

## MODEL 167

### GENERAL DESCRIPTION

The Robertshaw Model 167 is an RF Capacitance to Current transmitter producing a standard 4-20 mA DC current output signal directly proportional to the input capacitance. The Model 167 represents a totally new concept in capacitance instrumentation and features a patented circuit design to eliminate the effects of sensing probe coatings and provide a true level signal. This circuit design operates on the admittance principle such that all parameters are taken into account, such as susceptance and conductance.

The Model 167 offers various supply configurations. The Model 167-A is a two-wire system operating on any DC voltage ranging from 17 VDC to 35 VDC maximum. This system allows for simple, inexpensive installation since only two standard wires are used to power the instrument and also carry the output signal. The Model 167-B/C series are four wire instruments utilizing 120 VAC or 240 VAC supply power.

Standard features of the Model 167 include the "AntiCoating" feature, plug-in circuit boards for ease of maintenance when required, EMI suppression, lightning protection and reverse polarity protection on the two-wire version. The Model 167 is housed in an explosion-proof cast aluminum enclosure suitable for hazardous areas or Water-tight NEMA 4 locations. Due to the very low energy levels imposed on the sensing probe, as well as the low stored energy within the circuitry, the Model 167-A also qualifies as intrinsically safe when used with an approved safety barrier.

### PRINCIPLE OF OPERATION

The unique Model 167 design employs low power consuming CMOS type integrated circuits necessary for two-wire signal/power transmission. Operation is based on the proven charging rate comparison technique first developed by Robertshaw, wherein the rate of "charge" of an internal reference capacitor is compared to that of the external probe capacitance and an output signal is developed proportional to the difference.

Comparisons of charging rates of the two capacitors are made 125,000 times per second; the capacitors being quickly discharged after each comparison. This technique provides inherent stability and accuracy without the need for variable capacitors, transformers, or other bulky components.

A free running CMOS oscillator provides the basic comparison frequency operating a dual CMOS switch to effect the discharging of the reference and probe capacitors. The rate of charge measurement of both capacitors is performed by an integrated circuit operational amplifier whose output drives the output signal amplifier and simultaneously re-adjusts the charging rate of the probe capacitance until it equals that of the reference capacitor.

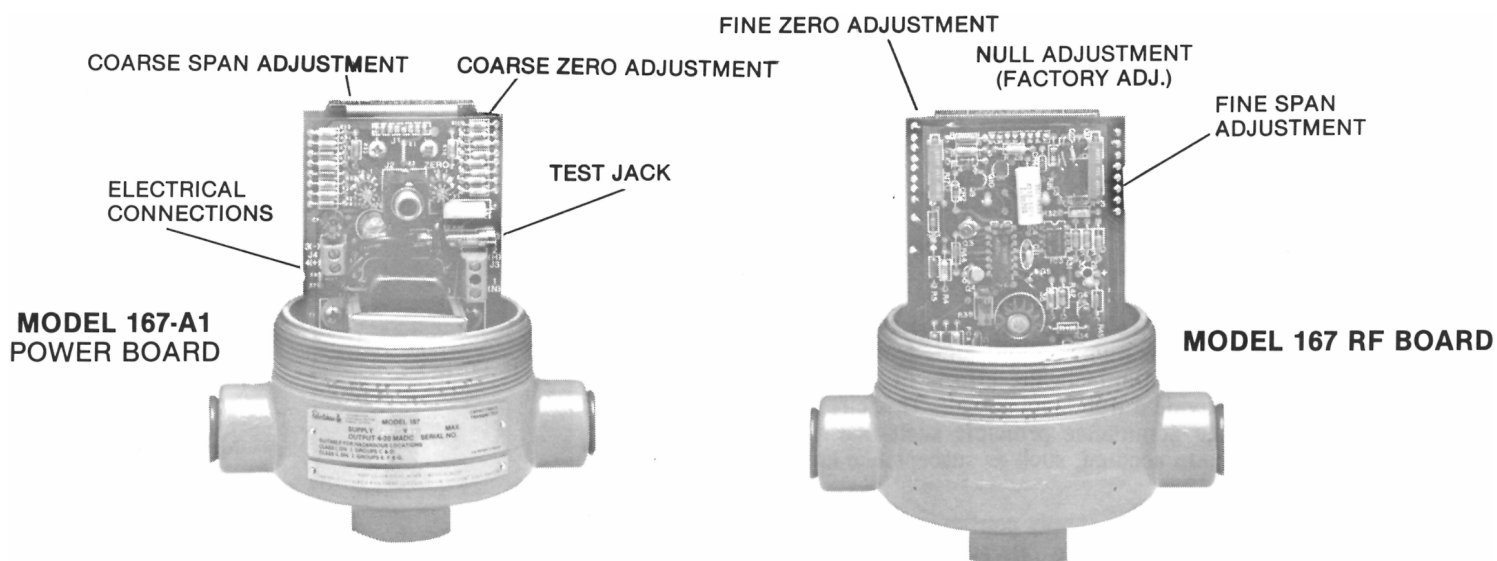


Probe shown for illustration only.  
Must be ordered separately.

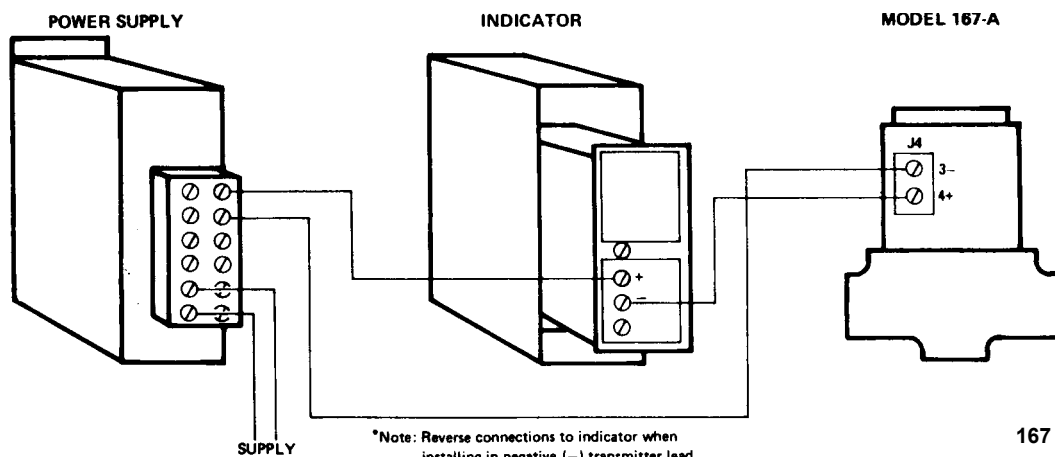
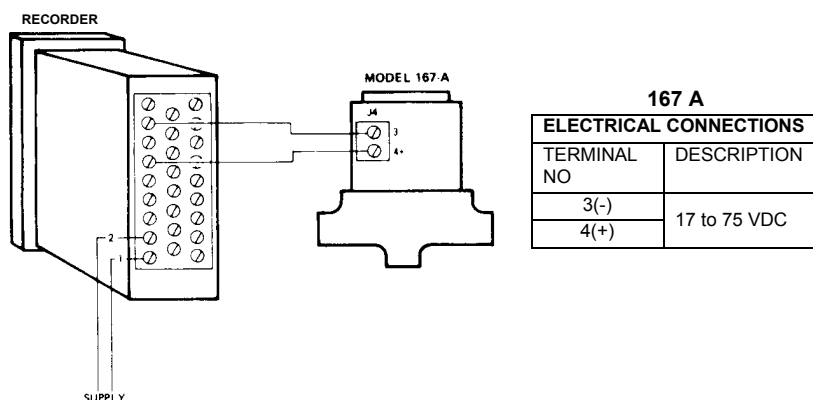
### FEATURES AND BENEFITS

- **Two or Four Wire versions available** - Simple, low cost, installations.
- **Operates on Admittance Principle** - Minimizes error due to material build-up on probe.
- **Reverse Polarity, Lightning and EMI Protection** - Tolerates long-lead wire runs without problems.
- **Non-interacting and Wide Adjustability of Zero and Span** - Simplifies initial calibration.
- **CSA Certified Explosion-Proof and NEMA 4 Enclosure** - Usable in Hazardous and Water-tight areas.
- **CSA Certified Intrinsically safe models when used with approved barriers.**
- **Plug-in Circuit Boards** - Ease of maintenance.

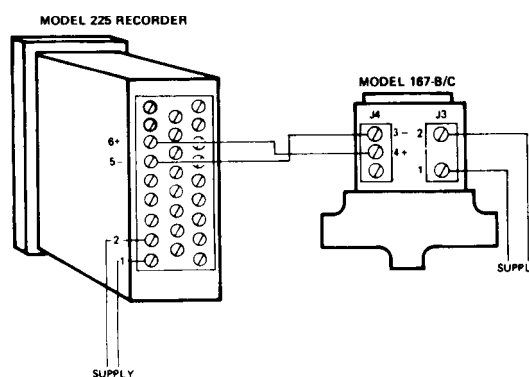
## CALIBRATION ADJUSTMENTS & CONTROLS



TYPICAL CONNECTIONS FOR MODEL 167-A (DC)  
TO DEVICES WITH BUILT-IN POWER SUPPLIES



\*Note: Reverse connections to indicator when installing in negative (-) transmitter lead.



**167 B/C**

ELECTRICAL CONNECTIONS	
TERMINAL NO	DESCRIPTION
3(-)	4 20 mA OUTPUT
4(+)	
1(N)	120 240 VAC
2(H)	SUPPLY

TYPICAL CONNECTIONS FOR MODEL 167-B/C (AC)

## SPECIFICATIONS

<b>Enclosure</b> .....	Models 167-A(1,2)
CSA Certified Explosion-Proof for Class I, Groups C & D, and Class II, Groups E, F, & G. Meets NEMA 4 water-tight	
<b>Intrinsic Safety</b> .....	Models 167-A(1,2)
CSA Certified intrinsically safe for Class I, Division 1, Groups C & D; Class II, Division 1, Groups E, F & G, when connected as shown on drawing 907GA681.	
<b>Optional</b> .....	4-20 mA Explosion-Proof Meter
<b>Storage Temperature Limits</b> .....	-65°F to +200°F (-54°C to +93°C)
<b>Operating Temperature Limits</b> .....	-40°F to +160°F (-40°C to +71 °C)
<b>Vibration</b> .....	±2g's 10 to 200Hz
<b>Shock</b> .....	75 g's for 11 Milliseconds
<b>Humidity</b> .....	95% RH @ 100°F (38°C)

## PERFORMANCE

<b>Maximum Total Capacitance (terminal, zero suppression &amp; maximum span)</b> .....	2000 pF
<b>Terminal Capacitance Range</b> .....	30 to 1000 pF
<b>Span Capacitance Range</b> .....	10 to 1700 pF
<b>Repeatability</b> .....	±0.1%
<b>Linearity</b> .....	± 0.25%, 10 to 500 pF span ± 0.5%, 500 to 1700 pF span

### Temperature Effect:

Span & Zero ..... 0.01 % °F (0.018 %/°C)  
or 0.01 pF/°F (0.018 pF/°C) whichever is greater

**Maximum recommended Terminal/Span ratio** .....5:1

**Supply Variation Effect** ..... 0.1 %/10% supply change max.

**Output Signal Ripple** ..... 0.25 % peak to peak

**Sensitivity** .....0.01 % Minimum

## ELECTRICAL

### 167-A

**Supply Voltage** ..... 17 VDC min to  
35 VDC max across input

\* NOTE: Lower supply voltages can be used if the load resistance is extremely low. See the Rmax formula below.

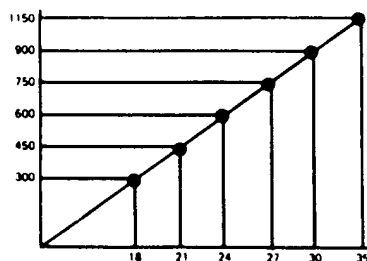
**Supply Current** ..... 28 mA maximum

**Output Signal** ..... 4-20 mA

**Output Load** ..... Limited by Supply Voltage

$$R_{max} = \frac{\text{Supply Voltage} - 12}{20} \times 1000 \text{ ohms}$$

Maximum  
Load Resistance  
ohms



SUPPLY VOLTAGE  
FOR TWO-WIRE VERSION

(Example: R=600 ohms for 24 VDC supply)  
Maximum Connecting Wire Length Limited  
by Total Load Resistance  
(Load Plus Wire Resistance)

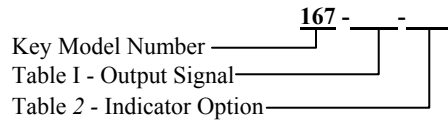
### 167-B/C

**Supply Power** ..... 3 VA, 1.75 Watts @ 120 VAC, 50/60 Hz  
3 VA, 1.75 Watts @ 240 VAC, 50/60 Hz

**Output Signal** ..... 4-20 mA DC

**Output Load** ..... 0-1150 ohms  
(Includes connecting wire)

## ORDERING INFORMATION



### KEY MODEL NUMBER

Model No.	Description
167	The Model 167 is a Capacitance Transmitter which converts the capacitance signal input to a standard 4-20 mA current output. The transmitter unit is contained in an explosion-proof, Water-tight housing for mounting directly on the sensing probe. The Model 167 is a self-contained blind transmitter with internal adjustments.

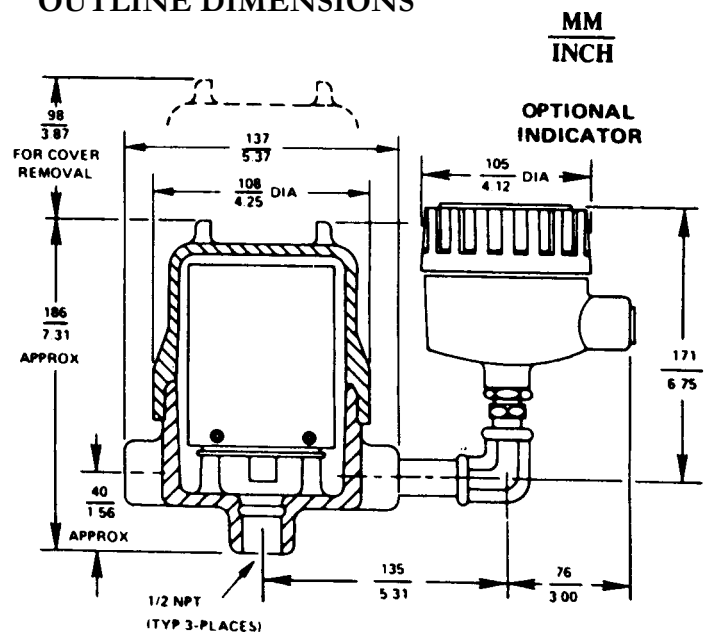
TABLE 1- SUPPLY POWER

Desig.	Description
A	17-35 VDC 2-wire system
B	120 VAC 50/60 Hz, 4-wire
C	240 VAC 50/60 Hz, 4-wire

TABLE 2 - INDICATOR OPTION

Desig.	Description
1	None
2	Explosion-proof Indicator

## OUTLINE DIMENSIONS



# Robertshaw

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