Range: Conductivity 0.05 – 1,000,000 µS, Temperature 0-210 °C

Cell Constants: 0.01–20.0, custom constants available

Low conductivity versions for K=0.01/cm (min 0-5 µS, max 0-20 µS), and K=0.1/cm (min 0-50 µS, max 0-200 µS).

1-Point Gain calibration for agreement with lab analysis or standard solution, Max ±70% from nominal cell
Offset calibration for a true zero reading with sensor dry in air

Integrated temperature compensation via Pt 100/1000 Ohm element

Display & Output Conductivity (in µS or mS) or Temperature

Scalable Analog Output 0-20 mA or 4-20 mA for Conductivity or Temperature, optional RS-485 Modbus Digital Output

Automatic correction for resistance and capacitance of sensor cable

Galvanic isolation between sensor input and analog output (3000V)

4mA offset & 20mA gain trim calibrations for accurate 4-20mA output

Custom sensor design and fabrication available

Automatic calibration hold: the last measured value is held for 4-20mA and MODbus output during calibration.

Manufactured and assembled in America

FX-300-CON Contacting Conductivity Analyzer

Shown: Conductivity, pH, temperature output with relay control of temperature

The Foxcroft FX-300-CON measures contacting conductivity and temperature in measurement ranges from 0.05 to 1,000,000 µS/cm and supports cell constants from 0.01 to 20.0.

You can order a single conductivity transmitter in a 4.33" enclosure or up to five transmitters in our standard 10" wide enclosure. Special systems for over 5 modules are optional.

Being a modular system, the transmitters can be any combination of conductivity, pH, ORP, temperature display and output from any sensor, alarm relays with basic control functions, or an ISE measurement such as ammonium or fluoride.

Each module includes a 3-digit display of the parameter and temperature as well as scalable 0/4-20mA output which can be inverted. RS-485 MODbus RTU output optional.

The system is easy to use with 3-buttons: the mode button toggles through operating modes and selects setup parameters. Values are changed using the up and down buttons.

For use with any of our cost effective, long life sensors available in materials for any application and mounting style including high temperature and pressure, chemical resistant, inline, submersible, hot-tap valve retractable and sanitary Tri-Clover flange mounting.

See the individual sensor brochures for more details.

General Specifications FX-300-CON

Measurement Type: Single or multi-channel inline Contacting Conductivity and Temperature

Applications: Drinking water through wastewater, chemical processes, pollution control, long service life with low maintenance applications, support for remote installation locations that can be powered on and off at will

Conductivity & Temperature Ranges: Conductivity Ranges for each Cell Shown Below, Temperature Range 0-210 °C, Accuracy ±0.2%

Pressure Ranges: Standard 100 psig @ 150°C, High Pressure 250 psig @ 205°C, Both Versions Max 500 psig @ 100°C

Wetted Materials of Construction

Sensing Electrodes: 316 Stainless Steel (316SS), Titanium, Monel, Hastelloy C, Nickel, Zirconium and others upon request

Insulators: CPVC, TEFLON (PTFE), KYNAR (PVDF), PEEK and others upon request

"O"-Rings: EPDM, EPR & Viton-75 and others upon request

Sealing Fittings: 316SS, Monel, Propylene, KYNAR (PVDF) and others upon request

Sensor Installation options: Inline ½" & ¾" MNPT, Immersion, Submersible, Valve Retractable (HOT-TAP) and Sanitary Tri-Clover flange sizes 1/2" to 2-1/2" diameter.

Display: Bright 3-digit red LED display visible in sunlight of Conductivity or Temperature with 6 LED indicators

Power Supply: CSA/UL/CE approved universal 100-240 VAC power supply input, 24VDC operating power, consumption 60mA max per module, 6A fused power entry module with 2-meter power cord with IEC #C13 and NEMA 5-15P connnectors

Signal Output: Scalable & invertible 0-20mA or 4-20 mA DC 500 Ω max, RS-485 Modbus digital output optional

Enclosures & Mounting Supported: Wall, Pipe or Panel Mounting for 1-5 modules per enclosure (NEMA 4X Rated & UL Listed). Larger enclosures as needed available upon request

General Specifications FX-300-CON

Supported Measuring Ranges & Cells:

Cell Constant	Full Scale Maximum Range	Minimum Scaling Available
20.0 *(6.0-34.0)*	0 to 1,000,000 microSiemens(µS)/cm	0 to 100,000 microSiemens(µS)/cm
10.0 *(3.0-17.0)*	0 to 500,000 microSiemens(µS)/cm	0 to 50,000 microSiemens(µS)/cm
2.0 *(0.6-3.4)* *	0 to 100,000 microSiemens(µS)/cm *	0 to 10,000 microSiemens(µS)/cm *
1.0 *(0.3-1.7)*	0 to 50,000 microSiemens(µS)/cm	0 to 5,000 microSiemens(µS)/cm
0.2 *(0.06-0.34)**	0 to 10,000 microSiemens(µS)/cm *	0 to 1,000 microSiemens(µS)/cm *
0.1 *(0.03-0.17)*	0 to 5,000 microSiemens(µS)/cm	0 to 500 microSiemens(µS)/cm
0.1L *(0.05-0.15)*	0 to 200 microSiemens(µS)/cm	0 to 50 microSiemens(µS)/cm
0.01 *(0.005-0.015)*	0 to 500 microSiemens(µS)/cm	0 to 50 microSiemens(µS)/cm
0.01L *(0.005-0.015)*	0 to 20 microSiemens(µS)/cm	0 to 5 microSiemens(µS)/cm

* Extended Ranges: K=2.0/cm 0-200mS (min 0-20mS); K=0.2/cm 0-20mS (min 0-2mS)
NOTES: Alternate cell constants/ranges upon request.

Low-Range Optimized Version

The FX-300-CON transmitter is available in a "L" low-range optimized version that can support as low as 0-5uS/cm and as high as 0-20uS/cm. The FX-300-CON-L style transmitters are only available in the dual 4-20mA analog current loop and RS485 MODBUS RTU output configuration.

Transmitter Details

- FX-300-CON is a transmitter for Conductivity & Temperature Measurement
- Measurement Ranges: 0.05 – 1,000,000 µS | 0.00005 – 1,000 mS, 0-210 °C
- Cell Constants Supported: 0.01-20.0 - custom cell constants available
- The measurement range and nominal cell constant must be defined at the time of order and cannot be changed in the field
- Production Calibration a.k.a. Single (1-Point Offset) Calibration supported for quick calibration to allow for agreement with laboratory conductance analysis
- Temperature compensation via Platinum 100 or 1000 Ohm element
- Display Conductivity (in µS or mS) or Temperature
- Scalable, invertible Analog Output 0-20 mA or 4-20 mA for Conductivity or Temperature
- Galvanic isolation between sensor input and analog output (3000V rating)
- Automatic correction for resistance and capacitance of sensor cable
- Optional: Serial communication via RS-485 MODbus Digital Output
- Field installations supported using weatherproof IP65 enclosures
- Up to 5 measurement modules can be used in a single standard enclosure, larger enclosures are available optionally.
- Options: relay/controller, temperature output, data logger, other measurement modules such as pH or ORP.

Programming

The module is programmed by use of 3 keys located on the front panel. The 'Mode' key is used to toggle between modes and for selecting setup to change parameter values. The 'Up' or 'Down' keys are used to scroll through the parameters. The parameter to be altered is selected with the 'Mode' key and the value is changed using the 'Up' or 'Down' keys. Parameter No. 01 is a "lock" which must be set to 'Off' to change <u>ANY</u> parameter, including the temperature and gain calibrations.

Transmitter Details

Input

The conductivity cell outer and inner electrodes are connected to terminals 1 and 2, respectively. The current through the cell is proportional to the conductivity of the solution and measurement of the current is the basis of the readout, the analog output as well as the value sent over the MODbus. The Pt100/Pt1000 temperature sensor is connected to terminals 4 and 5 and the measured value is the basis of the temperature correction, which is performed by the built-in microprocessor. Terminal 3 is the ground terminal and should be connected to sensor wire shield.

Analog Output (Standard)

The FX-300-CON transmitter (module) has a scalable analog output of either 0-20 mA or 4-20 mA (selectable) and can be standard or inverted. The conductivity scaling between the minimum (0mA or 4mA) and maximum (20mA) output is 10% to 100% of the full range scale specified where the low and high outputs can be otherwise arbitrarily defined in conductivity units. The output is galvanically isolated from inputs and proportional to conductivity or temperature.

MODbus (Optional)

Data is transferred using MODbus standard for multidrop communication and connected using RS485. The Modbus master may be the FX-300-DAT or any SCADA system. When units are ordered with MODbus, a Windows datalogging software is freely provided that can be used to monitor and record all process and temperature values from up to 247 transmitters simultaneously at distances to 6500 feet (2 km).

Transmitter Specifications

Mechanical

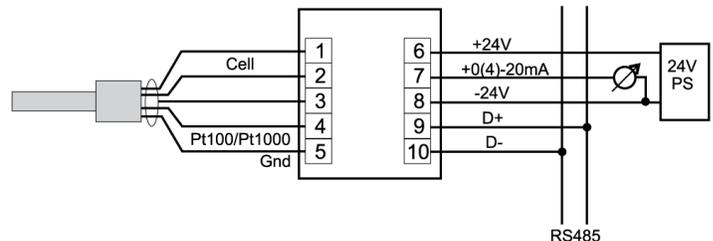|	
Housing:	Lexan UL94V-0 (Upper part)
	Noryl UL94V-0 (Lower part)
Mounting:	M36 for 35 mm DIN rail
IP Class:	Housing IP40. Connector IP20
Connector:	Max 16A. Max 2.5 mm^2
	Max torque 0.6 Nm
Temp.:	-15 to +50 °C
Weight:	75 grams (2.64 ounces)
Dimensions:	D 58 x W 36 x H 86 mm (2.3" X 1.4" X 3.4")
CE mark:	EN61326A

Electrical

Power Supply:	24VDC ±10%
Consumption:	60 mA max
Sensor:	2-Wire Contacting Cell
Measuring Range:	See Par. 21 for Max Full Range
Cell Constant:	See Par. 22 (Nominal) & 15 (Gain)
Accuracy:	Class 2 excluding Sensor
Temp Sensor:	Pt100, Pt1000
Temp Range:	0-210°C ± 0.3°C
Temperature Compensation:	Fixed (Manual) or Automatic using Temperature (TC) Measurement
Analog Output:	0-20mA or 4-20mA, max. 250Ω

Calibration

Use the 'Mode' key to select 'Gain', followed by 'Up' or 'Down' to adjust the readout corresponding to the expected value. The adjustment may be ±50% from nominal value, and may be entered manually using Par no. 15. The readout is the basis for the analog & MODbus outputs. It is possible to also perform a zero calibration when the sensor is clean and dry and exposed to only air with Par no. 14, with the steps determined by Par no. 13. The effective cell constant is found by multiplying the nominal cell constant (P22) with effective gain (P15).

Typical Installation

NOTE: The temperature can be calibrated pushing the "Up" or "Down" buttons when in the temperature display (°C) mode.

Transmitter Details

Function and Programming

The 22 programmable parameters are shown to the right. For access see the paragraph about programming on page 3.

If the software lock (Par. no. 1) is "On" the parameter can only be read. Set Software Lock to "Off "to change values.

Par. no. 2 sets module's address for MODbus communication.

Par. no. 3 indicates the type temperature input (Pt100 or Pt1000).

Par. no. 4 sets the temperature compensation to be either fixed (manual/set) or automatic from measured temperature.

Par. no. 5 sets the value for when temperature compensation of the conductivity measurement is in fixed (manual/set mode).

Par no. 6 is the temperature compensation coefficient used, expressed in %/°C units (valid for auto or manual TC mode)

Par. no. 7 the wire gauge (AWG) for the sensor cable used

Par. no. 8 the length of sensor cable in units of feet.

Par. no. 9 select the conductivity measurement *(S)* or temperature measurement *(°C)* signal to be used for the analog output.

Par. no. 10 sets the analog output to 0-20 mA or 4-20 mA.

Par. no. 11 sets low 0/4mA output scaling (in conductivity units).

Par. no. 12 sets high 20mA output scaling (in conductivity units). The difference between low & high output setpoints (P11 & P12) must be at least 10% of full range scaling per parameter P21.

Par. no. 13 Step change for up or down button during calibration.

Par. no. 14 Zero offset calibration done when sensor is dry in air.

Par. no. 15 Set/display the gain on cell constant. The effective cell constant is the product of P15 (gain) and P22 (nominal cell).

Par. no. 16 Offset adjustment for 0/4mA low analog output trim.

Par. no. 17 Gain adjustment for 20mA high analog output trim.

Par. no. 18 If no keys are pressed for 10 minutes, display will show flashing bar (Energy Save Mode). Press any key to exit

Par. no. 19 sets baudrate of 9,600 or 19,200 per MODbus master.

Par. no. 20 Feature to reset the analyzer back to factory default.

Par. no. 21 is the full range of the particular module/transmitter. This is a display (read-only) parameter.

Par no. 22 is the nominal conductivity cell constant. This is a display (read-only) parameter. Both P21 and P22 have been set at the factory prior to dispatch and cannot be changed in the field.

Par. no. 23 allows setting the output to be inverted (i.e. for use in control) with the output corresponding to 20-0mA or 20-4mA.

* Negative trim adjustments will be shown as flashing numbers.

List of Parameters

No	Parameter	Description	Range	Default
01	Lock	Software Lock	On / Off	On
02	Address	Address on MODbus	Off, 1…247	Off
03	Temperature	Type of Input	Pt100, Pt1000	Pt1000
04	Compensation	Temp. Comp. Conductivity	Auto, Fixed (Manual / Set)	Auto
05	Comp. Temp.	Compensating Temperature	0..210	25
06	Temp. Comp. Factor	Compensation Factor	0.50 – 5.00 %/°C	2.10
07	Wire Gauge	Sensor AWG	20, 22, 24	22
08	Cable Length	Length in feet	1…999 feet	10
09	Input for Iout	Input for the analog output	**Conductivity Con or Temp °C**	Con
10	Iout	Type of output	4-20mA, 0-20mA	4-20
11	0/4mA Low Output Scale	Low Output (Cond Units)	0%-90% of Full Range	0%
12	20mA High Output Scale	High Output (Cond Units)	10%-100% of Full Range	100%
13	Step Change	Increments for Calibration	**0=0.1%, 1 =0.2%, 2=0.5%, 3=1.0%**	2
14	Offset Adjustment	Zero Calibration	Increments per P13	N/A
15	Working Gain (Slope)	Gain on Cell Constant	±50% from Nominal	1.00
16	0/4mA Offset	Trim Low	±9.99% *	0.00
17	20mA Gain	Trim High	±9.99% *	0.00
18	Energy Save	Energy Save	On / Off	On
19	Baudrate	MODbus	**9,600 / 19,200**	19,200
20	Back to Default	Reset to Default	Def=Reset, Par=NoReset	Par
21	Full Range	Max Range	Per Cell K	N/A
22	Nominal Cell Constant	Cell constant a.k.a. "K"	As defined on order	N/A
23	Iout mode	Iout mode	noninverted, inverted	n.inv

Transmitter Details

MODBUS

In order to utilize the MODbus interface the FX-300-CON must be ordered with MODbus. FX-300-CON may be used as a slave for the 'Dat' - unit FX-300-DAT or as a slave in a SCADA system or with the free of charge Windows datalogging and graphing software.

With FX-300-DAT
If FX-300-CON is used together with the FX-300-DAT, the user must pay attention to two things: The baud rate on the MODbus as well as the address of the FX-300-CON. **The baud rate (P19)** must be set to the baud rate of the FX-300-DAT. Whether a baud rate of 19,200 or 9,600 is used is of no importance, as long as all units on the RS-485 MODbus network are set to the same baud rate.

The address (P02) must be unique in the network; Two units are not allowed to have the same address. In a network with the FX-300-DAT as the master, all addresses must be assigned without leaving any address out; i.e. if 3 units are connected to a FX-300-DAT, the addresses 01, 02 & 03 must be assigned to the three units. The order of the addresses is of no importance. In a network with a FX-300-DAT, up to 14 MODbus slaves may be connected, allowing only the addresses 01 to 14.

In a SCADA system or with Windows software
Since different SCADA systems may have different restrictions only the general are mentioned here: **The baud rate (P19)** must be set to the baud rate of the SCADA system. **The address (P02)** must be unique in the network; Two units are not allowed to have the same address. Up to 247 FX-300 transmitters may be connected on a single network, although repeaters may be required if more than 32 nodes are used and/or for long cable distances.

MODbus Scaling
The MODbus scaling for the conductivity process measurement output is the same as the analog output range as defined by P11 (low 0/4mA setpoint) and P12 (high 20mA setpoint).

The FX-300-CON contains 2 measurements (Conductivity and temperature). Access to these measurements are gained through the function code *Read_Input_Registers (04)*.

Read_Input_Registers

Function code	Start address	Number of values
04	**1**	**1 or 2**

Value 1 is Conductivity and value 2 is Temperature. Please note that the measurements are transmitted in sequence; If 2 values are chosen both conductivity and temperature are transmitted. If, for instance, the value for temperature is wanted, 2 values must be requested. Both values are rated to 0-1000 corresponding to the effective range, but the temperature has an offset of 1024; i.e. the effective conductivity range is transmitted as 0-1000 and the full scale temperature range (0-210°C) is transmitted as 1024- 2024.

The FX-300-CON gives access to different diagnostic values via *Diagnostics (08)*, as shown in the following.

Diagnostics

Function Code	Sub Code (HEX)	Description
08	00	Return Query Data
	0A	Clear counters and diagnostics register
	0B	Return Bus Message Count
	0C	Return Bus Communication Error count
	0D	Return Exception Error count
	0E	Return Slave Message count
	0F	Return Slave No Response count
	12	Return Bus Character Overrun count

Transmitter Details

High Resolution MODbus Output FX-300-CON-HR

The 3TX-CON-E series of contacting conductivity transmitters allows for high resolution MODbus output to take full advantage of the maximum internal resolution of the instrument for applications where this is advantageous. Please contact factory to determine if your application would benefit from use of the 3TX-CON-E version. All specifications not detailed below are identical to the standard FX-300-CON transmitter for the given cell constant and configuration.

Nominal Cell Constant	Calibrated Cell Range	Full Range with Temp. Comp.	Full Range Resolution MODBus Value 1 Scaling	Raw Conductivity Input Range	Raw Input Resolution MODBus Value 3 Scaling
K = 0.02/cm	0.006 to 0.034	0-2,000 µS(0-2mS)	0.1µS0-20,000 Steps	0-5,000 µS(0-5mS)	0.1µS0-50,000 Steps
K = 0.1/cm	0.03 to 0.17	0-5,000 µS(0-5mS)	0.5µS0-10,000 Steps	0-25,000 µS (0-25mS)	0.5µS0-50,000 Steps
K = 0.2/cm	0.06 to 0.34	0-20,000 µS(0-20mS)	1µS0-20,000 Steps	0-50,000 µS(0-50mS)	1µS0-50,000 Steps
K = 1.0/cm	0.30 to 1.70	0-50,000 µS(0-50mS)	5µS0-10,000 Steps	0-250,000 µS(0-250mS)	5µS0-50,000 Steps
K = 2.0/cm	0.60 to 3.40	0-200,000 µS(0-200mS)	10µS0-20,000 Steps	0-500,000 µS(0-500mS)	10µS0-50,000 Steps
K = 10.0/cm	3.00 to 17.0	0-500,000 µS(0-500mS)	50µS0-10,000 Steps	0-2,500,000 µS(0-2,500mS)	50µS0-50,000 Steps
K = 20.0/cm	6.00 to 34.0	0-1,000,000 µS(0-1,000mS)	100µS0-10,000 Steps	0-5,000,000 µS(0-5,000mS)	100µS0-50,000 Steps

Shared Modifications for all FX-300-CON-HR series units from standard FX-300-CON transmitters:

•The second MODbus value is always the temperature. The scaling is 0-210 °C sent as 0-1,000 steps.
•Changing parameter P11 (low 0/4 mA setpoint) and/or the parameter P12 (high 20mS setpoint) will modify the scaling on the analog0/4-20mA outputs only. The MODbus output ranges are fixed as defined above for the FX-300-CON-HR version. In contast, for the standard MODbus resolution CON-CELL/RANGE-D units, the MODbus scaling follows what is set for the analog 0/4-20mA outputs via parameters P11 & P12 and sent as 0-1000 steps.
•The MODbus output of any CON-E unitis incompatible with the DAT MODbus datalogger. To interface a conductivity transmitter with a FX-300-DAT, use the standard MODbus resolution CON-CELL/RANGE-D units instead.
•The CON-HR high resolution units are compatible with the Windows Datalogging & Graphing Software for FX-300 Conductivity Transmitters, Version 2.3 or above.
•The CON-HR high resolution units are compatible with any suitable standards compliant MODbus PLC, SCADA or data acquisition system. Please inquire to the factory if you have any specific question regarding compatibility for your planned use and setup or the protocol employed.

To order the FX-300-CON-HR style, simply include the desired nominal cell constant only when ordering. For example, the K=0.2/cm cell constant unit is simply ordered as FX-300-CON-HR-0.2. Note that there is no need to indicate that the CON-HR is a MODbus output style since this -HR high resolution MODbus conductivity transmitter ONLY comes in the dual analog plus MODbus output configuration. There is no difference in price between the standard MODbus resolution CON-CELL/RANGE-MB transmitters (and these are the DAT datalogger compatible units) and these high resolution MODbus CON-HR-CELL transmitters (which are DAT incompatible).
Please contact factory for assistance to ensure that you select the most appropriate unit for your desired application.