

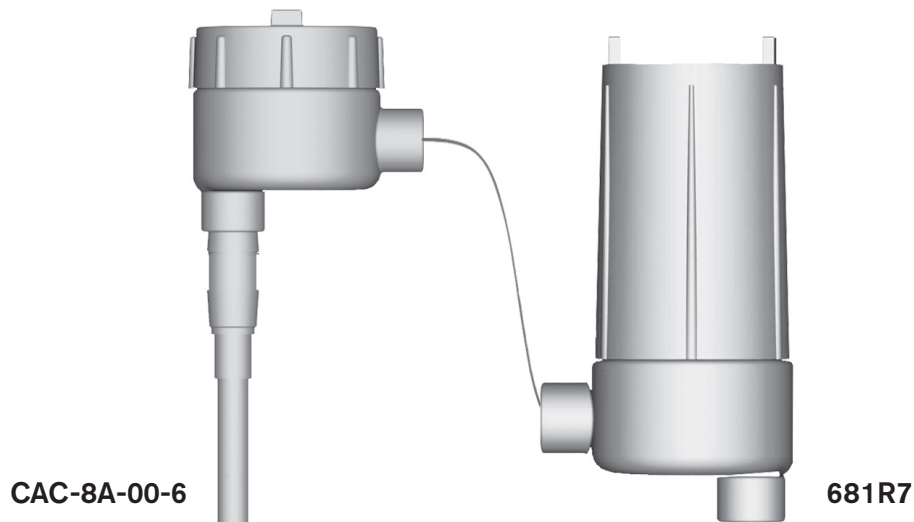


MEASUREMENT AND CONTROL

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RF Capacitance Level Controls



Features and Benefits

- Reliability
- Low maintenance costs
- No moving parts
- Interface measurement with on/off and continuous output
- Unaffected by changes in pressure, temperature, specific gravity, vapor or density
- Versatile - can be used with both conductive and non-conductive substances. Manages a variety of liquids, granular solids, powders and slurries.
- Dielectric range is unlimited
- 316SS or Teflon® probes
- Can be used in virtually every type of chamber
- Set point/span are completely adjustable
- Withstands temperatures up to 400°F (204°C)
- Withstands pressure up to 2000 psig (138 bar)

Agency Listings/Certification

- Select models with CSA, FM, IECEx and INMETRO
- Meets most code and customer requirements.

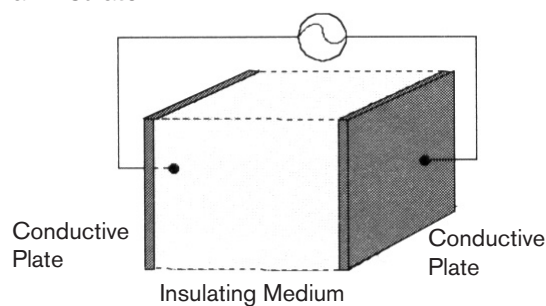
RF Capacitance Level Controls

Principle

Operating Principle

RF Capacitance level controls are based on an electronic device called a capacitor. The capacitor is a device that stores energy. This energy is not stored in the probe; rather, the RF Capacitance level control is merely measuring how much energy can be stored. The amount of capacitance the RF Capacitance level control is measuring is extremely small and is measured in picofarads (1×10^{-12} farads).

The capacitor is made up of two conductive plates parallel to each other. Separating the two plates is an insulator.



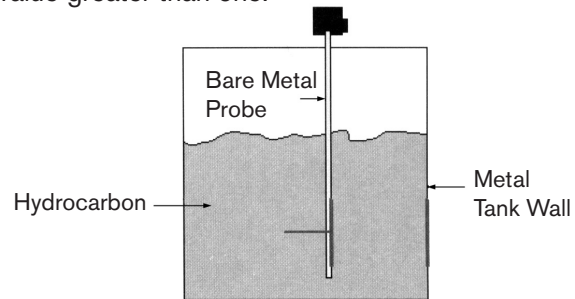
The amount of energy a capacitor can store is influenced by several things. First, a larger plate area results in more space to store energy. Second, more space between the plates reduces the amount of energy storage. Finally, a higher dielectric constant media can contain more energy than a lower dielectric media. The dielectric is where the actual capacitance is developed. The following chart shows the dielectric constant and conductivity for some sample materials.

Dielectric Constant				
2	6.9	20	50	80 or more
Acetone	Popcorn	Alcohol	Glycerin	Water
Mineral Oil				
Conductivity				
4.8	10	14.6	31.5	60 or more
1.6	5			
Acetone	Popcorn	Alcohol	Glycerin	Water
Mineral Oil				

Substances are considered either conductive or non-conductive. Non-conductive materials have a dielectric less than 10 or a conductivity less than $10 \mu\text{siemens/cm}$. Conductive materials have a dielectric constant greater than 10 or a conductivity greater than $10 \mu\text{siemens/cm}$. Interestingly, there is a similar relationship between dielectric constant and conductivity. Non-conductive substances tend to have low dielectric constants and conductive substances tend to have high dielectric constants.

Non-Conductive Substances

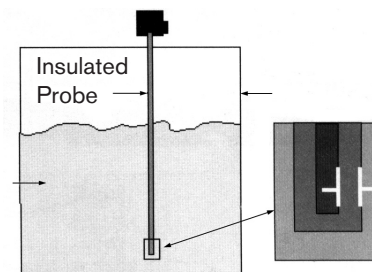
The structure of the capacitor actually changes in a level application. One plate is the probe and the other is the wall of the tank (see following figure). These do not change, nor does the distance between them. The only thing that changes is the dielectric constant. Air has a dielectric constant of one; anything else you measure will have dielectric value greater than one.



When the substance level increases, the dielectric of the substance is replacing the air and causes the capacitance to increase. The preset capacitance value is equal to the set point level wanted and trips a switch when the level is reached. The transmitter creates a linear output in relationship to the capacitance measured.

Conductive Substances

The substance between the two plates has to be an insulator in order to have a capacitor. When a conductive material is between the plates, an electrical short is created. This, in turn, signals the level transmitter to indicate a high level. A Teflon insulator around the sensor will prevent this from happening, as the figure below demonstrates.



An electrical connection is created through the conductive substance from the tank wall and the Teflon probe. When the level in the tank rises, the capacitor is created by the metal probe rod, the substance being measured and the probe insulator (Teflon), where the sensor rod and substance are the plates and insulator is the dielectric. This means that rather than measuring the dielectric of the substance, the dielectric of the probe where it is covered by the substance is being measured.

RF Capacitance Level Controls

Principle

Restrictions of RF

- Sensitive to changes in material dielectric (**Note:** dielectric compensation additives help, but the liquid can stratify.)
- Normally needs field calibration, which requires a change in level
- Dependent on contact with the substance being measured
- Conductive coatings can build up on the sensor and create false readings

The Difference Between RF Capacitance and RF Admittance

Contrary to popular belief, there really isn't an application difference between RF Capacitance and RF Admittance. The only difference is in the electronics; the overall performance of the unit remains the same. That's where the "RF" part comes in, as the following will explain:

RF measurement is actually measuring capacitance, as well as capacitance reactance (impedance). The energy (Radio Frequency) is traveling from one conductive plate to the other. The following equation represents capacitance reactance:

$$X_c = \frac{1}{2\pi fC}$$

where

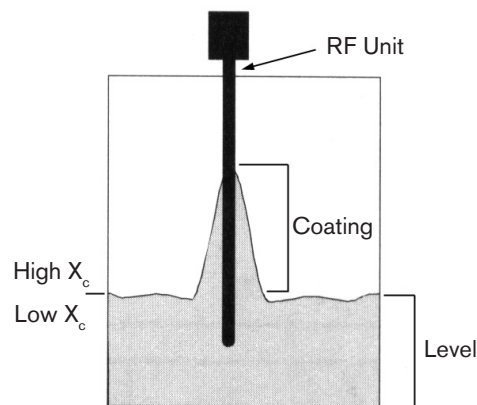
X_c = Capacitance Reactance (Ohms)

2π = Radians in a 360° cycle of AC (alternating current)

f = Frequency of AC (hertz)

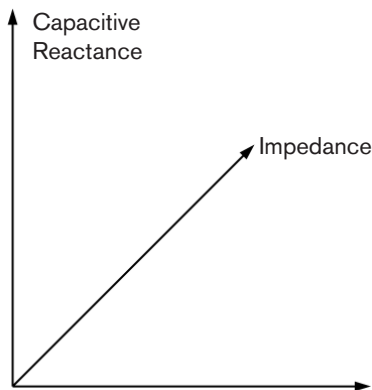
C = Capacitance of system (in farads)

When there is a conductive coating on the probe, a non-RF unit will indicate the level at the top of the coating. By looking at the conductivity, an RF system can reduce the error caused by the coating (see following figure). Consider this: At the actual level, the amount of capacitive reactance (impedance) is low because the space between the tank wall and probe is filled with a conductive liquid. However, at the coating on the probe, there is also a large air space between the probe and tank wall. This air space results in a high amount of capacitive reactance.



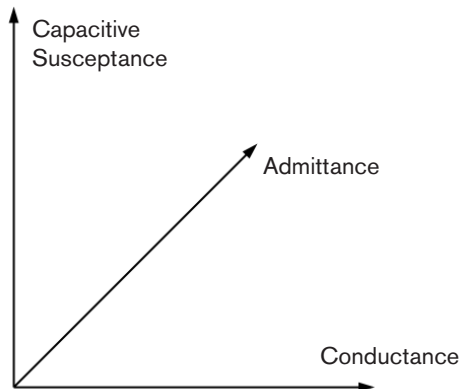
The Difference Between RF Capacitance and RF Admittance

Look at the formula for capacitive reactance. Since we are striving to measure the capacitance, C cannot change, and 2π is a constant and cannot change. The only thing left we can change is the frequency. If the frequency is increased (RF), the capacitive reactance decreases.



The level is represented on the vertical axis in these two graphs. Changes in the resistance are represented on the horizontal axis. A vector representing a combination of the two (impedance) is shown to the left. The inverse of this graph is shown below.

As you can see, an “admittance” measurement is just the inverse of a capacitance measurement. The important part, as previously stated, is the “RF”



Use this chart to select the RF instrument that best meets your needs.

Designator	Line Power	Loop Power
Single-Point Sensing		
Integral Mount Electronics	651 Pages 5-6	651 Pages 5-6
Integral Mount Electronics with Sensor Monitor (Self-Test)	681 Pages 7-8	681 Pages 7-8
Remote Mount Electronics with Sensor Monitor (Self-Test)	681 Pages 7-8	681 Pages 7-8
Multiple-Point Sensing		
Alarm or Pump Control	660 Pages 9-10	N/A

651 Single-Point RF Switch

The 651 provides basic, single-point switching for use as an alarm or indicator. It's virtually immune to process coatings on the probe, making it a useful solution for many tough level applications. This immunity, combined with the absence of any moving parts, makes the 651 well suited for applications that are difficult for other technologies.

Features

- Economical point sensing
- Suitable for 12 VDC service
- FM Approved, CSA Certified hazardous locations, IEC Certified
- Field-selectable failsafe



Product Specifications

Input Power - Line	120 VAC, 50/60 Hz 240 VAC, 50/60 Hz 24 VDC 12 VDC	Response Time	0.5 seconds
Input Power - Loop	12-28 VDC	Enclosure	NEMA 4X; IP65
Output Type - Line	10A DPDT, 250 VAC 10A DPDT, 30 VDC DC rating shown for resistive loads 5A DPDT for 12 VDC input power	Environmental Rating	
Output Type - Loop	8 mA (alarm), 16 mA (normal)	Electrostatic Discharge Protection	8000 volts (Line) 4000 volts (Loop)
Loop Resistive	780 ohms maximum @ 24 VDC	Line Surge Suppression	1000 volts line voltage EMC
Adjustment Range	0 to 1000 pF	Conduit Connection	3/4" NPT
Sensitivity	0.5 pF	Ambient Temperature Range	-40 to 160°F (-40 to 71°C)
Repeatability	0.5%	Process Temperature Range	Probe Dependent
Failsafe	Field-selectable	Maximum Process Pressure	Probe Dependent
Maximum Current Draw (line power)	12 VDC - 100 mA 24 VDC - 50 mA 120 VAC - 20 mA 240 VAC - 10 mA	Weight	2.5 lbs. (1.2 kg)

RF Capacitance Level Controls

How to Order

The 651 consists of two parts. The first is the electronics and housing. The second is the probe. For probe types and model numbers, see pages 21-25.

Model Number System

651 K 7-TTYY

651 RF Admittance Switch with 120 VAC power supply, oversized nameplate and epoxy-coated housing.

Power Supply	1
12 VDC	5
24 VDC	6
120 VAC	7
240 VAC	8
12 - 28 VDC (Loop)	9
651K	7

* Electronics and probe must have the same agency to maintain the listing integrity (i.e. CS or AI electronics with CS probe, or FM or FI electronics with FM probe).

2	Accessories & Certificates
AI	CSA Intrinsically Safe*
CS	CSA Explosion Proof Listing* (Not available with power supply 5)
FI	FM Intrinsically Safe*
FM	FM Explosion Proof Listing* (Not available with power supply 5)
MB	IEC Certified Intrinsically Safe*
NM	INMETRO approved*
OD	60-second time delay ON, 0.5-second delay OFF
OF	60-second time delay OFF, 0.5-second delay ON
PP	Fiber tag with customer-specified tag information
PY	Powder Coat epoxy coating. No coating on stainless steel parts or plated screws. (500 hours-salt spray)
RR	SS wired on nameplate with customer-specified information
TT	SS nameplate permanently affixed to housing with customer-specified tag information
VV	Fungicidal varnish applied to housing exterior
YY	Epoxy coating applied to housing exterior (200 hours-salt spray)
	Individual Certificates
C1	Certificate of Calibration
C3	Inspection
C4	Compliance/Conformance
C6	Insulation Resistance
D1	Certificate of Origin
D2	Manufacturer's Certification
TT YY	Model Number

Agency Approval

Agency	Safety Method	Approval	Model(s)	
FM	Explosion Proof	Class I, Groups C, D Class II, Groups E, F, G Class III, Division 1	651Kx-FM (Not available with 12 VDC line power)	
	Intrinsically Safe	Class I, Groups A, B, C, D Class II, Groups E, F, G Class III, Division 1	651Kx-FI	
CSA	Explosion Proof	Class I, Groups C, D Class II, Groups E, F, G Class III, Division 1	651Kx-CS (Not available with 12 VDC line power)	
	Intrinsically Safe	Class I, Groups A, B, C, D Class II, Groups E, F, G Class III, Division 1	651K9-AI	
IEC	Intrinsically Safe	Ex ia IIB T4	651K9-MB	
INMETRO	Intrinsically Safe	Ex ia IIB T4	651K9-NM	

681 Single-Point RF Switch with Self Test

Available as an integral or remote-mounted unit, the 681 provides single-point switching, and with its many safe and operation features, is well suited for demanding industrial applications.

Its "Self-Check" function constantly monitors circuit and probe integrity. A dedicated relay (line powered) or current shift (loop powered) indicates if the unit is not functioning properly. An optional, adjustable differential provides control of two set points with one relay, which gives the 681 pump and valve control for maintaining correct process levels.



Features

- Continuous self testing (Self-Check) verifies operation of the unit
- Optional adjustable differential for pump/valve control
- Available as integral or remote-mounted
- Field-selectable failsafe
- Resists process media coating

Product Specifications

Input Power - Line	120 VAC, 50/60 Hz 240 VAC, 50/60 Hz 24 VDC, 12 VDC	Repeatability	0.5%
Input Power - Loop	10-30 VDC	Failsafe	Field-selectable
Output Type - Line		Maximum Current Draw (line power)	12 VDC - 100 mA 24 VDC - 100 mA 120 VAC - 25 mA 240 VAC - 13 mA
Alarm	10A DPDT, 250 VAC 10A DPDT, 30 VDC	Response Time	0.1 second
Sensor Monitor	10A DPDT, 250 VAC 10A DPDT, 30 VDC DC rating shown for resistive loads	Enclosure Environmental Protection	NEMA 4X; IP65
Output Type - Loop		Electrostatic Discharge Protection	8000 volts (line) 4000 volts (loop)
Alarm	8 mA (Alarm), 16 mA (Normal)	Line Surge Suppression	1000 volts line voltage EMC
Sensor Monitor	24-27 mA	Conduit Connection	3/4" NPT
Loop Resistance	456 ohms maximum @ 24 VDC	Maximum Remote Distance from Sensor	150 ft. (45.7 m)
Adjustment Range	0 to 1000 pF	Ambient Temperature Range	Probe Dependent
Sensitivity	0.5 pF	Maximum Probe Pressure	Probe Dependent
Adjustment Range (Adjustment Differential)	Range I: 0 to 300 pF 0.5 pF sensitivity Range II: 300 to 1000 pF 1.0 pF sensitivity	Weight	3 lbs. (1.4 kg) plus 2 lbs. (1 kg) for remote

RF Capacitance Level Controls

How to Order

The 681 consists of two parts. The first is the electronics and housing. The second is the probe. For probe types and model numbers, see pages 21-25.

Model Number System

681 K 7-TTYY

Electrical Housing		2 Power Supply		3 Accessories & Certificates	
	1	5	12 VDC	AD	Adjustable differential
		6	24 VDC	BK	Remote electronics flat-surface mounting bracket (R housing only)
		7	120 VAC	PK	Pipe mounting kit - BK accessory required (R housing only)
		8	240 VAC	PP	Fiber tag with customer-specified information
		9	10 to 30 VDC (Loop)	PY	Powder Coat epoxy coating. No coating on stainless steel parts or plated screws. (500 hours-salt spray)
				RR	SS wired-on nameplate with customer information
				TT	SS nameplate permanently affixed to housing with customer-specified information
				VV	Fungicidal varnish applied to housing exterior
				YY	Epoxy coating applied to housing exterior (200 hours-salt spray)
				Individual Certificates	
				C1	Certificate of Calibration
				C3	Inspection
				C4	Compliance/Conformance
				C6	Insulation Resistance
				D1	Certificate of Origin
				D2	Manufacturer's Certification
681	K	7	TT YY	← Model Number	

Integral Housing K
Remote housing: 150 ft. (45m) maximum R
Order remote cable part #2924-113 and specify length in feet

Agency Approval

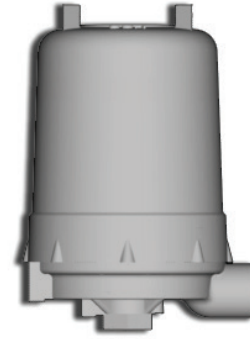
There are no third-party approvals at this time.

660 Series Multi-Point RF Switch

The 660 Series provides the options of multipoint switching plus narrow and wide differential switching. By combining these features, the 660 Series units can be used for a wide variety of control needs. The available switching combinations are designed to provide multiple alarms, pump/valve control, or a combination of alarms and equipment control. The 660 Series makes it possible to combine up to four singlepoint devices into one package for lower costs and reduced maintenance.

Features

- Up to 4-point indication
- Suitable for 12 VDC service
- FM Approved and CSA Certified for hazardous locations
- Field-selectable failsafe
- Resists process media coating



Switching Combinations

The 660 Series has eight different combinations of fixed differential and/or adjustable differential switching points. Each unit is equipped with one of four discreet switching points. These points can be used to provide true point level sensing with no level differential, or latched together to provide wide, adjustable differential.

See page 11 for available combinations. Required combinations are selected using step 1 in the How to Order chart on page 10.

Product Specifications

Input Power	120 VAC, 50/60 Hz 240 VAC, 50/60 Hz 24 VDC, 12 VDC	Enclosure	NEMA 4X; IP65
Output Type	10A DPDT, 250 VAC 10A DPDT, 30 VDC DC rating shown for resistive loads	Environmental Protection	
Adjustment Range	0 to 2000 pF	Electrostatic Discharge Protection	8000 volts
Sensitivity	0.5 pF	Line Surge Suppression	1000 volts line voltage EMC
Repeatability	0.5%	Conduit Connection	1" NPT(F)
Failsafe	Field-selectable	Maximum Remote Distance from Sensor	4000 feet (1219.2 m)
Maximum Current Draw	12 VDC - 245 mA 24 VDC - 123 mA 120 VAC - 74 mA 240 VAC - 36 mA	Ambient Temperature Range	-40 to 160°F (-40 to 71°C)
Response Time	0.5 second (standard)	Process Temperature Range	Probe Dependent
Time Delay (optional)	0 to 30 seconds	Maximum Probe Pressure	Probe Dependent
		Weight	J Housing: 9 lbs. (4.1 kg) R Housing: 11 lbs. (5 kg) W Housing: 6 lbs. (2.7 kg)

RF Capacitance Level Controls

How to Order

The Series 660 is comprised of two parts. The first is the electronics and housing. The second is the probe. Refer to pages 21-25 for probe model number.

Model Number System

66 3 J5-TD VV

Model Number System			
66 3 J5-TDVV			
Electrical Housing		2	3
Integral housing	J	5	12 VDC
Explosion-proof remote housing (4000 feet [1219.m] maximum)	R	6	24 VDC
		7	120 VAC
		8	240 VAC
Switching Combination		1	4
See page 11 for switching combinations.			BK
Single fixed differential switching point	1		Remote electronics flat surface mounting bracket (R housing only)
Two fixed differential switching points	2		CS
Three fixed differential switching points	3		CSA explosion-proof listing*
Four fixed differential switching points	4		FM
Single adjustable differential switching	5		FM explosion-proof listing*
High-level fixed differential point and adjustable differential switching	6		PK
Single adjustable differential and low-level fixed differential point switching	7		Pipe mounting kit- BK accessory required (R housing only)
High- and low-level fixed differential points and adjustable differential switching	8		PP
			Fiber tag with customer-specified information
			PY
			Powder Coat epoxy coating. No coating on stainless steel parts or plated screws. (500 hours-salt spray)
			RR
			SS wired-on nameplate with customer-specified information
			TD
			Time delay for each fixed differential set point
			TT
			SS nameplate permanently affixed to housing with customer-specified information
			VV
			Fungicidal varnish applied to housing exterior
			YY
			Epoxy coating applied to housing exterior (200 hours-salt spray)
			Individual Certificates
			C1
			Certificate of Calibration
			C3
			Inspection
			C4
			Compliance/Conformance
			C6
			Insulation Resistance
			D1
			Certificate of Origin
			D2
			Manufacturer's Certification
			</

Agency Approval

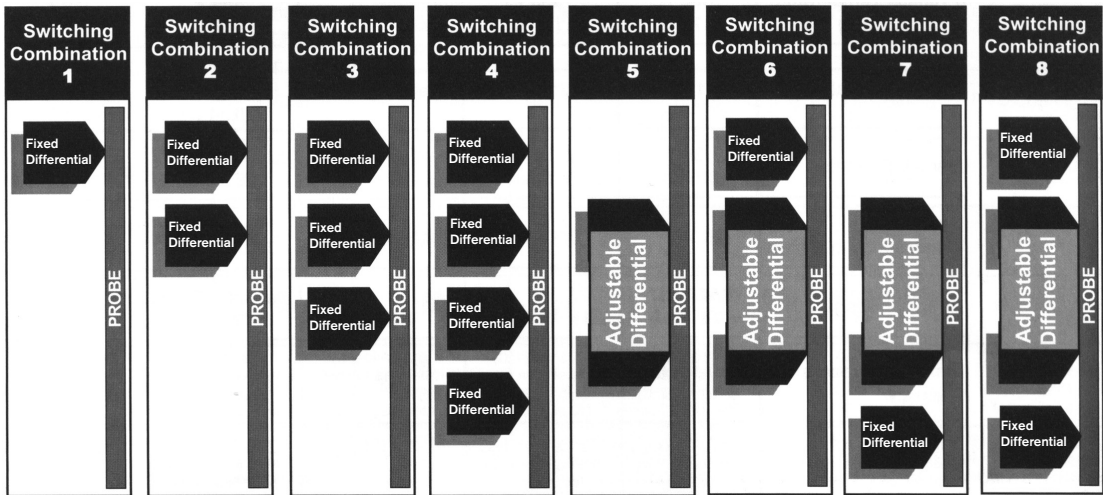
Agency	Safety Method	Approval	Model(s)	
FM	Explosion Proof	Class I, Groups B, C, D Class II, Groups E, F, G Class III, Division 1	66x-Jx-FM 66x-Jx-FM	
CSA	Explosion Proof	Class I, Groups C, D Class II, Groups E, F, G Class III, Division 1	66x-Jx-CS 66x-Rx-CS	

Connection Cable

Remote units require #22AWG shielded twisted pair cable to connect the control to the probe. The maximum length of this cable is 4000 feet (1219.2m).

A 25 ft. (7.6m) cable is supplied with each unit. Other lengths can be ordered per the information below. The cable glands supplied with the unit must be replaced with suitable fittings when installing conduit.

Series 660 Switching Combinations



670 RF Transmitter

The 670 provides continuous level measurement and a 4-20 mA linear output. It is a high-performance, general-purpose level transmitter that is well suited for many demanding applications that other technologies cannot handle.

Features

- FM Approved, CSA Certified hazardous locations
- Easy calibration
- Electrostatic discharge protection up to 4000 volts
- Resists process media coating



Product Specifications

Input Power	12-55 VDC 12-30VDC for Intrinsically Safe	Enclosure Environmental Rating	NEMA 4X; IP65
Output Type	4-20 mA	Electrostatic Discharge Protection	4000 volts
Loop Resistance	600 ohms maximum @ 24 VDC	Conduit Connection	3/4" NPT
Zero Range	0 to 500 pF	Maximum Remote Distance from Sensor	10 ft. (3m)
Span Range	50 to 2000 pF	Ambient Temperature Range	-40 to 160°F (-40 to 71°C)
Accuracy	±1.0% of span	Process Temperature Range	Probe Dependent
Linearity	±0.5% of full scale	Maximum Process Pressure	Probe Dependent
Sensitivity	0.5 pF	Weight	2.5 lbs. (1.2 kg) plus 2 lbs. (1 kg) for remote
Repeatability	±0.5% of full scale		
Response Time	0.1 second		

RF Capacitance Level Controls

How to Order

The 670 consists of two parts. The first is the electronics and housing. The second is the probe. For probe types and model numbers, see pages 21-25.

Model Number System

670 R 9-BKPK

670 RF Transmitter with loop-powered remote housing, flat-surface mounting bracket and pipe mounting kit.

Electrical Housing

1

Integral Housing

K

Remote housing -
10 feet (3m) maximum

R

Order remote cable as 670-XX-S
XX= cable length in feet

* Electronics and probe must have the same agency to maintain the listing integrity (i.e. CS or AI electronics with CS probe, or FM or FI electronics with FM probe).

2

Accessories & Certificates

AI	CSA Intrinsically Safe*
BK	BK Remote electronics flat surface mounting bracket (R housing only)
CS	CS CSA Explosion Proof*
FI	FI FM Intrinsically Safe*
FM	FM FM Explosion Proof*
PK	PK Pipe mounting kit - BK accessory required (R housing only)
PP	PP Fiber tag with customer-specified information
PY	PY Powder Coat epoxy coating. No coating on stainless steel parts or plated screws. (500 hours-salt spray)
RR	RR SS nameplate permanently affixed to housing with customer-specified information
TT	TT SS nameplate permanently affixed to housing
VV	VV Fungicidal varnish applied to housing exterior
YY	YY Epoxy coating applied to housing exterior (200 hours-salt spray)
Individual Certificates	
C1	Certificate of Calibration
C3	Inspection
C4	Compliance/Conformance
C6	Insulation Resistance
D1	Certificate of Origin
D2	Manufacturer's Certification

670 R 9 BK PK ← **Model Number**

Agency Approval

Agency	Safety Method	Approval	Model(s)
FM	Explosion Proof	Class I, Groups C, D Class II, Groups E, F, G Class III, Division 1	670x9-FM
	Intrinsically Safe	Class I, Groups A, B, C, D Class II, Groups E, F, G Class III, Division 1	670x9-FI
CSA	Explosion Proof	Class I, Groups C, D Class II, Groups E, F, G Class III, Division 1	670x9-CS
	Intrinsically Safe	Class I, Groups A, B, C, D Class II, Groups E, F, G Class III, Division 1	670x9-AI

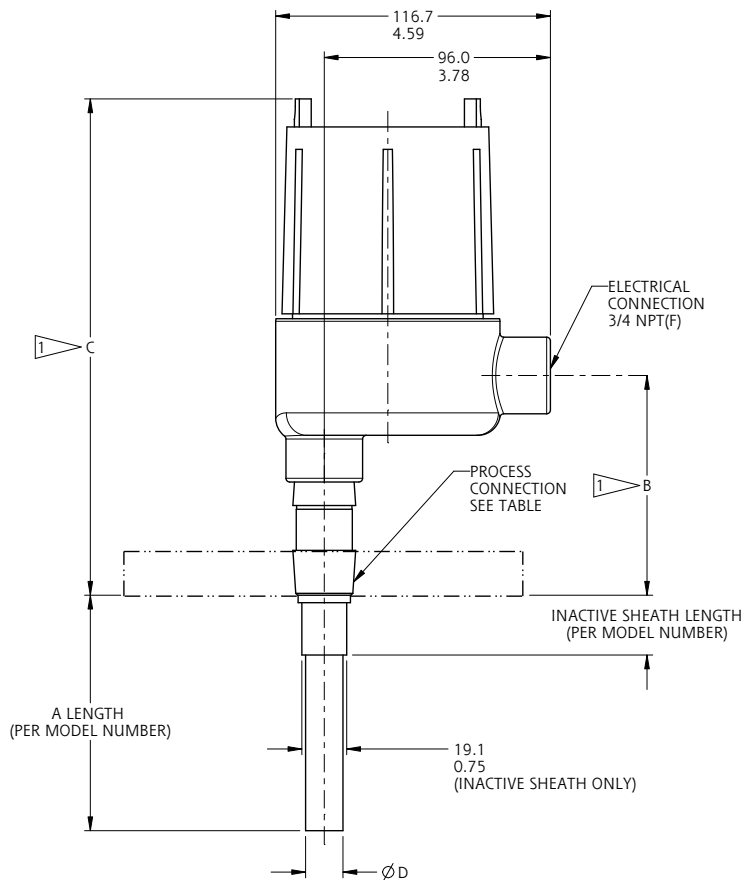


RF Capacitance Level Controls

Dimensions

Housing: K for Model 651

Dimensions in this catalog are for reference only. They may be changed without notice. Contact the factory for certified drawings for a particular model number. Dimensions in this catalog are expressed as millimeters over inches. (Linear = mm/in.)

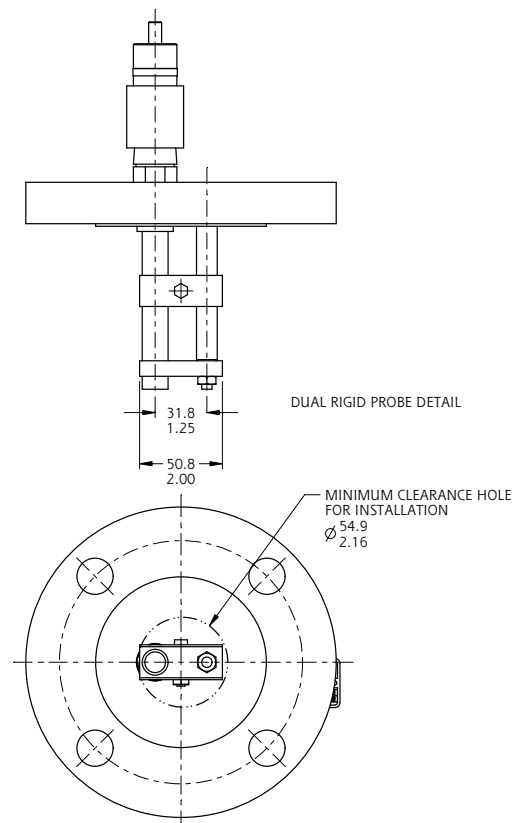
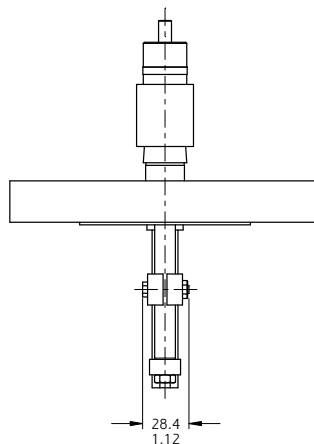


1 DIMENSION APPROXIMATE AND BASED ON A FIVE THREAD ENGAGEMENT.		
PROCESS CONNECTION	DIM B	DIM C
3/4 NPTM	94.1 3.71	211.6 8.33
1, 1-1/2, & 2 NPTM	97.3 3.83	214.8 8.46
FLANGED	158.5 6.24	276.0 10.87
STILLING WELL	120.0 4.72	237.5 9.35

SENSOR STYLE	Ø D
BARE	12.7 0.50
SHEATH	15.9 0.63
BARE WITH STILLING WELL	26.7 1.05
SHEATH WITH STILLING WELL	26.7 1.05
INACTIVE SHEATH	15.9 0.63

Drawing 0390652

Linear = $\frac{\text{mm}}{\text{in.}}$



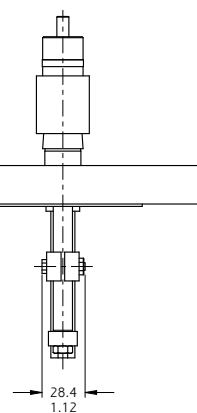
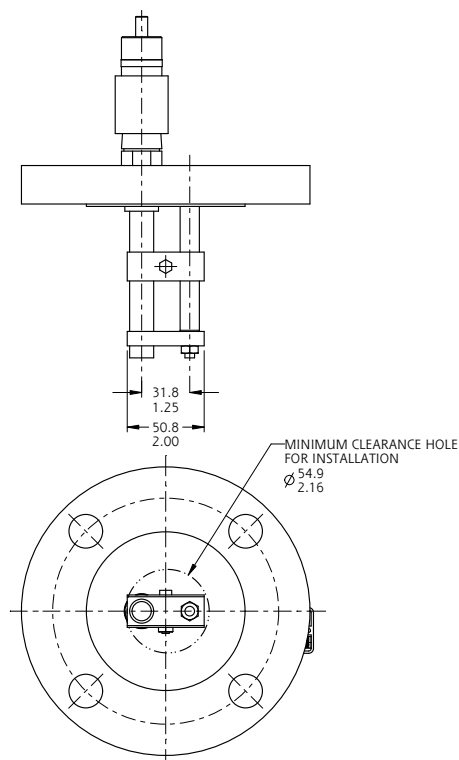
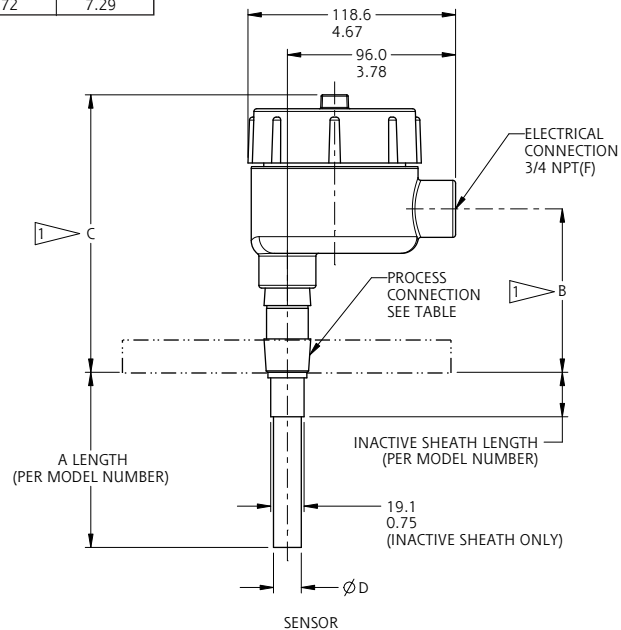
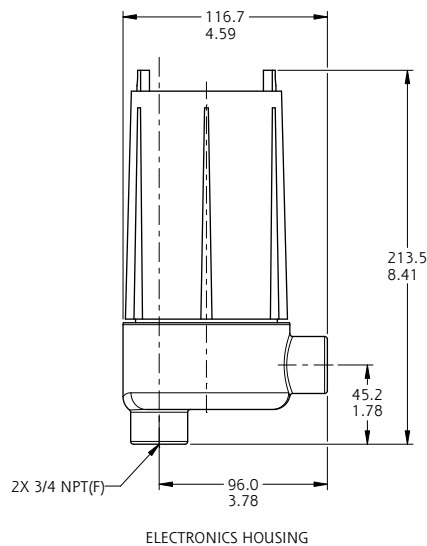
RF Capacitance Level Controls

Dimensions

Housing: R for Model 670 & 681

SENSOR STYLE	DIM D
BARE	12.7 0.50
SHEATH	15.9 0.63
BARE WITH STILLING WELL	26.7 1.05
SHEATH WITH STILLING WELL	26.7 1.05
INACTIVE SHEATH	15.9 0.63

1 DIMENSION APPROXIMATE AND BASED ON A FIVE THREAD ENGAGEMENT.		
PROCESS CONNECTION	DIM B	DIM C
3/4 NPTM	94.1 3.71	159.2 6.27
1, 1-1/2, & 2 NPTM	97.3 3.83	162.4 6.39
FLANGED	158.5 6.24	223.7 8.81
STILLING WELL	120.0 4.72	185.1 7.29



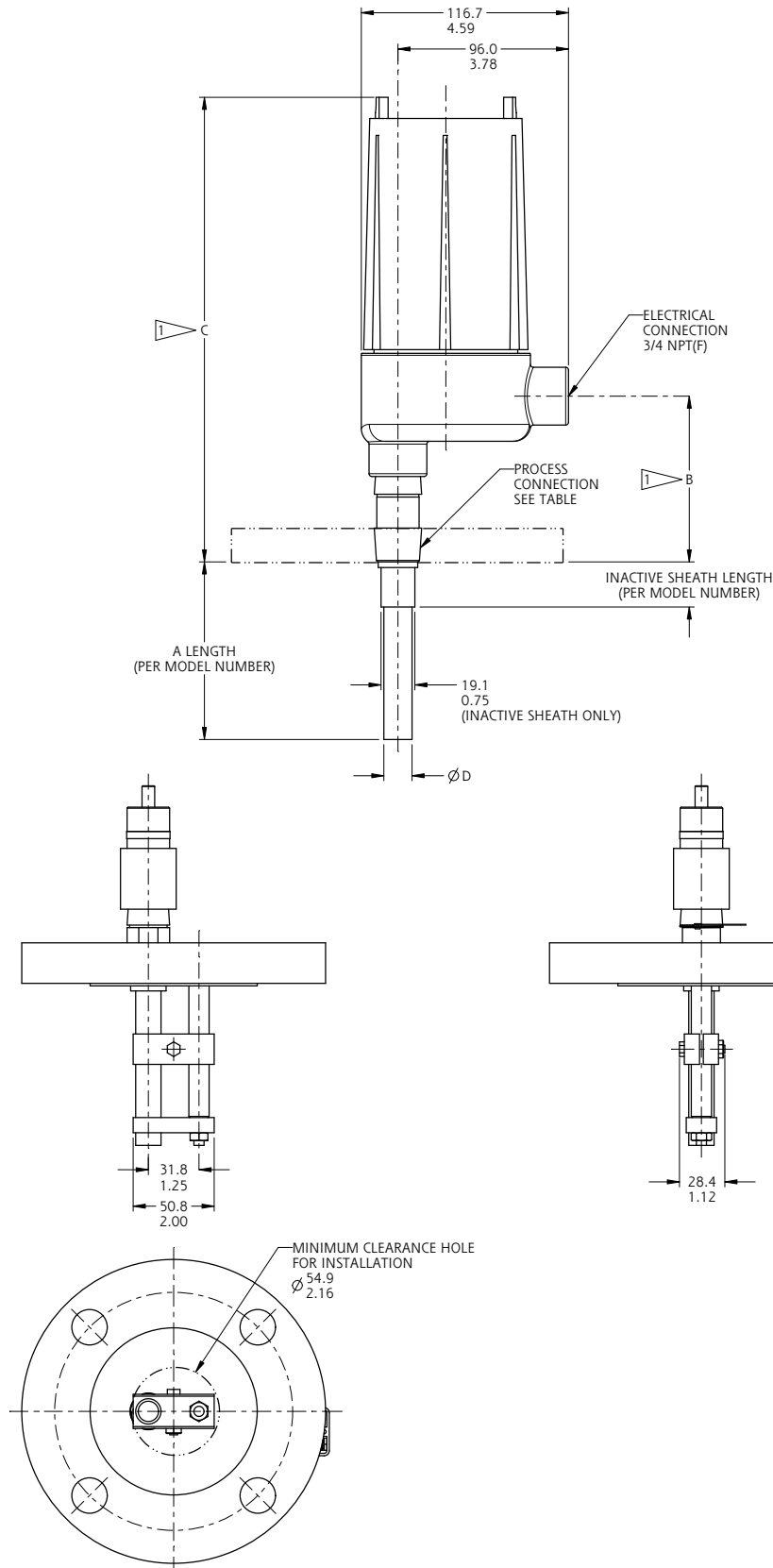
Linear = $\frac{\text{mm}}{\text{in.}}$

Drawing 0390653

RF Capacitance Level Controls

Dimensions

**Housing: K for Model 670 & 681
(RF Probe Model 651-K9)**



1 DIMENSION APPROXIMATE AND BASED ON A FIVE THREAD ENGAGEMENT.

PROCESS CONNECTION	DIM B	DIM C
3/4 NPTM	94.1 3.71	262.4 10.33
1, 1-1/2, & 2 NPTM	97.3 3.83	265.6 10.46
FLANGED	158.5 6.24	326.8 12.87
STILLING WELL	120.0 4.72	288.3 11.35

SENSOR STYLE	ϕD
BARE	12.7 0.50
SHEATH	15.9 0.63
BARE WITH STILLING WELL	26.7 1.05
SHEATH WITH STILLING WELL	26.7 1.05
INACTIVE SHEATH	15.9 0.63

Linear = $\frac{\text{mm}}{\text{in.}}$

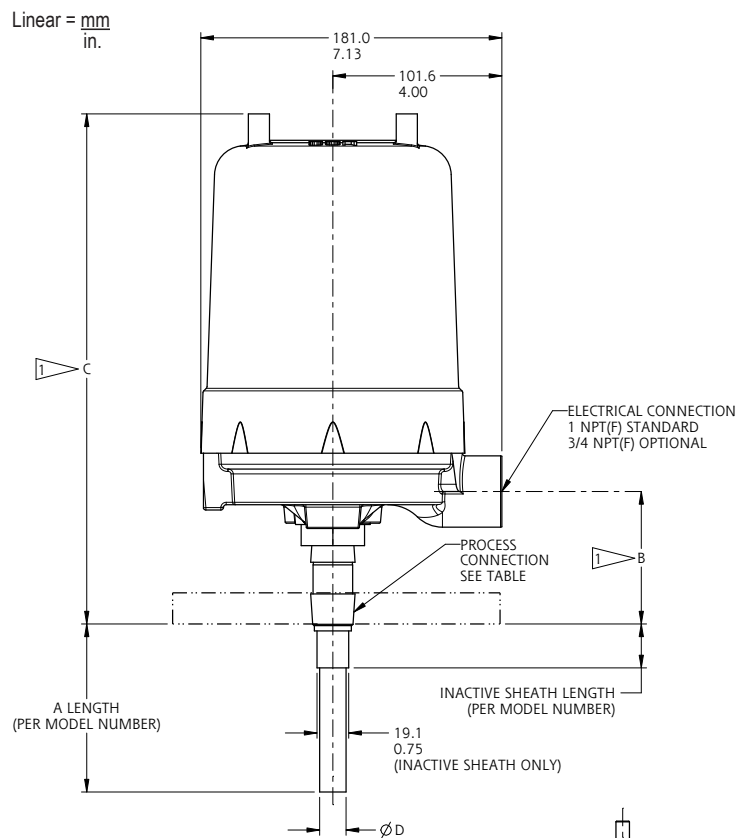
Drawing 0390654

RF Capacitance Level Controls

Dimensions

Housing: J for Model 66X

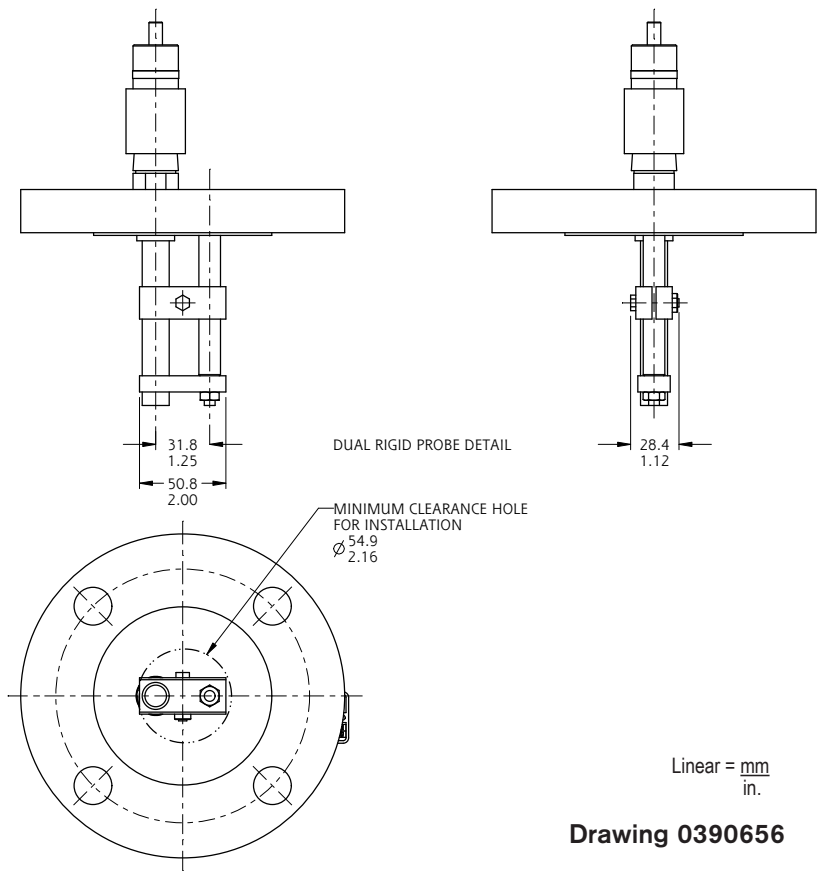
Drawing 0390656



PROCESS CONNECTION	DIM B	DIM C
3/4 NPTM	78.6 3.10	305.6 12.03
1, 1-1/2, & 2 NPTM	81.8 3.22	308.8 12.16
FLANGED	183.9 7.24	370.1 14.57
STILLING WELL	104.5 4.11	331.5 13.05

1 DIMENSION APPROXIMATE AND BASED ON A FIVE THREAD ENGAGEMENT

SENSOR STYLE	Ø D
BARE	12.7 0.50
SHEATH	15.9 0.63
BARE WITH STILLING WELL	26.7 1.05
SHEATH WITH STILLING WELL	26.7 1.05
INACTIVE SHEATH	15.9 0.63



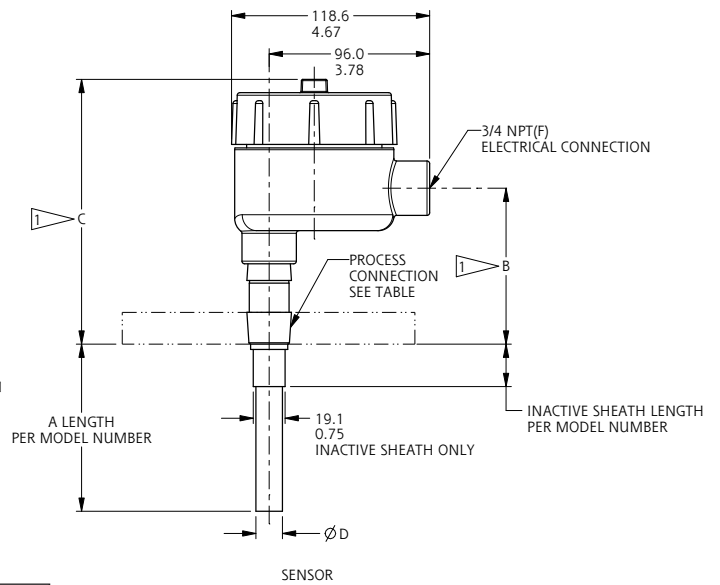
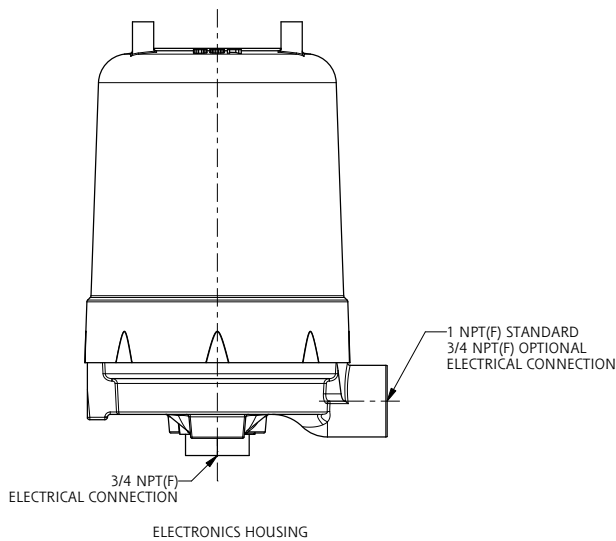
Linear = $\frac{\text{mm}}{\text{in.}}$

Drawing 0390656

RF Capacitance Level Controls

Dimensions

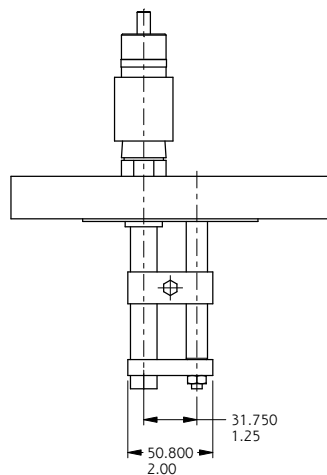
Housing: R for Model 66X



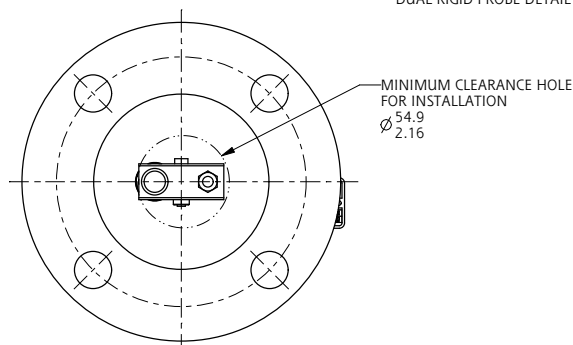
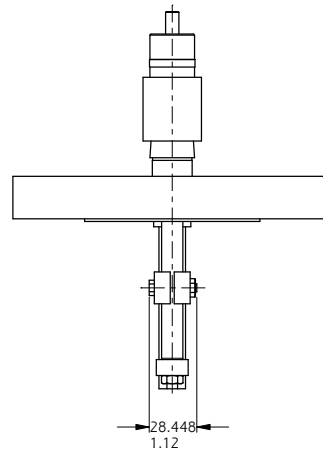
PROCESS CONNECTION	DIM B	DIM C
3/4 NPT (M)	94.1 3.71	159.2 6.27
1, 1-1/2, & 2 NPT (M)	97.3 3.83	162.4 6.39
FLANGED	158.5 6.24	223.7 8.81
STILLING WELL	120.0 4.72	185.1 7.29

SENSOR STYLE	Ø D
BARE	12.7 0.50
SHEATH	15.9 0.63
BARE WITH STILLING WELL	26.7 1.05
SHEATH WITH STILLING WELL	26.7 1.05
INACTIVE SHEATH	15.9 0.63

DIMENSION APPROXIMATE AND BASED
ON A FIVE THREAD ENGAGEMENT



DUAL RIGID PROBE DETAIL



Linear = $\frac{\text{mm}}{\text{in.}}$

Drawing 0390657

Selection Guidelines

Selecting the right probe for your application is very important. The objective is to maximize the amount of capacitance change for every inch (cm) of level change. Following are general guidelines for selecting a probe for a particular application. Please consult with SOR® or your local SOR sales representative for additional and/or specific information.

1. If process media is non-conductive - less than 10 μ Siemens/low dielectric (less than 10), select a bare probe. If there is any water in the process, go to number 2.
2. If process media is conductive - greater than 10 μ Siemens/high dielectric (greater than 10), select an insulated probe.
3. If process is non-conductive and in a horizontal (bullet) tank, or if the probe must be mounted more than 12 inches from the vessel wall, select a stilling well, or dual-rod.
4. If vessel is non-metallic, select a stilling well, or dual-rod.
5. Use rigid probes for measurement lengths of 10 feet or less.
6. For agency-listed controls, a matching agency listing must be specific on the probe. Available probe agency listings are provided in the following charts and specification pages.

Rigid Probes - Sheathed



Single Rigid
Sheath Probe

Model Number	Probe Material	Sensor Diameter	Spanned Capacitance in Water	Process Temperature Limits	Weight
CB	Teflon® sheath	5/8" (15.9 mm)	10 pF/in.	-100 to 400°F (-73 to 204°C)	1 lbs. (0.5 kg) +0.7 lb. (0.3 kg) per foot of probe



Rigid Sheath Probe
with Stilling Well

Model Number	Probe Material	Sensor Diameter	Spanned Capacitance in Water	Process Temperature Limits	Weight
CC	Teflon® sheath inside 316SS stilling well	1.05" (26.7 mm)	12 pF/in.	-100 to 400°F (-73 to 204°C)	2 lbs. (0.9 kg) +1.5 lb. (0.7 kg) per foot of probe



Rigid Sheath
Dual Probe

Model Number	Probe Material	Sensor Diameter	Spanned Capacitance in Water	Process Temperature Limits	Process Pressure	Weight
CD	Teflon® sheath and 316SS ground probe	1/2 & 5/8" (12.7 & 15.9 mm)	10 pF/in.	-100 to 400°F (-73 to 204°C)	Pressure per CB probe or flange rating, whichever is lower	12 lbs. (5.5 kg) +1.5 lb. (0.7 kg) per foot of probe

Rigid Probes - Sheathed



Single Inactive
Sheath Probe

Model Number	Probe Material	Sensor Diameter	Spanned Capacitance in Water	Process Temperature Limits	Weight
CJ	Teflon® sheath 316SS sheath	5/8 & 3/4" (15.9 & 19.1 mm)	10 pF/in.	-100 to 400°F (-73 to 204°C)	1 lb. (0.5 kg) +0.7 lb. (0.3 kg) per foot of probe

Rigid Probes - Bare



Single Rigid
Bare Probe

Model Number	Probe Material	Sensor Diameter	Spanned Capacitance in Water	Process Temperature Limits	Weight
CA	316SS	1/2" (12.7 mm)	N/A	-100 to 400°F (-73 to 204°C)	1 lb. (0.5 kg) +0.7 lb. (0.3 kg) per foot of probe



Single Rigid
Bare Probe
with Stilling Well

Model Number	Probe Material	Sensor Diameter	Spanned Capacitance in Water	Process Temperature Limits	Weight
CE	Bare 316SS probe inside 316SS stilling well	1.05" (26.7 mm)	N/A	-100 to 400°F (-73 to 204°C)	2 lbs. (0.9 kg) +1.5 lb. (0.7 kg) per foot of probe

RF Capacitance Level Controls

How to Order

Model Number System

CB C-8A-CS-12-TT

Process Connection		3	4		Agency Approval		
3/4" NPT		8A	00	No Agency Approvals required			
1" NPT (Required size on CC and CE probes)		1A	CS	CSA (not available on CA, CE)*			
1-1/2" NPT		9A	FM	FM (not available on CA, CE)*			
2" NPT		2A	MB	IECEX (not available on CA, CE, CJ)*			
1" 150# ANSI RF Flange		1C	NM	INMETRO (not available on CA, CE, CJ)*			
1-1/2" 150# ANSI RF Flange		9C	* Electronics and probe must have the same agency to maintain the listing integrity (i.e. CS or AI electronics with CS probe, or FM or FI electronics with FM probe).				
2" 150# ANSI RF Flange		2C					
3" 150# ANSI RF Flange		3C					
(3C, 3D, 4C, 4D only on CD & CP probes)							
4" 150# ANSI RF Flange		4C					
1" 300# ANSI RF Flange		1D					
1-1/2" 300# ANSI RF Flange		9D					
2" 300# ANSI RF Flange		2D					
3" 300# ANSI RF Flange		3D					
4" 300# ANSI RF Flange		4D					
Sensor Material		2	5			Sensor Length	
316SS Standard		C	XXX.X		Sensor length in inches. Lengths are 5 places including the decimal and leading zeros (see Accessories for different units). Sensor style CJ requires a sensor length followed by an inactive sheath length. See page 23 for limits of probe length.		
					Note: Inactive sheath length must be at least 6" shorter than sensor length		
Sensor Style		1	6		Accessories & Certificates		
Rigid 316SS Single Probe		CA	FT	Probe length specified in feet (ft.)			
Rigid Teflon Single Probe		CB	MK	Probe length specified in meters (m)			
Rigid Teflon Single Probe with Stilling Well		CC	ML	Probe length specified in centimeters (cm)			
Rigid Teflon Dual Probe (316SS Ground)		CD	PP	Fiber tag with customer-specified information			
Rigid 316SS Single Probe with Stilling Well		CE	RR	SS tag wired on with customer-specified information			
Rigid Teflon Single Probe with 3/4" OD Inactive Sheath		CJ	TT	SS tag riveted on with customer-specified information			
			<u>Individual Certificates</u>				
			C2	Hydrostatic Pressure Test			
			C8	Typical Material of Wetted Parts			
			D1	Certificate of Origin			
			D2	Manufacturer's Certification			
		CB	CS	00012	TT	← Model Number	
		C					
		8A					

RF Capacitance Level Controls

Agency Approval

Agency	Safety Method	Approval	Model(s)	
FM	Explosion Proof	Class I, Groups B, C, D Class II, Groups E, F, G Class III, Division 1	CB, CC, CD and CJ	
CSA	Explosion Proof	Class I, Groups C, D Class II, Groups E, F, G Class III, Division 1	CB, CC, CD and CJ	
IEC	Intrinsically Safe	Ex ia IIB T4	CB, CC and CD	
INMETRO	Intrinsically Safe	Ex ia IIB T4	CB, CC and CD	

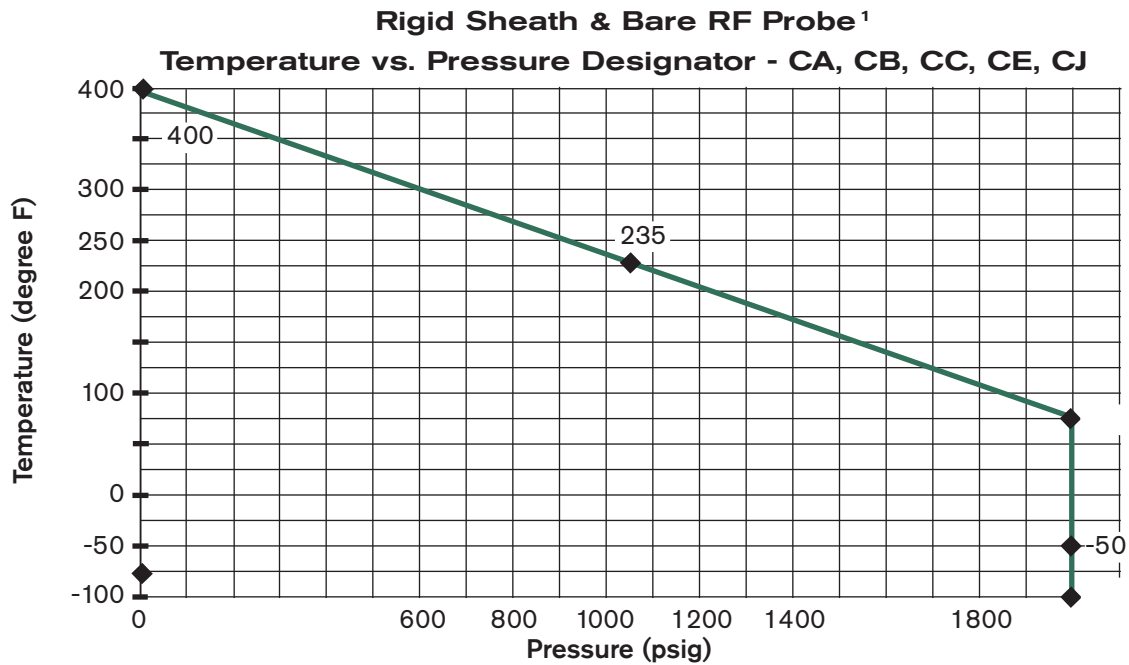
Probe Insertion Lengths

Probe Type	Length (inch)		Length (cm)	
	Minimum	Maximum	Minimum	Maximum
CA	3.5"	234"	8.89	594.4
CB	1.5"	234"	3.81	594.4
CC	2"	234"	5.08	594.4
CD	2"	120"	5.08	304.8
CE	4.5"	234"	5.08	594.4
CJ	7"	120"	17.78	304.8
Sheath*	1"	114"	2.54	289.6

*Sheath length must be selected with CJ only.

Flange Weight and Pressure Rating

Process Connection	Add to Shipping Weight	Maximum Pressure Rating
1C	2 lbs. (1.0 kg)	275 psig (19 bar)
9C	4 lbs. (1.8 kg)	275 psig (19 bar)
2C	5 lbs. (2.3 kg)	275 psig (19 bar)
3C	9 lbs. (4 kg)	275 psig (19 bar)
4C	17 lbs. (8 kg)	275 psig (19 bar)
1D	3 lbs. (1.5 kg)	720 psig (50 bar)
9D	6 lbs. (2.7 kg)	720 psig (50 bar)
2D	8 lbs. (3.6 kg)	720 psig (50 bar)
3D	16 lbs. (7.5 kg)	720 psig (50 bar)
4D	27 lbs. (12.5 kg)	720 psig (50 bar)



Notes

1. Standard pressure rating: 2000 psi @ 70°F.

RF Capacitance Level Controls

Application Data Sheet

[Link to online fillable three page
PDF Application Data Sheet \(Form 1983\)](#)

*This form must be completed prior
to engineering order review.*

General Information			
Company _____		Address _____	
Contact Name _____			
Phone _____	Fax _____	E-mail _____	
Rep. Company _____		Rep. Contact _____	
Tag Number _____	Function ☐ Alarm ☐ Control ☐ Other _____		
Application ☐ Level ☐ Interface	Hazardous ☐ Yes ☐ No	Agency Approval _____	
Sensor Information			
Probe Model _____		Orientation ☐ Vertical ☐ Horizontal	Style ☐ Rigid ☐ Flexible
Wetted Parts Materials _____			
Insertion Length _____ (in. or cm)		Process Connection _____ (size and type)	
Control Information			
Location ☐ Integral ☐ Remote		Enclosure Class _____ (example: Pf, I.S or NEMA 4)	
Conduit Connection & Size _____		Power Supply _____	
Switch Information			
Number of Set Points _____		Type ☐ Relay ☐ 8mA ☐ 16mA	Quantity & Form _____ (i.e. 1-DPDT)
Voltage Rating ☐ AC ☐ DC	Amperage Rating _____	Load Type ☐ Inductive ☐ Non-Inductive	
Connection (provide sketch at the end of form if necessary) _____			
Transmitter Information			
Output _____ (4-20 mA)		Measurement Range _____	
General Application Conditions			
Process Media Name _____		Vessel Shape ☐ Vertical Cylinder ☐ Horizontal Cylinder ☐ Sphere	
Vessel Lining ☐ Yes ☐ No	Vessel Material _____	Viscosity _____ (cp)	
Pressure _____ (normal) _____ (maximum)	Temperature _____ (normal) _____ (maximum)		
Ambient Temperature Range _____		Solids _____ (%)	Specific Gravity _____
Turbulence ☐ Yes ☐ No	Process Coating ☐ Yes ☐ No	Vibration/Mixing ☐ Yes ☐ No	
RF Instruments			
Upper Fluid Name _____		Dielectric Constant _____	
Lower Fluid Name _____		Dielectric Constant _____	
Ultrasonic Switches			
Aeration/Solids ☐ Yes ☐ No		Hydrocarbon Vapors ☐ Yes ☐ No	
Submersible Pressure			
Cable Length _____		Nose Cone ☐ Yes ☐ No	

Continued on next page

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Page 1 of 2



MEASUREMENT AND CONTROL

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