

# SECTION K

## ANALOG FLOW METERS

Revision Date: 5-9-23

### ANALOG FLOW METER - AFM1

The Analog Flow Meter AFM1 provides all the necessary logic and parameters to take the selected Analog Input's data and process it for the display of the Flow Rate in gallons / minute and the Flow Totalizer in gallons.

The Analog Flow Meter AFM1 receives a 4-20mA signal from a field device that measures the Flow Rate (Flow Meter). The 4-20mA signal from Flow Meter must be connected to one of the Analog Inputs on the Controller. The Analog Input must be setup so that its data is sent to Analog Flow Meter AFM1. To do this, the Analog Input selected for this task must have its Analog Input Setup parameter set for Function 3. See Parameters F.299 - F.308 in Section C. The value of the selected Analog Input in its unscaled form is displayed as the Analog Flow Rate Input (Parameter Fd.91), which has a range of 819 - 4095.

The logic in the Analog Flow Meter first takes the Analog Flow Rate Input (Parameter Fd.91) and subtracts 819 giving it a new range of 0 - 3276. Next the value is multiplied by the Multiply By Conversion Factor (Parameter P.552). Then it is divided by the Divide By Conversion Factor (Parameter P.553). The Flow Rate, scaled into gallons / minute is then made available to be viewed from Parameter Fd.92.

The Analog Flow Meter also keeps a running total of the flow and displays it on the Flow Totalizer. The flow total is stored in an EEPROM, so that no data is lost during a power outage. The Flow Totalizer value should be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Flow Totalizer value is in gallons and may be viewed from Parameter Fd.93.

Please see page K-4 for instructions on how to determine the Multiply and Divide By Conversion Factors.

User / Operator Info.		SCADA		Register Address	Description of Parameters and SCADA Notes
Parameter	Default Value	Current Value			
<b>Analog Flow Meter AFM1 - Setup</b>					
P.551	1		40551	Analog Flow Meter AFM1 - Mode 0 = Flow Meter Disabled    1 = Flow Meter Enabled	
P.552	1000		40552	Analog Flow Meter AFM1 - Multiply By Conversion Factor    Range: 1 - 65,535 Note: The Analog Flow Rate Input is first conditioned to have a range of 0 - 3,276 and is then multiplied by the value set on this parameter.	
P.553	3276		40553	Analog Flow Meter AFM1 - Divide By Conversion Factor    Range: 1 - 65,535 Note: After the Analog Flow Rate Input is multiplied by Parameter P.552, it is then divided by the value set on this parameter.	
P.554	240		40554	Analog Flow Meter AFM1 - Signal Conditioning Control    Range: 1 - 254 100 = Slow    240 = Normal    250 = Fast	
<b>Analog Flow Meter AFM1 - Data</b>					
Fd.91	-	-	42190	Analog Flow Meter AFM1 - Analog Flow Rate Input Notes: 1. Parameter Fd.91 shows the unscaled value from the Analog Input selected as the Analog Flow Rate Input for AFM1. It has a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The selected Analog Input must have its Analog Input Setup set for Function 3.	
Fd.92	-	-	42191	Least Significant of 32-Bit Number	Analog Flow Meter AFM1 - Flow Rate - gallons / minute  Display Range: 0 - 4,294,967,295
			42192	Most Significant of 32-Bit Number	
Fd.93	-	-	42193	Least Significant of 32-Bit Number	Analog Flow Meter AFM1 - Flow Totalizer - gallons  Display Range: 0 - 4,294,967,295
			42194	Most Significant of 32-Bit Number	
To reset AFM1 Flow Total to zero momentarily set Modbus Coil 222 (Register 40014 Bit 13).					

## ANALOG FLOW METER - AFM2

The Analog Flow Meter AFM2 provides all the necessary logic and parameters to take the selected Analog Input's data and process it for the display of the Flow Rate in gallons / minute and the Flow Totalizer in gallons.

The Analog Flow Meter AFM2 receives a 4-20mA signal from a field device that measures the Flow Rate (Flow Meter). The 4-20mA signal from Flow Meter must be connected to one of the Analog Inputs on the Controller. The Analog Input must be setup so that its data is sent to Analog Flow Meter AFM2. To do this, the Analog Input selected for this task must have its Analog Input Setup parameter set for Function 4. See Parameters F.299 - F.308 in Section C. The value of the selected Analog Input in its unscaled form is displayed as the Analog Flow Rate Input (Parameter Fd.94), which has a range of 819 - 4095.

The logic in the Analog Flow Meter first takes the Analog Flow Rate Input (Parameter Fd.94) and subtracts 819 giving it a new range of 0 - 3276. Next the value is multiplied by the Multiply By Conversion Factor (Parameter P.557). Then it is divided by the Divide By Conversion Factor (Parameter P.558). The Flow Rate, scaled into gallons / minute is then made available to be viewed from Parameter Fd.95.

The Analog Flow Meter also keeps a running total of the flow and displays it on the Flow Totalizer. The flow total is stored in an EEPROM, so that no data is lost during a power outage. The Flow Totalizer value should be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Flow Totalizer value is in gallons and may be viewed from Parameter Fd.96.

Please see page K-4 for instructions on how to determine the Multiply and Divide By Conversion Factors.

User / Operator Info.		SCADA		Description of Parameters and SCADA Notes	
Parameter	Default Value	Current Value	Register Address		
<b>Analog Flow Meter AFM2 - Setup</b>					
<b>P.556</b>	0		40556	Analog Flow Meter AFM2 - Mode 0 = Flow Meter Disabled    1 = Flow Meter Enabled	
<b>P.557</b>	1000		40557	Analog Flow Meter AFM2 - Multiply By Conversion Factor    Range: 1 - 65,535 Note: The Analog Flow Rate Input is first conditioned to have a range of 0 - 3,276 and is then multiplied by the value set on this parameter.	
<b>P.558</b>	3276		40558	Analog Flow Meter AFM2 - Divide By Conversion Factor    Range: 1 - 65,535 Note: After the Analog Flow Rate Input is multiplied by Parameter P.557, it is then divided by the value set on this parameter.	
<b>P.559</b>	240		40559	Analog Flow Meter AFM2 - Signal Conditioning Control    Range: 1 - 254 100 = Slow    240 = Normal    250 = Fast	
<b>Analog Flow Meter AFM2 - Data</b>					
<b>Fd.94</b>	-	-	42200	Analog Flow Meter AFM2 - Analog Flow Rate Input Notes: 1. Parameter Fd.94 shows the unscaled value from the Analog Input selected as the Analog Flow Rate Input for AFM2. It has a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The selected Analog Input must have its Analog Input Setup set for Function 4.	
<b>Fd.95</b>	-	-	42201	Least Significant of 32-Bit Number	Analog Flow Meter AFM2 - Flow Rate - gallons / minute  Display Range: 0 - 4,294,967,295
			42202		
<b>Fd.96</b>	-	-	42203	Least Significant of 32-Bit Number	Analog Flow Meter AFM2 - Flow Totalizer - gallons  Display Range: 0 - 4,294,967,295
			42204		
To reset AFM2 Flow Total to zero momentarily set Modbus Coil 223 (Register 40014 Bit 14).					

## ANALOG FLOW METER - AFM3

The Analog Flow Meter AFM3 provides all the necessary logic and parameters to take the selected Analog Input's data and process it for the display of the Flow Rate in gallons / minute and the Flow Totalizer in gallons.

The Analog Flow Meter AFM3 receives a 4-20mA signal from a field device that measures the Flow Rate (Flow Meter). The 4-20mA signal from Flow Meter must be connected to one of the Analog Inputs on the Controller. The Analog Input must be setup so that its data is sent to Analog Flow Meter AFM3. To do this, the Analog Input selected for this task must have its Analog Input Setup parameter set for Function 5. See Parameters F.299 - F.308 in Section C. The value of the selected Analog Input in its unscaled form is displayed as the Analog Flow Rate Input (Parameter Fd.97), which has a range of 819 - 4095.

The logic in the Analog Flow Meter first takes the Analog Flow Rate Input (Parameter Fd.97) and subtracts 819 giving it a new range of 0 - 3276. Next the value is multiplied by the Multiply By Conversion Factor (Parameter P.562). Then it is divided by the Divide By Conversion Factor (Parameter P.563). The Flow Rate, scaled into gallons / minute is then made available to be viewed from Parameter Fd.98.

The Analog Flow Meter also keeps a running total of the flow and displays it on the Flow Totalizer. The flow total is stored in an EEPROM, so that no data is lost during a power outage. The Flow Totalizer value should be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Flow Totalizer value is in gallons and may be viewed from Parameter Fd.99.

Please see page K-4 for instructions on how to determine the Multiply and Divide By Conversion Factors.

User / Operator Info.		SCADA		Description of Parameters and SCADA Notes
Parameter	Default Value	Current Value	Register Address	
<b>Analog Flow Meter AFM3 - Setup</b>				
P.561	0		40561	Analog Flow Meter AFM3 - Mode 0 = Flow Meter Disabled    1 = Flow Meter Enabled
P.562	1000		40562	Analog Flow Meter AFM3 - Multiply By Conversion Factor    Range: 1 - 65,535 Note: The Analog Flow Rate Input is first conditioned to have a range of 0 - 3,276 and is then multiplied by the value set on this parameter.
P.563	3276		40563	Analog Flow Meter AFM3 - Divide By Conversion Factor    Range: 1 - 65,535 Note: After the Analog Flow Rate Input is multiplied by Parameter P.562, it is then divided by the value set on this parameter.
P.564	240		40564	Analog Flow Meter AFM3 - Signal Conditioning Control    Range: 1 - 254 100 = Slow    240 = Normal    250 = Fast
<b>Analog Flow Meter AFM3 - Data</b>				
Fd.97	-	-	42210	Analog Flow Meter AFM3 - Analog Flow Rate Input Notes: 1. Parameter Fd.97 shows the unscaled value from the Analog Input selected as the Analog Flow Rate Input for AFM3. It has a range of: 819 @ 4.0mA & 4,095 @ 20mA. 2. The selected Analog Input must have its Analog Input Setup set for Function 5.
Fd.98	-	-	42211	Least Significant of 32-Bit Number
			42212	Most Significant of 32-Bit Number
Analog Flow Meter AFM3 - Flow Rate - gallons / minute Display Range: 0 - 4,294,967,295				
Fd.99	-	-	42213	Least Significant of 32-Bit Number
			42214	Most Significant of 32-Bit Number
Analog Flow Meter AFM3 - Flow Totalizer - gallons Display Range: 0 - 4,294,967,295				
To reset AFM3 Flow Total to zero momentarily set Modbus Coil 224 (Register 40014 Bit 15).				

## ANALOG FLOW METERS - AFM1, AFM2 & AFM3

The Controller determines the Flow Rate scaled into gallons / minute by the following procedure:

- Step 1: The Controller takes the Analog Flow Rate Input, with a range of 819 - 4095, and subtracts 819 from it giving it a new range of 0 - 3276.
- Step 2: Next the Controller takes the Analog Flow Rate Input (with its new range of 0 - 3276) and multiplied it by the Multiply By Conversion Factor.
- Step 3: The last step is for the Controller to divide by the Divide By Conversion Factor.

Flow Rate Equation:

$$\text{Flow Rate (gallons / minute)} = (\text{Analog Flow Rate Input}) \times \frac{\text{Multiply By Conversion Factor}}{\text{Divide By Conversion Factor}}$$

The Multiply By and Divide By Conversion Factors are determined based on the Calibration of the Flow Meter's Analog Output, which will be in gallons / minute @ 20mA.

### Determining the Multiply By and Divide By Conversion Factors

#### Example 1

The SC5000's Analog Flow Meter AFM1 receives a 4-20mA signal from a remote pipe mounted Flow Meter which has its Analog Output calibrated for: 1000 gallons / minute @ 20mA.

For the SC5000's Analog Flow Meter AFM1 to read correctly, what should its Multiply and Divide By Conversion Factor be set on?

Flow Rate Equation:

$$\text{Flow Rate (gallons / minute)} = (\text{Analog Flow Rate Input}) \times \frac{1000 \text{ gallons / minute}}{3276}$$

$$\text{Multiply By Conversion Factor} = 1000$$

$$\text{Divide By Conversion Factor} = 3276$$

#### Example 2

The SC5000's Analog Flow Meter AFM1 receives a 4-20mA signal from a remote pipe mounted Flow Meter which has its Analog Output calibrated for: 90.5 gallons / minute @ 20mA.

For the SC5000's Analog Flow Meter AFM1 to read correctly, what should its Multiply and Divide By Conversion Factor be set on?

Flow Rate Equation:

$$\text{Flow Rate (gallons / minute)} = (\text{Analog Flow Rate Input}) \times \frac{90.5 \text{ gallons / minute}}{3276}$$

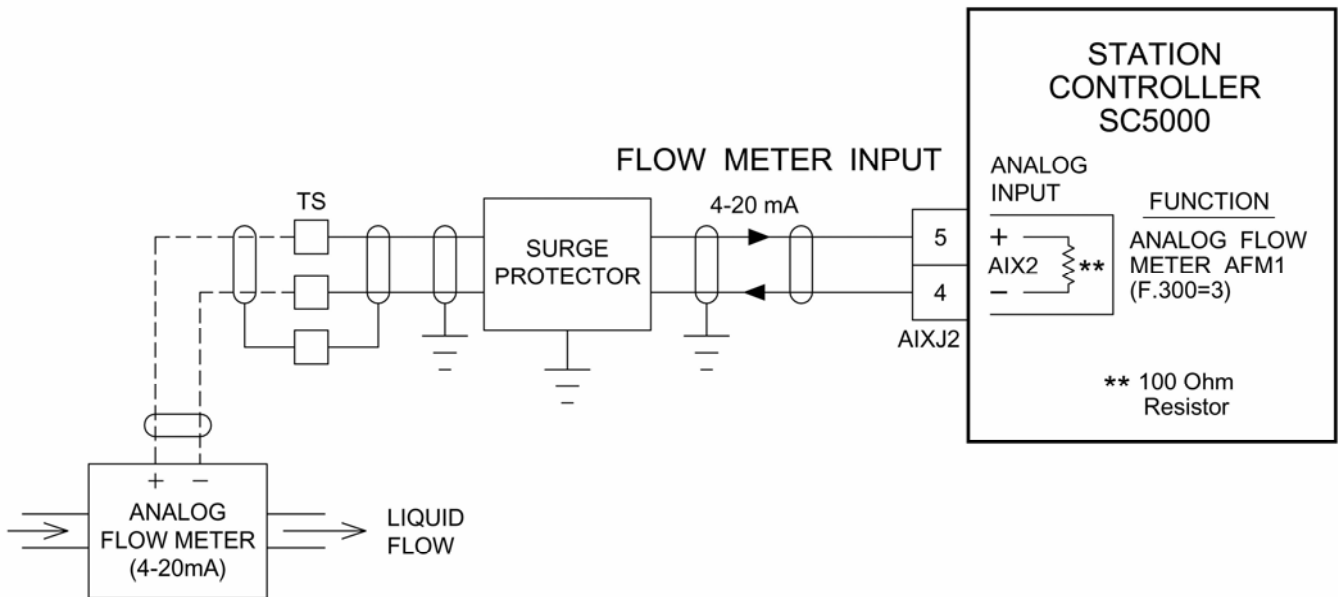
The number 90.5 can not be entered into a parameter, because it is a decimal number. Therefore, both Conversion Factors must be multiplied by 10, giving the following values:

Revised Flow Rate Equation:

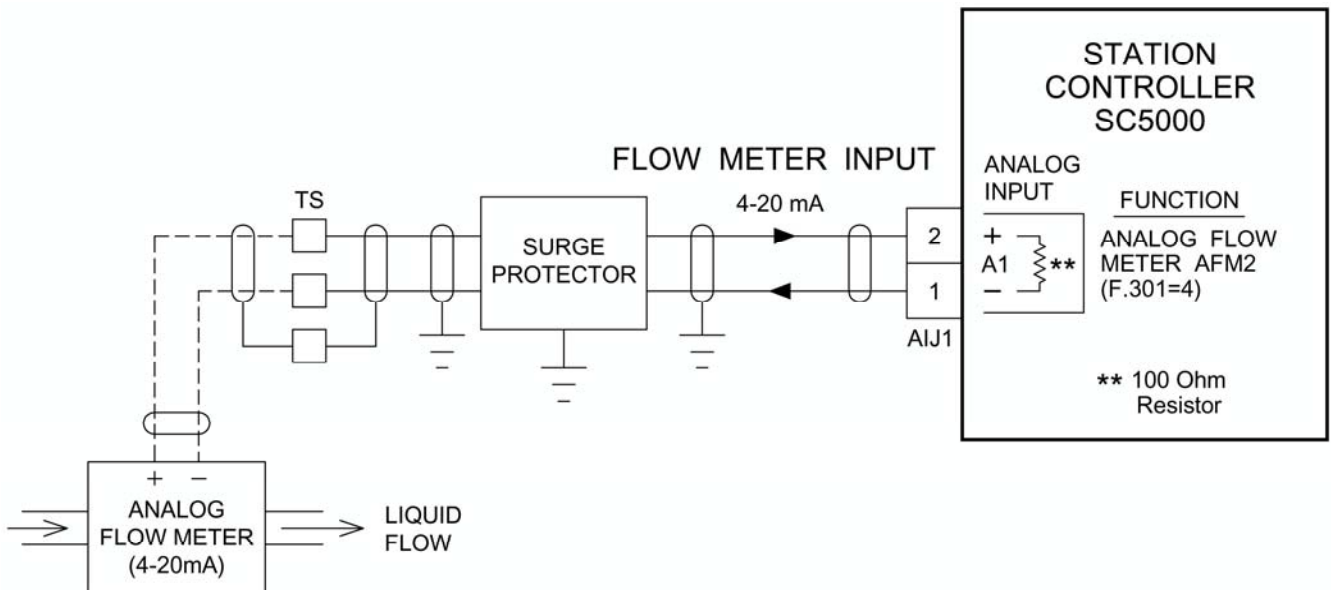
$$\text{Flow Rate (gallons / minute)} = (\text{Analog Flow Rate Input}) \times \frac{905 \text{ gallons / minute}}{32760}$$

## ANALOG FLOW METER INPUT EXAMPLES

### Using Analog Input AIX2 where the Analog Flow Meter provides a Powered Output



### Using Analog Input A1 where the Analog Flow Meter provides a Powered Output



**Note:**

All the Analog Inputs on the SC5000 are isolated from Power Supply ground and may be connected to remote devices that are at a different ground potential.

## ANALOG FLOW METER - Touchscreen HMI SCREENS

### Analog Flow Meter Data Display - Typical of Analog Flow Meter AFM1 - AFM3

ANALOG FLOW METER DATA DISPLAY - AFM1 Previous Screen

FLOW RATE (gallons / minute) 1,234,512,345  
Parameter: Fd.92

FLOW TOTALIZER (gallons) 1,234,512,345  
Parameter: Fd.93

Flow Totalizer rolls over to zero at:  
4,294,967,295 gallons

Flow Meter Setup FLOW TOTALIZER RESET

### Analog Flow Meter Setup - Typical of Analog Flow Meter AFM1 - AFM3

ANALOG FLOW METER SETUP - AFM1 Previous Screen

Analog Flow Rate Input

Analog Input Range:  
819 @ 4.0mA  
4095 @ 20mA

1234  
Parameter: Fd.91

Multiply by Conversion Factor 12345  
Parameter: P.552

Divide by Conversion Factor 12345  
Parameter: P.553

Flow Meter Mode 1  
Parameter: P.551

0 = Flow Meter Disabled  
1 = Flow Meter Enabled

Signal Conditioning Control 123  
Parameter: P.554

100 = Slow  
240 = Normal  
250 = Fast

The Analog Input used to provide the Flow Rate Input must have its Analog Input Setup parameter set for Function 3, in order to be connected to the Analog Flow Meter AFM1.