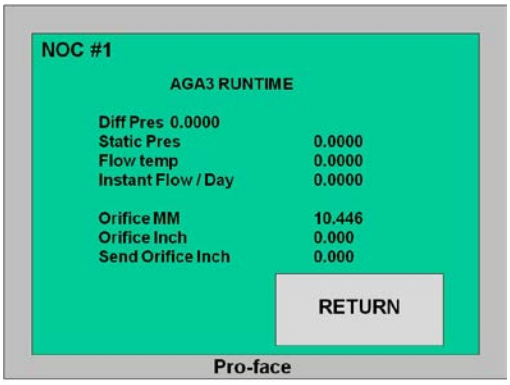
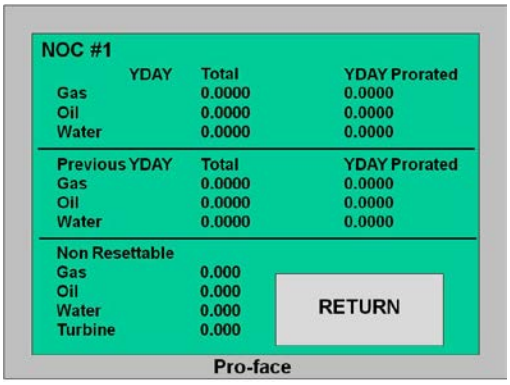
Chapter 4: Operation of ROCNOC

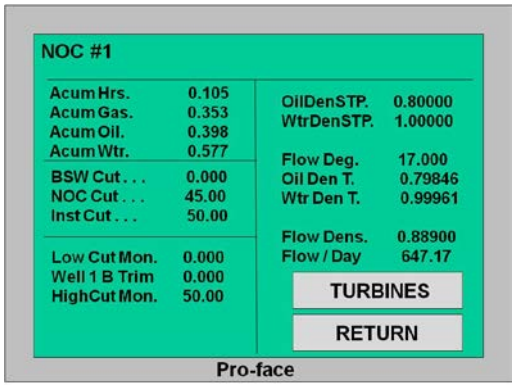
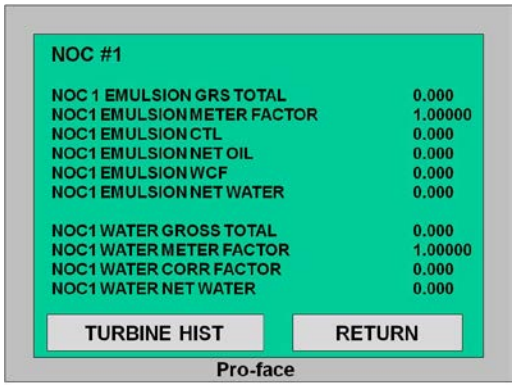
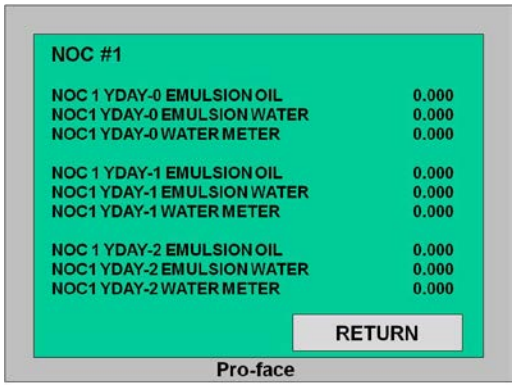
4.11 Accessing the Operation Screens

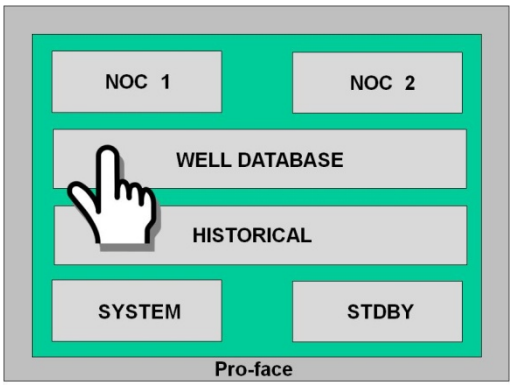
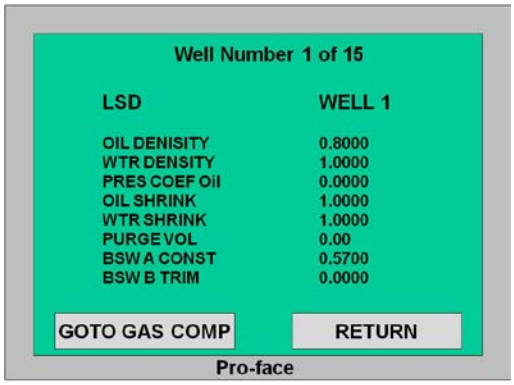
Menu Overview: The system has a variety of menus as shown in the illustration to the right. The screens are linked as illustrated.	
Standby: The standby screen is illustrated on the right. Touch the screen any location to proceed.	
Main Menu: From the main menu the user can navigate to any location in the program. The system can perform 2 liquid and 2 gas calculations through the **NOC 1** and **NOC 2** screens. We will start with the **NOC 1** Menu.	

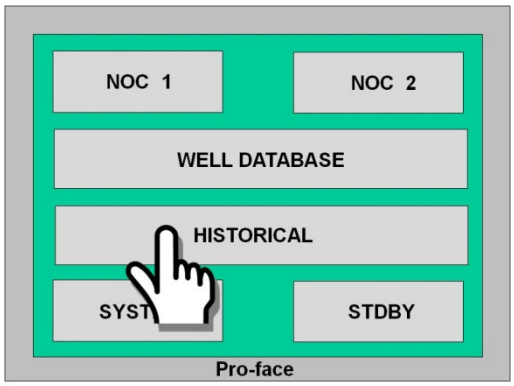
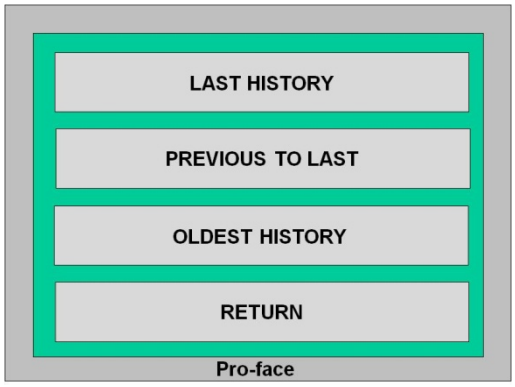
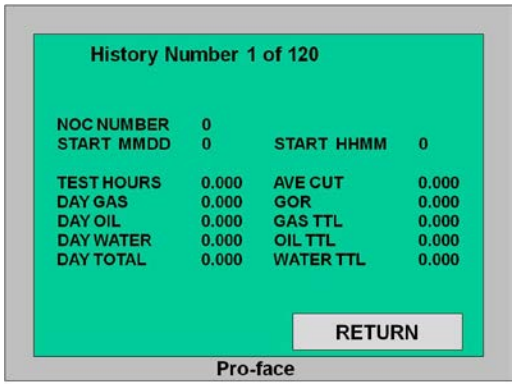
NOC 1: This screen allows the user to select or change the well to test and start/stop the test. It also provides access to additional screens. Next we will look at the **Runtime Screen**.	

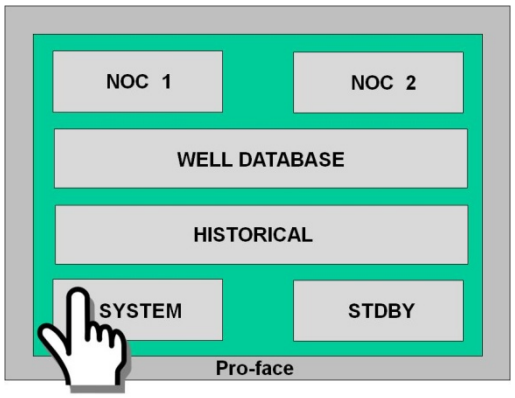
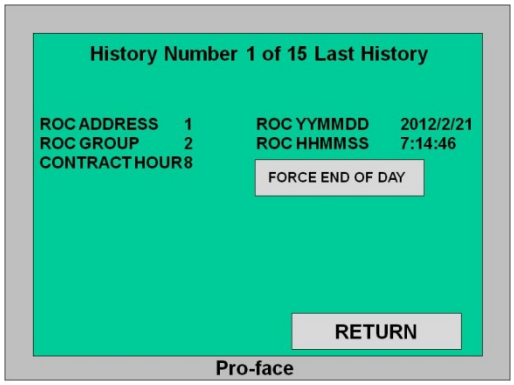
Runtime: The **Runtime** screen allows the user to see all the process variables while a well is in test. Touch the **Return** button to go back a screen then touch the **Proving Screen** button.	

Proving: The **Proving** Screen allows the meter prover to start and stop the totalizer during a meter prove. Touch **Return** to go back a screen then touch the **AGA Runtime** button.	
AGA Runtime: The **AGA Runtime** allows the user to look at gas calculation variables and the running gas volume flow rate. Touch **Return** to go back a screen then touch the **Yesterday** button.	
Yesterday: This screen allows the user to see the last 2 tests that were completed. Touch **Return** to go back a screen then touch the **Runtime** button.	

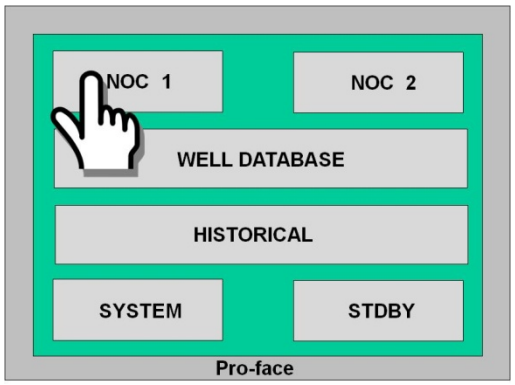
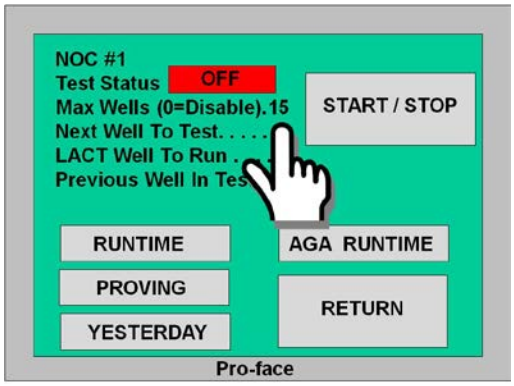
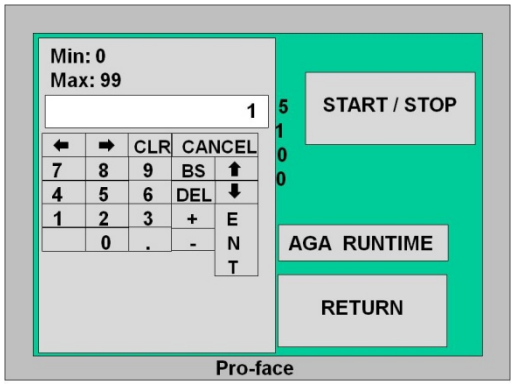
Runtime Screen: From the **Runtime** screen go to the **Turbines** screen.	
Turbines: The **Turbines** screen allows viewing of the emulsion and water turbine meter variables if a turbine meter is being used. Touch the **Turbine Hist** screen.	
Turbine History: The **Turbine Hist** screen allows the user to view recent completed tests from the turbines if being used. Touch the **Return** button in the next 4 screens to go back to the **Main Menu**.	

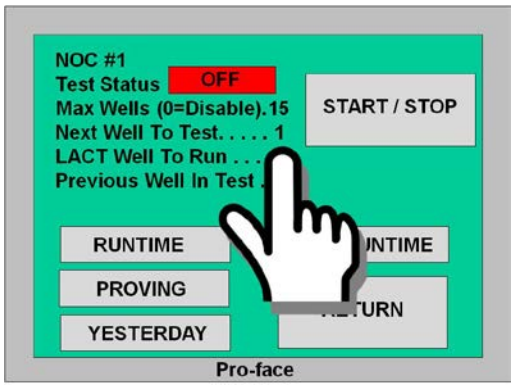
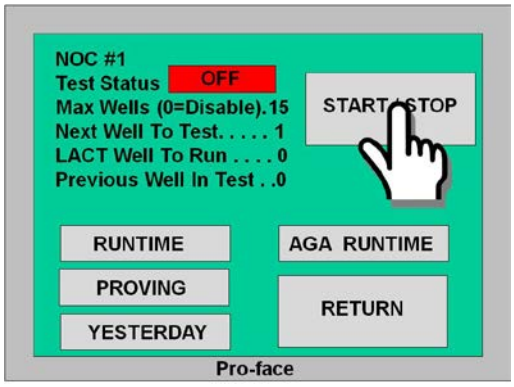
Well Database: The **Well Database** is where the process variables for oil, water and gas are stored for every well.	
Well Database: The oil & water **Well Database** can be viewed or changed from this screen. The well selection is made by touching the **"1"** in 1 of 15 displayed. If the system has a 40 well database the indication will be 1 of 40. Note: The 40 well database does not have individual gas compositions for every well.	
Well Database: The gas **Well Database** can be viewed or changed from this screen. The well selection is made by touching the **"1"** in 1 of 15 displayed. If the system has a 40 well database this screen will not be available.	

Historical: The Historical screen allows the user to view previous tests.	
Historical: For systems with test records of 3 test histories per will the following screen will be used. The user can view the last 3 tests for any of the wells in the database.	
Historical: The following test data is available for every well. The history selection is made by touching the **"1"** in 1 of 120 displayed. If the system has a 3 test per well database this screen allows the user to pick the well # to view instead of test to view.	

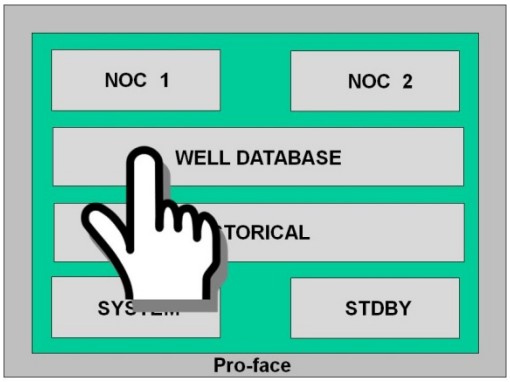
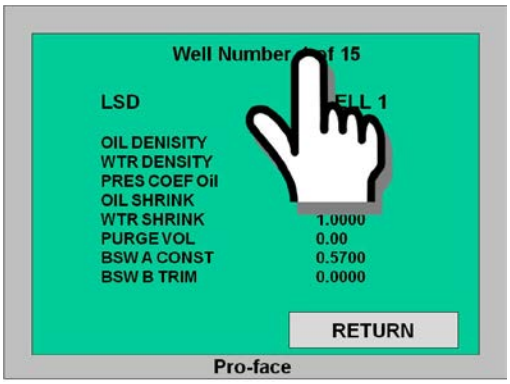
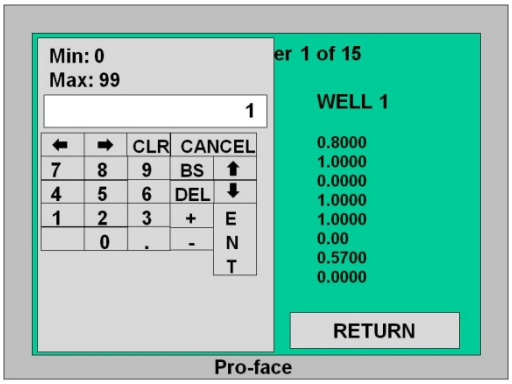
System: The system selection allows the user to see some basic information about the FB107 and contract hour.	
System: The following information is displayed in the system screen. These setting are typically just for information. The contract hour is to 24 hour test time to terminate. The test can be forced to end of day with the **Force End Of Day** button.	

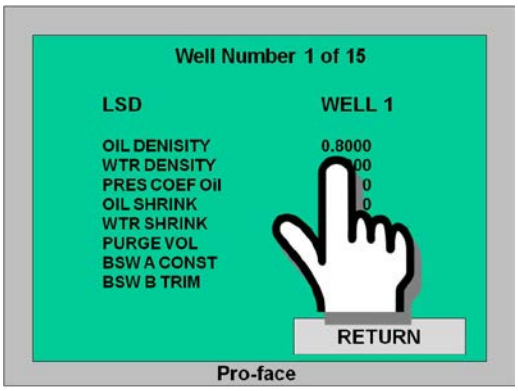
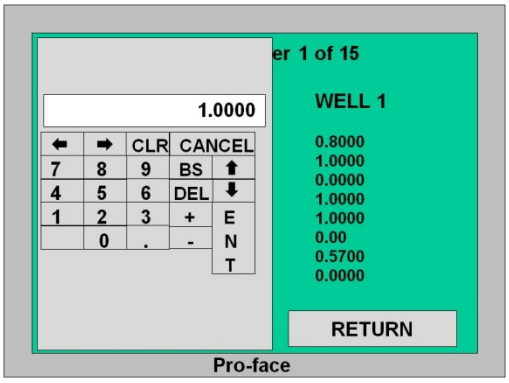
4.12 Starting a Test

Touch the **NOC 1** to initiate the test screen. If there are 2 separators being used the user will have to select NOC 1 or 2 depending on separator being used.	
The **Test Status** will show if the test is **Stopped** or is **Running**. The **Next Well To Test** displays the well # to be tested. The **Next Well To Test** can be changed by touching the number of the well as illustrated.	
When changing the well number the following screen will allow the user to change the well number. Enter the desired well number and the ENT button.	

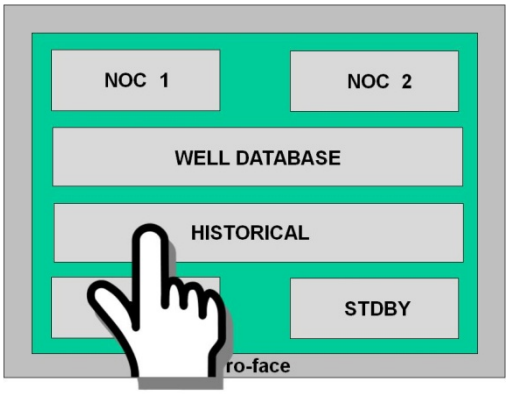
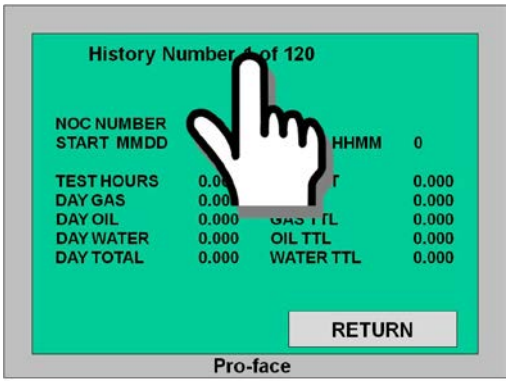
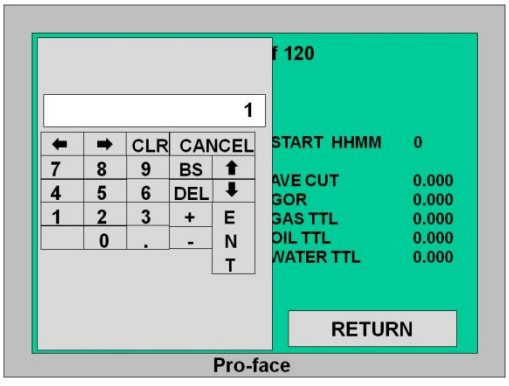
Do not change the **LACT Well To Run** unless the operation of the system is being changed. LACT mode is intended for continuous testing of only 1 well. For multiple wells being tested over a 24 hour test the **LACT Well To Run** should be set to 0. LACT MODE = 1 WELL TEST MODE = 0	
Start or Stop the well test by touching the **Start / Stop** button.	

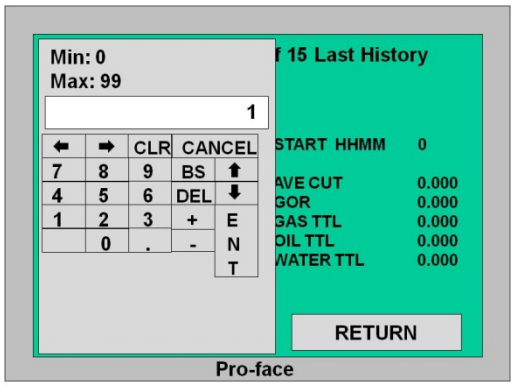
4.13 Adding a New Well to the Database

The **Well Database** is where the process variables for oil, water and gas are stored for every well.	
The oil & water **Well Database** can be viewed or changed from this screen. The well selection is made by touching the **"1"** in 1 of 15 displayed. If the system has a 40 well database the indication will be 1 of 40. Note: The 40 well database does not have individual gas compositions for every well.	
Select the desired well to edit then touch ENT button.	

Any variable in the database of the well can be edited by touching the variable entry. An edit screen will appear.	
Make the change required to we the oil, water or gas variable then touch ENT to accept the change.	

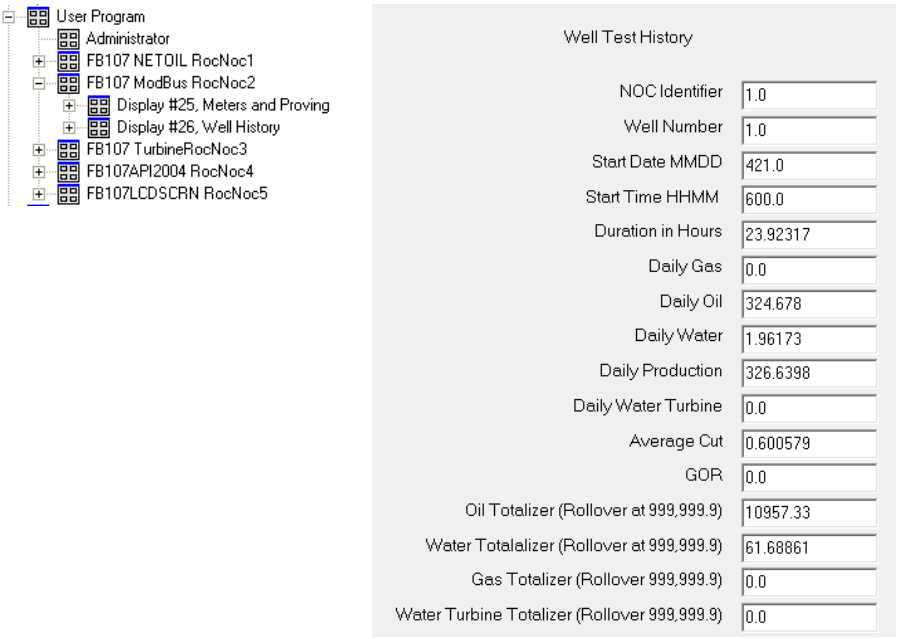
4.14 Viewing a Previous test

Enter the Historical data by touching the **Historical** button. There are 2 versions of software related to the history. The most common version saves 120 history record based on the test date. The other version saves 3 tests per well. If you have 5 wells being tested this means you will maintain 3 x 5 records or 15 historical records.	
The oil, water and gas test data is available for 120 previous tests (software version dependant). The history selection is made by touching the **"1"** in 1 of 120 displayed. If the system has a 3 test per well database this screen allows the user to pick the well # to view instead of test to view.	
Enter the desired test number to view then touch ENT button.	

Enter in the well number for viewing the test.	

4.2 Micro Motion Well History

The well history will maintain 120 production test histories. The history is saved as first in last out. To access select **FB107 NETOIL ROCNOC2** / **Display #26 Well History**. If running a single well in LACT mode a total of 31 days of historical well data can be saved. In order to save 31 days of data in LACT mode the LACT mode enable entry must be >100 instead of the standard entry of 1.



The parameters of this screen are described in the following table.

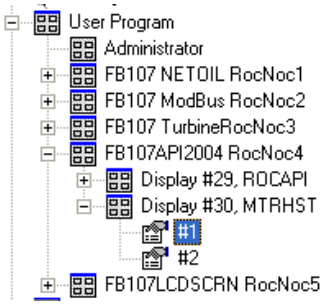
Parameters	Description
NOC Identifier	A number between 0 and 3 corresponding to the NOC which performed the well test.

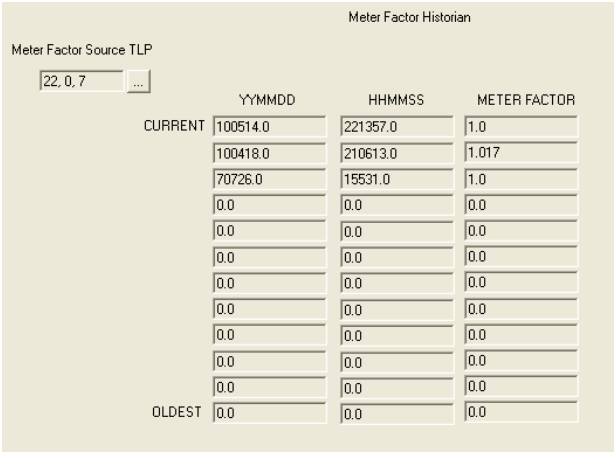
Start Date/Time	The date and time of the start of the well test. The values are in the format mmdd and hhmm. For example, if the test started on March 31, 2010 at 11:43am, the date and time values would be 331 and 1143.
Duration HR	The duration in hours of the well test.
Daily Gas	Daily accumulation of gas for the well test. The value has been extrapolated from the accumulated gas by multiplying by 24 / duration of well test. In LACT mode the actual volumes are displayed with no proration applied. E_3M_3
Daily Oil	Daily accumulation of oil for the well test. The value has been extrapolated from the accumulated oil by multiplying by 24 / duration of well test. In LACT mode the actual volumes are displayed with no proration applied. M_3
Daily Wtr	Daily accumulation of water for the well test. The value has been extrapolated from the accumulated water by multiplying by 24 / duration of well test. In LACT mode the actual volumes are displayed with no proration applied. M_3
Daily Turbine Wtr	Daily accumulation of oil and water for the well test. The value has been extrapolated from the accumulated oil and water by multiplying by 24 / duration of well test. In LACT mode the actual volumes are displayed with no proration applied. M_3
Avg Cut	The average cut of the well test expressed as a percentage.

Gas Oil Ratio	Average gas oil ratio expressed as a percentage.
Oil Total	Running totalizer of accumulated oil which rolls over at 1,000,000 M3. Only used when LACT functionality is enabled.
Water Total	Running totalizer of accumulated water which rolls over at 1,000,000 M3. Only used when LACT functionality is enabled.
Gas Total	Running totalizer of accumulated gas which rolls over at 1,000,000 M3. Only used when LACT functionality is enabled.

4.3 Micro Motion Meter Factor History

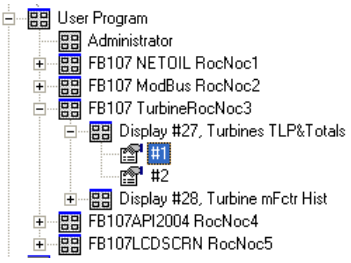
The system will maintain the last 12 meter factors for historical reference. The meter factor is entered in the NOC configuration screen and will maintain each entry with a time and date stamp.

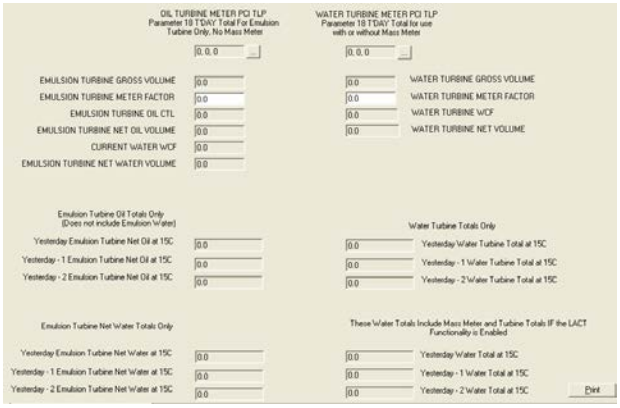




4.4 Turbine Well History

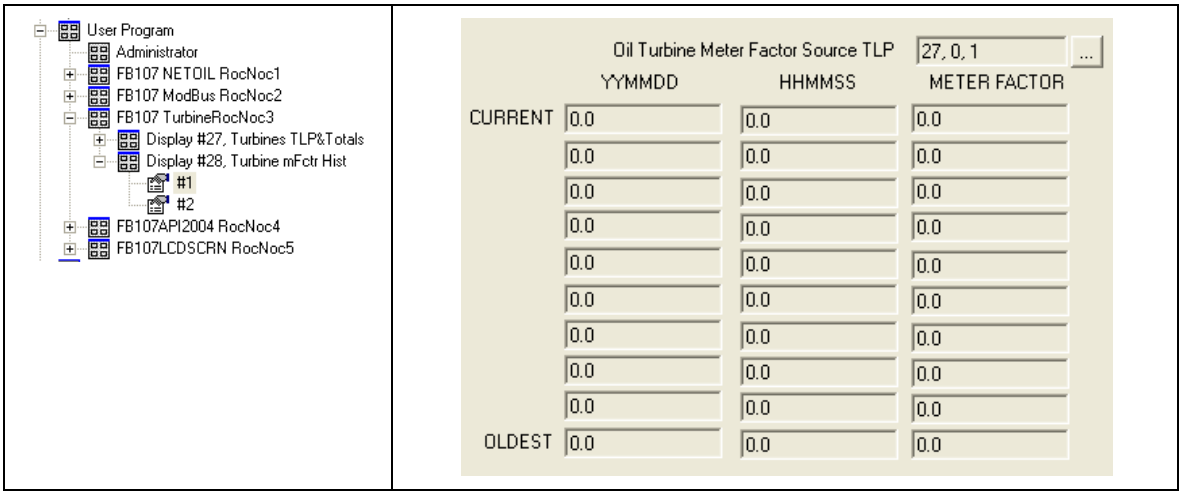
The well history will maintain 120 production test histories. To access select **FB107 NETOIL ROCNOC3 / Display #27 Turbines TLP & Totals - #1**. If running a single well in LACT mode a total of 31 days of historical well data can be saved. In order to save 31 days of data in LACT mode the LACT mode enable entry must be >100 instead of the standard entry of 1.





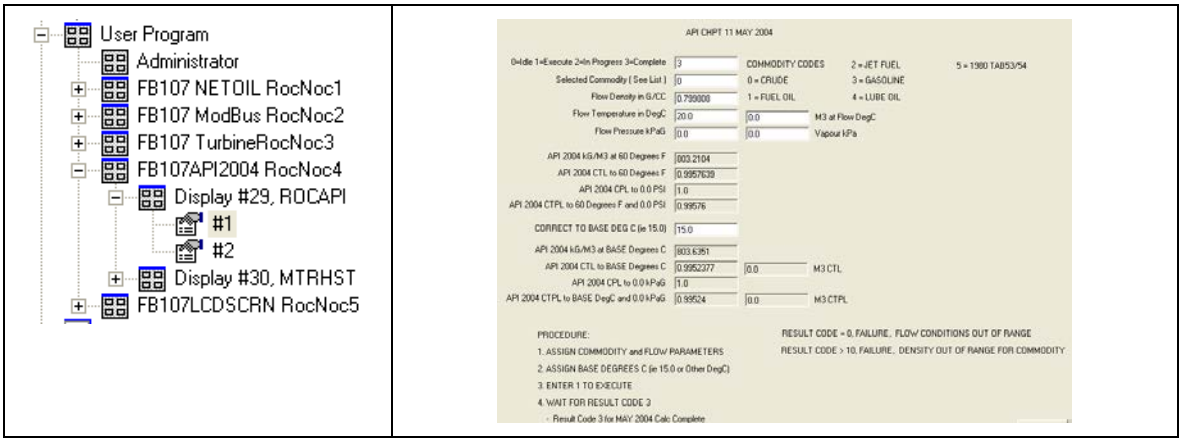
4.5 Turbine Meter Factor History

The system will maintain the last 10 meter factors for historical reference. The meter factor is entered in the Turbine TPL & Totals screen and will maintain each entry with a time and date stamp.



4.6 ROC API 2004

The system allows a test case calculation to verify the dry oil calculations used within the program are calculated properly. Instructions for the test are provided in the ROCAPI screen.



Chapter 5: Gas Flow

5.1 Multi-Variable Sensor (MVS) Module Overview

The FB107 supports a Multi-Variable Sensor (MVS) module, which plugs into any module slot (1 through 7) in the base unit or the expansion rack.

The MVS module provides communications and power to remote MVS/4088B transmitters and, in turn, provides differential pressure, static pressure, and temperature inputs to the FB107 for orifice flow calculations.

The module consists of interface electronics that provide the communications link between the FB107 and up to six MVS/4088B transmitters. The interface electronics controls communications with the sensor module, provides scaling of process variables, aids calibration, stores operating parameters, performs protocol conversion, and responds to requests from the FB107.

The module provides the communications interface and the short-circuit current-limited power required to connect up to six MVS/4088B transmitters. You can install the MVS module in any slot on the FB107 and expansion rack except for slot 0, where the CPU module resides.

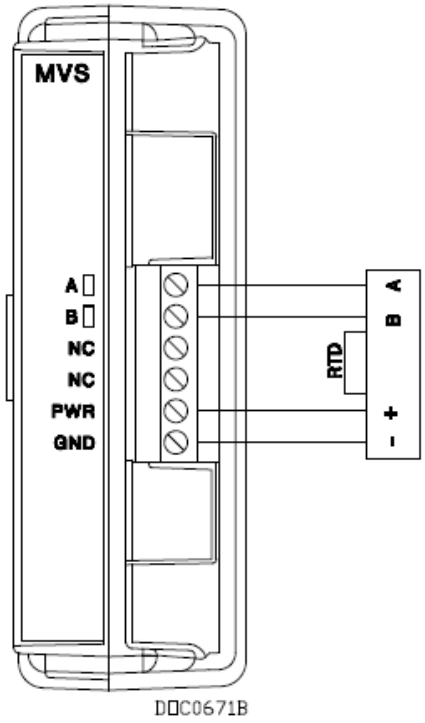
You can connect up to six MVS/4088B transmitters to the FB107's communications bus in a multi-drop connection scheme. You must set the address of **each** transmitter **before** you finalize the wiring of multiple transmitters. For proper operation of multiple MVS devices, each transmitter must have a unique address (in the range 1 through 255). **None** of the addresses can be 0 or 240.

Once you set a unique address for each transmitter, connect the transmitters in a multi-drop (or "daisy-chair") configuration (see *Figure 6-2*). The only requirement for multi-drop wiring is that you tie all like terminals together. This means all the "A" terminals on the devices are electrically connected to the FB107's "A" terminal and so on.

MVS modules have removable terminal blocks for convenient wiring and servicing. The terminal blocks can accommodate size 16 to 24 AWG.

The FB107 scans each MVS/4088B transmitter once every second, accessing values for differential pressure, static pressure, and temperature as inputs for flow calculations, history, calibration, and alarming.

Each input unit is based on selected system units:



	Differential Pressure Units	Static Pressure Units	Temperature Units
English Units	InH_2O	PSI	Deg F
Metric Units	kPa	kPa	Deg C

The MVS/4088B transmitter provides static pressure, differential pressure, and process temperature inputs. It functions as a remote unit that communicates via a serial format. The transmitter measures the three flow-related variables simultaneously. These variables are continuously available to the FB107 that polls the MVS/4088B.

The transmitter consists of a transducer and an interface circuit. The transducer, contained in the sensor body, uses capacitance-cell technology to sense differential pressure and piezo-resistive technology to sense the static (absolute or gauge) pressure.

The transducer's electronics convert the pressure variables directly into a digital format, allowing accurate correction and compensation. A microprocessor linearizes and corrects the raw pressure signals (from the sensor) using characterization data stored in non-volatile memory.

The interface circuit allows the transmitter to connect to and communicate with an FB107 using a serial 2-wire EIA-485 (RS-485) connection.

5.2 Installing/Removing an MVS Module

All FB107 modules are designed for ease of installation and removal. Refer to *Installing a Module, Removing a Module,* and *Wiring a Module* in *Chapter 4, Inputs/Outputs and RTD Inputs*, for specific instructions.

Note: Modules contain no user-serviceable components.

You can install an MVS module in any slot on the FB107 base unit or expansion rack with the exception of slot 0, which is reserved for the CPU.

CAUTION: Never connect the sheath surrounding shielded wiring to a signal ground terminal or to the common terminal of a MVS module assembly. Doing so makes the MVS module susceptible to static discharge, which can permanently damage the module. Connect the shielded wiring sheath only to a suitable earth ground.

5.2 Configuring a Multi-drop MVS Module Setup

The multi-drop ("daisy-chain") transmitter wiring configuration is the preferred configuration for the FB107 (see *Figure 6-2*).

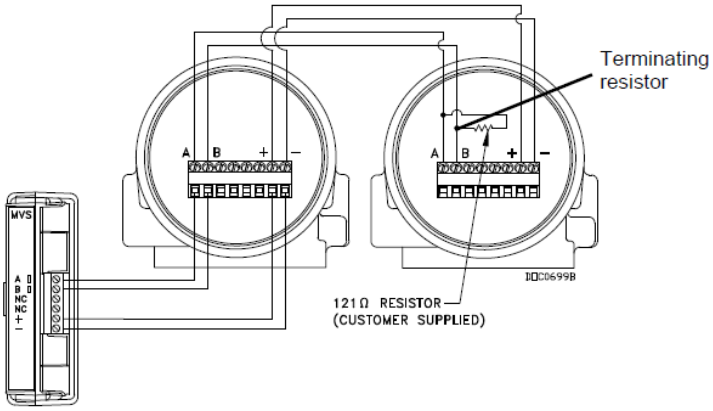


Figure 6-2 shows a terminating resistor—typically a 121 Ω customer-supplied resistor—on the last transmitter in the multi-drop. This resistor correctly terminates the multi-drop configuration.

To configure a multi-drop MVS transmitter setup, you connect each transmitter to the FB107 and configure it individually. Ensure that each transmitter functions correctly before you install the next transmitter.

1. Remove power from the FB107.

2. Wire the first MVS/4088B transmitter according to the following.

Terminal	Label	Definition
1	A	Receive / Transmit
2	B	Receive / Transmit
3	NC	No Connection
4	NC	No Connection
5	PWR	+ (Sensor Power)
6	GND	– (Common)

Run four wires (two for power, two for communications) from the remote transmitter and connect them to the terminal block on the MVS module. The wires should be size 16 to 24 AWG and a maximum length of 1220 meters (4000 feet).

Note: Do not reverse the power wires. Always make these connections **after** you remove power from the FB107. Double-check for proper orientation before applying power. If the connections are reversed and you apply power, you may damage both the transmitter and the FB107.

3. Connect the remote transmitter to a suitable earth ground according to applicable codes and standards.
4. Apply power to the FB107.
5. Open ROCLINK 800 and set the address of the **first** transmitter.

Notes:

Use ROCLINK 800's MVS Sensor screen (**Configure** > **I/O** > **MVS Sensor**) to set address values for transmitters.

All transmitters have a factory-set default interface address of **1**. (This allows you to accomplish first-time communications.) In the multi-drop configuration, each transmitter must have a **unique** address.

Do **not** use address 240 in multi-drop applications: all transmitters with this address try to respond to requests from the FB107.

6. Ensure the transmitter works correctly before you continue.
7. Repeat steps 1 through 7 for **each** transmitter (up to five more) in the multi-drop configuration.

Chapter 6: Diagnostics

6.1 FB107 Events

The system maintains an event record for any configuration changes or alarm codes that occur. An illustration of the event is listed below. Select **View** from the Main Menu and select **Events – From Device**.

Events: A1G2 - FB107
Uploaded: 05/15/2010 14:34:29 Operator: LOI

	Date/Time	Type	ID	Old Value	New Value	Description
1	05/15/2010 14:28:09	UDP29 1	LOI	15.25005	20.00000	Flow Temperture DegC
2	05/15/2010 14:28:09	UDP29 1	LOI	3	1	0=Idle 1=Exec 3=Done
3	05/14/2010 22:15:21	Initialization Sequence				
4	05/14/2010 22:15:21	FLG 1	LOI	0	1	Warm Start
5	05/14/2010 22:15:21	UCC 5	LOI	0	1	Program Enable
6	05/14/2010 22:15:06	Initialization Sequence				
7	05/14/2010 22:15:06	All Power Removed				05/14/2010 22:14:19
8	05/14/2010 22:14:19	Program Flash Memory	LOI			Segment 5E0000
9	05/14/2010 22:14:19		LOI			FB107LCDSC
10	05/14/2010 22:13:57	Initialization Sequence				
11	05/14/2010 22:13:57	FLG 1	LOI	0	1	Warm Start
12	05/14/2010 22:13:57	UCC 4	LOI	0	1	Program Enable
13	05/14/2010 22:13:39	Initialization Sequence				
14	05/14/2010 22:13:39	All Power Removed				05/14/2010 22:12:54
15	05/14/2010 22:12:54	Program Flash Memory	LOI			Segment 5D0000
16	05/14/2010 22:12:54		LOI			FB107API20
17	05/14/2010 22:12:35	Initialization Sequence				
18	05/14/2010 22:12:35	FLG 1	LOI	0	1	Warm Start
19	05/14/2010 22:12:35	UCC 3	LOI	0	1	Program Enable
20	05/14/2010 22:12:16	Initialization Sequence				
21	05/14/2010 22:12:16	All Power Removed				05/14/2010 22:11:52

6.2 FB107 Alarms

The system maintains records for any alarm codes that occur. An illustration of the event is listed below. Select **View** from the Main Menu and select **Alarm – From Device**.

Alarms: A1G2 - FB107
Uploaded: 05/15/2010 16:20:40 Operator: LOI

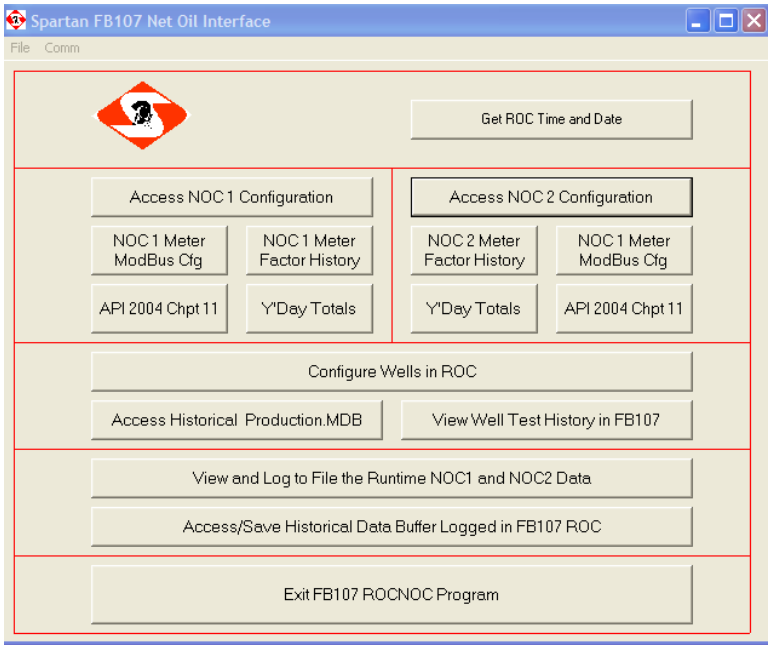
	Date/Time	Tag	Set/Clear	Value	Description

6.3 FB107 Datalogger

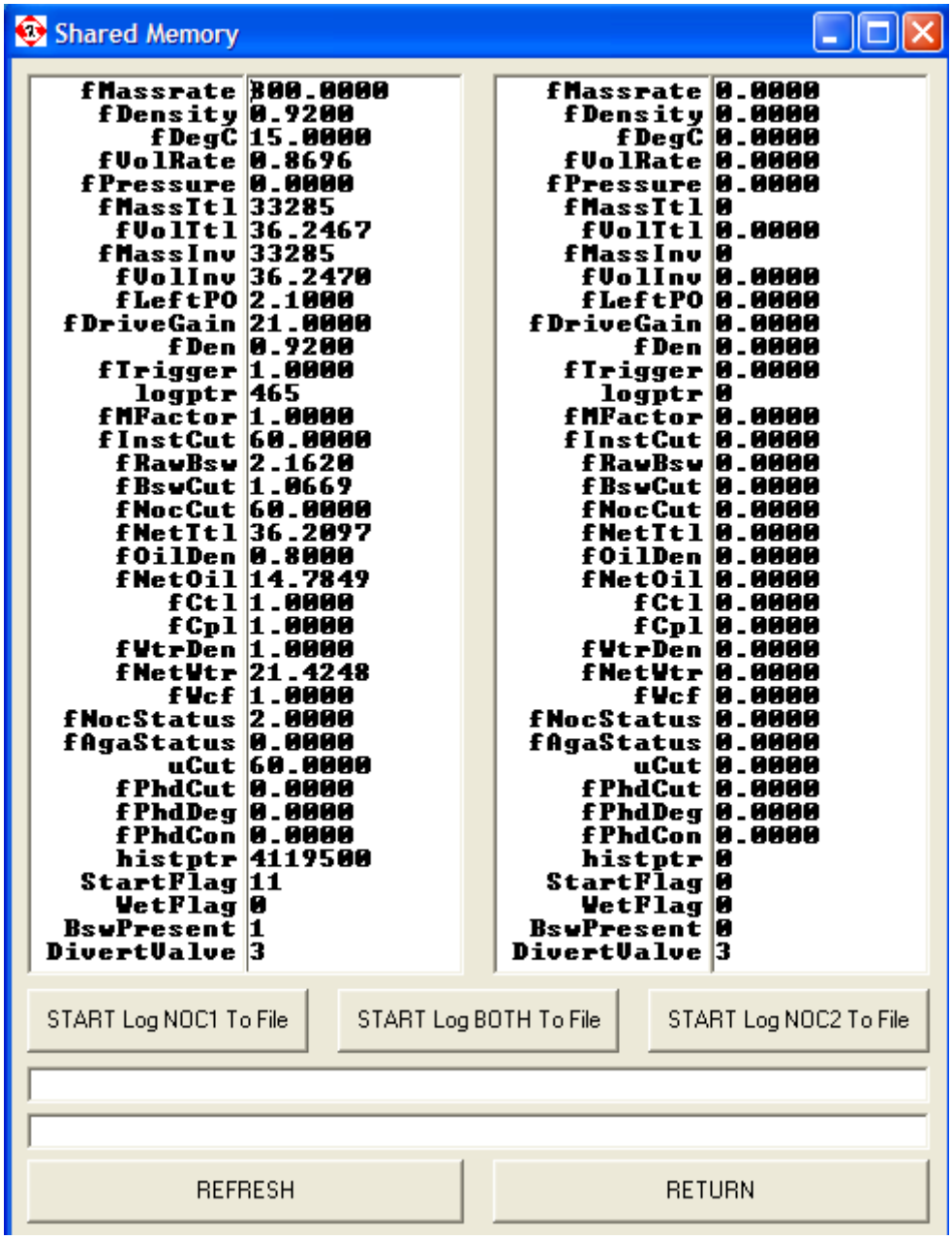
The FB107 has a built in 90 minute data logger that can be used for diagnosing operational or process problems. The data logger may not be available in all configurations of the FB107 ROCNOC program. To retrieve the data logger results requires the use of the FB107 ROCNOCWIN program that can be obtained from Spartan Controls.

If the internal data logger is going to be used the FB107 history points have to be set to 0. If the application has a gas meter run the history points may be in use by the AGA data. If this is the case then the internal data logger cannot be used. The ROC History Database is designed to support AGA calculations.

The FB107 ROCNOCWIN software main screen is illustrated below. The data logging options are accessed by the "View and Log to File the Runtime NOC1 & NOC2 Data" or "Access/Save Historical Data Buffer Logged in FB107 ROCNOC" menus.



The data log can be viewed with the interface software or viewed in the Excel csv file created. Below is the real time data view.



Below is an example of the csv file data. The data illustrated is a portion of the columns available. There are 47 columns of data in the data log sequence.

	A	B	C	D	E	F	G	H	I	J	K	L
1	fMassrate	fDensity	fDegC	fVolRate	fPressure	fMassTtl	fVolTtl	fMassInv	fVolInv	fLeftPO	fDriveGain	fDen
2	0	1.06106	15.94408	0	0	148	0.14023	1442063	1411.043	0.36384	12.765	1.06106
3	0	1.0612	15.92153	0	0	148	0.14023	1442063	1411.043	0.36384	12.63458	1.0612
4	0	1.06132	15.96142	0	0	148	0.14023	1442063	1411.043	0.36358	12.65115	1.06132
5	0	1.0614	15.95948	0	0	148	0.14023	1442063	1411.043	0.36454	12.63272	1.0614
6	0	1.06151	15.17861	0	0	148	0.14023	1442063	1411.043	0.36454	12.69656	1.06151
7	0	1.06164	15.93804	0	0	148	0.14023	1442063	1411.043	0.36395	12.57904	1.06164
8	0	1.06172	15.1548	0	0	148	0.14023	1442063	1411.043	0.36395	12.49133	1.06172
9	0	1.0618	15.94857	0	0	148	0.14023	1442063	1411.043	0.3643	12.51696	1.0618
10	0	1.06182	15.20242	0	0	148	0.14023	1442063	1411.043	0.3643	12.55292	1.06182
11	0	1.06187	15.1548	0	0	148	0.14023	1442063	1411.043	0.36451	12.47743	1.06187
12	0	1.06189	16.02453	0	0	148	0.14023	1442063	1411.043	0.3638	12.31812	1.06189
13	0	1.06194	16.03131	0	0	148	0.14023	1442063	1411.043	0.3638	12.21944	1.06194
14	0	1.06207	16.01843	0	0	148	0.14023	1442063	1411.043	0.36442	12.20666	1.06207
15	0	1.06212	16.01892	0	0	148	0.14023	1442063	1411.043	0.36442	12.02953	1.06212
16	0	1.06217	16.06742	0	0	148	0.14023	1442063	1411.043	0.36438	11.88732	1.06217
17	0	1.06227	15.20242	0	0	148	0.14023	1442063	1411.043	0.36451	11.80157	1.06227
18	0	1.06238	16.05362	0	0	148	0.14023	1442063	1411.043	0.36405	11.59373	1.06238
19	0	1.0624	15.17861	0	0	148	0.14023	1442063	1411.043	0.36356	11.52539	1.0624
20	0	1.06256	16.05172	0	0	148	0.14023	1442063	1411.043	0.36324	11.37616	1.06256
21	0	1.06263	16.04037	0	0	148	0.14023	1442063	1411.043	0.36324	11.28054	1.06263
22	0	1.06267	16.04958	0	0	148	0.14023	1442063	1411.043	0.36294	11.19379	1.06267
23	0	1.06273	16.06005	0	0	148	0.14023	1442063	1411.043	0.364	10.98775	1.06273
24	0	1.06282	16.03347	0	0	148	0.14023	1442063	1411.043	0.36379	11.0083	1.06282
25	0	1.06285	16.06113	0	0	148	0.14023	1442063	1411.043	0.36431	10.93446	1.06285
26	0	[illegible]	[illegible]	[illegible]	0	148	0.14023	1442063	1411.043	0.36431	10.79364	1.06284
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	148	0.14023	1442063	1411.043	0.36412	10.61428	1.06294
28	69.74941	1.05638	15.17861	0.06603	0	148	0.14023	1442063	1411.043	0.36412	11.88953	1.05638
29	105.3296	1.05498	15.27387	0.09984	0	149	0.14109	1442064	1411.044	0.36184	13.32092	1.05498
30	110.9412	1.05727	15.22624	0.10493	0	152	0.14406	1442067	1411.047	0.37148	9.87231	1.05727
31	109.1745	1.05777	16.13874	0.10321	0	155	0.1472	1442070	1411.05	0.3595	9.45046	1.05777

The NOC calculations are based on the following specifications and standards:

- Algorithm of Net Oil Computation using Micro Motion Flow Meter and FB107 for Satellite Applications.
- Manual of Petroleum Measurement Standards, Chapter 11.1 - Volume Correction Factors, API Standard 2540, 2004 Edition.

Appendix B – AGA Configuration Guide

FUTURE RELEASE

Appendix C – Soft Points, TLP, User Defined Points

The Modbus map is configurable and is a suggested format.

Default Modbus				DEFAULT FB107 ROCNOC Soft Point ASSIGNMENTS
Start	End	Soft Point		
1000	1039	1		NOC 1 RUNTIME NOC DATA PAGE 1 of 2
1040	1079	3		NOC 1 LAST TEST HISTORICAL
1080	1119	5		NOC 1 MASS METER RUNTIME DATA + NON RESETTABLE TOTALIZERS
1120	1159	7		NOC1 MISC
1160	1199	9		NOC 1 PREVIOUS TO LAST TEST NOC DATA FROM SFP 3
1200	1239	11		NOC 1 PREVIOUS TO PREVIOUS TO LAST TEST NOC DATA FROM SFP 9
1240	1279	13		NOC 1 RUNTIME NOC DATA PAGE 2 of 2
1280	1319	15		NOC 1 RUNTIME NOC DATA PAGE 2 of 2 IN TBR MODE
2000	2039	2		NOC 2 RUNTIME NOC DATA PAGE 1 of 2
2040	2079	4		NOC 2 LAST TEST HISTORICAL
2080	2119	6		NOC 2 MASS METER RUNTIME DATA + NON RESETABLE TOTALIZERS
2120	2159	8		NOC 2 MISC
2160	2199	10		NOC 2 PREVIOUS TO LAST TEST NOC DATA FROM SFP 4

2200	2239	12		NOC 2 PREVIOUS TO PREVIOUS TO LAST TEST NOC DATA FROM SFP 10
2240	2279	14		NOC 2 RUNTIME NOC DATA PAGE 2 of 2
2280	23199	16		NOC 2 RUNTIME NOC DATA PAGE 2 of 2 IN TBR MODE

The following reflects NOC 1 variable. NOC 2 are identical and can be viewed by incrementing 1 soft point to the below list. Example NOC1 RUNTIME variables are in soft point 1. NOC 2 are in soft point 2.

		SOFT POINT 1; NOC 1 RUNTIME DATA				
Start	**End**	**DATA**	**T**	**L**	**P**	
1000	1001	1	17	0	2	START TEST COMMAND = 1.0
1002	1003	2	17	0	3	STOP TEST COMMAND = 1.0
1004	1005	3	17	0	4	NEXT WELL TO TEST
1006	1007	4	17	0	5	TEST STATUS (0 = STOPPED) (1 = PURGE) (2 = RUNNING)
1008	1009	5	17	0	6	WELL NUMBER IN TEST
1010	1011	6	17	0	7	START DATE MMDD
1012	1013	7	17	0	8	START TIME HHMM
1014	1015	8	17	0	9	ACCUMULATED HOURS
1016	1017	9	17	0	10	ACCUMULATED GAS
1018	1019	10	17	0	11	ACCUMULATED OIL AT STP
1020	1021	11	17	0	12	ACCUMULATED WATER AT STP
1022	1023	12	17	0	13	INST WATER CUT PERCENT
1024	1025	13	17	0	14	AVERAGE CUT FOR TEST PERIOD
1026	1027	14	17	0	15	PRORATED PRODUCTION VOLUME FOR 24 HOURS
1028	1029	15	17	0	16	END TEST DATE
1030	1031	16	17	0	17	END TEST TIME
1032	1033	17	17	0	18	WELL OIL DENSITY AT STP
1034	1035	18	17	0	19	WELL WATER DENSITY AT STP

1036	1037	19	17	0	20	INST FLOW RATE VOL/DAY
1038	1039	20	17	0	21	INST FLOW TEMPERATURE

		SOFT POINT 3; NOC 1 LAST TEST DATA				
		DATA	**T**	**L**	**P**	
1040	1041	1	17	2	2	ACCUMULATED WATER TURBINE AT STP
1042	1043	2	17	2	3	ACC WATER TURBINE PRORATED TO 24 HOURS AT STP
1044	1045	3	17	2	4	PRODUCTION DAY OF MONTH WHEN LACT ENABLE > 100
1046	1047	4	17	2	5	TBR ACCUMULATED MINUTES FOR TEST
1048	1049	5	17	2	6	WELL NUMBER TESTED
1050	1051	6	17	2	7	START DATE MMDD
1052	1053	7	17	2	8	START TIME HHMM
1054	1055	8	17	2	9	ACCUMULATED HOURS
1056	1057	9	17	2	10	ACCUMULATED GAS PRORATED TO 24 HOURS AT STP
1058	1059	10	17	2	11	ACCUMULATED OIL PRORATED TO 24 HOURS AT STP
1060	1061	11	17	2	12	ACCUMULATED WATER PRORATED TO 24 HOURS AT STP
1062	1063	12	17	2	13	ACCUMULATED GAS AT STP
1064	1065	13	17	2	14	AVERAGE WATER CUT FOR TEST PERIOD AT STP
1066	1067	14	17	2	15	LIQUID VOLUME PRORATED TO 24 HOURS AT STP
1068	1069	15	17	2	16	TEST END DATE MMDD
1070	1071	16	17	2	17	TEST END TIME HHMM
1072	1073	17	17	2	18	WELL OIL DENSITY AT STP
1074	1075	18	17	2	19	WELL WATER DENSITY AT STP
1076	1077	19	17	2	20	ACCUMULATED OIL AT STP
1078	1079	20	17	2	21	ACCUMULATED WATER AT STP

	SOFT POINT 5; NOC 1 MASS METER FLOW PARAM AND NON RESETABLE TOTALIZERS					
Default	**Modbus**	**DATA**	**T**	**L**	**P**	SFP Used is Config SoftPoint n + 2 as in default SFP3 + 2 = SFP5
1080	1081	1	17	4	2	fMassrate Mass/Minute
1082	1083	2	17	4	3	fDensity (live density fed to TBR)
1084	1085	3	17	4	4	Flow Temperature from Mass Meter
1086	1087	4	17	4	5	fVolRate Volume/Minute from Mass Meter
1088	1089	5	17	4	6	Flow Pressure from Mass Meter
1090	1091	6	17	4	7	Mass Total in Mass Meter
1092	1093	7	17	4	8	Volume Total in Mass Meter
1094	1095	8	17	4	9	Mass Inventory in Mass Meter
1096	1097	9	17	4	10	Volume Inventory in mass Meter
1098	1099	10	17	4	11	fLeftPO Left Pick Off Voltage in Mass Meter
1100	1101	11	17	4	12	fDriveGain from Mass Meter
1102	1103	12	17	4	13	Flow Density (actual density from TBR used in NOC)
1104	1105	13	17	4	14	MMI COM Tries Since Contract Hour
1106	1107	14	17	4	15	MMI COM Good Since Contract Hour
1108	1109	15	17	4	16	PDI COM Tries Since Contract Hour
1110	1111	16	17	4	17	PDI COM Good Since Contact Hour
1112	1113	17	17	4	18	NET OIL TOTALIZER at STP NON RESETABLE
1114	1115	18	17	4	19	NET WATER TOTALIZER at STP NON RESETABLE
1116	1117	19	17	4	20	WATER TURBINE TOTALIZER NON RESETABLE VSN 1.14a

1118	1119	20	17	4	21	GAS TOTALIZER NON RESETABLE

		SOFT POINT 7; NOC 1				
Default	**Modbus**	**DATA**	**T**	**L**	**P**	
1120	1121	1	17	6	2	Ave GOR For Test (Total Gas Acc at STP / Total Oil Acc at STP)
1122	1123	2	17	6	3	Average Temperature For Test (Flow Dependent Linear)
1124	1125	3	17	6	4	Estimated Oil Density at STP from recent Samples in this test.
1126	1127	4	17	6	5	Estimated Water Density at STP from recent Samples in this test.
1128	1129	5	17	6	6	MINIMUM Flow Density for Test Period below Drive Gain Limit
1130	1131	6	17	6	7	MAXIMUM Flow Density for Test Period below Drive Gain Limit
1132	1133	7	17	6	8	Running Average Drive Gain over last 2 minutes
1134	1135	8	17	6	9	Meter Status Word Value V4.14d
1136	1137	9	17	6	10	future
1138	1139	10	17	6	11	future
1140	1141	11	17	6	12	future
1142	1143	12	17	6	13	future
1144	1145	13	17	6	14	future
1146	1147	14	17	6	15	future
1148	1149	15	17	6	16	future
1150	1151	16	17	6	17	future
1152	1153	17	17	6	18	future
1154	1155	18	17	6	19	future
1156	1157	19	17	6	20	future
1158	1159	20	17	6	21	future

		SOFT POINT 9; NOC1 PREVIOUS TO LAST TEST DATA				
Default	**Modbus**	**DATA**	**T**	**L**	**P**	
1160	1161	1	17	8	2	ACCUMULATED WATER TURBINE AT STP
1162	1163	2	17	8	3	ACC WATER TURBINE PRORATED TO 24 HOURS AT STP
1164	1165	3	17	8	4	PRODUCTION DAY OF MONTH WHEN LACT ENABLE > 100
1166	1167	4	17	8	5	GOR FOR TEST PERIOD
1168	1169	5	17	8	6	WELL NUMBER TESTED
1170	1171	6	17	8	7	START DATE MMDD
1172	1173	7	17	8	8	START TIME HHMM
1174	1175	8	17	8	9	ACCUMULATED HOURS
1176	1177	9	17	8	10	ACCUMULATED GAS PRORATED TO 24 HOURS AT STP
1178	1179	10	17	8	11	ACCUMULATED OIL PRORATED TO 24 HOURS AT STP
1180	1181	11	17	8	12	ACCUMULATED WATER PRORATED TO 24 HOURS AT STP
1182	1183	12	17	8	13	ACCUMULATED GAS AT STP
1184	1185	13	17	8	14	AVERAGE WATER CUT FOR TEST PERIOD AT STP
1186	1187	14	17	8	15	LIQUID VOLUME PRORATED TO 24 HOURS AT STP
1188	1189	15	17	8	16	TEST END DATE MMDD
1190	1191	16	17	8	17	TEST END TIME HHMM
1192	1193	17	17	8	18	WELL OIL DENSITY AT STP
1194	1195	18	17	8	19	WELL WATER DENSITY AT STP
1196	1197	19	17	8	20	ACCUMULATED OIL AT STP
1198	1199	20	17	8	21	ACCUMULATED WATER AT STP

		SOFT POINT11; NOC1 PREVIOUS TO PREVIOUS LAST TEST DATA+D103				
Default	**Modbus**	**DATA**	**T**	**L**	**P**	
1200	1201	1	17	10	2	ACCUMULATED WATER TURBINE AT STP
1202	1203	2	17	10	3	ACC WATER TURBINE PRORATED TO 24 HOURS AT STP
1204	1205	3	17	10	4	PRODUCTION DAY OF MONTH WHEN LACT ENABLE > 100
1206	1207	4	17	10	5	GOR FOR TEST PERIOD
1208	1209	5	17	10	6	WELL NUMBER TESTED
1210	1211	6	17	10	7	START DATE MMDD
1212	1213	7	17	10	8	START TIME HHMM
1214	1215	8	17	10	9	ACCUMULATED HOURS
1216	1217	9	17	10	10	ACCUMULATED GAS PRORATED TO 24 HOURS AT STP
1218	1219	10	17	10	11	ACCUMULATED OIL PRORATED TO 24 HOURS AT STP
1220	1221	11	17	10	12	ACCUMULATED WATER PRORATED TO 24 HOURS AT STP
1222	1223	12	17	10	13	ACCUMULATED GAS AT STP
1224	1225	13	17	10	14	AVERAGE WATER CUT FOR TEST PERIOD AT STP
1226	1227	14	17	10	15	LIQUID VOLUME PRORATED TO 24 HOURS AT STP
1228	1229	15	17	10	16	TEST END DATE MMDD
1230	1231	16	17	10	17	TEST END TIME HHMM
1232	1233	17	17	10	18	WELL OIL DENSITY AT STP
1234	1235	18	17	10	19	WELL WATER DENSITY AT STP
1236	1237	19	17	10	20	ACCUMULATED OIL AT STP
1238	1239	20	17	10	21	ACCUMULATED WATER AT STP

The following data will be live data even during entrained gas conditions.

		SOFT POINT13 NOC1 RUN TIME PAGE 2 of 2				
Default	**Modbus**	**DATA**	**T**	**L**	**P**	
1240	1241	1	17	12	2	Emulsion Density derived from High Range Monitor
1242	1243	2	17	12	3	Gas Void Fraction derived from High Range Monitor
1244	1245	3	17	12	4	PDI Serial Number
1246	1247	4	17	12	5	PDI Diagnostics
1248	1249	5	17	12	6	PDI Extended Diagnostics
1250	1251	6	17	12	7	PDI Diagnostics Error Code
1252	1253	7	17	12	8	PDI Process Value (Water Content)
1254	1255	8	17	12	9	PDI User Temperature
1256	1257	9	17	12	10	PDI Emulsion Phase
1258	1259	10	17	12	11	PDI Salinity
1260	1261	11	17	12	12	PDI Oil Adjust
1262	1263	12	17	12	13	PDI Water Adjust
1264	1265	13	17	12	14	PDI Oil P0
1266	1267	14	17	12	15	PDI Oil P1
1268	1269	15	17	12	16	PDI Frequency - Oil Oscillator
1270	1271	16	17	12	17	PDI Reflected Power - Oil Oscillator
1272	1273	17	17	12	18	PDI Frequency - Water Oscillator
1274	1275	18	17	12	19	PDI Reflected Power - Water Oscillator
1276	1277	19	17	12	20	PDI User Temperature Adjust

The following data will be variables used during a TBR event (entrained gas). The variables will lock at a last known good values to prevent proration errors due to 2 phase flow.

		SOFT POINT15; NOC1 Phase Dynamics Water Cut				
Default	**Modbus**	**DATA**	**T**	**L**	**P**	
1280	1281	1	17	14	2	PDI Cut Via Modbus
1282	1283	2	17	14	3	PDI Process Temperature via Modbus
1284	1285	3	17	14	4	PDI User Temperature via Modbus
1286	1287	4	17	14	5	PDI Emulsion Phase via Modbus
1288	1289	5	17	14	6	PDI Oil Adjust from TLP 25,0,24 User Configured
1290	1291	6	17	14	7	PDI Water Cut Offset TLP 25,0,25 User Configured
1292	1293	7	17	14	8	RawCut = PdiCut - PdiWCoffset
1294	1295	8	17	14	9	Density used for corrected water cut
1296	1297	9	17	14	10	Corrected Water Cut % not Zero Clipped
1298	1299	10	17	14	11	Corrected Water Cut % Zero Clipped
1300	1301	11	17	14	12	Flow Density g/cc
1302	1303	12	17	14	13	VCF
1304	1305	13	17	14	14	Location Oil Density g/cc
1306	1307	14	17	14	15	PDI Slope via TLP 25,0,26 User Configured
1308	1309	15	17	14	16	
1310	1311	16	17	14	17	
1312	1313	17	17	14	18	
1314	1315	18	17	14	19	

1316	1317	19	17	14	20	
1318	1319	20	17	14	21	

ROCNOC Configuration – UDP22

The following is a list of the common TLP points used by the ROCNOC program. L parameter changes to 2 for NOC 2.

UDP22 1			
T	**L**	**P**	**Descriptor**
22	0	0	ROC Name
22	0	1	Maximum # of Wells
22	0	2	TestStart/StopToggle
22	0	3	Density Input
22	0	4	Temperature Input
22	0	5	Gas Accum AGA (1-5)
22	0	6	Mass Rate Freq Input
22	0	7	Meter Factor
22	0	8	SoftPt Dest Part 1
22	0	9	SoftPt Dest Part 2
22	0	10	Pressure Input(comp)
22	0	11	Test Status
22	0	12	Well Selected
22	0	13	Printing
22	0	14	Last Well
22	0	15	Start Date
22	0	16	Start Time
22	0	17	Current Accum Hours

22	0	18	Current Accum Gas
22	0	19	Current Accum Oil
22	0	20	Current Accum Water
22	0	21	Low Monit.Swtchpt
22	0	22	High Monit.Swtchpt
22	0	23	Low Monit.Input
22	0	24	High Monit.Input
22	0	25	Low Monit.Value
22	0	26	High Monit Value
22	0	27	Low Monitor Flag
22	0	28	S&W Dielect K Oil
22	0	29	S&W Dielect K Wat
22	0	30	Monitor Inst.Cut
22	0	31	Density of Oil (15C)
22	0	32	Density of Oil(PCom)
22	0	33	Density of Oil FlowT
22	0	34	Density of Wtr (15C)
22	0	35	Density of Wtr FlowT
22	0	36	NOC Calculated Cut
22	0	37	Instantaneous Cut
22	0	38	Average Cut
22	0	39	Average Production

22	0	40	LACT Enable/Well Sel
22	0	41	MaxTest Duration Hrs
22	0	42	High Monit Emul g/cc
22	0	43	High Monit GasVoid %
22	0	44	MassMeterEmulsionVol
22	0	45	High Monit Emulsion Vol
22	0	46	BSW Upper Density
22	0	47	Low Mon Global Trim
22	0	48	Enable GVF
22	0	49	Next Seq Number
22	0	50	Curr FlowDeg wo Bias
22	0	51	Current FlowDeg Bias
22	0	52	Curr FlowDeg cw Bias

Well Database Configuration – UDP23

15 wells with the following TLP. L parameter changes per well. (Well 1 L=0)

UDP23 1			
T	**L**	**P**	**Descriptor**
23	0	0	Legal Site Descriptor
23	0	1	Oil Density at STP
23	0	2	Water Density at STP
23	0	3	Pressure Coeff of Oil
23	0	4	Shrinkage Factor of Oil
23	0	5	Shrinkage Factor of Water
23	0	6	Purge Volume
23	0	7	S&W A Constant (ie:0.57)
23	0	8	S&W +/- bFactor in Dielectric Units
23	0	9	N2 - Nitrogen
23	0	10	CO2 - Carbon Dioxide
23	0	11	CH4 - Methane
23	0	12	C2H6 - Ethane
23	0	13	C3H8 - Propane
23	0	14	C4H10 - n-Butane
23	0	15	C4H10 - i-Butane
23	0	16	C5H12 - n-Pentane
23	0	17	C5H12 - i-Pentane

23	0	18	C6H14 - nHexane
23	0	19	C7H16 - n-Heptane
23	0	20	C8H18 - Octane
23	0	21	C9H20 - n-Nonane
23	0	22	C10H22 - n-Decane
23	0	23	H2S - Hydrogen Sulphide
23	0	24	H2O - Water
23	0	25	He - Helium
23	0	26	O2 - Oxygen
23	0	27	C0 - Carbon Monoxide
23	0	28	H2 - Hydrogen

Mass Meter Driver / Phase Dynamics - UDP25

UDP25 1			
T	**L**	**P**	**Descriptor**
25	0	0	Meter ModBus Address
25	0	1	MB CommFail DOUT TLP
25	0	2	MeterTurnaroundDelay
25	0	3	Meter Max TBR Drive%
25	0	4	Min TBR LPO Volts
25	0	5	TBR Event DOUT TLP
25	0	6	DivertValve DOUT TLP
25	0	7	DivertWaterCut PerCt
25	0	8	Divert 1=Invert DOUT
25	0	9	Dry to Wet Delay Sec
25	0	10	Wet to Dry Delay Sec
25	0	11	Cut Averaging 0 > 59
25	0	12	Cut Avg Multiplier
25	0	13	PDI ModBus Address
25	0	14	MMProverEnbl 1=Prove
25	0	15	Gross Oil Flow Temp
25	0	16	Gross WaterFlow Temp
25	0	17	Gross Ttl Flow Temp
25	0	18	Total Mass for Prove

25	0	19	Sampler Drv DOUT TLP
25	0	20	Sampler Volume in M3
25	0	21	SamplerTime in 1/10S
25	0	22	MinMaxDenDrGainLimit
25	0	23	TbrTestTimeInMinutes
25	0	24	Current Drive Gain
25	0	25	TBR Flow Density
25	0	26	Phase Dynamics Slope
25	0	27	PDIRnge 1=L 2=H 3=HH
25	0	28	Meter ModBus Address
25	0	29	MB CommFail DOUT TLP

NOC Well History – UDP26

120 History points. L parameter 0-59 for NOC 1 and 60-120 for NOC 2

UDP26 1			
T	**L**	**P**	**Descriptor**
26	0	0	Hist NOC Identent
26	0	1	Hist Test WellNumber
26	0	2	Hist Start Date mmdd
26	0	3	Hist Start Time hhmm
26	0	4	Hist Duration HR
26	0	5	Hist Daily Gas
26	0	6	Hist Daily Oil
26	0	7	Hist Daily Wtr
26	0	8	Hist Daily Prod
26	0	9	Hist Daily WtrTurbne
26	0	10	Hist Avg Cut
26	0	11	GOR/HighMonEntrndGas
26	0	12	Hist Oil Total
26	0	13	Hist Water Total
26	0	14	Hist Gas Total
26	0	15	Hist Turbine Total

Turbine Meter Variables – UDP27

UDP27 1			
T	**L**	**P**	**Descriptor**
27	0	0	Oil Turbine Srce TLP
27	0	1	Oil Meter Factor
27	0	2	Current GrossOil Ttl
27	0	3	Current CTL
27	0	4	Current NetOil Total
27	0	5	Current Water WCF
27	0	6	Current NetWtr Total
27	0	7	Wtr Turbine Srce TLP
27	0	8	Water Meter Factor
27	0	9	Current GrossWtr Ttl
27	0	10	Current WCF
27	0	11	Current NetWtr Total
27	0	12	Yday-0 Turbine Oil T
27	0	13	Yday-0 Turbine Wtr T
27	0	14	Yday-1 Turbine Oil T
27	0	15	Yday-1 Turbine Wtr T
27	0	16	Yday-2 Turbine Oil T
27	0	17	Yday-2 Turbine Wtr T
27	0	18	Yday-0 Emulsion WtrT

27	0	19	Yday-0 Net Wtr Total
27	0	20	Yday-1 Emulsion WtrT
27	0	21	Yday-1 Net Wtr Total
27	0	22	Yday-2 Emulsion WtrT
27	0	23	Yday-2 Net Wtr Total

Turbine Meter Factor Variables – UDP28

UDP28 1			
T	**L**	**P**	**Descriptor**
28	0	0	Current Oil mF Date
28	0	1	Previous Oil mF Date
28	0	2	Previous Oil mF Date
28	0	3	Previous Oil mF Date
28	0	4	Previous Oil mF Date
28	0	5	Previous Oil mF Date
28	0	6	Previous Oil mF Date
28	0	7	Previous Oil mF Date
28	0	8	Previous Oil mF Date
28	0	9	Previous Oil mF Date
28	0	10	Current Oil mF Time
28	0	11	Previous Oil mF Time
28	0	12	Previous Oil mF Time
28	0	13	Previous Oil mF Time
28	0	14	Previous Oil mF Time
28	0	15	Previous Oil mF Time
28	0	16	Previous Oil mF Time
28	0	17	Previous Oil mF Time
28	0	18	Previous Oil mF Time

28	0	19	Previous Oil mF Time
28	0	20	Current Oil mFactor
28	0	21	Previous Oil mtrFctr
28	0	22	Previous Oil mtrFctr
28	0	23	Previous Oil mtrFctr
28	0	24	Previous Oil mtrFctr
28	0	25	Previous Oil mtrFctr
28	0	26	Previous Oil mtrFctr
28	0	27	Previous Oil mtrFctr
28	0	28	Previous Oil mtrFctr
28	0	29	Previous Oil mtrFctr
28	0	30	Oil mFctr Source TLP
28	0	31	Current Wtr mF Date
28	0	32	Previous Wtr mF Date
28	0	33	Previous Wtr mF Date
28	0	34	Previous Wtr mF Date
28	0	35	Previous Wtr mF Date
28	0	36	Previous Wtr mF Date
28	0	37	Previous Wtr mF Date
28	0	38	Previous Wtr mF Date
28	0	39	Previous Wtr mF Date
28	0	40	Previous Wtr mF Date

28	0	41	Current mFactor Time
28	0	42	Previous Wtr mF Time
28	0	43	Previous Wtr mF Time
28	0	44	Previous Wtr mF Time
28	0	45	Previous Wtr mF Time
28	0	46	Previous Wtr mF Time
28	0	47	Previous Wtr mF Time
28	0	48	Previous Wtr mF Time
28	0	49	Previous Wtr mF Time
28	0	50	Previous Wtr mF Time
28	0	51	Current Meter Factor
28	0	52	Previous Wtr mtrFctr
28	0	53	Previous Wtr mtrFctr
28	0	54	Previous Wtr mtrFctr
28	0	55	Previous Wtr mtrFctr
28	0	56	Previous Wtr mtrFctr
28	0	57	Previous Wtr mtrFctr
28	0	58	Previous Wtr mtrFctr
28	0	59	Previous Wtr mtrFctr
28	0	60	Previous Wtr mtrFctr
28	0	61	Water mFctr Srce TLP

API Calculation & Software License Variables – UDP29

UDP29 1			
T	**L**	**P**	**Descriptor**
29	0	0	0=Idle 1=Exec 3=Done
29	0	1	Assigned Commodity #
29	0	2	Flow Density G/CC
29	0	3	Flow Temperture DegC
29	0	4	Flow Pressure kPag
29	0	5	kG/M3 at 60F
29	0	6	CTL to 60F
29	0	7	CPL to 0.0 PSI
29	0	8	CTPL to 0.0 PSI @60F
29	0	9	Cor to this BaseDegC
29	0	10	kG/M3 at Base DegC
29	0	11	CTL to Base DegC
29	0	12	CPL to 0.0 kPa
29	0	13	CTPL to Base DegC
29	0	14	M3 at Flow DegC
29	0	15	CTL M3 at 15 DegC
29	0	16	CTPL M3 at 15C 0kPaG
29	0	17	Vapour Pressure kPaG
29	0	18	This code to Spartan

29	0	19	Code from Spartan
29	0	20	1 = License Enabled

Micro Motion MF History – UDP 30

UDP30 1			
T	**L**	**P**	**Descriptor**
30	0	0	Current mFactor Date
30	0	1	Previous mFactr Date
30	0	2	Previous mFactr Date
30	0	3	Previous mFactr Date
30	0	4	Previous mFactr Date
30	0	5	Previous mFactr Date
30	0	6	Previous mFactr Date
30	0	7	Previous mFactr Date
30	0	8	Previous mFactr Date
30	0	9	Previous mFactr Date
30	0	10	Previous mFactr Date
30	0	11	Previous mFactr Date
30	0	12	Current mFactor Time
30	0	13	Previous mFactr Time
30	0	14	Previous mFactr Time
30	0	15	Previous mFactr Time
30	0	16	Previous mFactr Time
30	0	17	Previous mFactr Time
30	0	18	Previous mFactr Time

30	0	19	Previous mFactr Time
30	0	20	Previous mFactr Time
30	0	21	Previous mFactr Time
30	0	22	Current mFactor Time
30	0	23	Previous mFactr Time
30	0	24	Current Meter Factor
30	0	25	Previous Metr Factor
30	0	26	Previous Metr Factor
30	0	27	Previous Metr Factor
30	0	28	Previous Metr Factor
30	0	29	Previous Metr Factor
30	0	30	Previous Metr Factor
30	0	31	Previous Metr Factor
30	0	32	Previous Metr Factor
30	0	33	Previous Metr Factor
30	0	34	Current Meter Factor
30	0	35	Previous Metr Factor
30	0	36	Meter Fct Source TLP

MVS Variables – UDP40

UDP40 1			
T	**L**	**P**	**Descriptor**
40	0	0	Point Tag ID
40	0	1	Sensor Address
40	0	2	Sensor Configuration
40	0	3	Poll Mode
40	0	4	Interface Revision
40	0	5	Sensor Status
40	0	6	Sensor Alarming
40	0	7	Sensor Voltage
40	0	8	Differential Pressure Reading
40	0	9	Static Pressure Reading
40	0	10	Temperature Reading
40	0	11	DP Reverse Flow
40	0	12	Static Pressure Effect
40	0	13	DP Minimum Calibration Value
40	0	14	Calibration Mid Point 1
40	0	15	Calibration Mid Point 2
40	0	16	Calibration Mid Point 3
40	0	17	DP Maximum Calibration Value

40	0	18	AP Minimum Calibration Value
40	0	19	Calibration Mid Point 1
40	0	20	Calibration Mid Point 2
40	0	21	Calibration Mid Point 3
40	0	22	AP Maximum Calibration Value
40	0	23	PT Minimum Calibration Value
40	0	24	Calibration Mid Point 1
40	0	25	Calibration Mid Point 2
40	0	26	Calibration Mid Point 3
40	0	27	PT Maximum Calibration Value
40	0	28	Calibrate Command
40	0	29	Calibrate Type
40	0	30	Calibrate Set Value
40	0	31	Manual DP
40	0	32	Manual AP
40	0	33	Manual PT
40	0	34	DP Mode
40	0	35	DP Alarm Code
40	0	36	DP Low Alarm
40	0	37	DP High Alarm
40	0	38	DP Deadband

40	0	39	DP Alarm Fault Value
40	0	40	AP Mode
40	0	41	AP Alarm Code
40	0	42	AP Low Alarm
40	0	43	AP High Alarm
40	0	44	AP Deadband
40	0	45	AP Alarm Fault Value
40	0	46	PT Mode
40	0	47	PT Alarm Code
40	0	48	PT Low Alarm
40	0	49	PT High Alarm
40	0	50	PT Deadband
40	0	51	PT Fault Value
40	0	52	RTD Bias
40	0	53	Pressure Offset

Gas Meter Variables and Configuration Parameters – UDP46

UDP46 1			
T	**L**	**P**	**Descriptor**
46	0	0	Point Tag ID
46	0	1	Point Description
46	0	2	Calculation Method
46	0	3	Calculation Method II
46	0	4	Options
46	0	5	RESERVED
46	0	6	IMP | BMP
46	0	7	Pipe Diameter
46	0	8	Pipe Reference Temperature
46	0	9	Pipe Material
46	0	10	Orifice Diameter
46	0	11	Orifice Reference Temperature
46	0	12	Orifice Material
46	0	13	Base or Contract Pressure
46	0	14	Base or Contract Temperature
46	0	15	Atmospheric Pressure
46	0	16	Specific Gravity
46	0	17	Heating Value

46	0	18	Viscosity
46	0	19	Specific Heat Ratio
46	0	20	Elevation
46	0	21	Latitude
46	0	22	Local Gravitational Acceleration
46	0	23	N2 - Nitrogen
46	0	24	CO2 - Carbon Dioxide
46	0	25	H2S - Hydrogen Sulfide
46	0	26	H2O - Water
46	0	27	He - Helium
46	0	28	CH4 - Methane
46	0	29	C2H6 - Ethane
46	0	30	C3H8 - Propane
46	0	31	C4H10 - n-Butane
46	0	32	C4H10 - i-Butane
46	0	33	C5H12 - n-Pentane
46	0	34	C5H12 - i-Pentane
46	0	35	C6H14 - n-Hexane
46	0	36	C7H16 - n-Heptane
46	0	37	C8H18 - n-Octane
46	0	38	C9H20 - n-Nonane
46	0	39	C10H22 - n-Decane

46	0	40	O2 - Oxygen
46	0	41	CO - Carbon Monoxide
46	0	42	H2 - Hydrogen
46	0	43	Low hw Cutoff | Static K Factor
46	0	44	High hw Setpoint | Low Flow Rate Cutoff
46	0	45	Low hw Setpoint
46	0	46	Enable Stacked hw
46	0	47	Low hw TLP
46	0	48	hw TLP | Uncorrected Flow Rate TLP
46	0	49	Pf TLP
46	0	50	Tf TLP
46	0	51	hw | Uncorrected Flow Rate
46	0	52	Pf - Static Pressure
46	0	53	Tf - Temperature
46	0	54	Alarm Code
46	0	55	Low Alarm Flow
46	0	56	High Alarm Flow
46	0	57	Averaging Technique
46	0	58	Full Recalculation Flag
46	0	59	Input TLP for Multiple K Factor Calculation
46	0	60	Deadband for Multiple K Factor Calculation

46	0	61	Lowest K Factor
46	0	62	2nd K Factor
46	0	63	3rd K Factor
46	0	64	4th K Factor
46	0	65	5th K Factor
46	0	66	Lowest EU Value
46	0	67	2nd EU Value
46	0	68	3rd EU Value
46	0	69	4th EU Value
46	0	70	5th EU Value
46	0	71	6th K Factor
46	0	72	7th K Factor
46	0	73	8th K Factor
46	0	74	9th K Factor
46	0	75	10th K Factor
46	0	76	11th K Factor
46	0	77	Highest K Factor
46	0	78	6th EU Value
46	0	79	7th EU Value
46	0	80	8th EU Value
46	0	81	9th EU Value
46	0	82	10th EU Value

46	0	83	11th EU Value
46	0	84	Highest EU Value
46	0	85	Ar - Argon
46	0	86	Configuration Statuses
46	0	87	No Flow Time
46	0	88	Primary Element Type
46	0	89	Venturi CdFT
46	0	90	Alarm Deadband
46	0	91	Pressure Loss
46	0	92	Joule-Thomson Coefficient

Appendix D – Directive 17 Compliance

The following is a summary of the Directive 17 compliance requirements and confirmation on what we believe provides system compliance.

Application: Well Production Testing

Requirement	Compliance	Reference
Single point oil production uncertainty requirement: 2%	Micro Motion volume accuracy: 0.1%. Typical water cut accuracy for 2 phase separator applications: 1%	Section 1 of Directive 17
Single point gas production uncertainty requirement: 3%	MVS 205 volume accuracy: 0.1% of span for 1:1 to 10:1 turn down	Section 1 of Directive 17
Calibration & proving requirements: Annually	Micro Motion requires proving annually unless Meter Verification (MV) is in use. With MV proving is not required providing MV testing confirms meter performance is good.	Section 2 of Directive 17 See Exceptions note 1 for information on Meter Verification.
Calibration of density for water cut calculation requirements: Annually	The Micro Motion density can be calibrated vs. a known density of liquid as required.	Section 2.11 of Directive 17
Accounting for shrinkage	The NOC software has an individual shrinkage factor for each well in the database.	Section 2.7.1 of Directive 17
Accounting for shrinkage	The NOC software has an individual shrinkage factor for each well in the database.	Section 6.3.2.3 of Directive 17

Calculation requirements for volume	The FB107 NOC program complies to 2 decimal places per 6.3.2	Section 6.3.2 of Directive 17
Calculation requirements for daily volume	The system provides daily volumes and non-resettable running totalizers to meet 6.3.2.4	Section 6.3.2.4 of Directive 17
Temperature correction requirements	The NOC system provides real time CTL using an electronics flow measurement system	Section 6.3.2.1 of Directive 17
Pressure correction requirements (not required for test production measurement)	The NOC system provides real time CPL using an electronics flow measurement system	Section 6.3.2.2 of Directive 17
Water Cut calculation requirements. **The percentage of water in the gross volume is determined by measuring the percentage of sediment (%S&W) of a representative sample or by continuous on-line measurement.**	The FB107 NOC program computes water cut using an inferred density calculation based on patent # U.S. patents# 4,689,989, 4,773,257 in the range of 0-100% water cut The system optionally computes water cut in the low range 0-5% based on a density corrected water cut probe based on patent U.S. Patent: 5,325,066, Canadian Patent # 2,074,017	Section 6.3.2.4 of Directive 17
Calculation performance evaluation	The FB107 NOC system has a Test Calc feature that is initiated using the Spartan Controls supplied host software. The calculation verifies the	Section 6.8 of Directive 17

	calculation taking place within the FB107 NOC program.	
Electronic Flow Measurement for Oil Systems **Hardware and software requirements:** **The memory on board the EFM must allow for at least 32 days of storage of the required flow data before being overwritten or erased**	FB107 NOC There are 2 versions of the FB107 software: 15 well version – maintains 45 well test records (history records are dependent on user set up) 40 well version – maintains 120 well test records (history records are dependent on user set up)	Section 6.8 of Directive 17
Electronic Flow Measurement for Oil Systems **Hardware and software requirements:** **The EFM must be equipped with its own on-board battery to protect the memory in the event of a power failure**	FB107 NOC Has on board battery back up	Section 6.8 of Directive 17
Electronic Flow Measurement for Oil Systems **Hardware and software requirements:** **The system must have various levels of system security, with the highest level of access to the program restricted to authorized people.**	FB107 NOC USER DISPLAY: ROCLINK 800 security enables you can determine which user IDs can access which Touchpad features. You can define up to 16 user IDs, each of which can have read-only, read-write, or no access to the	Section 6.8 of Directive 17

	four userlists and standard features of the Touchpad. COMMUNICATIONS ACCESS: The FB107 permits device-based security. You can define and store a maximum of 16 log-on identifiers (IDs). In order for the unit to communicate, the log-on ID supplied to ROCLINK 800 software must match one of the IDs stored in the FB107. This security feature is enabled by default on the Local Operator Interface port (Security on LOI). You can configure security protection on COM1, COM2, and COM3.	
Electronic Flow Measurement for Oil Systems **Hardware and software requirements:** **The communication system must use a data integrity error-checking routine to ensure that the data transmitted are correct.**	FB107 NOC Communications has integrity error-checking	Section 6.8 of Directive 17
Electronic Flow Measurement for Oil Systems **Hardware and software requirements:** **The EFM must be set to alarm on high and low differential pressure, if applicable, over range of any end devices, low**	FB107 NOC Any device failure, under/over range condition, low power or communications failure can be configured to provide alarms. Alarm related conditions are also automatically logged to an event log in the FB107	Section 6.8 of Directive 17

power, and communication failures.		
Electronic Flow Measurement for Oil Systems **Hardware and software requirements:** **Any changes made to the data or any manually entered values that affect the flow calculation must be flagged so it is clear that these are estimated, not actual, readings.** **This flagging must carry through to values calculated from the data.**	FB107 NOC Flow data records can not be edited. Any changes to the system configuration are logged in the event log for tracking purposes.	Section 6.8 of Directive 17
Electronic Flow Measurement for Oil Systems **Hardware and software requirements:** **When any parameter that affects the flow calculation is changed, such as meter factor, fluid densities, or transmitter range, a signoff procedure or an event log must be set up to ensurethat the change is made in the EFM system. All data and reports must be retained for aminimum of 12 months.**	The system event log has the capacity to maintain and store up to 240 events in a circular log. The event log operates in a circular fashion with new entries overwriting the oldest entry when the buffer is full. The event log provides an audit trail history of past operation and changes. The system stores the event log separately from the alarm log to prevent recurring alarms from overwriting configuration audit data. In addition to providing functionality for appending new events to the log, the event log allows host packages to request the index of the most recently logged event entry. Event logging is available internally to the	Section 6.8 of Directive 17

	system, to external host packages, and to the FST.	
The Daily Report **The daily report must include** **• meter identification** **• daily accumulated flow with indicating flags for estimated flow made by the system or manual inputs and alarms that have occurred for over ranging of end devices** **• hours on production or hours of flow (specify)** **• flow data audit trail—include at least one of the following:** **- instantaneous values for flow rate, operating pressure (if applicable), and temperature taken at the same time each day,** **- average daily values for volumes, operating pressure (if applicable), and temperature, orhourly accumulated flow rate and average hourly values for operating pressure (if applicable) and temperature.**	FB107 NOC Daily records available from the FB107 NOC are compliant	Section 6.8 of Directive 17
The monthly report is for the entire system, providing data for each measurement point. It isto contain the following at each measurement point as applicable:	FB107 NOC The listed information is available through non resettable totalizers, event log and well test history**.**	Section 6.8 of Directive 17

• **monthly cumulative flow** • **flags indicating any change made to flow volumes** • **total hours on production or hours of flow (specify)**		

The Meter Report **The meter report details the configuration of each meter and flow calculation information.** **These values are used as part of the "audit trail" to confirm that the flow calculation is functioning correctly. The meter report must include the following as applicable and be** **produced upon request:** **1) Instantaneous flow data:** **• instantaneous flow rate** **• instantaneous operating pressure** **• instantaneous flowing temperature** **• CTL** **• CPL** **2) Current configuration information:** **• meter identification** **• date and time** **• atmospheric pressure** **• pressure base** **• temperature base** **• calibrated operating pressure range** **• calibrated temperature range** **• meter factor and/or k factor** **• shrinkage factor**	FB107 NOC All instantaneous data for meter report can be accessed through modbus registers. The system also have the ability to provide a real time datalog report of all operating variables and calculated results per illustrated screen. The files can be viewed or logged with PC to a CSV Excel file.	Section 6.8 of Directive 17

The Event Log **The event log is used to note and record exceptions and changes to the flow parameter, configuration, programming, and database affecting flow calculations, such as** **• transmitter range changes** **• algorithm changes** **• meter factor or k-factor changes** **• other manual inputs**	FB107 NOC The system event log has the capacity to maintain and store up to 240 events in a circular log. The event log operates in a circular fashion with new entries overwriting the oldest entry when the buffer is full. The event log provides an audit trail history of past operation and changes. The system stores the event log separately from the alarm log to prevent recurring alarms from overwriting configuration audit data. In addition to providing functionality for appending new events to the log, the event log allows host packages to request the index of the most recently logged event entry. Event logging is available internally to the system, to external host packages, and to the FST	Section 6.8 of Directive 17

The Alarm Log **The alarm log includes any alarms that may have an effect on the measurement accuracy of the system. The time of each alarm condition and the time each alarm is cleared must be recorded. Alarms that must be reported include** **• master terminal unit failures** **• remote terminal unit failures** **• communication failures** **• low-power warning** **• high/low volumetric flow rate** **• overranging of end devices**	FB107 NOC The alarm log contains the change in the state of any alarm signal that has been enabled for alarms. The system alarm log has the capacity to maintain and store up to 240 alarms in a "circular" log. The alarm log has information fields that include time and date stamp, alarm clear or set indicator, and either the tag name of the point or a 14-byte detail string in ASCII format. In addition to providing functionality for appending new alarms to the log, the alarm log allows host packages to request the index of the most recently logged alarm entry. Alarm logging is available internally to the system, to external host packages, and to FSTs.	Section 6.8 of Directive 17