

SECTION K FLOW CALCULATOR

Revision Date: 3-20-24

Latest Inflow Rate **65,535** gallons / minute
Parameter: Fd.01

Display Range: 0 - 65,535

Inflow Totalizer **4,294,967,295** gallons
Flow Total since the last Inflow Totalizer Reset.
Parameters: Fd.02

Display Range: 0 - 4,294,967,295

To Reset Inflow Totalizer:
Momentarily set Modbus Coil 610
(Register 40039 Bit 1).

Pump 1 - Outflow Rate **65,535** gallons / minute
Parameter: Fd.04

Display Range: 0 - 65,535

Pump 2 - Outflow Rate **65,535** gallons / minute
Parameter: Fd.05

To Reset Pump 1 - 4 Outflow Rates:
Momentarily set Modbus Coil 611
(Register 40039 Bit 2).

Pump 3 - Outflow Rate **65,535** gallons / minute
Parameter: Fd.06

Pump 4 - Outflow Rate **65,535** gallons / minute
Parameter: Fd.07

Average Daily Inflow Total **4,294,967,295** gallons / day
Flow Totals from the Last 7 days Averaged Together.
Parameters: Fd.10

Display Range: 0 - 4,294,967,295

Data Used to Calculate the **Average Daily Inflow Total**

Current Day

4,294,967,295

Parameters: Fd.12

Daily Inflow Totals gallons / day

Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
4,294,967,295	4,294,967,295	4,294,967,295	4,294,967,295	4,294,967,295	4,294,967,295	4,294,967,295
Parameters: Fd.14	Fd.16	Fd.18	Fd.20	Fd.22	Fd.24	Fd.26

Newest Complete Day's Data

Display Range: 0 - 4,294,967,295

Oldest Complete Day's Data

FLOW CALCULATOR DATA

Latest Inflow Rate - The Most Recently Determined Flow Rate into the Lift Station

The Flow Calculator determines the “Latest Inflow Rate” of liquid flowing into the lift station by observing how long it takes for the wet well level to rise a “known distance”, while all pumps are off. Knowing the surface area of the wet well (Parameter P.77), the volume of liquid per minute flowing into the wet well is calculated. The “known distance” used in the calculation is a change in level of one foot when an Analog Level Input is used (Level Input Select: Parameter P.22 = 1), or the distance between electrodes (Parameter P.27) when using Level Probe Inputs (Level Input Select: Parameter P.22 = 2). The “Latest Inflow Rate”, in gallons / minute, may be viewed from Parameter Fd.01.

Inflow Totalizer - The Inflow Total since the last “Inflow Totalizer Reset”

The Flow Calculator keeps a running total of how much liquid flows into the lift station, since the last “Inflow Totalizer Reset”, which resets the totalizer to zero. The Inflow Totalizer value must be read and recorded at some consistent interval (daily, weekly, monthly) and then reset back to zero. The Inflow Totalizer value is in gallons and may be viewed from Parameters Fd.02. To reset the Inflow Totalizer momentarily set Modbus Coil 610 (Register 40039 Bit 1).

Pump 1-4 Outflow Rate - The Most Recently Determined Outflow Rate of Each Pump

The Flow Calculator also determines and updates the “Pump Outflow Rate” of each pump whenever it completes a pumping cycle by itself. This is done by first calculating the volume of liquid in the wet well between the level where the pump was turned on and where it was turned off, and then adding to it what had flowed into the wet well while the pump was running (“Latest Inflow Rate” multiplied by the “Pump Run Cycle Time”). This total volume of liquid is then divided by the “Pump Run Cycle Time” to arrive at the “Pump Outflow Rate”. The most recent “Pump Outflow Rate” of each pump in gallons / minute, may be viewed from Parameters Fd.04 - Fd.07. To Reset to zero momentarily set Modbus Coil 611 (Register 40039 Bit 2).

Average Daily Inflow Total - The Inflow Totals from the Last 7 days Averaged Together

The Flow Calculator uses the “Latest Inflow Rate” to keep a running total of how much liquid flows into the lift station during a 24 hour period. This is done for each 24 hour period. The flow totals from the previous 7 days are all kept stored. These flow totals are added together and divided by 7. The “Average Daily Inflow Total”, in gallons may be viewed from Parameters Fd.10.

Parameter	Register Address	Data Description	
Flow Calculator - Latest Inflow Rate			
Fd.01	42101	Flow Calculator - Latest Inflow Rate (gallons / minute)	Display Range: 0 - 65,535
Flow Calculator - Inflow Totalizer			
Fd.02	42102	Least Significant of 32-Bit Number	Flow Calculator - Inflow Totalizer (gallons) Display Range: 0 - 4,294,967,295
	42103	Most Significant of 32-Bit Number	
Inflow Totalizer Reset - To Reset Inflow Totalizer to zero momentarily set Modbus Coil 610 (Register 40039 Bit 1).			
Flow Calculator - Pump 1 - 4 Outflow Rate			
Fd.04	42104	Flow Calculator - Pump 1 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.05	42105	Flow Calculator - Pump 2 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.06	42106	Flow Calculator - Pump 3 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.07	42107	Flow Calculator - Pump 4 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Pump Data Reset - To Reset Pump 1 - 4 Outflow Rate to zero momentarily set Modbus Coil 611 (Register 40039 Bit 2).			
Flow Calculator - Average Daily Inflow Total			
Fd.10	42110	Least Significant of 32-Bit Number	Flow Calculator - Average Daily Inflow Total (gallons) Display Range: 0 - 4,294,967,295
	42111	Most Significant of 32-Bit Number	

FLOW CALCULATOR DATA

Daily Inflow Total - Current Day

This is inflow data that is currently being collected. It is the total of the inflow that has been collected, since the last “Start New Day” command. Upon receiving the “Start New Day” command, the Flow Calculator will move the value into “Daily Inflow Total - Day 1”, reset itself back to zero, and then start collecting inflow data for the next 24 hour period. It may be viewed in gallons from Parameter Fd.12.

Daily Inflow Totals - Day 1 - 7

Each of the Daily Inflow Totals are the total of the inflow that was collected during a 24 hour period one day in the previous week. Upon receiving the “Start New Day” command signal, the Flow Calculator will move all of the values down one position in the data table shown below. The oldest day’s data is discarded. The values may be viewed in gallons / day from the Parameters shown below.

Parameter	Register Address		Data Description
Flow Calculator - Daily Inflow Total - Current Day			
Fd.12	42112	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Current Day (gallons)
	42113	Most Significant of 32-Bit Number	Collects Current Day’s Data Display Range: 0 - 4,294,967,295
Flow Calculator - Daily Inflow Totals - Day 1 - 7			
Fd.14	42114	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 1 (gallons)
	42115	Most Significant of 32-Bit Number	Newest Complete Day’s Data Display Range: 0 - 4,294,967,295
Fd.16	42116	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 2 (gallons)
	42117	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.18	42118	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 3 (gallons)
	42119	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.20	42120	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 4 (gallons)
	42121	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.22	42122	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 5 (gallons)
	42123	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.24	42124	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 6 (gallons)
	42125	Most Significant of 32-Bit Number	Display Range: 0 - 4,294,967,295
Fd.26	42126	Least Significant of 32-Bit Number	Flow Calculator - Daily Inflow Total - Day 7 (gallons)
	42127	Most Significant of 32-Bit Number	Oldest Complete Day’s Data Display Range: 0 - 4,294,967,295

FLOW CALCULATOR DATA

Pump 1 - 4 Run Cycle Time

This is the most recently determined pump run time of a respective pump, while it is running by itself. This is done by determining how long it takes to pump down from the “1st On Level” to the “1st Off Level”. This information is used in the calculation of the “Pump Outflow Rate”. The most recent “Pump Run Cycle Time” of each pump may be viewed in minutes from Parameters Fd.28 - Fd.31. To Reset to zero momentarily set Modbus Coil 611 (Register 40039 Bit 2).

Internal Time Clock - Hours and Minutes Elapsed Since the Start of a New Day

This clock keeps track of how much time has elapsed since the last signal to a “Start New Day”. The time may be viewed from Parameters Fd.34 and Fd.35.

With the Flow Calculator Mode (Parameter P.75) = 1, the Internal Time Clock will run and the signal to “Start New Day” will be automatically issued when it gets to 24 hours, the Time Clock is also reset to zero at that time.

With the Flow Calculator Mode (Parameter P.75) = 2, the Internal Time Clock will run, but not issue the “Start New Day” signal. The signal to “Start New Day” must be initiated externally, once each day by an External Time Clock by one of the following ways:

1. By using an External Time Clock to close a Discrete Input programmed for the “Start New Day”, Function 28. The Internal Time Clock will also be reset to zero.
2. By programming the SCADA system to send the signal to “Start New Day” by momentarily setting Modbus Coil 609 (Register 40039 Bit 0). The Internal Time Clock will also be reset to zero.

Time Measuring the Latest Inflow Rate

This is the time it takes for the wet well to rise 0.5 foot using the Analog Level Meter ALM1 as the level input (Parameter P.22 = 1) or if Level Probe Meter LPM1 is used for the Level Input (Parameter P.22 = 2), then it is the time it takes for the wet well to rise 1 Electrode spacing. It may be viewed in minutes from Parameters Fd.36.

Parameter	Register Address	Data Description
Flow Calculator - Pump 1 - 4 Run Cycle Time		
Fd.28	42128	Flow Calculator - Pump 1 Run Cycle Time (minutes) Display Range: 0.00 - 655.35
Fd.29	42129	Flow Calculator - Pump 2 Run Cycle Time (minutes) Display Range: 0.00 - 655.35
Fd.30	42130	Flow Calculator - Pump 3 Run Cycle Time (minutes) Display Range: 0.00 - 655.35
Fd.31	42131	Flow Calculator - Pump 4 Run Cycle Time (minutes) Display Range: 0.00 - 655.35
Pump Data Reset - To Reset Pump 1 - 4 Run Cycle Time to zero momentarily set Modbus Coil 611 (Register 40039 Bit 2).		
Flow Calculator - Internal Time Clock		
Fd.34	42134	Flow Calculator - Internal Time Clock - Minutes Since the Start of a New Day The time (minutes) elapsed since the signal to “Start New Day” Also see: Parameter Fd.35 Display Range: 0 - 60
Fd.35	42135	Flow Calculator - Internal Time Clock - Hours Since the Start of a New Day The time (hours) elapsed since the signal to “Start New Day” Also see: Parameter Fd.34 Display Range: 0 - 65535
Flow Calculator - Time Measuring the Latest Inflow Rate		
Fd.36	42136	Flow Calculator - Time Measuring the Latest Inflow Rate (minutes) Display Range: 0.00 - 655.35

FLOW CALCULATOR LEGACY DATA

The Flow Calculator Legacy Data shown below is placed into the same Modbus Registers as the SC2000 Controllers with Program Revision Numbers: 10 - 16 (earlier versions).

For new installation please use the Flow Calculator Data shown on pages K-3, K-4 and K-5.

Parameter	Register Address	Data Description	
Flow Calculator - Latest Inflow Rate			
Fd.01	40080	Flow Calculator - Latest Inflow Rate (gallons / minute)	Display Range: 0 - 65,535
Flow Calculator - Average Daily Inflow Total			
Fd.10	40081	Flow Calculator - Average Daily Inflow Total	Display Range: 0 - 65,535
Note: Parameter P.76 sets the Display Scaling of the Legacy SCADA Register 40081.			
Flow Calculator - Pump 1 - 4 Outflow Rate			
Fd.04	40082	Flow Calculator - Pump 1 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.05	40083	Flow Calculator - Pump 2 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.06	40084	Flow Calculator - Pump 3 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Fd.07	40085	Flow Calculator - Pump 4 Outflow Rate (gallons / minute)	Display Range: 0 - 65,535
Flow Calculator - Daily Inflow Totals - Day 1 - 7			
Fd.14	40086	Flow Calculator - Daily Inflow Total - Day 1	Display Range: 0 - 65,535
Fd.16	40087	Flow Calculator - Daily Inflow Total - Day 2	Display Range: 0 - 65,535
Fd.18	40088	Flow Calculator - Daily Inflow Total - Day 3	Display Range: 0 - 65,535
Fd.20	40089	Flow Calculator - Daily Inflow Total - Day 4	Display Range: 0 - 65,535
Fd.22	40090	Flow Calculator - Daily Inflow Total - Day 5	Display Range: 0 - 65,535
Fd.24	40091	Flow Calculator - Daily Inflow Total - Day 6	Display Range: 0 - 65,535
Fd.26	40092	Flow Calculator - Daily Inflow Total - Day 7	Display Range: 0 - 65,535
Note: Parameter P.76 sets the Display Scaling of the Legacy SCADA Registers 40086 - 40092.			

FLOW CALCULATOR SCADA REGISTER

SCADA Register Address	Description of Register Contents (Where a Modbus Coil is represented by a Bit in a Register)															Coil	
	624	623	622	621	620	619	618	617	616	615	614	613	612	611	610		609
40039							Flow Calculator - Active Determining Pump 4 Outflow Rate Status	Flow Calculator - Active Determining Pump 3 Outflow Rate Status	Flow Calculator - Active Determining Pump 2 Outflow Rate Status	Flow Calculator - Active Determining Pump 1 Outflow Rate Status	Flow Calculator - Active Determining Latest Inflow Rate Status	Flow Calculator - Active Forcing On Another Pump(s) Status	Flow Calculator Level Rising Too Fast Status	Flow Calculator Pump Outflow Rate & Run Time Reset	Flow Calculator Inflow Totalizer Reset	Flow Calculator Start New Day	
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Bit

FLOW CALCULATOR SURFACE AREA CALCULATION

Rectangular Wet Well

Area = Length x Width Where Length & Width Measurements are in: Feet

Circular Wet Well

Area = $\pi \left[\frac{1}{2} \text{Diameter} \right]^2$ Where Diameter is in: Feet

Area = 3.14159 x 1/2 Diameter x 1/2 Diameter

$\pi = 3.14159$