Cox®
Turbine Flow Meters

Flow Processor

EC80

Badger Meter®

CXX-UM-03060-EN-02 (February 2022)

User Manual

CONTENTS

DESCRIPTION

The EC80 Flow Processor provides a state-of-the-art interface for today's flow meters. With multiple frequency inputs and one temperature input in a compact design, the flow processor is compatible with single and dual rotor turbine flow meters for precise calculation and output of flow rate or accumulated flow. The linearization, viscosity and density correction features improve flowmeter accuracy to the highest levels available today. Our newest feature allows the flow processor, with a Cox Auto Viscosity Turbine Meter, to automatically measure and compensate for kinematic liquid viscosity.

SAFETY INFORMATION

The installation of the flow processor must comply with all applicable federal, state and local rules, regulations and codes.

Failure to read and follow these instructions can lead to misapplication or misuse of the flow processor, resulting in personal injury and damage to equipment.

Safety Symbol Explanations

⚠DANGER

INDICATES A HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED WILL RESULT IN DEATH OR SERIOUS PERSONAL INJURY.

⚠WARNING

INDICATES A HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED COULD RESULT IN DEATH OR SERIOUS PERSONAL INJURY.

⚠CAUTION

INDICATES A HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED COULD RESULT IN MINOR OR MODERATE PERSONAL INJURY OR DAMAGE TO PROPERTY.

UNPACKING AND INSPECTION

Upon opening the shipping container, visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

OPERATING PRINCIPLE

The EC80 Flow Processor accepts all types of square wave pulse inputs. Fully compensated and linearized volumetric flow rates, totals and temperature are examples of flow parameters that can be viewed through serial communications, included software program or an embedded rate indicator (depending on product configuration).

The EC80 Flow Processor can use a universal viscosity curve to compensate for varying liquid temperature and viscosity conditions. It can also use Strouhal-Roshko algorithms for a more comprehensive compensation method, taking into consideration all the secondary effects to which the meter is sensitive like the expansion and contraction of the meter bore diameter. The flow processor extracts the density value of a known liquid from a stored temperature/density table and multiplies by the volumetric flow rate to get the inferred mass flow rate.

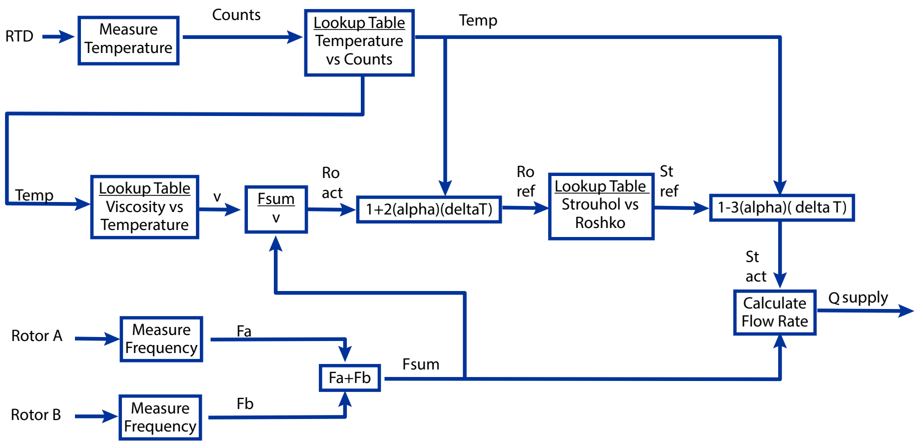


Figure 1: Flow Processor Calculations

INSTALLATION

Precautions

⚠CAUTION

- Turn off power supply prior to making any connections to the flow processor.
- Verify that the power supply is rated to deliver enough current for your application.
- Do not submerge or place flow processor in moisture-prone environments.
- Do not place the flow processor in close proximity to high voltage and/or current carrying lines. It is sensitive to Electro-Magnetic Interference (EMI).
- Verify that all terminations at the flow processor are free from frayed wires and terminate with proper insulation at terminal blocks.
- Before applying supply power, make sure the power setting is not in excess of the flow processor's rating. A setting over the rating will cause the flow processor to fail and not be covered under the warranty.
- Tighten all terminal block connections with reasonable firmness. Do not over-tighten the screw down terminals.
- Use adequately gauged wires for transferring signals to and from the flow processor printed circuit board (PCB).
- Make sure the PCB will not be exposed to excessive shock.
- Make sure the PCB will not be exposed to heat that exceeds the temperature rating of the flow processor electronics.
- Pay careful attention to the grounding scheme for your application. Use low impedance grounds, common to all electronics.
- If the PCB is exposed, be careful that debris, loose conductor strands or any other foreign matter does not come in contact with terminals and/or electrical components and connections.

Typical Configurations

RM1

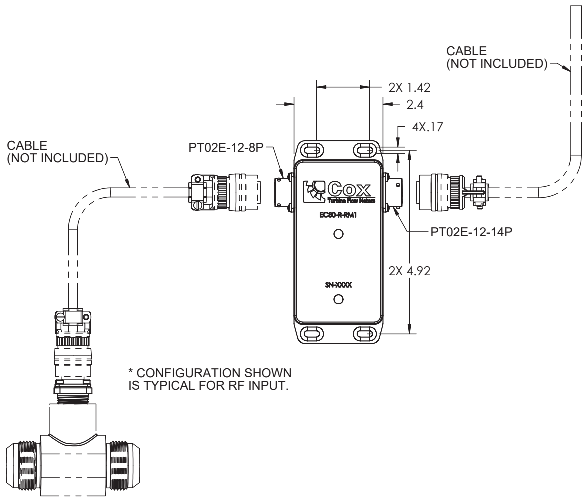


Figure 2: RM1 Configuration

RM2

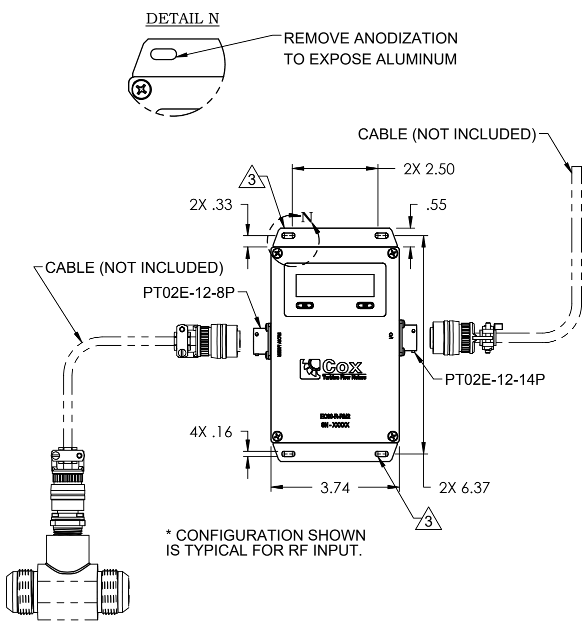


Figure 3: RM2 Configuration

XP1

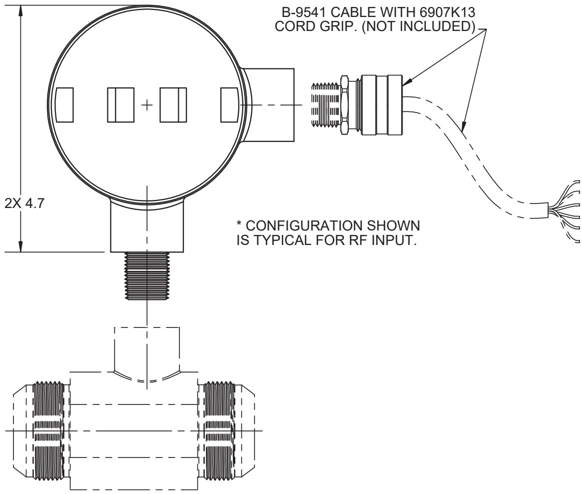


Figure 4: XP1 Configuration

INPUT

The flow processor has inputs for turbine meters (both single and dual rotor) and temperature. The flow processor calculates mass flow rates based on volumetric flow with temperature compensation.

Analog Input

You can configure the analog input for different types of temperature transducers. The flow processor is supplied with a 10 kΩ thermistor but can be jumper-configured for 0…5V DC, 0…10V DC or 4…20 mA temperature transducers. Consult the factory if you need to incorporate the analog input for reasons other than temperature acquisition. See *"Installation" on page 7* and *"Wiring and Jumpers" on page 12* to select a particular temperature transducer.

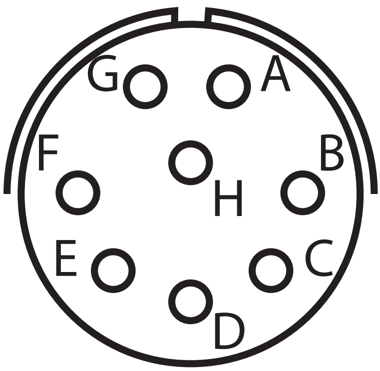


Figure 5: Input diagram

Function/Signal	Pinout	
	RM1	**RM2**
RF PICKOFF A	A	A
RF A RETURN	B	B
RF PICKOFF B	C	C
RF B RETURN	D	D
RF PICKOFF Q	N/A	N/A
RF Q RETURN	N/A	N/A
RTD EX+	E	E
RTD +	F	F
RTD –	G	G
RTD EX-	H	H

OUTPUTS

You can configure all flow processor outputs for different parameters, and can do so independently of other channels. Use the IFC15 software to program the following output parameters:

Frequency

- Linearized Flow Rate (Volumetric or Mass)
- Raw Frequency Rotor A
- Raw Frequency Rotor B
- Raw Sum; Frequency A + Frequency B (Dual Rotor Applications)
- Total Flow (Accumulation)

Analog

- Linearized Flow Rate
- Temperature

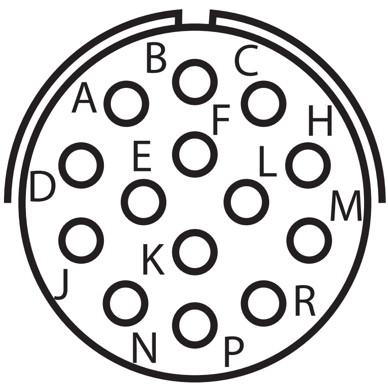


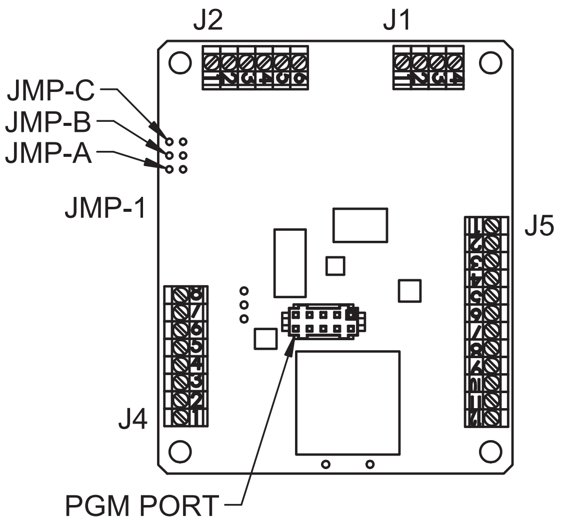
Figure 6: Output diagram

Function/Signal	Pinout	
	RM1	**RM2**
PWR +	A	A
PWR RETURN	B	B
RS-485 +	C	C
RS-485 –	D	D
RAW A OUT	E	E
RAW B OUT	F	F
GND	H	H
FREQ 1 OUT	J	J
FREQ 2 OUT	K	K
GND	L	L
ANALOG 1 VOLTAGE OUT	M	M
ANALOG 2 VOLTAGE OUT	N	N
AGND	P	P
ANALOG 4-20 mA RETURN –	P	P
ANALOG 4-20 mA OUT +	R	R

WIRING AND JUMPERS

RM1

EF4295 TERMINAL BLOCK LAYOUT



EC80 Flow Computer to PT02E-12-14P

			EC80			B-9541 CABLE	PT02E-12-14P
SCALING	UNITS	FUNCTION/SIGNAL	J1	J4	J5	WIRE COLOR	PINOUT
N/A	VDC+	PWR +	1			RED	A
	VDC-	PWR RETURN	2			BLK	B
N/A	N/A	RS-485 +			5	WHT	C
	N/A	RS-485 –			6	WHT/BLK	D
N/A	Hz	RAW A OUT		1		ORG	E
N/A	Hz	RAW B OUT		2		RED/WHT	F
N/A	Hz	GND		3		ORG/BLK	H
	Hz	FREQ 1 OUT		4		GRN	J
	Hz	FREQ 2 OUT		5		GRN/WHT	K
N/A	Hz	GND		6		GRN/BLK	L
	V	ANALOG 1 VOLTAGE OUT			9	BLU	M
	V	ANALOG 2 VOLTAGE OUT			8	BLU/WHT	N
N/A	N/A	AGND			7	BLU/BLK	P
N/A	N/A	ANALOG 4-20 mA RETURN –	3			RED/BLK	P
	mA	ANALOG 4-20 mA OUT +	4			BLK/WHT	R

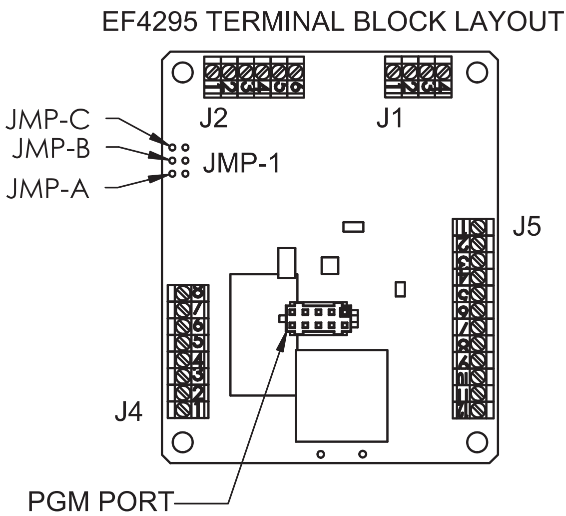
Flow-Meter to EC80 Flow Computer

B-9541 WIRE COLOR	FUNCTION/SIGNAL	J2	J5	PT02E-12-8P PINOUT
WHT	RF PICKOFF A	1		A
WHT	RF A RETURN	2		B
BLU	RF PICKOFF B	3		C
BLU	RF B RETURN	4		D
GRN	RF PICKOFF Q	5		N/A
GRN	RF Q RETURN	6		N/A
ORG	RTD EX+		4	E
ORG	RTD +		3	F
ORG	RTD –		2	G
ORG	RTD EX-		1	H

JMP-1 Pickoff Jumper Table

JMP-A	ON	ROTOR A	4 OHMS
JMP-A	OFF	ROTOR A	10 OHMS
JMP-B	ON	ROTOR B	4 OHMS
JMP-B	OFF	ROTOR B	10 OHMS
JMP-C	ON	ROTOR Q	4 OHMS
JMP-C	OFF	ROTOR Q	10 OHMS

RM2



EC80 Flow Computer to PT02E-12-14P

			EC80			B-9541 CABLE	PT02E-12-14P
SCALING	UNITS	FUNCTION/SIGNAL	J1	J4	J5	WIRE COLOR	PINOUT
N/A	VDC+	PWR +	1			RED	A
	VDC-	PWR RETURN	2			BLK	B
N/A	N/A	RS-485 +			5	WHT	C
	N/A	RS-485 –			6	WHT/BLK	D
N/A	Hz	RAW A OUT		1		ORG	E
N/A	Hz	RAW B OUT		2		RED/WHT	F
N/A	Hz	GND		3		ORG/BLK	H
	Hz	FREQ 1 OUT		4		GRN	J
	Hz	FREQ 2 OUT		5		GRN/WHT	K
N/A	Hz	GND		6		GRN/BLK	L
	V	ANALOG 1 VOLTAGE OUT			9	BLU	M
	V	ANALOG 2 VOLTAGE OUT			8	BLU/WHT	N
N/A	N/A	AGND			7	BLU/BLK	P
N/A	N/A	ANALOG 4-20 mA RETURN –	3			RED/BLK	P
	mA	ANALOG 4-20 mA OUT +	4			BLK/WHT	R

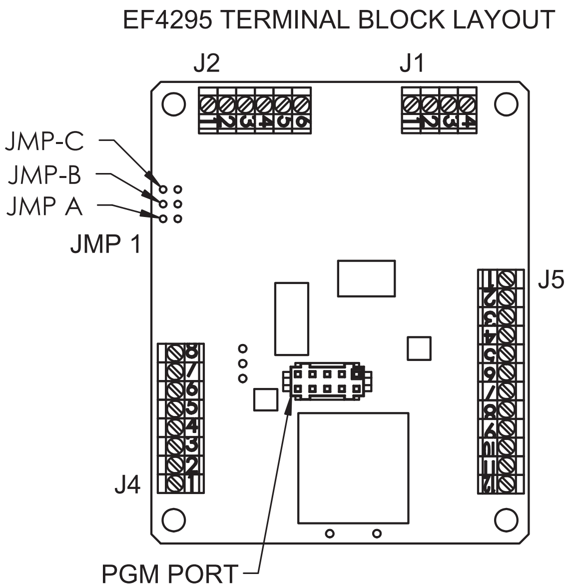
Flow-Meter to EC80 Flow Computer

B-954 WIRE COLOR	FUNCTION/SIGNAL	J2	J5	PT02E-12-8P PINOUT
WHT	RF PICKOFF A	1		A
WHT	RF A RETURN	2		B
BLU	RF PICKOFF B	3		C
BLU	RF B RETURN	4		D
GRN	RF PICKOFF Q	5		N/A
GRN	RF Q RETURN	6		N/A
ORG	RTD EX+		4	E
ORG	RTD +		3	F
ORG	RTD –		2	G
ORG	RTD EX-		1	H

JMP-1 Pickoff Jumper Table

JMP-A	ON	ROTOR A	4 OHMS
JMP-A	OFF	ROTOR A	10 OHMS
JMP-B	ON	ROTOR B	4 OHMS
JMP-B	OFF	ROTOR B	10 OHMS
JMP-C	ON	ROTOR Q	4 OHMS
JMP-C	OFF	ROTOR Q	10 OHMS

XP1



EC80 Flow Computer to B-9541 Cable

			EC			B-9541
SCALING	UNITS	FUNCTION/SIGNAL	J1	J4	J5	WIRE COLOR
N/A	VDC+	PWR +	1			RED
	VDC-	PWR RETURN	2			BLK
N/A	N/A	RS-485 +			5	WHT
	N/A	RS-485 –			6	WHT/BLK
N/A	Hz	RAW A OUT		1		ORG
N/A	Hz	RAW B OUT		2		RED/WHT
N/A	Hz	GND		3		ORG/BLK
	Hz	FREQ 1 OUT		4		GRN
	Hz	FREQ 2 OUT		5		GRN/WHT
N/A	Hz	GND		6		GRN/BLK
	V	ANALOG 1 VOLTAGE OUT			12	BLU
	V	ANALOG 2 VOLTAGE OUT			11	BLU/WHT
N/A	N/A	AGND			10	BLU/BLK
	mA	ANALOG 4-20 mA OUT +	4			RED/BLK
N/A	N/A	ANALOG 4-20 mA OUT –	3			BLK/WHT

JMP-1 Pickoff Jumper Table

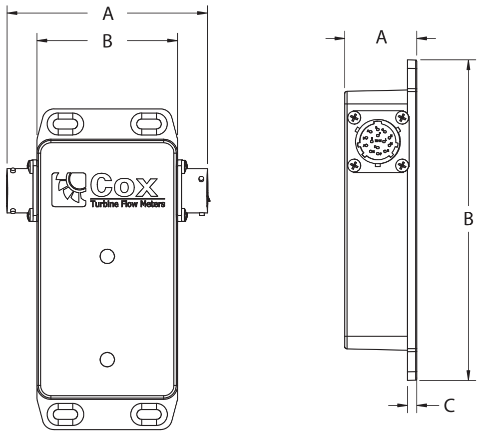
JMP-A	ON	ROTOR A	4 OHMS
JMP-A	OFF	ROTOR A	10 OHMS
JMP-B	ON	ROTOR B	4 OHMS
JMP-B	OFF	ROTOR B	10 OHMS
JMP-C	ON	ROTOR Q	4 OHMS
JMP-C	OFF	ROTOR Q	10 OHMS

Flow-Meter to EC80 Flow Computer

WIRE COLOR	FUNCTION/SIGNAL	J2	J5
WHT	RF PICKOFF A	1	
WHT	RF A RETURN	2	
WHT	RF PICKOFF B	3	
WHT	RF B RETURN	4	
WHT	RF PICKOFF Q	5	
WHT	RF Q RETURN	6	
RED OR YLW	RTD EX+		4
RED OR YLW	RTD +		3
WHT OR YLW	RTD –		2
WHT OR YLW	RTD EX-		1

DIMENSIONS

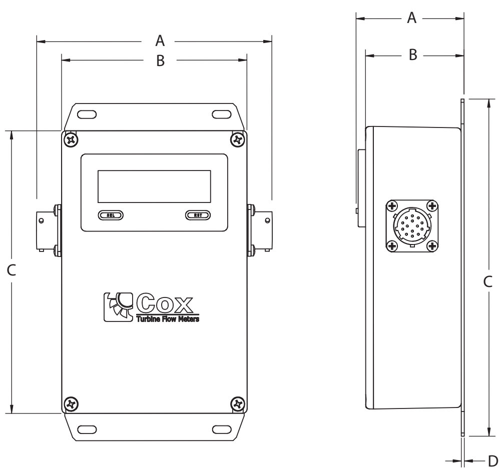
RM1 Configuration



Front View   Side View

	Front View	Side View
A	3.40 in (86.36 mm)	1.22 in. (30.99 mm)
B	2.38 in. (60.45 mm)	5.43 in. (137.92 mm)
C	—	0.16 in (4.06 mm)

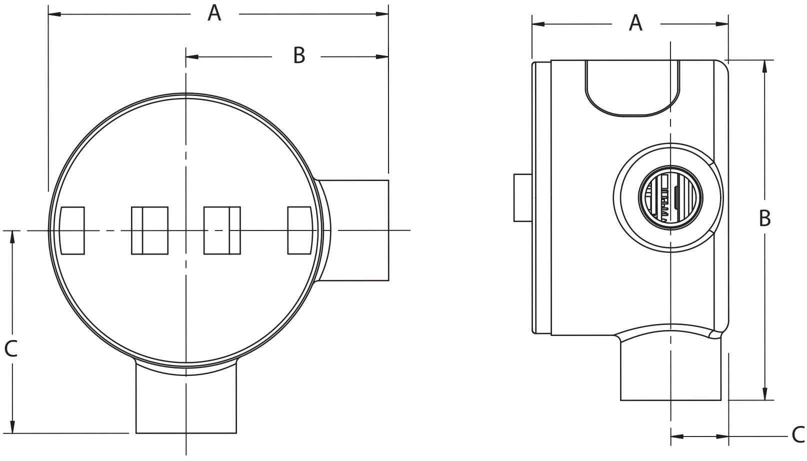
RM2 Configuration



Front View   Side View

	Front View	Side View
A	4.75 in (120.65 mm)	2.18 in. (55.37 mm)
B	3.74 in. (95.00 mm)	1.99 in. (50.55 mm)
C	5.71 in. (145.03 mm)	6.81 in. (172.97 mm)
D	—	0.06 in. (1.52 mm)

XP1 Configuration



Front View

Side View

	Front View	Side View
A	4.70 in. (119.38 mm)	2.71 in. (68.83 mm)
B	2.80 in. (71.12 mm)	4.70 in. (119.38 mm)
C	2.80 in. (71.12 mm)	0.80 in. (20.32 mm)

SPECIFICATIONS

Performance	**Linearized Frequency**	± 0.1% of reading
	Linearized Analog Output	± 0.1% of full scale
	Process Latency	100 µs
Input Power	**Nominal**	24V DC, 2w maximum
	With Digital Output	7…32V DC
	With Analog Output	12…32V DC
Temperature Environment	**Operating**	–40…185° F (–40…85° C)
	Storage	–67…257° F (–55…125° C)
	Humidity	0…80% RH, non-condensing
Flow Meter Input Type (A and B) (Two Independent Channels)	**Pulse TTL Compatible (A and B)**	Frequency range: 5 Hz…5.0 kHz
	RF Carrier 4 or 10 Ohm Pickup	Carrier frequency range: 25…65 kHz
		Frequency range: 5 Hz…5.0 kHz
RTD Temperature Input 4-Wire	**Type**	100 Ohm platinum, 0.00385 alpha
	Useable Range	–65…365° F (–55…185° C)
Analog Input (For Temperature)	5 Hz Sine Response	
	Voltage	0…5V or 0…10V DC
	ADC Resolution	12 bit (1/4096)
	Input Impedance	>100k Ohms
Frequency Output (Two Independent Channels)	0…5V, TTL, 1…20,000 Hz, square wave	
	50% duty cycle	
	Minimum Load Impedance	10k Ohm
Analog Outputs (Two Independent Channels)	16-bit resolution	
	Channel One	4…20 mA, 0…5V DC or 0…10V DC
	Channel Two	0…5V DC or 0…10V DC
	Load Impedance (4…20 mA)	500 Ohms maximum
EIA-485 Serial Data	**Baud**	115k
	Update Rate	Selectable, 0.1 sec minimum
	Data Bits	8
	Stop Bit	1
	Parity	None
Raw Frequency Output (Two Independent Channels)	0…5V, TTL, 5…3500 Hz, square wave	
	5k Ohm minimum load	
Enclosure Environmental Rating	**Remote**	Aluminum enclosure with weatherproof mounting flange
	Remote with Display	Aluminum enclosure with weatherproof mounting flange
	Blind Integral	NEMA 4 (IP65) Class 1, Groups C and D Class 2, Groups E, F and G Class 3, WET LOC — Cast Aluminum
Remote Cable Length	**Flow Meter to EC80**	20 ft (6.1 m)
	EC80 to DAQ or Control System	100 ft (30.5 m)
Software	Conforms to SAE ARP4990 calculations for temperature	

USING THE IFC SOFTWARE

NOTE: When you first run the program, if any error messages display, close them out. The *IFC configuration* has not been initialized yet.

Password Initialization

The *Password* feature allows only users with permission to access or manipulate the data in the configuration profile and flow processor.

If multiple users are interfacing with the software, set a default *User Name* and *Password* that is easily remembered. For example: *User Name*=**admin**; *Password*=**admin**

Un-installing or re-installing does not erase any set users.

To set the password for the first time, or to add a user name later:

1. Click the **Options** icon in the upper left portion of the toolbar of the main GUI screen.

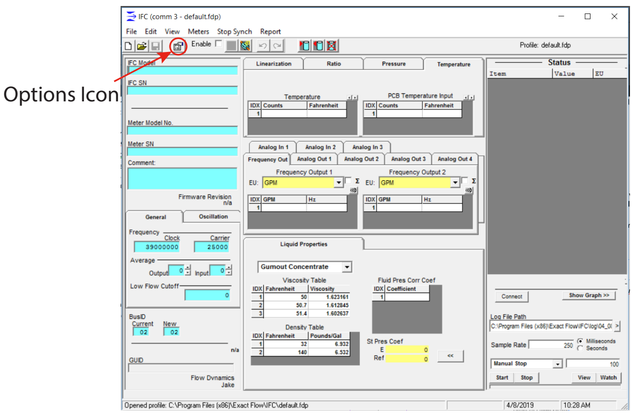


Figure 7: Options icon

2. Select the **General** tab to view the password options.

NOTE: The *General* options are also available from *File > Options > General*.

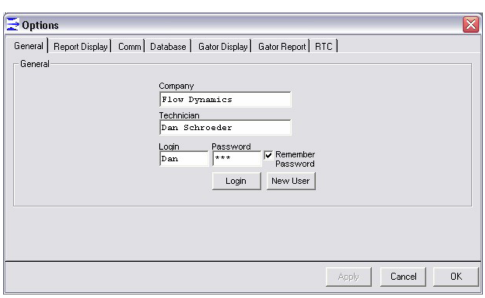


Figure 8: General options

3. Enter a *Company* name and *Technician* name. These two fields remain the same when opening the *Options* window, and are not protected.
4. Enter a *Login* name and *Password* to be associated with a specific profile.

IMPORTANT

Be sure to write down the password or click the Remember Password checkbox. Entering an incorrect password locks the software.

5. Click **New User**.
6. Enter the same password in the *Confirm Password* box, and click **OK**. After confirmation a new user is created and you are returned to the options screen.

Figure 9: Confirm password box

7. Click **Login** to login with the user you just created. The currently logged-in person can then access the *Graphical User Interface (GUI)*, and make changes to IFC profiles.

NOTE: The first user to initialize the software can also choose to add new users.

Establish Link Via RS485

You need to establish communication between the PC and the flow processor hardware before you can program the flow processor using IFC. Make sure the cable is connected and the flow processor is powered on.

NOTE: You can see which com port you are connected to using your operating system's device manager.

To establish communications:

1. Click the **Options** icon  in the upper left portion of the toolbar of the main GUI screen.
2. Select the *Comm* tab to view the communications configuration options.

NOTE: The *Comm* tab is also available from *File* > *Options* > *Comm*.

3. From the drop-down menu, select the communication port.
4. Set the *Baud Rate* to **115200**.
5. Click **Apply**.
6. Click **OK**.
7. View the status area for connection info.

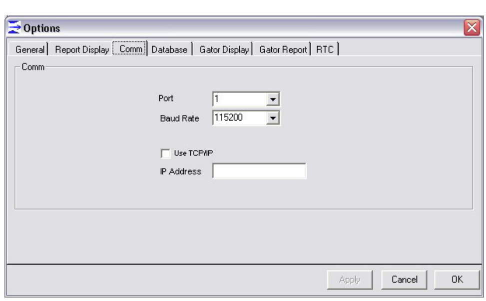


Figure 10: Comm Section

Establish Link Via Ethernet

If the flow processor in use is capable of Ethernet communication you can connect to the PC with an ethernet cable.

To establish communications:

1. Check the **Use TCP/IP** box.
2. Type the *IP Address* for the connected flow processor.
3. View the Status area for connection info.

PROFILE

A profile is all the information that is programmed into the software, including Linearization tables, liquid properties, input and output settings, and others. You can use a profile to program the EC80 Flow Processor. You can also upload a profile from a previously programmed flow processor, save a profile for later use and copy a profile.

The following sections describe how to work with profiles.

Creating, Saving and Loading Profiles

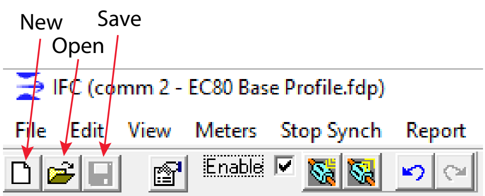


Figure 11: New, Load and Save buttons

Create a new profile by going to *File>New* or clicking the New button on the toolbar. Save a new profile by selecting *File>Save As* and then choosing a save location and filename. You can quickly save the file later by selecting *File>Save*, or clicking the Save button on the toolbar. Open a previously saved profile by selecting *File>Open*, or clicking the Open button on the toolbar.

Uploading a Profile

You can upload an existing profile from the EC80 Flow Processor and save it under a different filename, then manipulate the data, yet still retrieve the old data if necessary.

IMPORTANT

Always keep an OEM copy (original) of the profile, in case you want to restore the factory configuration.

1. Click the **Upload** button in the toolbar of the main GUI screen. This retrieves the profile currently stored in the flow processor (if previously downloaded) and places all profile data from the flow processor in the GUI.
2. Click the **File** menu.
3. Click **Save As**.

4. Click the **Down Arrow** the *Save In:* field and browse to the directory in which you want to save the file.
5. In the *File name:* field, type a name for your file (for example, YOUR FILE NAME.fdp).
6. Make sure the *Save as Type:* field indicates *Profiles (*.fdp)* and click **Save**.

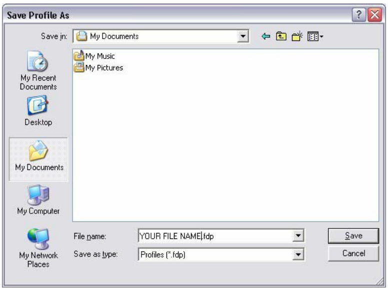


Figure 12: Save profile

All tables and configuration information are now in the profile for ready access.

PROFILE PROGRAMMING

You can Enter data into a profile and use it to program the flow processor.

You can program profiles in two ways:

- Manually change each cell value to correspond with calibration data, or
- Import multiple values into the interface using Microsoft Excel®.

Although the *Linearization* table is the table most often modified, any of the data entry look-up tables can be modified. Make sure to follow these guidelines when importing or exporting the data.

- Always erase the cell(s) entirely before entering data so the new data does not combine with prior profile data.

NOTE: To erase all cells of a grid, right-click the **IDX** button in the upper left corner of the grid and select **Clear Grid**.

- The number of XY pairs imported from Excel must be less than or equal to the available number of index numbers (IDX) for each respective look-up table.
- To avoid truncation or excessive interpolation of profile data, make sure the Excel data tables match the maximum number of columns for each respective look-up table. For example, if the table holds 100 XY pairs, then maximize the resolution of the table by placing points at all 100 index points.
- Data obtained through independent testing needs to be manually entered, cell by cell, or entered into Excel first and then copied into the profile.

- If the data collected is not formatted to use the maximum number of IDX entries in the GUI, accuracy is jeopardized. For example, if independent testing yields only 50 Roshko/Strouhal points (IDX linearization entries) the data will not be as accurate as it would be by using all 100 points in the *Linearization* table.
- Data tables interpolate between points.
- Data tables do not extrapolate beyond the minimum and maximum values. The flow processor holds the last value in the table, if the threshold is exceeded.

Flow processors with factory-created profiles have pre-formatted data in the cells of each lookup table. Powerful software, in conjunction with highly repeatable and accurate calibration systems, provides Badger Meter the ability to fit accurate curves to calibration profiles. Using linear, exponential or logarithmic interpolation, the flow computer can use and optimize the maximum number of IDX entries.

Table Data Entry

To **manually** modify or update a table in the IFC software (using the linearization table as an example):

1. Navigate to the table.
2. Right-click the **IDX** button in the upper left corner of the grid and select **Clear Grid**. The table may change appearance slightly.

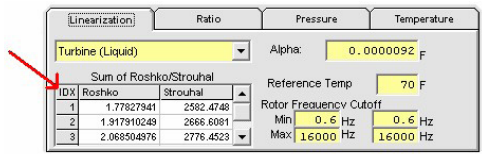


Figure 13: IDX button

3. Click in each cell and type the new value.

IMPORTANT

Be careful when typing the values, as keystroke errors can occur. Verify all data entries prior to downloading the profile into the EC80 Flow Processor.

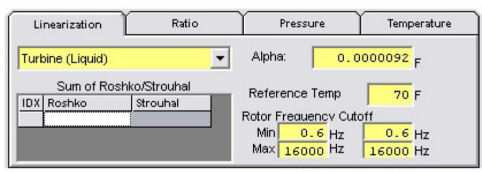


Figure 14: Example table

A more convenient method is to copy and paste multiple data entries from Microsoft Excel. This procedure saves time and provides data accuracy.

To ***import*** multiple values into the interface using Microsoft Excel:

1. In Excel, highlight a minimum of 2 (X,Y) pairs and a maximum of up to 200 (X,Y) pairs, and copy them to the clipboard.
    a. For example, if we had a total of three Roshko/Strouhal (X,Y) pairs (for the example Linearization table, other tables use different calculated values), the Excel spreadsheet would be set up as below:

Roshko (X)	**Strouhal (Y)**
1.7782794	1.77827941
1.9179102	2666.6081
2.068505	2776.4523

    b. Click and drag over the data to be copied, but not the column or row labels. Only grab the raw data from the Excel spreadsheet. Make sure that the Roshko values are located on the left side as the X-axis variable, and the Strouhal values are on the right side as the Y-axis variable (for the example Linearization table, other tables have different calculated values).

c. With the Roshko/Strouhal values highlighted, right-click in the shaded area and click **Copy** to place data onto the clipboard. Alternatively, with the data highlighted, press **Ctrl+C** to copy the data to the clipboard.

2. Switch to or re-open the GUI and right-click **IDX** in the upper left corner of the table.
3. Select **Paste Grid** to copy the raw data from the clipboard to the table.

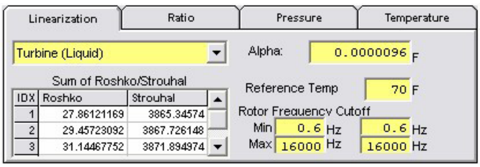


Figure 15: Pasted table

Linearization

The *Linearization* process takes a raw, non-linear output from a turbine meter and performs mathematical calculations to provide a linearized output. The EC80 Flow Processor uses the Roshko/Strouhal method for correlating the meter's volumetric flow rate and reflects the sum of all rotors. In a single rotor application, the sum Roshko and sum Strouhal equate to the correlation of a single rotor. In a dual rotor application, the sum Roshko and sum Strouhal equate to the correlation of both rotors, summed together.

The minimum number of IDX (X,Y) entries for the linearization table is 2. The maximum number of IDX (X,Y) entries for the linearization table is 200. Fill out the table according to instructions in *"Table Data Entry" on page 25*.

In addition to the Linearization table itself, a number of additional fields on the linearization tab can be changed. Although not typically modified from factory settings, they perform additional advanced operations in the EC80 Flow Processor.

Field	**Function**
Alpha	Corresponds to the coefficient of thermal expansion of the flow meter housing. This field is factory configured for the thermal expansion of stainless steel. The thermal expansion coefficient for stainless steel is 9.6×10^{-4} or 0.0000096. Other expansion coefficients are available from the factory.
Reference Temp	The reference temperature, in degrees Fahrenheit, in which the calibration data was obtained. Typical calibration reports state the reference temperature in which the data was obtained, and should be the same as the temperature in which the Roshko/Strouhal calibration data was obtained.
Rotor Frequency Cutoff	These fields limit the output of the flow processor to a minimum and maximum frequency threshold. If rotor frequency decreases below the minimum flow rate or over the maximum flow rate, the flow processor stops outputting a flow rate. The left column corresponds to the rotor frequency of the A rotor (Upstream), and the right column is for the B rotor (Downstream). In single rotor applications, only the left field is used.

Standard vs. Auto-Viscosity

The EC80 Flow Processor, when used with a dual rotor turbine meter, incorporates the ability to determine liquid viscosity directly from the turbine meter. The *Auto-Viscosity* feature is applicable only to liquid viscosities at or below 40 cStk. If you are unsure as to what range of viscosity you are operating over, please contact Badger Meter, as a large database of liquid properties has been generated.

To select the *Auto-Viscosity* feature:

1. Click the **Linearization** tab on the GUI interface main screen.

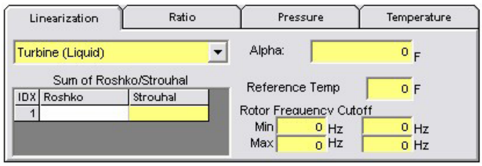


Figure 16: Linearization tab

2. Click on the drop-down menu.

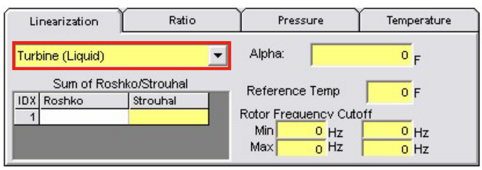


Figure 17: Liquid drop-down menu

3. Highlight **Turbine (Liquid - Auto Viscosity)** and click to select:

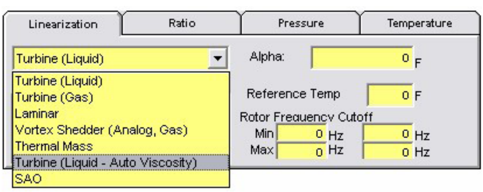


Figure 18: Auto Viscosity option

The *Linearization* table displays, showing the *Auto-Viscosity* feature enabled. Remember, the liquid being metered must be below 40 cStks to use this feature. If you're unsure of the liquid's viscosity, call Badger Meter at 877-243-1010.

Rotor Ratio

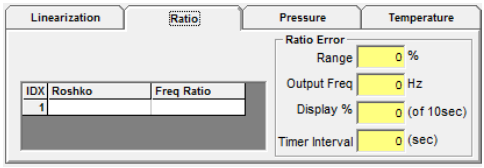


Figure 19: Ratio tab

The *Rotor Ratio* table provides a number of powerful diagnostic and analytical features. In dual-rotor applications, the ratio of the upstream and downstream rotors can be compared to provide self checks, diagnostic provision or automatically determine the liquid viscosity.

Rotor ratio is typically configured at the factory; however it can be implemented by the user as well. The flow processor obtain's frequency data from each rotor and calculates the frequency ratio. Once the flow processor calculates the ratio it associates a high order polynomial and a Roshko number to the data. The frequency ratio is calculated as follows:

$$\text{RotorRatio} = \frac{\text{Fb}}{\text{Fa}}$$

Where, *Fa* = Frequency of Rotor A, and *Fb* = Frequency of rotor B.

Use this ratio function to address any potential failures in the meter. Because the flow processor is comparing the frequency output of one rotor to the other, you can determine if bearing failure, pickoff failure or even liquid particulates are hindering meter performance. This same method is also used to determine viscosity.

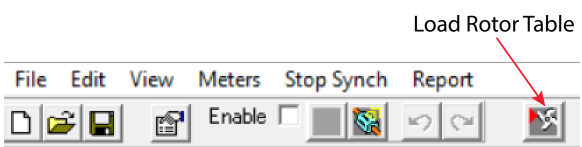


Figure 20: Load rotor table button

Upon editing any fields contained in the *Rotor Ratio* table, the Load Rotor Table button appears in the menu bar as seen in *Figure 20*. This provides the ability to write updated *Rotor Ratio* information to the EC80 Flow Processor.

NOTE: The Load Rotor Table button does not write the entire profile down to the flow processor, it only writes the information contained in the Rotor Ratio table.

Field	**Function**
Error Range	If the ratio is exceeded by the set percentage, the flow processor will output zero flow, therefore stating a malfunction has occurred. Further prognosis could lead to pickoff failure, bearing failure or flow processor failure
Error Timer	Once the ratio is exceeded, therefore indicating a failure of some kind, the error timer dictates how long the meter will have to stay in excess of the current set ratio percentage, before an error condition occurs and zero flow results

Pressure Calibration

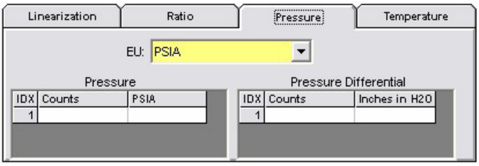


Figure 21: Pressure tab

The *Pressure* table is used for calibrating pressure transducers. Pressure calibration does not apply to the EC80 flow processor.

Temperature Compensation

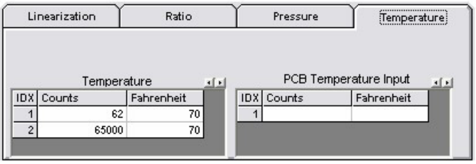


Figure 22: Temperature tab

The *Temperature* table provides the necessary calibration of the flow processor's temperature input device. Obtain a temperature profile by testing the temperature sensor being used. The temperature profile is unique to the individual sensor. To calibrate the temperature sensor:

1. Place the temperature sensor in a temperature bath.
2. Enter the temperature vs. counts data into the Temperature Compensation table.

Typical applications use either a 10kΩ Thermistor or 100 Ohm Platinum RTD. This provides the flow processor the look-up table necessary for temperature acquisition.

CONFIGURING FLOW PROCESSOR OUTPUTS AND INPUTS

Frequency Outputs (1 and 2)

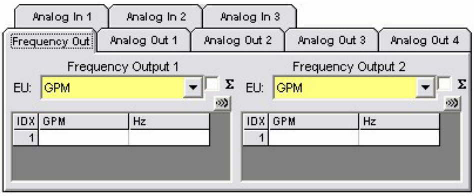


Figure 23: Frequency out tab

The *Frequency Out* table is used for configuring both of the EC80 Flow Processor's frequency outputs. All EC80 Flow Processors come with 2 frequency channels, and the channels can be configured independently. Use this table to completely configure the type of information to be output for each channel, and adjust the output scaling. A few possible types are volumetric flow rates, mass flow rates, temperature (both ° F and ° C), the sum of rotor frequencies (Rotor A + Rotor B), pressure and differential pressure.

1. Click the down arrow to select the engineering unit. The engineering units for Frequency 1 and frequency 2 do not need to be the same.
2. Fill the tables according to instructions in *"Table Data Entry" on page 25*. The first entry typically corresponds to zero flow and is set to zero Hertz, while the last entry is typically maximum flow. The maximum output frequency is sixteen Hertz.

NOTE: Setting the maximum flow rate to a frequency greater than 16 kHz causes the flow processor to output 16 kHz.

Σ Click the summation check box to enable totalizing (accumulation) of the frequency output. This feature is only applicable to special firmware editions. The feature needs to be configured at the factory and is not available in standard applications. The feature works by summing flow rates and outputting a frequency proportional to total flow, not flow rate.

The test frequency button takes the value input as the scaling frequency and outputs that frequency from the flow processor. Use this feature to verify that the flow processor is outputting the appropriate frequency and to verify the calibration of the flow processor.

Analog Output (Channels 1, 2, 3 and 4)

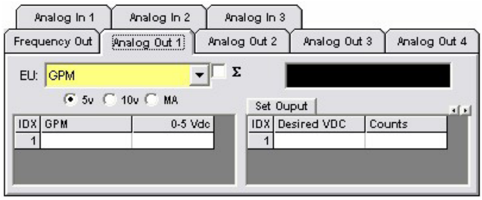


Figure 24: Analog out 1 tab

Use the *Analog Out* tables to configure the EC80 Flow Processor's analog channels. Use this table to completely configure the type of information and scaling. Not all EC80 Flow Processor boards have an analog output. If yours does, use this procedure. You can select the engineering unit for things such as volumetric flow rate, mass flow rate and temperature.

NOTE: The EC80 Flow Processor needs to be jumper-configured prior to selecting the corresponding electrical type. See *"Wiring and Jumpers" on page 12* for more information.

The electrical waveform needs to match your board's jumper configuration.

1. Select the bullet next to the waveform for which the flow processor's analog channel is jumper-configured (0…5V DC, 0…10V DC or 4…20 mA).
2. Select the engineering unit from the drop-down menu.
3. Fill the tables according to instructions in *"Table Data Entry" on page 25*. The first entry typically corresponds to zero flow, and is set to 0V DC or mA.

Calibrate Analog Channels

In addition to adjusting the scaling and determining the unit of measurement, you need to calibrate the analog channels. Typically, 10 points are performed in calibration, evenly spaced throughout the range of the channel. For instance, on a 0…10V channel, the output would be calibrated at 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10V DC.

1. Use a multimeter to monitor the output.
2. Press the left or right arrows to adjust the Digital-to-Analog Converter (DAC) counts until the multimeter reads the correct value.
3. Click **Set Output** to store the number of DAC counts and move on to the next index point.

Use the summation check box for totalizing (accumulation) of the frequency output. This feature is only applicable to special firmware editions. The feature needs to be configured at the factory and is not available in standard applications. The feature works by summing flow rates and outputting a frequency proportional to total flow, not flow rate.

Configuring Analog Input

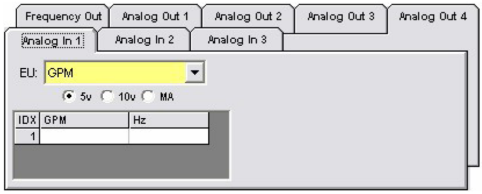


Figure 25: Analog input 1 tab

You can configure the analog inputs (*Analog In 1*, *Analog in 2* and *Analog In 3*) to accept external analog devices.

Typically, this applies to flow processors that use pressure compensation, where an external pressure transducer is used. In special instances, analog inputs may be used for other functions. Consult the factory if your application includes an analog input.

The electrical waveform needs to match your board's jumper configuration. See *"Wiring and Jumpers" on page 12* for more information.

1. Select the bullet next to the waveform that the flow processor's analog channel is jumper-configured for (0…5V DC, 0…10V DC or 4…20 mA).
2. Select the engineering unit from the drop-down menu.
3. Fill the tables according to instructions in *"Table Data Entry" on page 25*. The first entry typically corresponds to zero flow, and is set to zero V DC or mA.

CONFIGURING LIQUID PROPERTIES

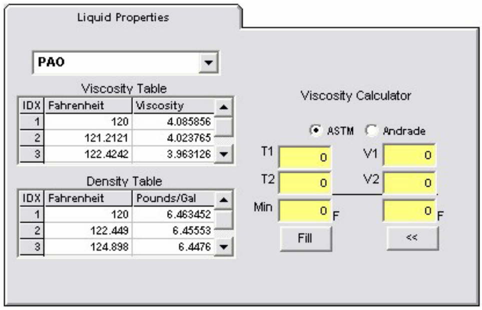


Figure 26: Liquid properties tab

Use the *Liquid Properties* table to correct for changes in liquid viscosity, compute mass flow rate via density tables and provide pressure versus viscosity compensation.

Use the drop-down menu to select a liquid and display the liquid properties that were factory configured.

If needed, create a new liquid by following these instructions:

1. Click the text of the drop-down menu to highlight the text.
2. Type a new liquid name.
3. Fill the viscosity table through use of the viscosity calculator or import a table.
4. Click the Save Liquid Tables button to Save the new liquid.

When you change the data in the table or re-name an existing liquid, the software shows additional options in the menu bar:

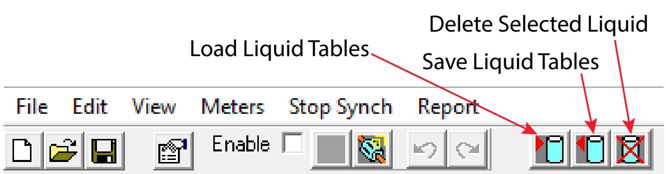


Figure 27: Liquid tables buttons

The teal cylinders buttons appear for modification of the liquid registry. The choice is:

Field	Function
Load Liquid Tables	Loads the currently stored liquid tables. The liquid tables are stored on the PC
Save Liquid Tables	Overwrites any existing liquids stored on the PC and creates a group of liquids based on what is saved
Delete Selected Liquid	Deletes the currently selected liquid from the liquid registry. Liquids are selected via the drop-down box or placing your cursor in the corresponding liquids table, which activates the liquid and allows for deletion from the liquid registry

Temperature vs Viscosity Table

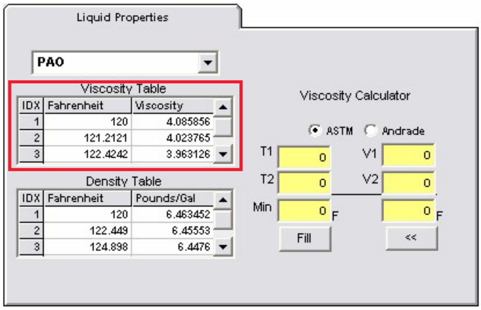


Figure 28: Temperature vs Viscosity Table

You can populate the entire viscosity table, all 100 index points, with the Viscosity Calculator tool. You need to know two liquid viscosities and the corresponding liquid temperature and enter them in the yellow cells.

NOTE: Please pay close attention to appropriate units when entering data into the fields above. The temperature units are in Fahrenheit (° F), the Density units are in Pounds per Gallon (Pounds/Gal) and Viscosity is in Centi-Stokes (cStk). The temperature engineering unit (T1 and T2) is degrees Fahrenheit (° F) and kinematic viscosity (V1 and V2) is in centistokes (cStk).

To populate the table:

1. Type a liquid name in the white field near the top of the table.
2. Click the bullet next to the **ASTM** or **Andrade** method for computation of viscosity. The ASTM equation is typically more accurate.
3. Input the lesser temperature value and the corresponding viscosity value in the top-most yellow data fields of the viscosity calculator (T1 and V1), and the greater temperature value and the corresponding viscosity value in the middle row of yellow data fields of the viscosity calculator (T2 and V2).

⚠CAUTION

NOTE: Do not place the lesser temperature on the middle row of yellow cells because that causes the viscosity calculator to fail and possibly corrupt profile data.

4. Specify minimum and maximum temperature values. This tells the viscosity calculator over which range in temperature to populate the temperature vs viscosity table.

NOTE: Exceed your intended operating temperature by 5…10 degrees or more so that temperature range is not exceeded and proper viscosity correction takes place in the flow processor.

5. Click the **Fill** button to populate the temperature vs viscosity table.

The software calculates the viscosity across the entire specified temperature range. The most commonly used and most accurate method for calculating viscosity is the *ASTM* method. However, the *Andrade* method may be used.

NOTE: All calculations are done per ASTM D341 when *ASTM* is selected.

Temperature vs Density Table

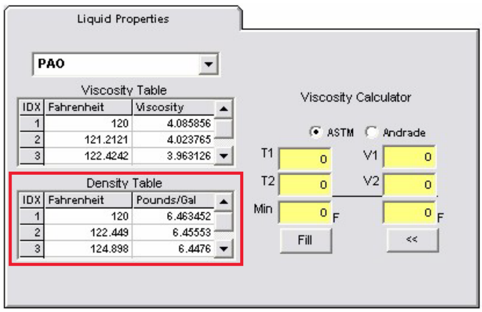


Figure 29: Temperature vs Density Table

The density table is only applicable when a mass flow rate is needed. Using the flow meters temperature sensor, density is calculated from the *Temperature vs Density* table and then multiplied by the volumetric flow rate to obtain the mass flow rate.

$MassFlowRate = VolumetricFlowRate \times Density$

Leave these fields blank or clear the table using the IDX button (right-click the **IDX** button and select **Clear Grid**), if a mass flow rate is not needed.

You will need to get the density properties from our factory or independently in order to calculate mass flow rate. If difficulty arises in obtaining density information regarding your liquid, have Badger Meter test the liquid properties in our laboratory, and supply you with the temperature vs density information.

Liquid Pressure Compensation

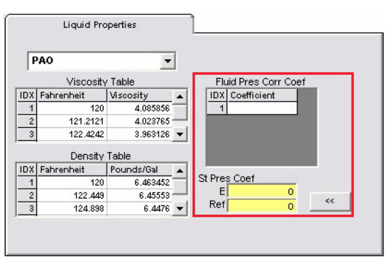


Figure 30: Liquid Pressure Correction Coefficient table

Liquid pressure compensation is not available for the EC80 Flow Processor.

HARDWARE CONFIGURATION

Model Information

The model information is on the left side of the interface. It shows information pertaining to the profile currently loaded (For example, if you upload a profile from the flow processor, the hardware information is for that flow processor). The model information is input at the factory and offers our technicians the base information needed for troubleshooting or profile tracking. **Do not change these factory settings**.

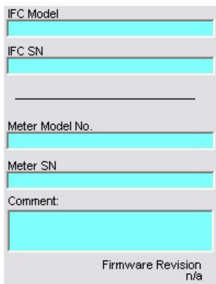


Figure 31: Model information

Field	Function
IFC Model	Identifies the configuration of EC80 Flow Processor for which the profile was designed
IFC SN	Provides traceability of an individual EC80 Flow Processor and associated documentation
Meter Model No	Identifies the configuration and features of the flow meter
Meter SN	Provides traceability and calibration information for the flow meter
Firmware Revision	States the flow processors firmware configuration and provides historical revision control

General Hardware Information

The general hardware information is on the left side side of the interface just below the model information. It contains factory configuration information regarding the *Clock Frequency*, *Carrier Frequency*, *Input and Output Average,* and *Low Flow Cutoff* (in gpm).

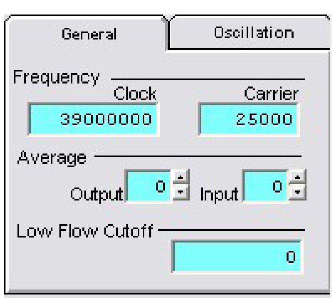


Figure 32: General hardware information

NOTE: The clock frequency and carrier frequency match the particular model of flow processor in use. ***Do not change these factory settings***.

Field	Sub-Field	Function
Frequency	Clock (Hz)	Configured at the factory to match individual EC80 Flow Processor.
	Carrier (Hz)	Configured at the factory to optimize resonance curve when using RF carrier pickoffs.
Average	Output (Cycles)	The number of output samples necessary before the flow processor yields a single value at the output. If data obtained from the flow processor is updating too fast, use this feature to smooth the data so more samples are taken prior to outputting a value.
	Input (Cycles)	The number of input samples necessary before the flow processor yields a single value at the processor. If data obtained from the flow processor is updating too fast, use this feature to smooth the data so more samples are taken prior to inputting a value to the processor.
Low Flow Cutoff	Numeric Entry (GPM)	The low flow cutoff omits erroneous data in the low flow region of a turbine meter. Near zero state conditions or pulsating flow may cause erratic readings near zero flow. In this case, the flow processor can be told to not output a flow rate below the set flow rate. Low Flow Cutoff is typically set to zero and not used.

Oscillation

The *Oscillation* tab is only used at the factory to calibrate the flow processor's internal clock. ***Do not change these factory settings***.

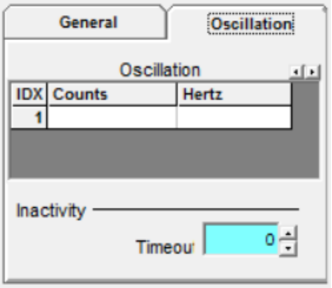


Figure 33: Oscillation tab

Meter Selection (BUS ID)

The software has provisions for multi-drop applications, where multiple flow processors need to communicate to one central location. In order to address multiple meters, you must designate a different Bus ID# to each flow processor. There are 256 available Bus IDs (0…FF). Each ID consists of a one- or two-digit hexadecimal value, where 0 = 0, and 255 = FF. In order for the software to search and display a particular flow processor, you must upload the Bus ID (see instructions below). This tells the interface to attempt communication with that particular Bus ID.

The Bus ID information displays in the lower left corner of the main screen.

Figure 34: Bus ID information

To address an individual flow processor:

1. Click on the **Current Bus ID #** field.
2. Change the value to correspond with the meter to be addressed.
3. Click the **Upload** icon on the toolbar of the main GUI screen.
   The profile from the flow processor you addressed then populates the software interface with the information stored in that particular flow processor.
4. (Optional) Click the **Download** icon to place another flow processor's profile into the currently selected flow processor.

REAL-TIME MONITORING

The EC80 Flow Processor outputs real-time values via the established RS485 communication. Parameters and variables can be viewed in the *Status* section of the IFC15 GUI. The *Status* screen displays the item (variable), the numerical value, the engineering unit, and, if applicable, the number of counts associated with that particular variable.

You can select which parameters to view in the options menu under the *Report Display* tab. See *"Report Display" on page 43* for more information. The *Report Display* is programmed from the factory to display a core group of variables. More variables can be applied to the report format.

The status display is shown in *Figure 35*; however it is necessary to follow the instructions in *"Real-Time Report Display"* to establish real-time update of the selected variables.

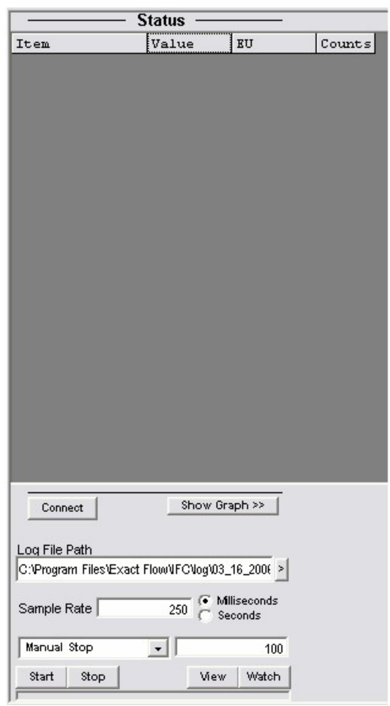


Figure 35: Status section

Real-Time Report Display

To view the parameters in real-time, a flow processor must have established communication with the PC and be communicating properly.

Once connected, click the **Connect** button below the *Status* window.

NOTE: See *"Report Display" on page 43* for all the variables for monitoring.

In addition to viewing all real time variables, you can also access the following features:

The *Show Graph* button switches the logging information section to a small graph of the currently selected table. To select another table, click somewhere in that table's data.

Use the IFC GUI data logging feature to create a log of selected data measured over a period of time. The GUI sends information to a tab-delimited file. The software measures the information either for a pre-programmed or manually selected amount of time.

Figure 36: Log File field

To configure the IFC GUI to provide log reports:

1. Type or browse to a location on your computer to output data logging. This designates the file name and location in which you wish to store the information.
2. Type a numeric value in the *Sample Rate* field to specify how often a new entry should be placed in the data log.
3. Select either seconds (**S**) or milliseconds (**mS**).
4. Select the interval stop from the drop-down menu, by clicking the drop-down menu, then clicking an option to select it.

Option	Function
Manual Stop	Manual stop begins data logging when you click **Start** and ends data logging when you click **Stop**.
Timed Stop (Seconds)	Timed stop (Seconds) begins data logging when you click **Start** and ends data logging when it reaches the numerical value adjacent to the drop-down menu. For Example, if 100 were placed in the time field adjacent to the drop-down menu, 100 seconds would elapse before the data would cease to log.
Timed Stop (Minutes)	Timed stop (Minutes) begins data logging when you click **Start** and ends data logging when upon reaching the numerical value adjacent to the drop-down menu. For Example, if 100 were placed in the time field adjacent to the drop-down menu, 100 minutes would elapse before the data would cease to log.
Timed Stop (Date)	Timed stop (Date) begins data logging when you click **Start** and ends data logging when upon reaching the numerical value adjacent to the drop-down menu. For Example, if 1/1/20 were placed in the time field adjacent to the drop-down menu, the GUI would continue to log data until January 1st 2020.
Sample Stop	Sample stop begins data logging when you click **Start**. The software logs one sample's worth of data and stops at the set interval in the sample rate field.

Viewing Log

To view the log being populated, click **View**. You will be transferred to the logging file you have designated. Values update at the intervals set.

Watching Log

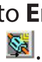
To watch the log being populated in real-time, click **Watch**. You will be transferred to the logging file you have designated.

FLOW PROCESSOR PROGRAMMING

Connect all sensors, transducers, pickups and com-link cables to the EC80 Flow Processor before powering up the computer. Communication needs to be established with the EC80 Flow Processor prior to uploading or downloading a profile. All flow processors, unless specially configured, communicate via an RS485 connection to the PC. The PC, in conjunction with an RS485 converter is required for communicating with the flow processor. Ask your sales representative regarding purchase of USB-to-RS485 converters (PN EF I-7561).

Downloading Profiles

Downloading a profile is how you use all the information you programmed into the IFC GUI to program the flow processor. Follow this procedure to download the current profile to the flow processor:

1. Click the white box next to **Enable** on the tool bar.
2. Click the **Download** icon . All information in the data tables, either blank or populated, is written to the flow processor.

Locating Multiple EC80 Flow Processors

The *Locate IFC* function is for users who use many flow processors that all communicate with a central PC. Daisy-chained flow processors, all communicating via RS485, can be addressed individually via their corresponding Bus ID. You can search to see which flow processors are currently connected in the loop. Since each flow processor has its own Bus ID, each flow processor appears on this display. Information such as the Bus ID, Firmware Revision and GUID hexadecimal string can all be displayed in this screen.

To locate an EC80 Flow Processor:

1. Click the **View** menu.
2. Click **Find IFC**.

Figure 37: Locate IFC window

The **Refresh** button clears the display and begins searching again for EC80 Flow Processors.

The **Get Profile** button loads the currently selected flow meter's profile into the GUI tables so you can modify the tables.

Commands

The *Commands* feature is for specific applications where polling or Ethernet configurations are being used. Do not use this feature unless the application requires it. Consult your sales representative if this feature interests you.

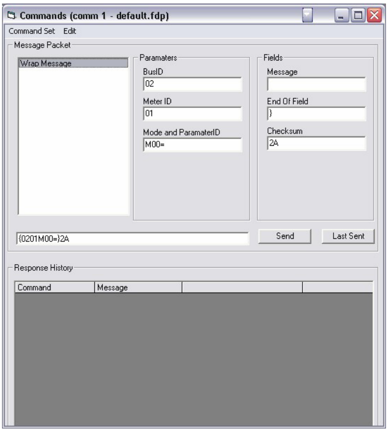


Figure 38: Commands menu

CONFIGURATION OPTIONS

Access the options menu either by clicking the **Options Icon**, or navigating to *File>Options*.

General

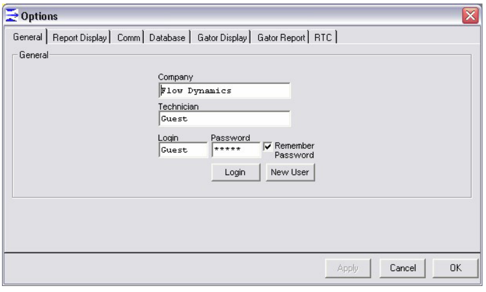


Figure 39: General tab

Use the *General* tab for user sign in. A company name, technician name, login ID and password can be set here. See *"Password Initialization" on page 20* for more information.

Report Display

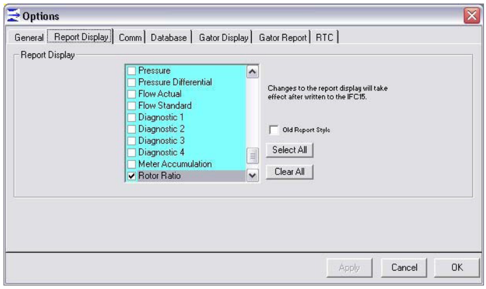


Figure 40: Report display tab

Use the *Report Display* tab to select which flow processor variables to view in the *Status* window. Every variable the flow processor uses for computation of flow is listed here. If you want to display all the variables, click **Select All**. To display none of the variables, click **Clear All**. To view the old report style, click the box next to *Old Report Style*.

Communication (Comm.)

Use the *Communications* tab to establish communications with the flow processor. See *"Establish Link Via RS485" on page 21* or *"Establish Link Via Ethernet" on page 22* for more information.

Database, Gator Display, Gator Report and Real Time Clock (RTC)

The Database, Gator Display, Gator Report and Real Time Clock (RTC) tabs are currently used for Flow Gator products. They are not applicable to the EC80 Flow Processor.

VERSION INFORMATION

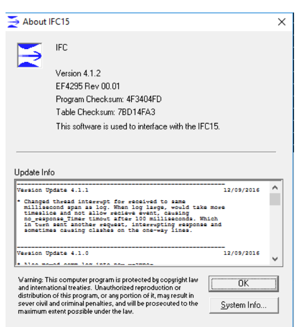


Figure 41: Version information window

Click the **View** menu bar and select **About** to display important information regarding the software. The factory may ask for the version of software you are using.