

Technical Bulletin

Bulletin No. 024 Rev F
Subject: Flow Sensor Size Selection
Page 1 of 10
Product Applicability: Evolution and Evolution DX2 Controllers
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1.0 Introduction

Flow sensors are used to monitor irrigation systems for proper flow rates within defined limits. They allow the system to read real-time water flow, which can be displayed to the operator, be used for control purposes, or to provide alerts and alarms. They have proven to be cost-effective devices that can save large amounts of water and prevent property damage, in the case of a water line break or loss of a sprinkler head. However, to get the full value from these sensors, they must be sized properly.

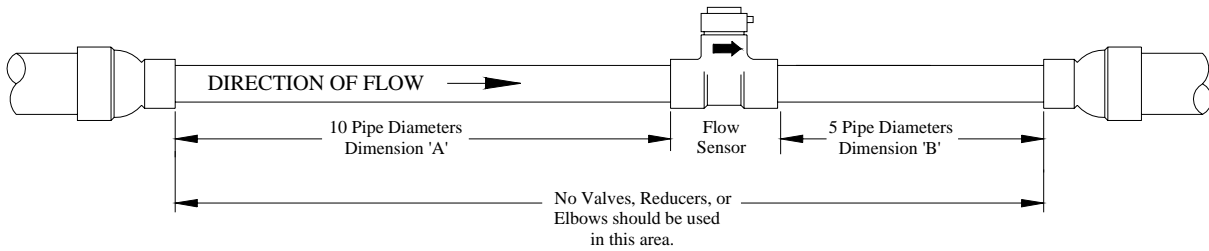
The methods outlined below cover a number of possible applications. However, should you run into a unique situation, which may not be covered by this Technical Bulletin or should you have any questions, please contact Rain Master Irrigation Systems at (800) 777-1477.

- 2.0 Flow sensors operate within a limited flow range. This range is based on a water velocity of 0.5-30 feet per second. To acquire flow data in Gallons Per Minute (GPM), pipe diameter size must be taken into consideration. Consequently, the allowable range in GPM will vary with different pipe sizes. Table 1.0 shows the minimum and maximum flow rates for the tee mounted flow sensors sold by Rain Master Irrigation Systems, installed in Polyvinyl Chloride (PVC) (schedule 40) pipe as well as various types of metal pipe. (Refer to the Rain Master DX2 User's Manual for pipe material and sizes.)

TABLE 1.0 – FLOW RATES

PIPE SIZE INCHES	MINIMUM GPM	MAXIMUM GPM	RM MODEL#	
1	2	40	FS-B100	} Brass
1 ¼	3	60	FS-B125	
1 ½	4	80	FS-B150	
2	10	100	FS-B200	
2 ½	16	160	FS-B250	
1 ½	5	100	FS-150	} PVC
2	10	200	FS-200	
3	20	300	FS-300	
4	40	500	FS-400	

3.0 A flow sensor should be selected which can measure the flow range between the irrigation system's minimum and maximum flow rates. This often requires the flow sensor to be one or even two sizes smaller than the main pipeline size. The following drawing shows a typical installation.



EXAMPLE: Using a 3 inch Flow Sensor:

Dimension 'A' is a minimum of 30 inches
Dimension 'B' is a minimum of 15 inches

4.0 Pressure loss from friction must also be considered when selecting flow sensors. Generally, the loss is minimal because the water flows in a straight path and the smaller diameter pipe length is short. However, you should always calculate the friction loss.

To calculate the Pressure loss from friction, the “RC” formula is:

$$(Q \times F)^{1.85} \times L = PL_2$$

where:

Q = flow, GPM

F = F table factor, obtain from industrial reference tables

L = pipe length in hundreds of feet (actual length / 100 = L)

PL₂ = pressure loss per 100 feet of pipe, pounds per square inch

- 5.0 Installed irrigation systems may have a wide variation of station flow rates and at times, one flow sensor cannot accurately measure the entire range. This problem can be resolved by installing two flow sensors in parallel (dual sensor manifold). One flow sensor is sized for stations with low flow rates and a second sensor is sized for the higher flow rates.
- 6.0 In a dual sensor manifold, only one flow sensor is operating at a time. Installing a Normally Open Master Valve (NOMV) with the smaller sensor and a Normally Closed Master Valve (NCMV) with the larger sensor, controls this operation. Stations with low flow rates are then assigned to programs that only control the NOMV. Stations with high flow rates are assigned to programs that only control the NCMV. Water is available on demand for quick couplers through the NOMV side of the manifold.
- 7.0 The manifold setup requires the use of a 24 VAC two-pole relay. When the NCMV is energized (hydraulically opened), it also energizes the relay. This in turn energizes the NOMV (hydraulically closed). Refer to the electrical schematic on page 4.
- 8.0 When the NCMV is energized, there are a total of three devices drawing current. This must be accounted for in the total ampere requirements of the system. (An Amperage Worksheet is provided on page 5)

Figure 1.0 - Electrical Schematic

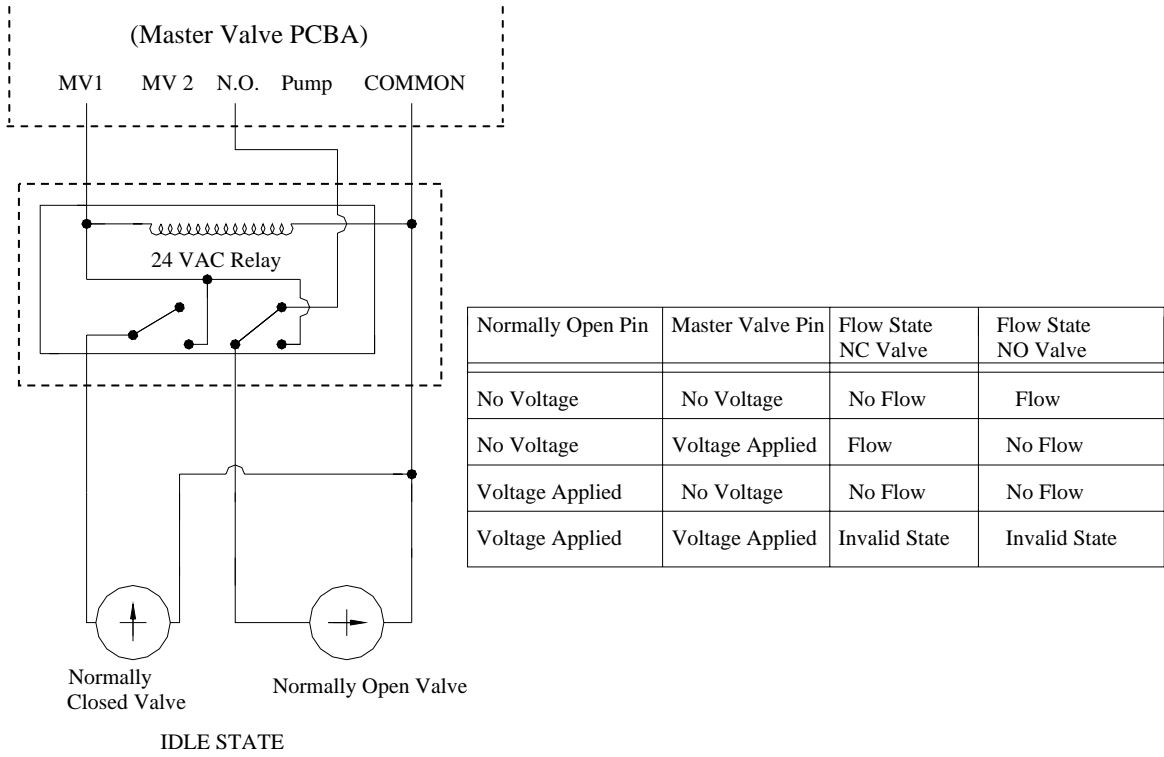


Table 2.0 – Master Valve Operations

MASTER VALVE OPERATIONS		
	Normally Open Master Valve	Normally Closed Master Valve
SYSTEM IDLE	OFF	OFF
STATION LOW FLOW EVENT	OFF	OFF
STATION HIGH FLOW EVENT (may be concurrent with low flow event)	ON (via relay)	ON
MAIN LINE HIGH FLOW EVENT	ON	OFF
MAIN LINE UNSCHEDULED EVENT	ON	OFF

Table 3.0 - Valve Assignments

MASTER VALVE ASSIGNMENTS	
STATIONS	VALVES
LOW FLOW	NORMALLY OPEN
HIGH FLOW	NORMALLY CLOSED

Table 4.0 – Current Worksheet

AMPERAGE WORKSHEET	
RELAY =	
NORMALLY CLOSED MASTER VALVE =	
NORMALLY OPEN MASTER VALVE =	
STATION VALVES OPERATING CONCURRENTLY	
TOTAL	

Part Numbers: FS-B100, FS-B125, FS-B150

Description: Brass Irrigation Flow Sensor

SPECIFICATIONS

- The flow sensor shall be an in-line type with a non-magnetic, spinning impeller (paddle wheel) as the only moving part.
- The electronics housing shall be glass-filled PPS (Polyphenylene Sulfide).
- The impeller shall be glass-filled nylon or Tefzel® with a UHMWPE (Ultra-High Molecular Weight Polyethylene) or Tefzel® sleeve bearing.
- The shaft material shall be tungsten carbide.
- The electronics housing shall have two ethylene-propylene O-Rings and shall be easily removed from the meter body.
- The sensor electronics shall be potted in an epoxy compound designed for prolonged immersion.
- Electrical connections shall be 2 single conductor 18 AWG leads 48 inches long.
- Insulation shall be direct burial UF (Underground Feeder) type colored WHITE for the positive lead and BLACK for the negative lead.
- The sensor shall operate in line pressures up to 400 PSI (Pounds per Square Inch) and liquid temperatures up to 150° F, and operate in flows of 0.5 to 15 feet per second with linearity of $\pm 0.7\%$ and repeatability of $\pm 0.7\%$.
- The meter body shall be cast 85-5-5-5 bronze, available in 1", 1¼", and 1½" female iron pipe thread sizes.
- These flow sensors are *Rain Master Irrigation Systems* Part Numbers: FS-B100, FS-B125, and FS-B150.

Part Numbers: FS-B200, FS-B250

Description: Brass Irrigation Flow Sensor

SPECIFICATIONS

- The flow sensor shall be an in-line type with a non-magnetic, spinning impeller (paddle wheel) as the only moving part.
- The electronics housing shall be glass-filled PPS (Polyphenylene Sulfide).
- The impeller shall be glass-filled nylon or Tefzel® with a UHMWPE (Ultra-High Molecular Weight Polyethylene) or Tefzel® sleeve bearing.
- The shaft material shall be tungsten carbide.
- The electronics housing shall have two ethylene-propylene O-Rings and shall be easily removed from the meter body.
- The sensor electronics shall be potted in an epoxy compound designed for prolonged immersion.
- Electrical connections shall be 2 single conductor 18 AWG leads 48 inches long.
- Insulation shall be direct burial UF (Underground Feeder) type colored WHITE for the positive lead and BLACK for the negative lead.
- The sensor shall operate in line pressures up to 200 PSI (Pounds per Square Inch) and liquid temperatures up to 150° F, and operate in flows of 0.5 to 30 feet per second with linearity of $\pm 0.7\%$ and repeatability of $\pm 0.7\%$.
- The meter body shall be cast 85-5-5-5 bronze, available in 2", and 2½" female iron pipe thread sizes.
- These flow sensors are *Rain Master Irrigation Systems* Part Numbers: FS-B200 and FS-B250.

Part Number: FS-INSERT-B

Description: Irrigation Flow Sensor

SPECIFICATIONS

- The flow sensor shall be an insertion type with a non-magnetic, spinning impeller (paddle wheel) as the only moving part.
- The sensor sleeve shall be brass with the sensor housing being PPS (Polyphenylene Sulfide).
- The impeller shall be glass-filled nylon or Tefzel® with a UHMWPE (Ultra-High Molecular Weight Polyethylene) or Tefzel® sleeve.
- The shaft material shall be tungsten carbide.
- The sensor shall be supplied with a 2" NPT (National Pipe Thread) adapter for installation into any commercially available weld-on fitting or pipe saddle.
- The adapter shall have two ethylene-propylene O-Rings.
- The sensor electronics shall be potted in an epoxy compound designed for prolonged immersion.
- Electrical connections shall be 2 single conductor 18 AWG leads 48 inches long.
- Insulation shall be direct burial UF (Underground Feeder) type colored WHITE for the positive lead and BLACK for the negative lead.
- Insertion of the sensor into any pipe size shall be 1 ½" from the inside wall to the end of the sensor housing.
- The sensor shall operate in line pressures up to 400 PSI (Pounds per Square Inch) and liquid temperatures up to 150° F, and operate in flows of 0.5 to 30 feet per second.
- This flow sensor is *Rain Master Irrigation Systems* Part Number: FS-INSERT-B.

Part Numbers: FS-150, FS-200, FS-300, FS-400

Description: PVC Irrigation Flow Sensor

SPECIFICATIONS

- The flow sensor shall be an in-line type with a non-magnetic, spinning impeller (paddle wheel) as the only moving part.
- The electronics housing shall be glass-filled PPS (Polyphenylene Sulfide).
- The impeller shall be glass-filled nylon or Tefzel® with a UHMWPE (Ultra-High Molecular Weight Polyethylene) or Tefzel® sleeve bearing.
- The shaft material shall be tungsten carbide.
- The electronics housing shall have two ethylene-propylene O-Rings and shall be easily removed from the meter body.
- The sensor electronics shall be potted in an epoxy compound designed for prolonged immersion.
- Electrical connections shall be 2 single conductor 18 AWG leads 48 inches long.
- Insulation shall be direct burial UF (Underground Feeder) type colored WHITE for the positive lead and BLACK for the negative lead.
- The sensor shall operate in line pressures up to 100 PSI (Pounds per Square Inch) and liquid temperatures up to 140° F, and operate in flows of 0.5 to 30 feet per second with linearity of $\pm 0.7\%$ and repeatability of $\pm 0.7\%$.
- The meter body shall be fabricated from Schedule 80 PVC (Polyvinyl Chloride) Tees, available in 1½", 2", 3", and 4" with slip connections.
- These flow sensors are *Rain Master Irrigation Systems* Part Numbers: FS-150, FS-200, FS-300 and FS-400.

RAIN MASTER FLOW SENSORS

SELECTION CHART

FLOW SENSOR MODEL NO.	PIPE CONNECTION SIZE	SUGGESTED OPERATING RANGE	MAXIMUM WATER PRESSURE	K Value	OFFSET Value	BODY MATERIAL	CONNECTION TYPE
FS-B100	1 inch	2-40 gpm	400 psi	109	27	Bronze	NPT female
FS-B125	1 1/4 inch	3-60 gpm	400 psi	209	32	Bronze	NPT female
FS-B150	1 1/2 inch	4-80 gpm	400 psi	291	24	Bronze	NPT female
FS-B200	2 inch	10-100 gpm	200 psi	750	0	Bronze	NPT female with copper male adapters
FS-B250	2 1/2 inch	16-160 gpm	200 psi	1021	370	Bronze	NPT female
FS-150	1 1/2 inch	5-100 gpm	100 psi @ 68F	457	0	PVC	Slip
FS-200	2 inch	10-200 gpm	100 psi @ 68F	776	104	PVC	Slip
FS-300	3 inch	20-300 gpm	100 psi @ 68F	2268	483	PVC	Slip
FS-400	4 inch	40-500 gpm	100 psi @ 68F	3752	834	PVC	Slip
FS-INSERT-B	3 to 40 inches	Varies, call factory	400 psi	Varies, call factory		Requires pipe saddle with 2 inch female NPT	

End of Bulletin



Technical Bulletin 024

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Sheet 10 of 10

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