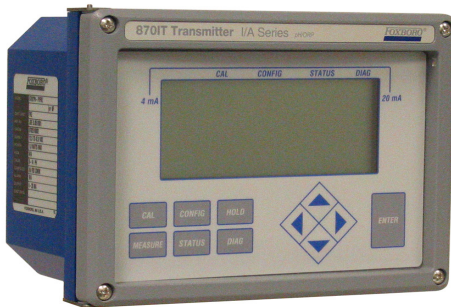


**Model 870ITEC**  
**Intelligent Electrochemical Transmitter for Electrodeless Conductivity Measurements**



PANEL-MOUNTED TRANSMITTER

**PIPE- OR SURFACE-MOUNTED  
TRANSMITTER**



The Foxboro® brand Model 870ITEC is available from Invensys Process Systems (IPS). This micro-processor based, 2-wire intelligent transmitter provides measurement indication, and a choice of analog or digital outputs for recording or control of electrodeless conductivity. A human interface guides the user through intuitive, menu-driven configuration, calibration, status, and troubleshooting procedures. On-line diagnostics for both transmitter and sensor are also provided to indicate real-time measurement faults.

**FEATURES**

- ▶ 4 to 20 mA or Digital Output, Fully Configurable.
- ▶ Digital Output Compatible with I/A Series® System.
- ▶ Foxboro PC-Based Intelligent Transmitter Configurator Offered for Remote Digital Communications. Compatible with IBM (or Compatible) Computer.
- ▶ Human Interface for Local Display, Status, Configuration, Calibration, and Fault Isolation.
- ▶ Continuous Transmitter/Sensor Diagnostics.
- ▶ NEMA 4X and IEC IP65 Housing. Mounts to Panel, Surface, or DN 50 or 2-inch Pipe.
- ▶ Intrinsically Safe Construction.
- ▶ RFI and EMI Protection.
- ▶ Digital Output for Process Measurement and Process Temperature.

- ▶ Preprogrammed Temperature and % Concentration Curves are Standard. User Programmable Curves may also be used.
- ▶ Two Levels of Passcode Protection provided.
- ▶ Compatible with Foxboro 871EC Series Invasive Electrodeless Conductivity Sensors.
- ▶ Conforms to all applicable European Union Directives; product marked with “CE” symbol.

### **RUGGED FIELD-MOUNTED ENCLOSURE**

Housed in a tough, epoxy-painted cast aluminum housing, the 870ITEC is designed to withstand the harshest field conditions. The enclosure provides the environmental and corrosion-resistant protection of NEMA 4X, CSA Enclosure 4X, and IEC IP65. It also protects against RFI and EMI. Its efficient DIN panel-size design allows easy mounting for panel, pipe, or surface applications. A hinged front door provides easy front access to field connections. Large spade lug terminals for sensor and communications connections facilitate quick maintenance and calibration procedures.

The transmitter can be provided with an optional polycarbonate storm door to prevent accidental activation of the front panel controls.

### **CONDUCTIVITY OR CONCENTRATION MEASUREMENT**

This transmitter can be configured to measure in either conductivity units ( $\mu\text{S}/\text{cm}$  or  $\text{mS}/\text{cm}$ ), or one of a host of chemical concentration units such as percent (%) by weight, grams per liter (g/L), parts per million (ppm), parts per thousand (ppt), and ounces per gallon (oz/gal). A series of preprogrammed temperature and percent chemical concentration curves are available as a standard feature. User programmable curves may also be used for special applications such as uncommon chemicals, proprietary processes, or nonbinary solutions.

### **FLEXIBLE COMMUNICATIONS**

The 870ITEC is available in two different communications platforms. For users who need only transmit a 4 to 20 mA analog output without the requirement for remote digital communication, a transmitter with analog output only (Model Code Selection “-A”) is available. Complete configuration, calibration, status checking, and fault identification is through the local human interface only.

For applications where remote communications is required, a digital platform is available (Model Code Selection “-F”). Within this digital environment, two kinds of communications are selectable. First, the transmitter may operate in a low speed (600 baud) digital mode with the digital signal superimposed over an analog 4 to 20 mA signal. Second, the transmitter may operate in a high speed (4800 baud) digital only mode. Communications with this digital version may be via one of three methods – local human interface, Foxboro PC-based configurator interface, or an I/A Series system workstation. Any of these three methods allows complete configuration, calibration, status checking, and fault identification.

When operating in either of the two digital modes, the transmitter continuously delivers three measurement values, namely temperature compensated measurement, uncompensated (absolute) measurement, and temperature.

Outputs are scalable and programmable as either normal or reverse acting. In the analog mode, where only one output is available, the user may assign the output to one of three parameters – temperature compensated measurement, uncompensated (absolute) measurement, or temperature.

Several selections of output damping are available ranging from 1 to 120 seconds. An output HOLD feature, easily accessible from the user interface, allows the output(s) to be frozen at user-defined value(s) to facilitate calibrations or sensor maintenance while not disturbing the control loop.

## LOCAL HUMAN INTERFACE

This interface allows full configuration, calibration, and fault location without needing a configurator. The interface consists of a 3-line LCD display and a keypad with eleven tactile keys. See Figure 1.

The 3-line display provides a digital bar graph (which is activated while in the MEASURE mode) at the top and two lines of alphanumeric. The bar graph comprises twenty segments and indicates %-of-range of the 4 to 20 mA output. When in the CAL, CONFIG, STATUS, or DIAG mode, two segments are lit to indicate the present mode of operation. The bar graph also “zips” to confirm that a configuration entry has been accepted.

The second and third lines of the display are the alphanumeric relating to measurement values, measurement error indications, message reporting, and configuration and calibration prompts. These prompts simplify programming the transmitter and greatly reduce the need for instruction manuals. The primary measurement (e.g., mS/cm) is shown on the

second line of the display. Legends available for the primary measurement include mS/cm, S/m, %, g/L, oz/gal, ppm, and ppt. A secondary user configurable measurement (temperature, absolute conductivity, or output in mA), is shown on the third line of the display. The display characters are 15 mm (0.60 in) high, and allow easy reading from afar.

## HIGH SENSITIVITY, WIDE RANGEABILITY

Using patented IPS sensor technology, the transmitter delivers a high sensitivity conductivity solution for applications such as steam condensate or boiler blowdown. Full scale ranges as low as 0 to 50 mS/cm can be measured. However, the transmitter is also capable of measuring as high as 0 to 2000 mS/cm with numerous intermediate range choices, thus assuring full compatibility with all applications. Range selection can be made from the integral keypad, or (for 870ITEC-F) via a PC-based Configurator or an I/A Series System Workstation.

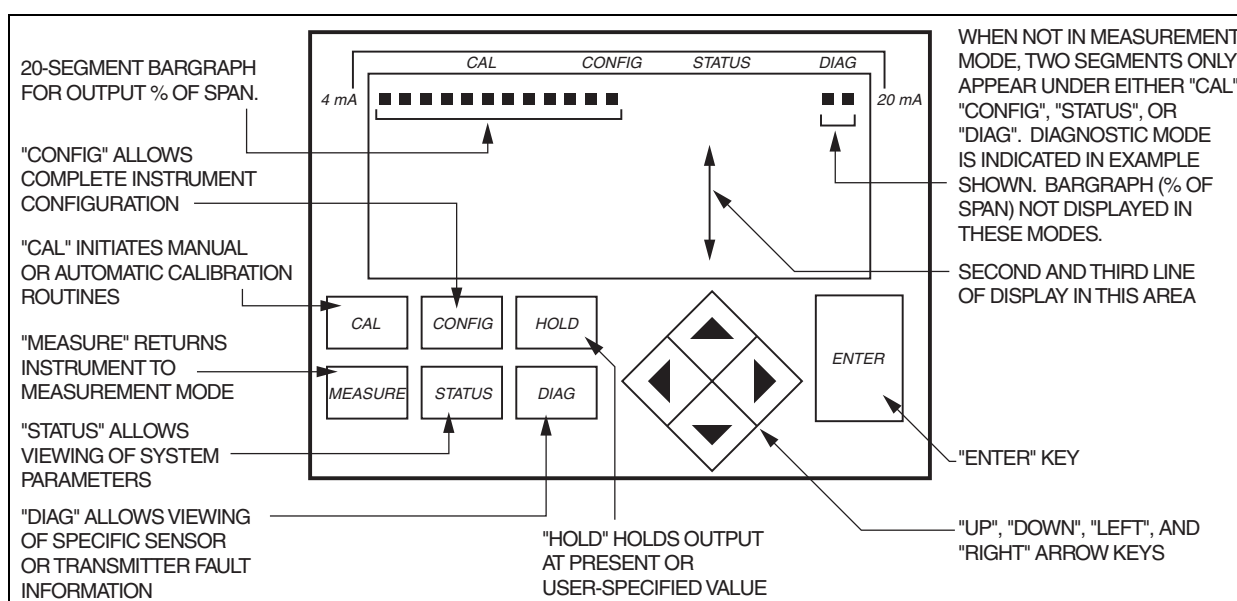


Figure 1. Human Interface—Display and Keypad

## **CUSTOMIZE AND EMPLOY UP TO THREE APPLICATIONS**

This unique feature allows the user to preconfigure the transmitter for up to three distinct applications. Each application may have its own range, temperature compensation curve, chemical concentration curve (if applicable), and output configuration. Each application is assigned a number, for example, application 1, application 2, or application 3. If the user wishes to switch from one application to another, the user simply changes one parameter in the configuration menu and the entire application set switches in automatically. This is a powerful feature for users who frequently change between a handful of common, or even custom, recipes.

## **AUTO-SWITCHING**

A useful extension to the multi-application feature is an auto-switching capability between either two or three applications. User-programmable switch limits determine when the transmitter auto-switches from application 1 to application 2, then again from application 2 to application 3. Similarly, the transmitter auto-switches in a descending fashion depending on the CONFIG NUM APPS and CONFIG TRIGGER programmed by the user. Because each of the applications (three maximum) is individually configured, calibration constants are stored in memory and invoked as the application is retrieved.

Thus, the transmitter can switch from a wide range conductivity application to a very sensitive one (e.g., Rinse, Product, and CIP) without the need to recalibrate the system for the new range. This results in tremendous time savings for operators, and eliminates common sources of error in critical applications.

## **SENSOR AND TRANSMITTER DIAGNOSTICS**

When used with Foxboro 871EC Series Invasive Electrodeless Conductivity Sensors, or 871FT (flow-

through) Series Electrodeless Conductivity Sensors, the 870ITEC provides sensor diagnostics. These include:

- ▶ Liquid Leakage into Sensor Body
- ▶ Failure of Temperature Compensation Element

In addition to sensor diagnostics, the transmitter continuously performs health checks on its own circuits. In the event of a fault in the system, one of three messages appears on the local display: "PROBE ER", "XMTR ER", or "CONFIG ER". This top level message reporting allows the user to quickly isolate the problem to either the sensor or the transmitter. For additional information about the specific fault or faults, the user need only access the "DIAG" key and follow the prompts. Not only does this procedure identify the specific faults, but it also guides the user to a corrective action without referring to an instruction book.

## **INTRINSICALLY SAFE DESIGN**

The 870ITEC Transmitter is designed for compliance with FM, CSA, and ATEX standards for intrinsically safe and nonincendive apparatus in hazardous locations. Refer to Electrical Safety Specifications section.

## **EASE OF SENSOR CONFIGURATION**

IPS manufactures an extensive range of 871EC and 871FT (Flow-Through) Electrodeless Conductivity Sensors in numerous sizes, materials, geometries, and mounting configurations to satisfy the majority of applications in process industries. Different sensor form factors result in different sensor cell factors which affect the sensitivity and range of a particular conductivity loop. To simplify the sensor compatibility process, the transmitter provides menu selections for each type of 871EC and 871FT Sensor, as well as a user-programmable cell factor for optimization of special sensors (such as Foxboro EP307 sensors). In addition, a selection of three series temperature

compensator inputs (100  $\Omega$  platinum RTD, 1000  $\Omega$  platinum RTD, and 100 k $\Omega$  thermistor), ensures compatibility with standard temperature sensors, high temperature sensors, and sensors of a specialized nature. Refer to Figure 2.

### SECURE DATA AND CALIBRATIONS

Multiple levels of security protect against unauthorized configuration/calibration changes, loss of data, and/or invalid measurement signals. Two levels of passcode protection are provided. The first level permits access to routine maintenance functions, including calibration and output hold. The second level permits changes to configuration parameters by authorized personnel. Data is stored in EEPROM, obviating the need for battery backup. Measurement loop security is enhanced by a user programmable “fail signal” parameter activated by any transmitter fault and certain serious sensor faults.

This “fail signal” parameter forces the transmitter output to any user-defined value between 3.8 and 20.5 mA (or equivalent percentages of full scale when operating with digital communications).

### QUICK AND INFORMATIVE STATUS

At the touch of a single key, the user gains access to all the information necessary to assess the

performance of the conductivity loop. Among the parameters this “read only” key accesses are:

- ▶ Application being Run
- ▶ Process Temperature
- ▶ Absolute (Uncompensated) Conductivity Value
- ▶ Full Measurement Units ( $\mu$ S/cm, S/m, etc.)
- ▶ Analog Output Value in Milliampères
- ▶ Resistance of Temperature Compensator
- ▶ Date of Last Calibration

### 2-WIRE TRANSMITTER—POWER AND SIGNAL

The power and signal to the transmitter is supplied over two wires. The power may be provided from an applicable I/A Series Fieldbus Module (FBM), or alternatively, from a user-provided power supply. Two levels of communications functionality are offered:

- 1 A device with a 4 to 20 mA output only (no digital communications).
- 2 A digital device featuring communication with an I/A Series system having a software configurable IT1 or IT2 mode. The IT1 mode offers both a 4 to 20 mA and low speed (600 baud) digital signal over the same line. The IT2 mode offers a high speed (4800 baud) digital signal only.

The transmitter supports both normal and reverse acting output.

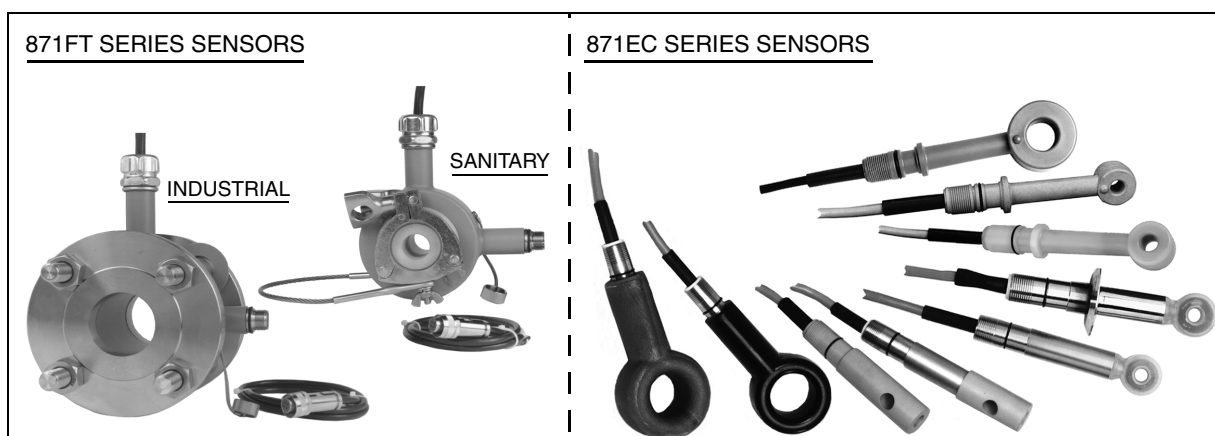


Figure 2. Foxboro 871FT and 871EC Series Sensors

OPERATING, TRANSPORTATION, AND STORAGE CONDITIONS

Influence	Reference Operating Conditions	Normal Operating Conditions	Operative Limits	Transportation and Storage Limits
Ambient Temperature ▶ without Display (LCD) ▶ with Display (LCD)	▶ $23 \pm 2^{\circ}\text{C}$ ( $73 \pm 4^{\circ}\text{F}$ ) ▶ $23 \pm 2^{\circ}\text{C}$ ( $73 \pm 4^{\circ}\text{F}$ )	▶ $-25$ to $+55^{\circ}\text{C}$ (a) ( $-13$ to $+131^{\circ}\text{F}$ ) ▶ $-25$ to $+55^{\circ}\text{C}$ (a)(b) ( $-13$ to $+131^{\circ}\text{F}$ )	▶ $-40$ and $+85^{\circ}\text{C}$ (a) ( $-40$ and $+185^{\circ}\text{F}$ ) ▶ $-30$ and $+60^{\circ}\text{C}$ (a)(b) ( $-22$ and $+140^{\circ}\text{F}$ )	▶ $-55$ and $+85^{\circ}\text{C}$ ( $-67$ and $185^{\circ}\text{F}$ ) ▶ $-55$ and $+85^{\circ}\text{C}$ ( $-67$ and $185^{\circ}\text{F}$ )
Relative Humidity	$50 \pm 10\%$	$5$ to $95\%$ (c) Noncondensing	$5$ and $95\%$ Noncondensing	$5$ and $95\%$ Noncondensing
Supply Voltage Over 4 to 20 mA 2-Wire Line	$24 \pm 2$ V dc	$12.5$ to $42$ V dc See Figure 3	$12.5$ and $42$ V dc See Figure 3	Not Applicable
Output Load	$250 \Omega$	$0$ to $1450 \Omega$ See Figure 3	$0$ and $1450 \Omega$ See Figure 3	Not Applicable
Isolation	$\pm 1$ V dc	For Intrinsically Safe Applications: $\pm 24$ V dc For General Purpose (Ordinary) Locations: $\pm 42$ V dc		Not Applicable
Vibration	Negligible	For Panel Mounting: $2.5 \text{ m/s}^2$ ( $0.25$ "g") from $5$ to $200$ Hz For Pipe or Surface Mounting: $10 \text{ m/s}^2$ ( $1$ "g") from $5$ to $200$ Hz		Protected by Shipping Container

(a) Refer to the Electrical Safety Specifications section for a restriction in ambient temperature with certain electrical certifications.

(b) The LCD Indicator may have degraded performance between  $-20$  and  $-30^{\circ}\text{C}$  ( $-4$  and  $-22^{\circ}\text{F}$ ).

(c) The transmitter will operate at a low limit of  $0\%$  RH but with a possible degradation of performance.

**PERFORMANCE SPECIFICATIONS**  
(Transmitter Specifications Under Reference Operating Conditions Unless Otherwise Specified. Refer To Sensor Literature For Sensor Specifications.)

**Accuracy – Measurement (Includes Linearity)<sup>(1)</sup>**

**DIGITAL**

± 0.3% of full scale, typical

**ANALOG**

Digital Accuracy ±0.04% of full scale

**Accuracy – Solution Temperature<sup>(2)</sup>**

**WITH 3-WIRE 100 Ω PLATINUM RTD**

± 0.1°C (± 0.18°F)

**WITH 3-WIRE 1000 Ω PLATINUM RTD**

± 0.03°C (± 0.05°F)

**WITH 100 kΩ THERMISTOR**

± 0.1°C (± 0.18°F)

**Repeatability**

Same performance as Accuracy

**Ambient Temperature Effect**

**DIGITAL MEASUREMENT**

± 0.03% of full scale per °C

**DIGITAL TEMPERATURE**

± 0.05% of full scale per °C

**ANALOG**

Digital value ±0.03% of full scale per °C

**Relative Humidity Effect (0 to 95% RH)**

Less than 0.1% of full scale

**Supply Voltage and Load Effect**

**DIGITAL**

Less than 0.005% of full scale/V

**ANALOG**

Less than 0.005% of full scale/V

**Output Load Effect**

Less than 0.05% of span. Effect is on output for a change in resistance of series circuit containing transmitter overload limits specified in Figure 3.

**Vibration Effect (Sensor not included)**

Less than 0.1% of full scale

**Mounting Position Effect (All Mounting Positions)**

Less than 0.01% of full scale

**Response Time**

**TEMPERATURE**

3-Wire Element: < 16 seconds

2-Wire Element: < 12 seconds

**ABSOLUTE CONDUCTIVITY**

< 5 seconds

**Output Noise (Sensor Dependent)**

Less than 0.25% of full scale, typical

**Measurement Stability (Temperature Compensated)**

± 0.25% of full scale, through six months

**Minimum Output Span**

5% of upper measurement range value

**Solution Temperature Stability (Noncumulative)**

± 0.1% of full scale, through six months

**Common Mode Rejection Ratio**

120 dB, dc; or 50/60 Hz, ac; between loop and sensor (42 V peak maximum)

(1) Sensor dependent. Specification is shown for Sensor Types “-SP” and “-LB”, but is typical for all sensors.

(2) Does not include accuracy of RTD or Thermistor.

## PERFORMANCE SPECIFICATIONS (CONT.)

### High Frequency Transients

Can withstand a high frequency transient on the dc power line of 2 kV, 5 x 50 ns impulse. (Per IEC Standard 801-4.)

### Lightning Transient

Withstands a transient of 2 kV on the dc power line (per IEC 801-5).

### Radiated RFI Emissions

Meets CISPR Standard 11

### Electrostatic Discharge

Meets IEC Standard 801-2

### RFI Immunity

Output error of < 5% of full scale when tested with field strength of 10 V/m (with 80% amplitude modulation) with conduit, from 26 to 1000 MHz.

### Electromagnetic Compatibility

Complies with EMC Directive 89/336/EEC when sensor and I/O Cables are enclosed in rigid metal conduit.

## FUNCTIONAL SPECIFICATIONS

### Communications and Measurement Output

#### NO DIGITAL COMMUNICATIONS

4 to 20 mA Analog Output

#### I/A Series COMMUNICATION, SOFTWARE CONFIGURABLE

IT1 Mode

4 to 20 mA Analog Output and Low Speed Digital Communications, 600 Baud

IT2 Mode

High Speed Digital Communications, 4800 Baud

### Measurement Range – Selectable

#### SOLUTION TEMPERATURE

- ▶ with 100  $\Omega$  and 1000  $\Omega$  Platinum RTD

-20 to +200°C (-4 to +392°F)

- ▶ with 100 k $\Omega$  Thermistor

-20 to +150°C (-4 to +302°F)

#### SOLUTION CONDUCTIVITY

50, 100, 200, 500, 1000, and 5000  $\mu$ S/cm;  
1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, and 2000 mS/cm.

### Digital Outputs

#### 1ST MEASUREMENT

Primary measurement in units of primary display

#### 2ND MEASUREMENT

Solution temperature

#### 3RD MEASUREMENT

Absolute primary measurement

### Analog Outputs

- ▶ Configurable to conductivity, temperature, % concentration, g/L, ppm, ppt, and oz/gal.
- ▶ Linear output within measurement range.
- ▶ Analog output hold.
- ▶ Analog output is programmable to any value between 3.8 and 20.5 mA upon failure.

### Measurement Damping

1, 5, 10, 20, 40, and 120 seconds

### Temperature Inputs

100 K $\Omega$  thermistor

100  $\Omega$  platinum RTD, two or three wires

1000  $\Omega$  platinum RTD, two or three wires



## FUNCTIONAL SPECIFICATIONS (CONT.)

### Sensor Compatibility

The transmitter is compatible with all Foxboro 871EC and 871FT (Flow-Through) Series Sensors, including both standard and high temperature versions. Also compatible with older Sensor Model Types PN, PX, and AB, as well as special sensors such as the EP307 Series sensors.

### Sensor Cell Factor

In addition to a menu of cell factors for the standard Foxboro Sensors above, the transmitter allows for user programmable cell factors between  $0.1 \text{ cm}^{-1}$  and  $99.99 \text{ cm}^{-1}$  to allow for compatibility with special and/or non-Foxboro sensors.

### Calibration Coefficients

To allow for one transmitter to handle both narrow and wide band conductivity measurement without the need for resetting the full scale value and recalibrating, the transmitter provides an optional program for preconfiguring up to three applications and storing each application's calibration coefficients. This optimizes its "auto-switching" capability since the transmitter switches in new coefficients as it crosses over a user-defined conductivity threshold.

### Continuous Diagnostics

#### DIGITAL OUTPUT

Complete check every four seconds

#### ANALOG OUTPUT

Complete check every eight seconds

### Background Electronics Self-Diagnostics

- ▶ Checksum, EEPROM, EPROM, and RAM Image of Database
- ▶ Code Space Checksum
- ▶ Stack Checking
- ▶ Watch-Dog Timer
- ▶ Verify Readable Processor Registers

### Background Sensor Diagnostics

- ▶ Liquid Leakage into Sensor
- ▶ Short Temperature Compensator
- ▶ Open Temperature Compensator

### Calibration Diagnostics

- ▶ Measurement Range Checks
- ▶ Temperature Range Checks

### Supply Voltage vs. External Load Limitations DIGITAL OUTPUT

Power supplied through I/A Series system

#### 4 TO 20 mA OUTPUT

See Figure 3.

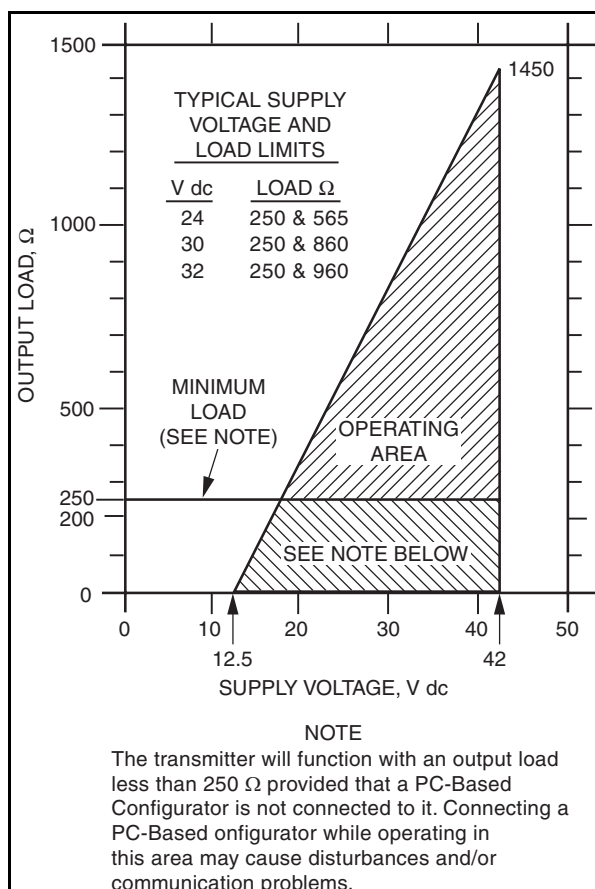


Figure 3. Supply Voltage vs. Output Load

### FUNCTIONAL SPECIFICATIONS (CONT.)

#### Chemical Concentration Conversion

Description and Reference	Name
0 to 25% NaCl at 25°C	Sodium Chloride
0 to 35% H <sub>3</sub> PO <sub>4</sub> at 25°C	Phosphoric Acid
0 to 15% HCl at 25°C	Hydrochloric Acid
0 to 25% H <sub>2</sub> SO <sub>4</sub> at 25°C	Sulfuric Acid
99.5 to 93% H <sub>2</sub> SO <sub>4</sub> at 50°C	Sulfuric Acid
99.5 to 93% H <sub>2</sub> SO <sub>4</sub> at 30°C	Sulfuric Acid
42 to 18% Oleum at 65°C	Oleum
0 to 10% Oleum at 65°C	Oleum
0 to 10% HNO <sub>3</sub> at 25°C	Nitric Acid
0 to 15% NaOH at 25°C	Sodium Hydroxide
0 to 15% NaOH at 50°C	Sodium Hydroxide
0 to 20% NaOH at 100°C	Sodium Hydroxide
0 to 6% KOH at 25°C	Potassium Hydroxide
0 to 16% KCl at 20°C	Potassium Chloride
0 to 8% CH <sub>3</sub> COOH at 25°C	Acetic Acid
0 to 30% HF at 25°C	Hydrofluoric Acid
90 to 99% HF at 0°C	Hydrofluoric Acid
Custom Conversion – User Programmable	

#### Temperature Compensations

Description	Reference	Range
Absolute	–	–
Dilute NaCl	25°C	0 to 200°C
0 to 25% NaCl	25°C	0 to 200°C
0 to 35% H <sub>3</sub> PO <sub>4</sub>	25°C	4 to 93°C
0 to 15% HCl	25°C	-10 to +122°C
0 to 25% H <sub>2</sub> SO <sub>4</sub>	25°C	-10 to +120°C
99.5 to 93% H <sub>2</sub> SO <sub>4</sub>	50°C	-10 to +120°C
99.5 to 93% H <sub>2</sub> SO <sub>4</sub>	30°C	20 to 90°C
42 to 18% Oleum	65°C	32 to 120°C
0 to 10% Oleum	65°C	32 to 120°C
0 to 10% HNO <sub>3</sub>	25°C	-10 to +120°C
0 to 15% NaOH	25°C	0 to 120°C
0 to 15% NaOH	50°C	0 to 100°C
0 to 20% NaOH	100°C	-11 to +122°C
0 to 6% KOH	25°C	10 to 40°C
0 to 16% KCl	20°C	0 to 25°C
0 to 8% CH <sub>3</sub> COOH	25°C	4 to 120°C
0 to 30% HF	25°C	0 to 50°C
90 to 99% HF	0°C	-20 to +208°C
Kraft Green Liquor	85°C	35 to 95°C
Kraft Black Liquor	160°C	100 to 175°C
Linear TC Gain	25°C	0.5 to 5%/°C
Custom Compensation – User Programmable		

#### Conductivity Values of Common Solutions

See Table 1 for approximate Conductivity Values of Common Solutions.

FUNCTIONAL SPECIFICATIONS (CONT.)

Table 1. Approximate Conductivity Values of Common Solutions

Standard Curves (a)	Typical Conductivity Values at Reference Temperature and at Various Percent Concentrations Values Listed are in mS/cm <sup>(b)</sup>													
	1%	5%	10%	15%	18%	20%	25%	35%	42%	93%	96%	99.50%	99.90%	99.99%
NaCl (25°C) 0 to 25%	20	80	140	188	212	225	248							
H <sub>3</sub> PO <sub>4</sub> (25°C) 0 to 35%	10	32	64	92	112	123	153	208						
HCl (25°C) 0 to 15%	112	430	700	820										
H <sub>2</sub> SO <sub>4</sub> (25°C) 0 to 25%	50	221	440	595	670	721	790							
H <sub>2</sub> SO <sub>4</sub> (50°C) 99.5 to 93%										230	205	63	46	42
H <sub>2</sub> SO <sub>4</sub> (30°C) 99.5 to 93%										158	130	20		
Oleum (65°C) 42 to 18%					76	74	64	34	15					
Oleum (65°C) 0 to 10%	39	67	79											
HNO <sub>3</sub> (25°C) 0 to 10%	63	281	500	672										
NaOH (25°C) 0 to 15%	60	220	355	410										
NaOH (50°C) 0 to 15%	76	320	530	650	680									
NaOH (100°C) 0 to 20%	100	495	850	1110	1230	1310								
KOH (25°C) 0 to 6%	38.5	178	356	495	525									
KCl (20°C) 0 to 16%	15.7	71.9	143	208										
CH <sub>3</sub> COOH (25°C) 0 to 8%	0.64	1.43	1.704	1.82										
HF (25°C) (c) 0 to 30%	11.7	59	120.5	189.5	236	260	325							
HF (0°C) 90 to 99.9%											224	39.9	12.6	2.089
Na <sub>2</sub> CO <sub>3</sub> (85°C) Green Liquor	Typically some combination of sodium hydroxide, sodium carbonate, and sodium sulfite; 1000 mS/cm most commonly used for Full Scale Range.													
Na <sub>2</sub> O (160°C) Black Liquor	Can be, for example, some combination of the following: sodium hydroxide and sodium carbonate, and could include sodium thiosulfate, sodium sulfide, and sodium sulfate; 1000 mS/cm typically used for Full Scale Range.													

- (a) The standard curves listed are resident in the 870ITEC Transmitter memory.  
(b) The conductivity values listed have been taken from data published by numerous sources and are to be considered estimations only. Therefore, this table is provided for reference only, and precise conductivity values should be determined independently.  
(c) At 30% HF, the mS/cm value is 395.

## PHYSICAL SPECIFICATIONS

### Transmitter Enclosure

The housing and its gasketed cover are made from a cast low copper aluminum alloy, finished and protected by a textured epoxy paint.

### Transmitter Mounting

The transmitter can be panel-mounted, surface-mounted, or mounted to a DN 50 or 2-in pipe. Refer to “Dimensions – Nominal” section for mounting details.

### Enclosure Protection

The transmitter enclosure is dusttight and weatherproof as defined by IEC IP65, and provides the environmental and corrosion resistant protection of NEMA Type 4X.

### Sensor Cable Length

30.5 m (100 ft) recommended maximum  
(for longer lengths, contact Foxboro)

### Approximate Mass

#### PANEL-MOUNTED TRANSMITTER

2.2 kg (4.9 lb)

#### SURFACE-MOUNTED TRANSMITTER

2.8 kg (6.2 lb)

#### PIPE-MOUNTED TRANSMITTER

2.8 kg (6.2 lb)

#### OPTIONAL STORM DOOR

Negligible

### Electrical Connections

Field wires enter through three cable entry holes at the lower surface of the housing, and terminate at screw terminals located on the power and signal PWA located within the enclosure. These terminals are accessible by swinging back the hinged front cover. The cable entry holes accept standard wiring conduit or cable glands. See Figure 4 for the screw terminal wiring, and the “Dimensions – Nominal” section for the cable entry holes.

#### NOTE

Each cable entry hole must be fitted to conduit or sealed to maintain the level of integrity required by IEC IP65 and NEMA 4X (see previous Enclosure Protection paragraph).

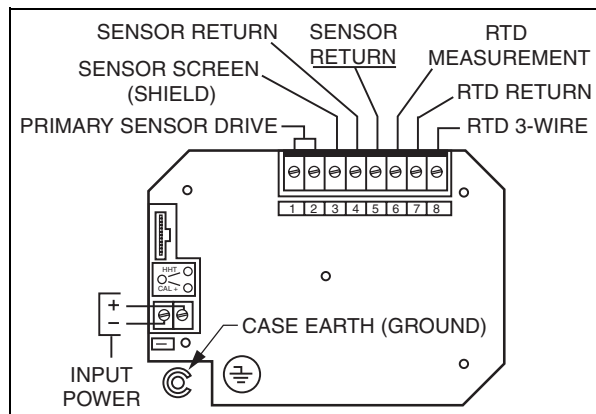


Figure 4. Wiring Terminals on Power and Signal PWA

### ELECTRICAL SAFETY SPECIFICATIONS

Testing Laboratory, Type of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
ATEX Type ia for II I G, EEx ia IIC hazardous locations.	Refer to MI 611-208. Temperature Class T4 - T6; Ta = -20 to +40°C	AAA
ATEX Type n energy limited for II 3 G EEx nL IIC hazardous locations.	Refer to MI 611-208. Temperature Class T4 - T6; Ta = -20 to +60°C	ANN
CSA intrinsically safe for Class I, II, and III, Groups A, B, C, D, E, F, and G, Division 1 hazardous locations.	Connect per MI 611-206. Temperature Class T4.	CAA
CSA suitable for use in Class I, Groups A, B, C, D, F, and G, Division 2 hazardous locations.	Temperature Class T4.	CNZ
FM intrinsically safe for Class I, II, and III, Groups A, B, C, D, E, F, and G, Division 1 hazardous locations.	Connect per MI 611-206. Temperature Class T4.	FAA
FM nonincendive for Class I, II, and III, Groups A, B, C, D, F, and G, Division 2 hazardous locations.	Temperature Class T4.	FNZ

#### NOTES

1. These transmitters have been designed to meet the electrical safety descriptions listed in table above. For detailed information, or status of the testing laboratory approvals or certifications, contact IPS.
2. MI 611-206 contains Intrinsic Safety Connector Diagrams relating to FM and CSA approvals and certifications.
3. MI 611-208 contains Electrochemical Products Safety Information relating to ATEX certifications. Also provides additional information regarding higher allowable ambient temperature (Ta) limits.
4. With intrinsically safe and nonincendive certifications/approvals, a certified energy barrier is required.

## OPTIONAL SELECTIONS

### **Option - 1: Custom Curves Input at Foxboro**

All transmitters allow calibrating into memory up to three (3) curve sets "On-Site". This option provides custom (nonstandard) chemical concentration, temperature compensation curve(s) preprogrammed into the instrument at the factory. This option requires preapproval by the IPS Analytical Marketing Department. Contact IPS to discuss custom curve(s) desired, applicable requirements, estimated delivery, and additional charges. Select Optional Selection -1.

### **Option - 7: Storm Door**

This door is attached to the front surface of the enclosure and hinges upward. It is used to prevent accidental or inadvertent actuation of front panel controls, particularly in field mounting applications. The door is clear plastic to allow viewing of the display when closed, and also hinged to allow ready access to front panel controls. Select Optional Selection -7.

### **Options -F, -G, -S: Foreign Language Menus**

Menus are available in the French, German, and Spanish language. Select Optional Selection -F, -G, or -S, respectively.

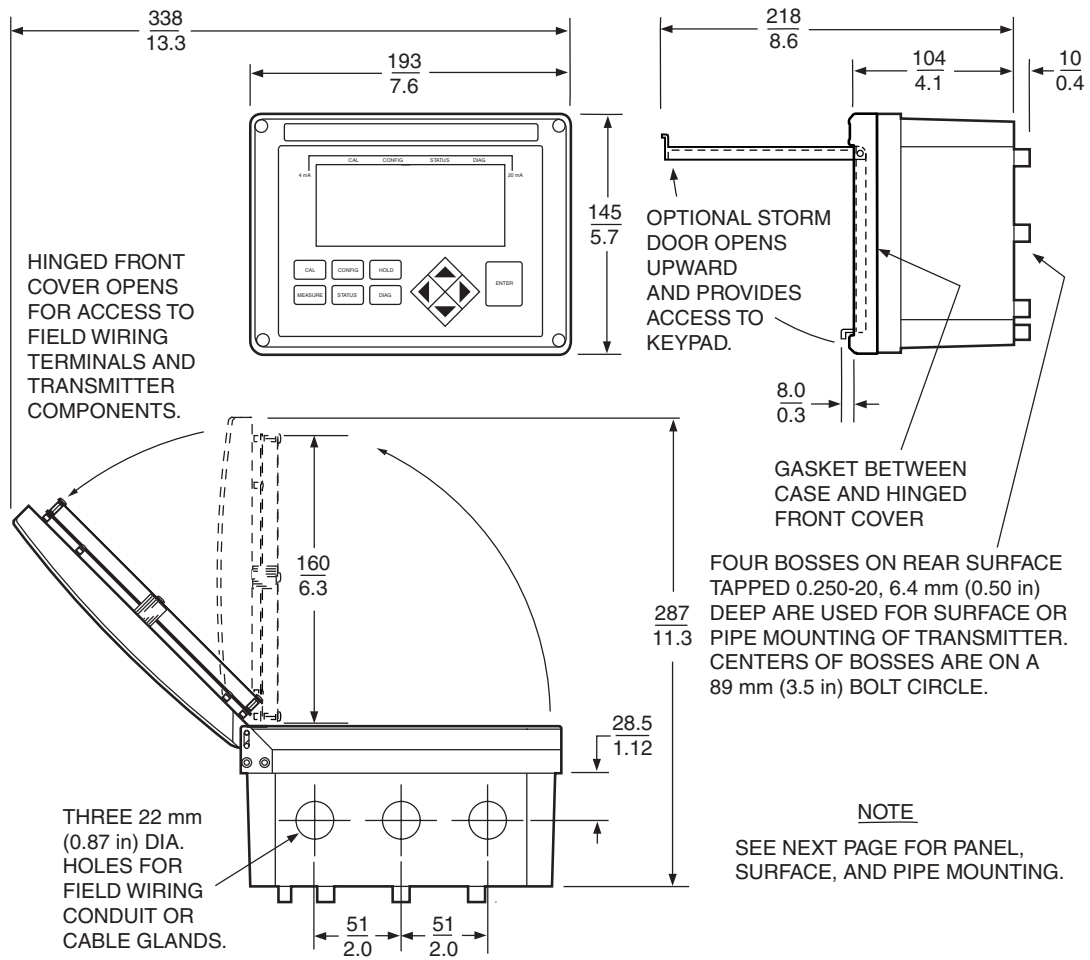
**MODEL CODE**

<b>Description</b>	<b>Model</b>
Intelligent Electrochemical Transmitter for Electrodeless Conductivity Measurement	870ITEC
<b>Communications and Measurement Output</b>	
No Digital Communication, 4 to 20 mA Analog Output only	-A
I/A Series Communication, Software Configurable to:	-F
▶ IT1 Mode: 4 to 20 mA Output and Low Speed Digital Communications, 600 Baud	
▶ IT2 Mode: High Speed Digital Communications only, 4800 Baud	
<b>Enclosure Mounting</b>	
Panel Mounting	W
Surface Mounting	X
Pipe Mounting to a DN 50 or 2-in Pipe	Y
<b>Electrical Safety (also see “Electrical Safety Specifications” section)</b>	
ATEX Type ia for II 1 G, EEx ia IIC.	AAA
ATEX Type n energy limited for II 3 G, EEx nL IIC.	ANN
CSA certified intrinsically safe, Class I, II, III, Groups A, B, C, D, E, F, and G, Division 1.	CAA
CSA certified suitable for use in Class I, Groups A, B, C, D, F, and G, Division 2.	CNZ
FM approved intrinsically safe, Class I, II, and III, Groups A, B, C, D, E, F, and G, Division 1.	FAA
FM approved nonincendive, Class I, II, and III, Groups A, B, C, D, F, and G, Division 2.	FNZ
<b>Optional Selections</b>	
Special – Custom Curve(s) input at IPS <sup>(a)</sup>	-1
Storm Door	-7
French Language Menus	-F
German Language Menus	-G
Spanish Language Menus	-S
Example: 870ITEC-FXFAA-7	

(a) IPS Analytical Marketing Department approval required prior to IPS inputting the custom curve(s).

**DIMENSIONS - NOMINAL**

**mm**  
**in**

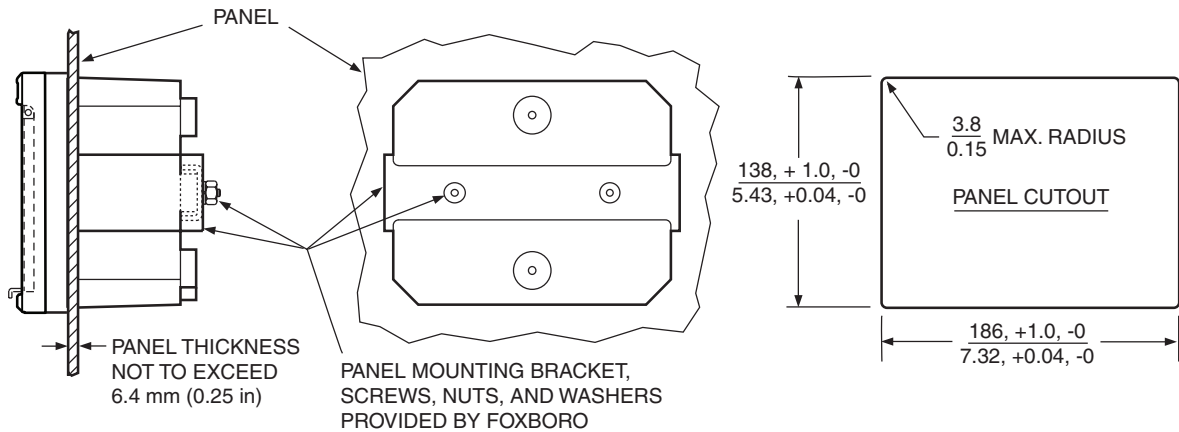




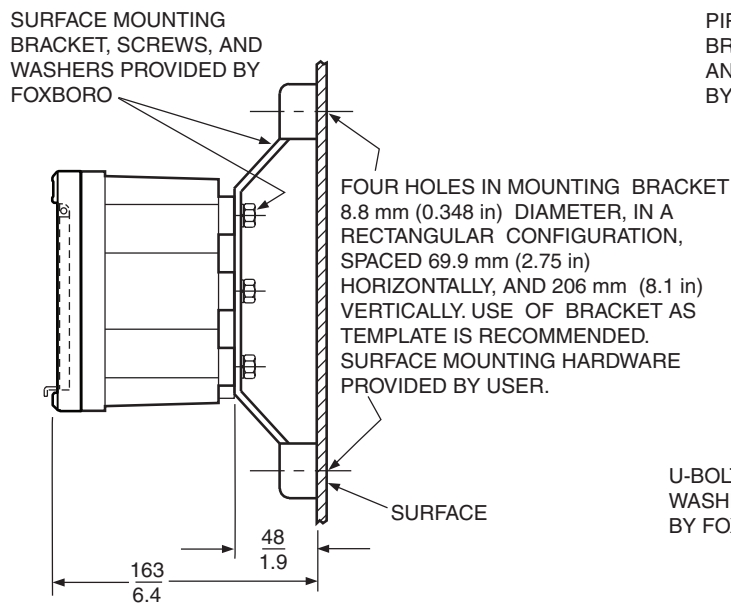
**DIMENSIONS – NOMINAL (CONT.)**

**mm  
in**

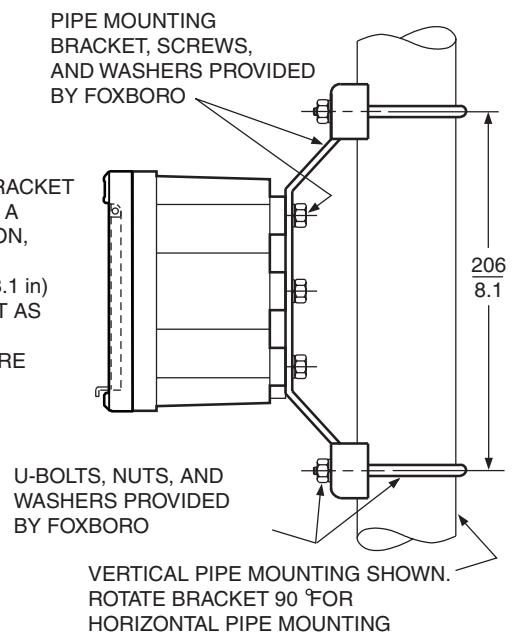
**PANEL MOUNTING**



**SURFACE MOUNTING**



**PIPE MOUNTING**



### REFERENCE DOCUMENTS

Document Number	Document Description
PSS 2A-1Z3 G	Model PC50 Field Device Tool for Use with Intelligent Field Devices
PSS 6-C34 A	871EC Series Electrodeless Conductivity Sensors and Accessories
PSS 6-3Q1 A	871FT Series Non-Invasive Sanitary and Industrial Flow-Through Conductivity Sensors
MI 611-150	871EC Electrodeless Conductivity Sensors
MI 611-202	871FT Series Flow-Through Conductivity Sensors
MI 611-206	Intrinsic Safety Connector Diagrams - FM, CSA, and IECEx
MI 611-208	Electrochemical Products Product Safety Information - ATEX
MI 611-212	870ITEC Intelligent Electrochemical Transmitter
MI 611-220	Electrodeless Conductivity System Calibration Examples
Bulletin K99-5B	EP307B - Electrodeless Conductivity Sensors
Bulletin K99-6	EP307G - Electrodeless Conductivity Sensors
Bulletin K99-7B	EP402 - Electrodeless Conductivity Assemblies
Bulletin K99-8	EP485A - Calibration Plugs for Use with 871FT Sensors
Bulletin K99-9	EP485N - Calibration Plugs for Use with 871FT -8/-9 Sensors
Bulletin K99-10	EP485Q - Calibration Plugs for Use with 871EC and EP307 Sensors
Bulletin K107	Sensor Selector Wheel



## ORDERING INSTRUCTIONS

1. Model Number.
2. Measurement Range.
3. Measuring Sensor Type:
  - 871EC-SP, -HP, -PP, -LB, -UT, -RE, -BW, -NL, -TF, -EV, -AB, or -PT; or
  - 871FT-1C, -1D, -1E, -1F, -1G, -1H, 1J, -2C, -2D, -2E, -2F, -2G, -2H, -2J; also
  - 871FT-3C, -3E, -3F, -3G, -3H, -3J, 4C, -4E, -4F, or -4G, -4H, or -4J.Please specify sensor and note if other than the 871EC or 871FT Series listed above.
4. Temperature Compensation Input (100  $\Omega$  RTD, 1000  $\Omega$  RTD, or 100 k $\Omega$  Thermistor).
5. User Tag Data and Application.

## OTHER M&I PRODUCTS

IPS provides a broad range of measurement and instrument products, including solutions for pressure, flow, analytical, positioners, temperature, controlling and recording. For a listing of these offerings, visit the IPS web site at:

[www.ips.invensys.com](http://www.ips.invensys.com)



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Foxboro Global Client Support  
Inside U.S.: 1-866-746-6477  
Outside U.S.: 1-508-549-2424 or contact  
your local Foxboro representative.  
Facsimile: 1-508-549-4999

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