D-2 INCORPORATED

Jet Fuel 1A Conductivity Sensor
JF-1A

OPERATION MANUAL

REVISION 2.1
FIRMWARE VERSION 2.2
P/N A441-009

This manual covers the operational aspects of the D-2 JF-1A Conductivity Sensor. D-2 continuously strives to meet the full expectations of our customers and we welcome comments on the structure, content and the ability of this manual to answer your questions regarding our product. If you have any suggestions or comments please contact us at Mail@D-2inc.com. This document is provided with the understanding that future versions of this instrument may have additional commands, and the function of the commands shown in this document may vary from the present operation.

Revision History

Revision	Description	Date	Approved
2.0	Incorporated A440-010-FC, Application Note's 10-006, 10-007 as standard elements, remove references to JFWIN, change to Hyperterminal	15DEC10	A Fougere
3.0	Correct Air/Zero Notations	28MAR11	A Fougere

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1.0 GENERAL

The D-2 JF-1A Conductivity Sensor is a reliable instrument for the continuous measurement of electrical conductivity of fuels. The JF-1A Conductivity Sensor incorporates innovative electronics Digital Signal Processing (DSP) techniques to accurately determine the electrical conductivity of fuel products. The instrument will measure fuel electrical conductivities between 0 and 2000 picosiemens/meter (pS/M), although it is optimized and normally used in the 0 to 500 pS/M range. The sensor offers RS-232 data output, or traditional industrial loop compliant 4-20 mA. The 4 -20 mA output can be user programmed to represent a prescribed range of conductivity. User configurations and instrument calibration terms are stored in internal non-volatile memory. The D-2 sensor is continuously internally electronically calibrated. Absolute calibration relies only on the sensor cell constant that is very stable by design. The conductivity sensor has a built-in temperature sensor. Output from the temperature sensor is used to fully compensate the conductivity output from variations due to changes in electrical conductivity as a function of temperature per the ASTM D 2624, Appendix X2 Standard (Appendix A), (See Also Document "NRC-22648 The Relationship Between Electrical Conductivity and Temperature of Aviation Turbine Fuels Containing Static Dissipater Additives". The sensor can be provided with an optional 2 (4 – 20mA) wire temperature interface, allowing remote monitoring of fuel temperature.

Figure 1
Typical Installation Courtesy of Motiva

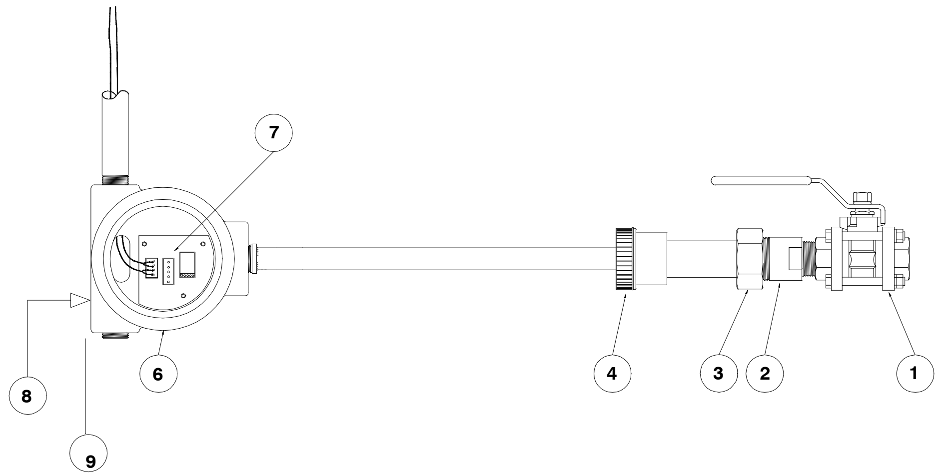
2.0 USAGE

Fuel products such as jet aviation and diesel fuels that are transferred at high pumping rates may develop a static electrical charge due to the very low conductance of the fluid. The D-2 JF-1A Conductivity Meter measures the ability of the fuel to dissipate that charge. The conductivity of aviation fuels is purposely increased using additives that reduce the ability of the fuel to store static charge. These additives are normally injected prior to transfer to the load vessel. The D-2 JF-1A Conductivity Sensor has the ability to monitor the electrical conductivity of fuel continuously, allowing its use as a sensing element in an automated additive injection system. The D-2 JF-1A ability to measure with high precision continuously at a high sampling rate (1 hertz) allows for precision control of additive injection. The industrial standard 4-20 mA sensor allows for its use with industry standard PID Controller/Display units combined with additive injector pumps to provide real-time control over addition of conductivity-enhancing additives during the transfer process. The Digital Signal Processing (DSP) full numerical compensation of conductivity for fuel temperature allows the system to be used in facilities independent of a wide range of ambient temperatures. The D-2 JF-1A provides consistent results independent of temperature (when temperature compensation is enabled). Optionally a second 2 Wire (4 – 20 mA) temperature output interface is available.

3.0 FUNCTION

The D-2 JF-1A Conductivity Meter reads conductivity in picosiemens/meter, fuel temperature in ITS-90 degrees C, and fully compensated Conductivity in picosiemens/ meter per ASTM D 2624, Appendix X2. These measures are equivalent to CU or Conductivity Units. The sensor can be used in a 2 wire 4-20 mA industrial control loop or in conjunction with a serial input device using RS-232 IEEE Standard ASCII Serial Input Data. Optionally a 2 wire (4-20 mA) temperature interface can be added to allow remote monitoring of fuel temperature.

Figure 2
Major System Components



1 Ball Valve
2 Sensor Mount Adaptor
3 Mounting Nut
4 Locking Collar
6 Electronics Housing
7 Electrical Connection Side
8 Label
9 Installation Reference Plane

4.0 THEORY OF OPERATION

The D-2 JF-1A Conductivity Sensor uses a probe consisting of two concentric stainless steel electrodes. When the probe is immersed in fuel, a very low frequency AC voltage is applied to the electrodes. Conduction through the fuel results in an AC electrical current that is amplified, detected, and output as either direct serial ASCII data, or as a standard 4-20 mA industrial current loop. The use of a precision AC voltage overcomes the problem associated with electrode polarization impedance typical of DC type meters, and residual DC charges that may exist in the fuel due to static generation from high-speed pumping. Fluids such as aviation fuels can hold DC charge due to the very low conductance of the fluid. These fuels can have conductivities lower than 5 pS/M in the absence of conductivity-increasing additives.

5.0 D-2 JF-1A SENSOR

Figure 3
D-2 JF-1A On-Line Fuel Sensor
With Retractable Mount

The D-2 JF-1A Conductivity Sensor with Retractable Mount is shown in Figure 3. The unit is fully contained in a sealed approved housing. The sensor is designed to be fully intrinsically safe for operation in fuel facilities. The back cover allows for direct conduit connection to the meter and offers both 4 - 20 mA output and Serial Data Output Connections. The D-2 JF-1A Conductivity Sensor can be operated as a “two wire” device under ISA 4 - 20 mA loop specification ANSI/ISA-12.12-1994 – Non-incendive Electrical Equipment for Use in Hazardous Locations.

6.0 MECHANICAL INSTALLATION

See Installation and Safe Use Manual for detailed mechanical installation instructions.

6.1 LOCATION

The JF-1A Sensor should be mounted in downstream proximity to the additive injection site. The user MUST insure that additive will be completely mixed at the point at which the fuel is sensed by the JF-1A sensor. An in-line mixer can be used, or more conveniently the injection site can be followed by a pipe "T" or bend to cause turbulent flow mixing of additive. Insufficient mixing will result in poor controller results and erratic average load conductivities.

NOTE: The Sensor should be mounted well away from possible sources of electromagnetic noise, such as large pump motors, AC power Lines, or electrical circuits containing large transient switching currents.

Note: Prior to arc welding in proximity to the JF-1A sensor (closer than 10 meters (30 feet) the sensor should be either removed from the product line or at a minimum disconnected from all electrical connections to the sensor. Welding circulation voltages can exceed protection ratings of the sensitive output circuits located in the JF-1A sensor.

6.2 PIPE CONNECTIONS

See Installation and Safe Use Manual for detailed mechanical pipe connections instructions.

6.3 PIPE VALVE

The nipple should be supplied with a 1" Open Throat Ball Valve.

NOTE: The Ball Valve MUST Have a Clear Opening of 1.0" through its center to allow the D-2 sensor to pass unobstructed. Ball valves can be purchased directly from D-2.

6.3 SENSOR ADAPTOR

The D-2-supplied sensor adaptor should be mounted directly into the outboard side of the ball valve using Teflon tape or other suitable thread sealer.

6.5 High Flow Rate Installation

See Installation and Safe Use Manual for detailed mechanical installation in high flow rate lines.

7.0 ELECTRICAL INSTALLATION

See Installation and Safe Use Manual for detailed electrical installation instructions.

7.1 2-Wire 4-20mA LOOP CONSIDERATIONS

Warning 2-Wire Loop Maximum Resistance including wire can not exceed 500 ohms, or internal intrinsic over voltage safety devices in the JF-1A sensor may be activated.

The 4-20 mA Loop supply open circuit voltage must be consistent with the "Open Circuit Supply" needs of the JF-1A at both its minimum and maximum indicating currents. The JF-1A has both input voltage limiting protection and polarity protection. These protection devices affect user supply voltage requirements. If proper loop supply voltage is not maintained, errors in indicated conductivity current may occur. The 4-20 mA loop supply voltage should comply with specifications section of the manual.

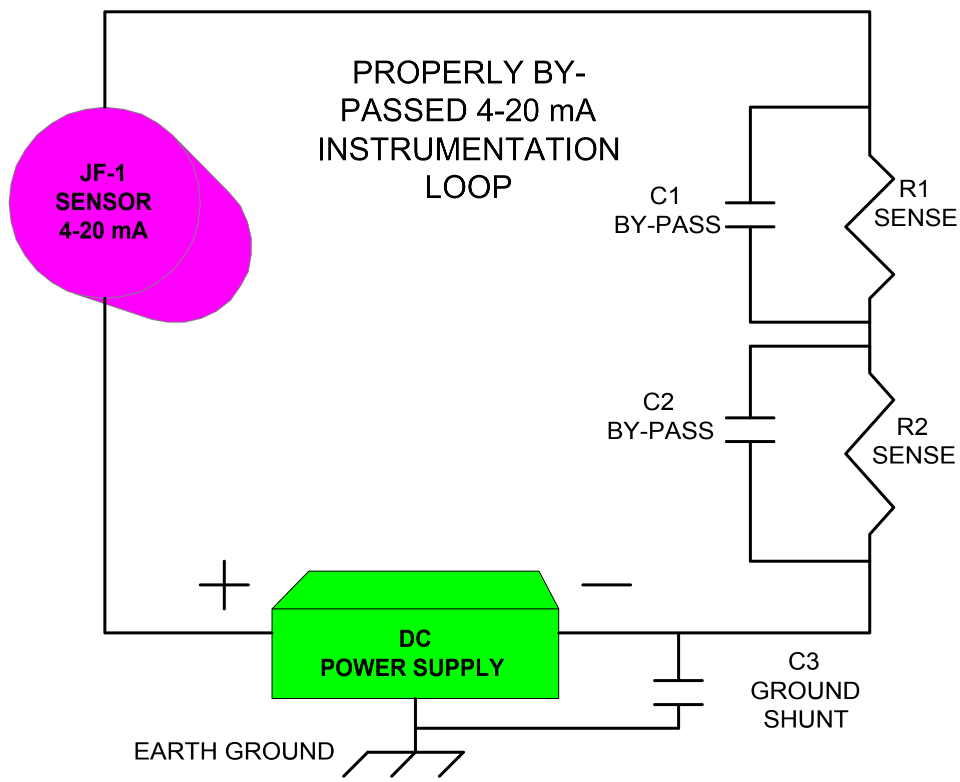
The maximum loop power supply voltage, under all conditions, must also prevent the voltage across the sensor loop terminals from exceeding the maximum voltage listed in the specifications section of the manual. If this condition is not maintained, errors in the current output may occur.

D-2 recommends that a 24 VDC isolated supply be used to power the instrumentation loop. The supply should have high isolation (>500 Mohm), and be single point grounded. The current loop should be wired using shielded twisted pair wire. The shield should also be single point grounded to a solid earth ground.

Sensing resistors should be capacitive by-passed to ensure low common mode loop noise. Sense resistors should be by-passed using the following table as a guide. Note the capacitor should be rated to sustain the working voltage for the loop and should comply with the requirements of the local electric code.

R-Loop	By-Pass
OHMS	uF
250	1
350	2.2
500	3.3

In the figure below a typical loop wiring with by-pass capacitors is shown for the JF-1A sensor. The loop shows two sensing resistors in series with the JF-1A sensor. At the negative terminal of the Isolated Power Supply the "loop" is AC grounded using a capacitor. This capacitor helps to eliminate "common mode" voltages that may be coupled to the loop. Note the sense resistors should be connected to isolated input detectors such that entire loop remains floating eliminating any ground conflicts of differences. Please consult the factory for specific application support in the design of your measurement system.



NOTE: Sensor wiring should be performed as defined by the National Electric Code (NEC), and ATEX sensor certificate.

7.2 4 – 20 mA CONDUCTIVITY READINGS

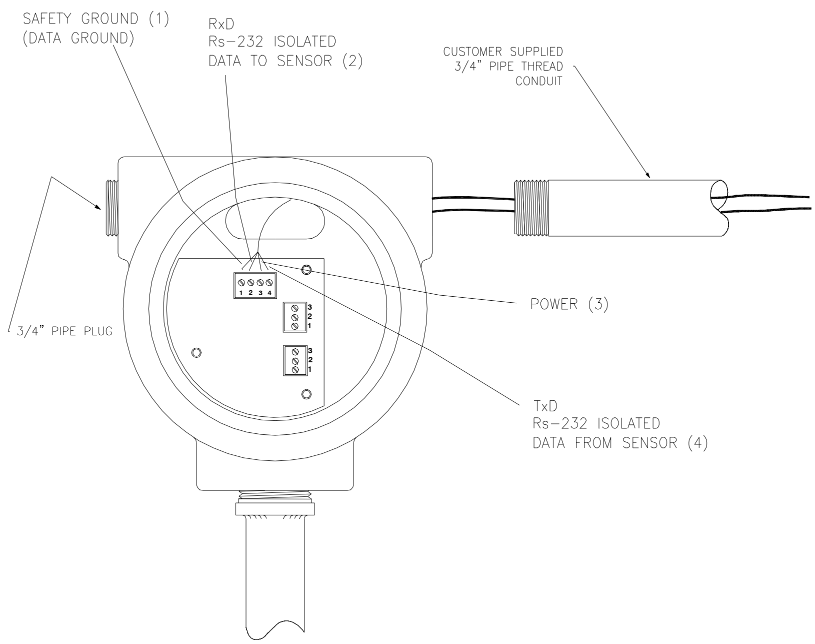
The following table details current output readings for the JF-1A sensor with a nominal 0-500 pS/M range representing 4 – 20 mA. (Please consult the factory for alternate range settings of the current output):

CONDUCTIVITY (Ps/M)	Current (mA)	Voltage * (Volts)
0.0	4.0	1.00
62.5	6.0	1.50
125.0	8.0	2.00
187.5	10.0	2.50
250.0	12.0	3.00
312.5	14.0	3.50
375.0	16.0	4.00
437.5	18.0	4.50
500.0	20.0	5.00

- 250 Ohm Voltage Sensing Resistor Used

7.3 RS-232 CONNECTIONS Considerations (4-Wire)

Figure 8A
4-WIRE ELECTRICAL CONNECTION DETAIL



The 4 Terminal Screw Connector has both Power Input and RS-232/RS-485 Connections as listed in Table 1 below:

TABLE 1
SCREW TERMINAL CONNECTION PIN DETAIL

TERMINAL	Function
1	Data/Power Ground
2	RS-232 Data In (RXD)
3	Power Input +
4	RS-232 Data Out (TXD)

The RS-232 Interface is fully isolated from the sensor electronics through the use of optical isolators located in the JF-1A/ATEX sensor.

7.4 RS-232 Wiring Considerations (4-Wire)

Data cable for the RS-232 should be low capacitance data cable. Lengths in excess of 20 meters may result data degradation of the RS-232 signals.

7.5 Power Input (4-Wire)

Power input to the 4-Wire power connections should be clean filtered DC voltage in the range of 7 – 35 VDC. Current consumption is approximately 10 mA.

8.0 TEST PROCEDURE

8.1 POWER INSTRUMENT

Connect Instrument to suitable power supply (See Section 7.0 for detailed electrical connections). Attach D-2 Test Cable P/N B440-079 to the 4-Wire connector located on the user connection interface. See Figure 7.

8.2 TERMINAL SOFTWARE

Locate appropriated serial port terminal software, such as Hyperterminal. Consult computer manual for configuration and settings. Set Port for 9600 Baud. Confirm connection turning JF-1A sensor on, wake up banner should display on terminal screen. Pressing <CR> will result in a single frame of data being displayed on the screen (Note: Wait 5-10 seconds from power turn of JF-1A).

8.3 CHECK ZERO READING

With the sensor removed from the Load line rinse the sensor in “Clean” Isopropyl Alcohol and blow dry using “dry” compressed air. Note that this step should be repeated until all signs of fuel residual have been removed from the sensor.

Note: Isopropyl Alcohol is highly conductive and any residual traces inside the sensor between the two electrodes will overage the instrument. To flush the Isopropyl Alcohol a reagent grade toluene can be used as an after rinse and allowed to air dry. Note that if the Isopropyl Alcohol is well blown off with dry compressed air no residuals will be left, eliminating the need to use the more exotic Toluene.

Set the sensor to send continuous data using the "SC" command entered from the Terminal. When the JF-1A is reporting values (less than 5 pS/M) the user can be satisfied that the sensor is clean. Readings on the screen should report less than 2 pS/M and should be stable. (Data is displayed as Conductivity, Temperature, Compensated Conductivity <CR><LF>).

Note: The sensor is factory calibrated in certified "zero" conductance fluid. The serial port may read a slightly negative value with the sensor in air, this is normal due to the difference in dielectric constant from air to fuel.

8.4 SCALE CHECK SENSOR

Place the sensor in a fuel with additive that is near the full-scale range of interest. We suggest a value "higher" than the range over which the sensor is going to be operated. For example, if the user intends to measure conductivity in the 0 – 500 pS/M range a good value to calibrate the sensor with is 750 – 1000 pS/M. This reduces uncertainty over the range of interest. The value of the standard can be measured using a D-2 Incorporated JF-1A-HH hand-held meter or other suitable and industry-accepted standardization device. Confirm from the terminal the data reported is within instrument specification.

9.0 SENSOR REMOVAL

See Installation and Safe Use Manual for detailed mechanical removal instructions.

10.0 SPECIFICATIONS

The electrical parameters are factory calibrated to 1% of reading. However, due to fuel measurement characteristics, the repeatability and reproducibility limits are as follows:

Table 2
SENSOR SPECIFICATIONS

SENSORS:

Parameter	Conductivity	Temperature
Range	0 – 500 pS/M	-5 – 50 C
Accuracy *	+/- 2 pS/M (+/- 2%) of Reading	+/- 0.5 C
Resolution	0.1 pS/M	0.1 C
Sensor Type	Coaxial Electrode	Platinum RTD
Calibration	Internal Zero & Scale	NIST ITS-90

* This is at temperatures +/- 10° C of 20° C for the compensated output data only.

Table 3
SYSTEM SPECIFICATIONS

SYSTEM:

ELEMENT	SPECIFICATION
Flow Range	0 – 7.0 M/s Max
Environmental	-10 to 60 C Operation -40 to 80 C Storage
Power 2-Wire Input	24 VDC Minimum 38 VDC Maximum
Power 4-Wire Input	7 VDC Minimum 38 VDC Maximum
Pressure	200 PSIA Maximum
Certification Housing	FM, CSA, UL, CENELEC
Certification Sensor	ATEX
Usage	Class 2, Division 2
ATEX Certification	EExd [ia] IIC T4/5/6
FM Certification	
UL Certification	

11.0 SERIAL DATA INTERFACE

The D-2 JF-1A has a comprehensive serial interface. The instrument contains no internal electrical adjustments. All instrument calibration constants and configurations are stored in internal non-volatile memory. The unit also has programmable output span range for the 4-20 mA output, allowing the user to customize the unit to a specific application. The factory default range is for the 4 - 20 mA range to represent 0 - 500 pS/M conductivity range. The unit also has programmable temperature compensation constants, for observing alternate thermal compensation for the specific additive effect on the conductivity of the treated fuel. Lastly, the user has the ability to set averaging of data that is applied to both serial output data and to 4-20 mA data.

Note: Windows has terminal program built in "Hyperterminal" This program is located in the Accessories sub directory in drive which windows resides.

11.1 RUN MODE

When powered the unit commences operation in the "RUN MODE." The unit sends the following sign on ASCII message at 9600 Baud, 8 Data Bits, No Parity and 1 Stop bit:

(Note: Orator Text Used For All Instrument Outputs)

```
D-2 Incorporated
Fuel Cell JF1
1.6
 COND,  TEMP,  COMP COND
(ps/m)   (C)   (ps/m-C)
```

The last two lines are headers for the data output columns. To collect data the user need only send an ASCII Carriage Return (Hex 0A) <CR> or ASCII Line Feed (Hex OD) <LF>. The unit will respond with a single line of data:

```
13.0,    15.4,    23.8<CF><LF>
```

Where: 13.0 = Conductivity Measured
15.4 = Temperature of Fuel in Celsius
23.8 = Compensated Conductivity

11.2 CONTINUOUS DATA

To have the unit send data continuously without polling, the user can send the "SC" Set Continuous Command. The unit will commence sending data at the data rate and current averaging rate. If the averaging is set to 1 sample then the data rate is approximately 2.0 hertz. If the averaging is set to 2 samples then the 2 samples are averaged together and the data rate is 1 hertz. Boxcar averaging is used, i.e., Data Average = 1/N New Data + N-1/N Old Data. To stop continuous data the unit will only accept one command, which is the capital "S" Stop Command followed by a carriage return or line feed.

Note: The Stop Command is the only case sensitive command!

11.3 OPEN MODE

In OPEN MODE the unit stops collecting data and awaits user instructions such as calibration constants, or averaging settings, etc. The OPEN MODE can be attained by sending the "***O" command. The unit after entering open mode will send "OPEN MODE" when polled using a carriage return or line feed. From open mode the user can view all constants using the "RCAL" command. The RCAL Command will return the following:

***O

Open Mode
RCAL
1314
ZERO=55.000000
FS=1900.000000
BT=67.759354
MT=-9.510620E-05
TREF=20.100000
MC=1.280000E-02
N=1.000000
W=30
NREF=1.000000
DAO=375
DAF=500.000000

In the Table Below the definition of each of these constants is given:

Table 4
OPERATIONAL CONSTANTS

Constant	Definition
1314	Unit Serial Number
ZERO	The value assigned to the zero reference reading, used to set Y=MX+B for the conductivity channel
FS	The value assigned to the Full Scale reference reading, used to set Y=MX+B for the conductivity channel
BT	The Temperature Channel Offset Value
MT	The Temperature Channel Slope Value
TREF	The Temperature Reference for Conductivity Compensation
MC	The Temperature Coefficient of Jet

	Fuel with Additive Per ASTM
N	The Number of Samples of Conductivity Box Car Averaged See Section 13.0
NREF	The number of Reference Channels Averaged
DAO	The 4-20 mA output offset counts to trim current to 4.0 mA at Zero Conductivity
DAF	The 4-20 mA full Scale in pS/M for an load current of 20 mA Total
W	Anti Spike Filter Maximum Scan-Scan Change in pS/M

Any constant can be read individually by entering the reference name followed by a <CR>. Any constant can be set by entering the reference followed by an equal's sign and then the new value to be entered. All constants can be stored in non-volatile memory using the ***E command. Note, cycling power after changing constants and before storing them in non-volatile memory using the ***E command will result in the unit reverting to the original values stored.

To return to run mode, issue the ***R command or cycle power.

Current Loop Output Testing

The JF-1A, while in OPEN MODE, can temporarily output a current equal to a given conductivity reading for system testing. To output a current equal to a given conductivity, as example 250 pS/M, while in OPEN MODE issue the command COND=250. This command will configure the output to draw current equal to a reading of 250 pS/M, or on a 0 – 500 pS/M configured sensor 12 milliamps. Readings and output currents for various range configured units is given in the table below. (Note, the JF-1A is normally configured for a 0 – 500 pS/M range equating to a 4 – 20 mA current range.)

Conductivity	0-500 pS/M * CURRENT mA	0-1000 pS/M CURRENT mA	0-2000 pS/M CURRENT mA
0	4	4	4
125	8	6	5
250	12	8	6
375	16	10	7
500	20	12	8
750	-	16	10
1000	-	20	12
1250	-	-	14
1500	-	-	16
1750	-	-	18
2000	-	-	20

11.4 CALIBRATION MODE

In CALIBRATION OPEN MODE the unit collects data and outputs all raw data and processes measurements allowing a user to calculate operational constants. To enter the CALIBRATION MODE the "***C" command sent from the OPEN MODE (See Open Mode Above). After entering CALIBRATION MODE the unit will send the following frame of data when polled using a carriage return or line feed. The SET CONTINUOUS "SC" command also operates in Calibration Mode

***C

```
-9433, 639606, -8351, 491805, 2.2, 21.0, 2.1
```

Where:
-9433 = Counts Electronic Zero Reference
639606 = Counts Electronic Full Scale Reference
-8351 = Counts Conductivity Circuit Reference
491805 = Counts Temperature Circuit
2.2 = Calculated Conductivity pS/M
21.0 = Calculated Temperature Celsius
2.1 = Calculated Compensated Conductivity pS/M

(Note that the numbers above are examples only; actual values obtained will vary)

12.0 CALIBRATION CHECK (Also See A440-010-FC Manual, at the end of this documents)

Note: Users of this section should be familiar with section 11.0 of this manual, Serial Commands.

If AIR Reading of ZERO larger than +/- 2pS/M is observed or the user suspects that the unit is not reading correctly the instructions in A440-010-FC Manual should be completed.

Note: The sensor is factory calibrated in certified "zero" conductance fluid. The serial port may read a slightly negative value with the sensor in air, this is normal due to the difference in dielectric constant from air to fuel.

12.1 SENSOR REMOVAL

To remove the probe from the fuel load line, please refer to section 9.0.

12.2 POWER SENSOR

Using D-2 Test Cable P/N A440-043 Connect the sensor to a suitable power supply, and the serial connector to COM 1 of the PC. On the PC run "Hyperterminal" or other suitable serial port terminal program.

12.2 CLEAN SENSOR

Clean the sensor in "Clean" Isopropyl Alcohol and blow dry using "dry" compressed air. Note that this step should be repeated until all signs of fuel residual have been removed from the sensor.

Note: Isopropyl Alcohol is highly conductive and any residual traces inside the sensor between the two electrodes will overage the instrument. To flush the Isopropyl Alcohol a reagent grade toluene can be used as an after rinse and allowed to air dry. Note that if the Isopropyl Alcohol is well blown off with dry compressed air no

residuals will be left, eliminating the need to use the more exotic Toluene.

When the JF-1A is reporting low values (less than 5 pS/M), the user can be satisfied that the sensor is clean.

12.3 CHECK SENSOR SCALE

Place the sensor in a fuel with additive that is near the full-scale range of interest. We suggest a value "higher" than the range over which the sensor is going to be operated. For example, if the user intends to measure conductivity in the 0 – 500 pS/M range a good value to calibrate the sensor with is 750 – 1000 pS/M. This reduces uncertainty over the range of interest. The value of the standard can be measured using an D-2 Incorporated JF-1A-HH Hand-held meter or other suitable and industry-accepted standardization device. Verify reported conductivity from JF-1A and hand held are within acceptable limits.

13.0 COMPENSATED OUTPUT

The D-2 JF-1A Conductivity Sensor outputs conductivity compensated for temperature differences in the fuel from the temperature at which the sensor was physically calibrated. The compensation is based on a numerical algorithm:

Ci = 10^ (MC* (TREF - t) + Log (C)

Where:
Ci = Compensated Conductivity Reading
C = Measured Conductivity Reading
MC = Compensation Constant (Nominally 0.028 for fuels treated with Stadis 450)
TREF = Reference Temperature (the temperature at which the sensor was initially calibrated)
T = Measured Temperature
Log = Log Base 10

This formula is based on the ASTM D 2624, Appendix X2 Standard See also NRC-22648 The Relationship Between Electrical Conductivity and Temperature of AVIATION Turbine Fuels Containing Static Dissipater Additives"

Table 5 gives the change in conductivity as a function of temperature for several values of initial conductivity at 22 C.

Table 5
Conductivity (pS/M) as a Function of Temperature (Aviation Fuel Treated with Stadis 450)

Conductivity	50	150	250	350	450
Temperature					
-2	25	74	123	173	222
2	28	83	139	194	250
6	31	94	156	218	281
10	35	105	176	246	316
14	39	118	197	276	355
18	44	133	222	311	400
22	50	150	250	350	450
26	56	169	281	394	506
30	63	190	316	443	570
34	71	214	356	499	641
38	80	240	401	561	721
42	90	270	451	631	811
46	101	304	507	710	913
50	114	342	571	799	1027

The D-2 JF-1A Current Output is base on *Compensated Conductivity*. To prevent compensation the user must set “MC” to zero (See Serial Command Section of this manual).

14.0 FILTERED OUTPUT

Boxcar (low pass filter) Average:

The D-2 JF-1A Conductivity Sensor has a user specified filtered output. The output is box car averaged. The number of box cars can be set from 1 (no filtering) to 10 (maximum filtering). The box car filter has the numerical equivalent of a low pass filter. Mathematically the form is:

Filtered Output = 1/n * new reading + n-1/n * old reading

In the table below 63% and 90% response times are given for each box card setting. See Section 10.0 for setting the box car number constant n.

Box Car Average N	**63% Response Seconds**	**90% Response Seconds**
1	1	**1**
2	3	**7**
3 *	6	**11**
4	7	**17**
5	9	**21**
6	11	**26**
7	13	**30**
8	15	**36**
9	17	**40**
10	**19**	**44**

- N= 3 is Factory Default

Window (Data De-Spike filter):

Window Filter "W". This Window filter can be used with or without N set. Essentially the window filter limits the rate at which the JF-1A sensor output can change from scan to scan. W has units pS/cm/scan, and can be set from 0 – 999. W is an effective tool to reduce data output spikes in installations where sudden physical changes of the system may cause data spikes. In essence if the raw conductivity value changes greater more than the current setting of W, the output change is limited to W. If N is also set then the output change is limited to W * 1/N.

The mathematical formula for Window Filter has the form:

Test = Raw old – Raw new
If Test > W then Limit Change to W
De-spiked Output = 1/n * W + n-1/n * old reading

15.0 MAINTENANCE

NOTE: There are no user-serviceable components inside the D-2 JF-1A Conductivity Sensor. There are NO Electronic adjustments inside the sensor.

15.1 Calibration Interval

The D-2 JF-1A Conductivity sensor should be calibrated annually. The sensor can be returned to the factory or the procedures found in the calibration section of this manual performed. The instrument has no internal electrical adjustments that need to be maintained.

15.2 Cleaning

The JF-1A Conductivity Sensor should be cleaned every 6 months of use. Fuel additives or particulate may build up on the sensor, degrading its performance. The sensor can be cleaned using the same procedure found for checking the instrument Zero in the previous sections.

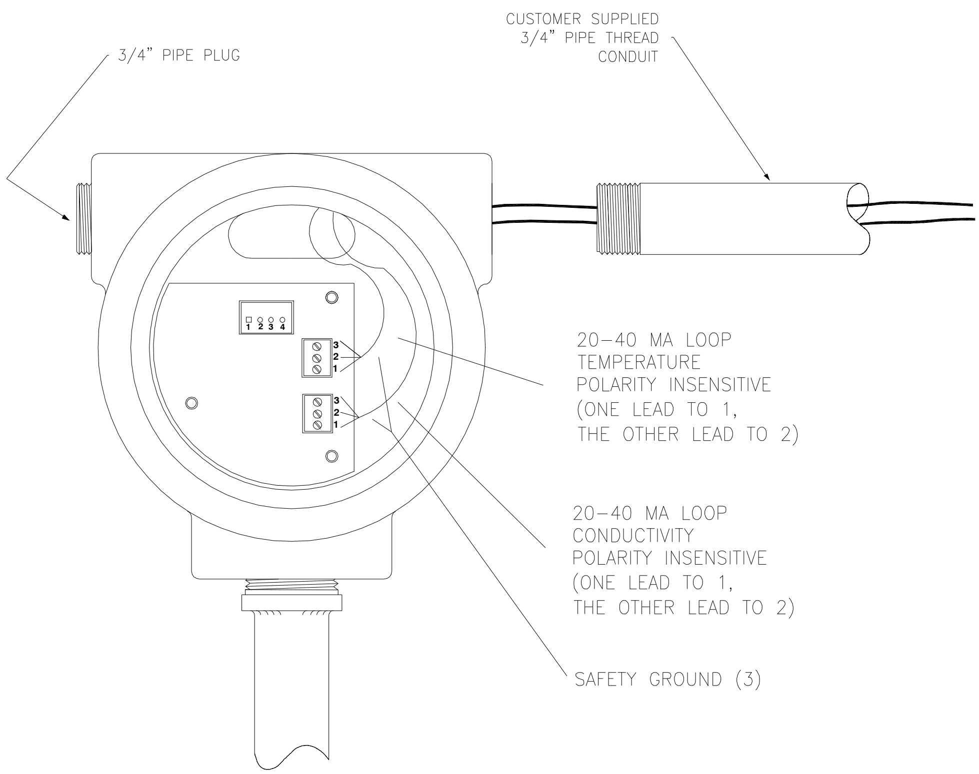
15.3 Sensor

The main electronics housing is sealed to the environment. The housing is purged prior to sealing with dry nitrogen after drying. This ensures that moisture or condensation do not develop inside the electronics compartment that would degrade the ability of the sensor to measure the very low conductivities typical of aviation fuels. If the housing is opened the unit must be returned to the factory for re-calibration.

16.0 Optional 2 Wire Temperature Interface

The connection details are shown in figure 8. The optional 2-wire temperature interface is connected to JP2 Terminals. These are "snap" out Molex screw terminals which can be removed to assist in wiring. Cabling used should be in compliance with the JF-1A Ex examination certificate. The 2 wire temperature interface is "polarity insensitive". The loop is not powered; power must be supplied by the user.

Figure 8
OPTIONAL TEMPERATURE LOOP
ELECTRICAL CONNECTION DETAIL



16.1 2-Wire 4-20mA LOOP CONSIDERATIONS

Warning 2-Wire Loop Maximum Resistance including wire can not exceed 500 ohms, or internal intrinsic over voltage safety devices in the JF-1A sensor may be activated.

The maximum loop power supply voltage, under all conditions, must also prevent the voltage across the sensor loop terminals from exceeding the maximum voltage listed in the specifications section of the manual.

D-2 recommends that a 24 VDC isolated supply be used to power the instrumentation loop. The supply should have high isolation (>500 Mohm), and be single point grounded. The current loop should be wired using shielded twisted pair wire. The shield should also be single point grounded to a solid earth ground.

NOTE: Sensor wiring should be performed as defined by the National Electric Code (NEC), and ATEX sensor certificate.

14.2 4 – 20 mA Temperature Readings

The following table details current output readings for the JF-1A sensor with a nominal -10 to 60 Celsius range representing 4 – 20 mA. (Please consult the factory for alternate range settings of the current output):

Temperature (C)	Current (mA)	Voltage * (Volts)
-10.0	4.0	1.00
0.0	6.3	1.57
10.0	8.6	2.14
20.0	10.8	2.71
30.0	13.1	3.28
40.0	15.4	3.85
50.0	17.7	4.42
60.0	20.0	5.00

- 250 Ohm Voltage Sensing Resistor Used

APPENDIX A:

LIMITED WARRANTY

One year from date of shipment, D-2 Incorporated, guarantees its products to be free of defects in materials and workmanship. In the event a product malfunctions during this period, the company obligation is limited to repair of the defective item at our factory, or the defective item may be replaced at our option. Instruments found defective should be returned to the factory prepaid and carefully packed, as customer will be responsible for freight damage. D-2 will pay return shipping on any warranty repairs.

Repairs or replacements under warranty will be at no cost to the customer for parts, labor, or return shipment from our factory to the customer. This warranty is void if in our opinion the instrument has been damaged by accident, mishandled, altered or repaired by the customer where such treatment has affected its performance or reliability. In the event of such abuse by the customer, all costs for repairs plus freight costs will be borne by the customer. All equipment supplied by D-2 that is designed for use under hydrostatic loading has been certified by actual pressure testing prior to shipment.

The customer will be charged a diagnostic fee plus all shipping costs if an instrument is returned for warranty repair and no defect is found by the factory. Incidental or consequential damages or costs incurred as a result of product malfunction are not the responsibility of D-2 Incorporated.

Equipment not manufactured by D-2 Incorporated, is supported only to the extent of the original manufacturer's original warranties. All OEM sensors which utilize electrodes (oxygen cartridges, pH, ORP, etc.) is warranted at the time of shipment, and shall perform upon initial installation within stated specifications. If the product proves to be defective within the OEM's warranty we will replace the product or defective part with a similar model, product or part, but only to the extent that the OEM will warrant.

All returned products must be accompanied by a Returned Material Authorization (RMA) number issued by D-2 Incorporated. Shipments will not be accepted without the RMA number. An RMA number can be obtained by calling

Customer Service Department at 508-564-7640 or by emailing Mail@D-2inc.com.

The following information should accompany any instrument being returned to the factory:

Return Authorization Number
Model/Serial Number
Brief Description of the Problem
Customer Contact/Telephone Number

CALIBRATION SERVICE POLICY

A calibration only service is available for JF-1A Conductivity Sensors.

The service is limited to instruments requiring only calibration and minor adjustment. Instruments that are not operating properly and require repair or replacement parts will not be covered. If repair is necessary the customer will be contacted and apprised of the additional cost. The customer will be charged the standard repair cost, which includes repair and calibration. In the event that the customer does not approve repair, the unit will be returned in "as received" condition and the teardown and inspection charge will be invoked.

The customer will be required to obtain a return authorization number from Customer Service at D-2 Incorporated prior to the return of the instrument. This number should be displayed on the outside of the container, preferably on the shipping label, and included on the shipping documentation sent with the instrument.

If possible, the following information should accompany the instrument:

Return Authorization Number
Model/Serial Number
Customer Contact/Telephone Number

D-2 INCORPORATED

Jet Fuel 1A Conductivity Sensor (JF-1A)

FIELD CALIBRATION

REVISION 1
P/N A440-010 - FC

This manual covers field calibration of the D-2 JF-1A Conductivity Sensor. D-2 continuously strives to meet the full expectations of our customers and we welcome comments on the structure, content and the ability of this manual to answer your questions regarding our product. If you have any suggestions or comments please contact us at Service@D-2inc.com. This document is provided with the understanding that future versions of this instrument may have additional commands, and the function of the commands shown in this document may vary from the present operation.

1.0 GENERAL

The D-2 JF-1 Conductivity Sensor is a reliable instrument for the continuous measurement of electrical conductivity of fuels. The JF-1 Conductivity Sensor incorporates innovative electronics Digital Signal Processing (DSP) techniques to accurately determine the electrical conductivity of fuel products. The instrument will measure fuel electrical conductivities between 0 and 2000 picosiemens/meter (pS/M), although it is optimized and normally used in the 0 to 500 pS/M range. The sensor offers RS-232 data output, or traditional industrial loop compliant 4-20 mA. The 4 -20 mA output can be user programmed to represent a prescribed range of conductivity. User configurations and instrument calibration terms are stored in internal non-volatile memory. The D-2 sensor is continuously internally electronically calibrated. Absolute calibration relies only on the sensor cell constant that is very stable by design. The conductivity sensor has a built-in temperature sensor. Output from the temperature sensor is used to fully compensate the conductivity output from variations due to changes in electrical conductivity as a function of temperature per the ASTM D 2624, Appendix X2 Standard (Appendix A), (See Also Document "NRC-22648 The Relationship Between Electrical Conductivity and Temperature of Aviation Turbine Fuels Containing Static Dissipater Additives".

The user should have a general knowledge of process control instrumentation, serial data, standards, tolerances, and mathematics prior to attempting a field calibration of the JF-1A Sensor. If the use has any doubt or confusion in relation to an applied field calibration the sensor MUST not be placed back into service until corrected.

2.0 REQUIRED EQUIPMENT

1) JF-1A Sensor, Device under Test, (DUT)
2) Laboratory Stand (Capable of holding the DUT Vertical
3) Isopropyl Alcohol
4) Air Source
5) 500 mL Beaker
6) 300 ml Aviation Kerosene with Stadis 450 treated to 1600 pS/M +/- 200 pS/M

7) JF-1A-HH Hand Held Meter or Calibrated JF-1A Sensor Used as Standard (Check unit must be within its valid calibration interval)
8) Laboratory power supply or 9VDC battery with wires to JF-1A Terminal Block.
9) JF-1A Serial Test Cable B440-079
10) PC running terminal emulation software, or serial terminal.

3.0 CONDUCTIVITY PROCEDURE

3.1 POWER INSTRUMENT

Attach D-2 Test Cable P/N B440-079 to the 4-Wire connector located on the user connection interface. Connect Instrument to suitable power supply (See operations manual for detailed electrical connections).

3.2 ESTABLISH SERIAL DATA COMMUNICATION WITH JF-1A

With PC or terminal connected to serial data port of JF-1A turn on instrument power and validate that "power up" banner is received from the unit. Request data from the unit after 10 seconds and confirm data responses are received to validate serial data out connection to instrument.

3.3 CHECK ZERO READING

With the sensor removed from the Load line rinse the sensor in "Clean" Isopropyl Alcohol and blow dry using "dry" compressed air. Note that this step should be repeated until all signs of fuel residual have been removed from the sensor.

Note: Isopropyl Alcohol is highly conductive and any residual traces inside the sensor between the two electrodes will overage the instrument. To flush the Isopropyl Alcohol a reagent grade toluene can be used as an after rinse and allowed to air dry. Note that if the Isopropyl Alcohol is well blown off with dry compressed air no residuals will be left, eliminating the need to use the more exotic Toluene.

Request continuous serial data using the "SC" command. When JF-1AS is reporting low values (less than 5 pS/M) the user can be satisfied that the sensor is clean. If the reading in air is less than +/- 2 pS/M skip onto section 3.5 "Set Scale", otherwise perform section 3.4 Reset Zero.

3.4 RESET INSTRUMENT ZERO READING

a) Note the value read with unit in air, as example JF-1A reading 4.3 pS/M, the offset is high by 4.3 pS/M (label OFFold).

b) Place the unit in open mode by sending the "***O" command.

c) Read the current offset by sending the "ZERO" command (label as ZEROold).

d) Mathematically determine the new ZEROnew = ZEROold – OFFold.

e) Enter new calibration value using command "ZERO=ZERONEW".

g) Check by returning to run mode using the ***R command.

h) Iterate steps a-g as is needed to gain a reading less than 2 pS/M.

i) Save constant by returning to Open Mode and using the "***E" command.

2.5 SCALE CHECK SENSOR

a) Using either the calibrated Hand Held Meter or the in calibration JF-1A sensor measure the value of a beaker of fuel. Add fuel or additive to obtain a value in the beaker of 1600 pS/M +/- 200 pS/M. Once established record the value for use in this process, label that value as C-std.

b) Place the sensor in a fuel additive mixture; ensure that bubbles are not trap in the electrode region by visual inspection.

c) Note the value read with unit in the sample, as example JF-1A reading 1575 pS/M, record this value as C-old.

d) Place the unit in open mode by sending the "***O" command.

e) Read the current slope constant by sending the "FS" command (label as FS-old).

f) Mathematically determine the new FS-new = C-old/C-std* FS-old.

g) Enter new calibration value using command "FS=FS-new".

h) Check by returning to run mode using the ***R command.

i) Iterate steps a-h as is needed to gain a reading where the JF-1 sensor is less than 10% different from the C-std value.

j) Save constant by returning to Open Mode and using the "***E" command.

k) Repeat the Zero Adjustment in 2.4 Above.

2.5 4-20 mA OUTPUT CALIBRATION

General:

The JF-1 Sensor can be used with fuel conductivities from 0 – 2000 pS/M. Normally the sensor has the 4-20 mA output scaled for a specific range which allows the user to optimize the interface for a specific application. The procedure below can be followed to either "re-calibrate" the current output or if the user elects to calibrate the current output for an alternate range for a specific application. The JF-1 is nominally set for 0 – 500 pS/M representing the output range of 4 – 20 mA. This is detailed in Table 1 below:

Reading	Current mA	Voltage 250 Ohm Sense
0	4.0	1.00
125	8.0	1.25
250	12.0	2.50
375	16.0	3.75

500	20.0	5.00

Equipment Required:

a) JF-1 Serial Test Cable FSI P/N B440-079
b) Serial Data Communicating Device, set for operation at 9600 baud, 1 stop, 8 data, No parity
c) 250 ohm sensing resistor
d) Digital Multi Meter with 0.001 VDC resolution.
e) Power supply +24.0 VDC

Procedure:

a) Connect the probe to the power supply as detailed in the manual in series with either the 100 or 200-ohm sense resistor.

b) Select the range of operation the 4 – 20 ma output is to represent, as example, say we want 20 mA to equal 700* pS/M and 4 mA to Equal 0 pS/M.

(* Non Standard Range)

c) Connect the serial cable to the test jack on the JF-1 Sensor. On the PC press enter and confirm connection is made by the receipt of a single line of data from the JF-1 Sensor.

d) Place the unit in open mode using the "***O" command followed by the enter key. Verify the unit is in OPEN MODE by pressing an additional entering key, the JF-1 will respond with the words "OPEN MODE".

e) Read the current full scale value of the current output DAC, enter the request "DAF" the unit will return "DAF=585, where "585"is the current setting, one can assume the full scale range is 500, note the DAF value represents a "scaling" factor and will not exactly be equal to the range.

f) As we are changing he range to 700 pS/m full scale we can make an initial assumption the DAF value will need to be increased proportionately, i.e. DAF=585 700/500= 820. This value is temporarily entered into DAF by sending "DAF=820".

g) To test this value we need only to set conductivity to our desired full-scale value by sending "Cond=700" to the JF-1A unit.

h) Read the Digital Voltage Meter output that should be connected across either the 250 or 100-ohm sense resistor. The voltage should equal 5.00 +/- 0.01 volt for the 250-ohm resistor. If this is not attained DAF needs to adjusted, increase the value of DAF if the voltage is high, decrease the value if the voltage is low. Repeat Step6 unit the correct voltage (current is attained).

i) After steps a-h are complete the user should now check the "low end of the range to ensure the slope adjustment has not resulted in "significant errors of the low end.

j) To test this value we need only to set conductivity to our desired full-scale value by sending "Cond=0" to the JF-1 unit. Then temporarily "disconnect the serial port from the computer" as this may result in current loop errors due the serial port driver load.

k) Read the Digital Voltage Meter output that should be connected across either the 250 or 100-ohm sense resistor. The voltage should equal 1.00 +/- 0.02 volt for the 250-ohm resistor. If this is not attained DA0 needs to adjusted, reconnect the serial cable, increase the value of DA0 if the voltage is low, and increase the value if the voltage is low. DAO is set using the DAO=XXX, where XXX is the new entry. Repeat Step h until the correct voltage (current is attained).

l) Full scale can then again be checked using the entry again of the full-scale values, when complete unit is ready.

m) Store the values in the internal EEPROM using the "***E" command. The when complete will respond with a carriage return.

n) Return the unit to RUN MODE using the "***R" command.

November 22, 2010

JF-1A FUEL CONDUCTIVITY SENSOR
Technical Application Note 10-006

Power/Ground Requirements for JF-1A, when 4-20 mA and Serial Data Ports are used simultaneously

Background

In some applications of the JF-1A both the current ports and serial data ports are used. In these applications the user must take care to ensure that input voltage ratings are not exceeded and that power supplies do not create multiple ground paths through the instrument. These issues can either result in improper readings from the sensor, or result in damage to the sensor output electronics.

JF-1A has 3 Distinct Outputs

Conductivity: is output as a 4-20 mA signal. This 2-Wire port is also used to supply power to the instrument when used alone. The current that flows in the loop is proportional to the conductivity read by the meter.

Temperature: is output as a 4-20 mA signal. This 2-Wire port does not power the instrument, so it cannot be used alone. The current that flows in the loop is proportional to the temperature read by the meter. (The loop needs its own external power supply).

Serial data: This 4-Wire port allows the connection of a RS-232 equipped computer to access both the conductivity and temperature data from the instruments serial port. As this is a four wire port. Power to run the instrument can also be applied via this port to operate the instrument. The power input is OR'ed with the conductivity current output port listed above.

General Power Requirements

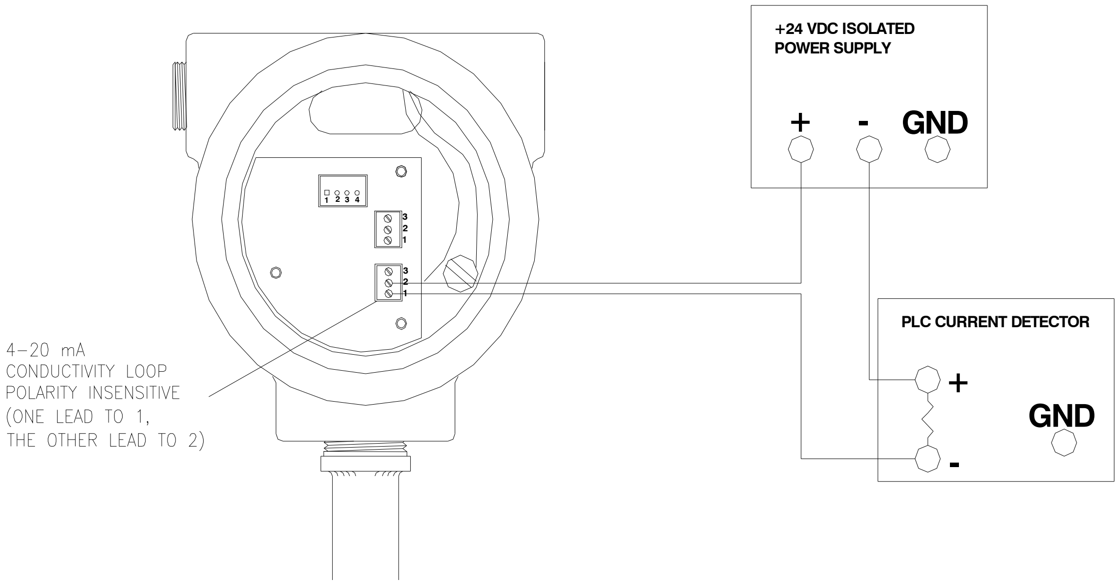
Power input to the JF-1A is required in order for the instrument to operate properly. If multiple output data sources from the JF-1A are to be used then the sensor needs multiple power inputs. In all cases, it is very important that power inputs are wired correctly to the JF-1A; harm can come to the sensor due to improper power levels or connection of multiple grounds that may be at different voltages.

Definition: Power isolation. Power is isolated when it is fully floating with respect to ground and/or other power sources. I.E. if two isolated power supplies are in use, you cannot measure the voltage of one with the return lead of the voltage measuring device attached to the other.

All power sources used with the JF-1A should be isolated both from ground, but, also from each other. Be cautious of common grounds (tie points) in PLC analog input channels; consult your PLC user's manual.

Example 1
JF-1A Conductivity Current Device Loop:

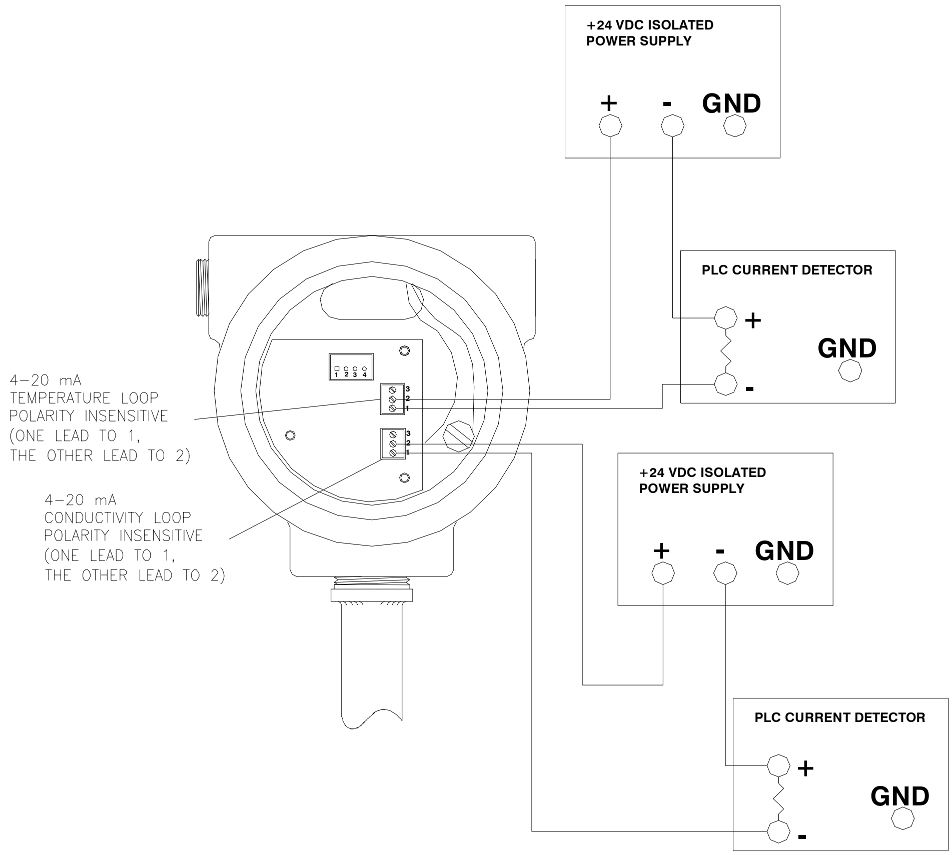
This is the standard configuration, a 24 VDC isolated power supply supplies loop power and a 250 ohm sense resistor is used to sense the conductivity current in the loop (convert the current to a voltage in the PLC). The JF-1A derives its power for its operation from the loop current supply. **Note**: both the supply and loop current detector are normally isolated from ground .


+24 VDC ISOLATED
POWER SUPPLY
+
-
GND
PLC CURRENT DETECTOR
+
GND
-
1 2 3 4
3
2
1
3
2
1
4-20 mA
CONDUCTIVITY LOOP
POLARITY INSENSITIVE
(ONE LEAD TO 1,
THE OTHER LEAD TO 2)

Example 2
JF-1A Conductivity Current Device Loop, with a secondary Temperature Current Loop:

As in example 1 a 24 VDC isolated power supply supplies loop power and a 250 ohm sense resistor is used to sense the current in the conductivity loop (convert the current to a voltage in the PLC). As in example 1 the JF-1A derives its power for its operation from the loop current supply. Note both the supply and loop current detector are normally isolated from ground.

A second fully isolated 24 VDC supply is needed for the temperature current loop. This is required as the conductivity loop which powers the JF-1A has established a "virtual" common voltage point. If the user is to establish another connection between the two loops then the virtual loop ground is corrupted and neither loop current will be correctly set by the JF-1A, and, under extreme circumstances may result in damage to the JF-1A current output devices. A common method to avoid this problem is to install a 4 - 20 mA to 4 – 20 mA isolator in the Temperature loop (Example http://www.api-usa.com/pdf/api/api_lpi-1_lpi-2.pd).



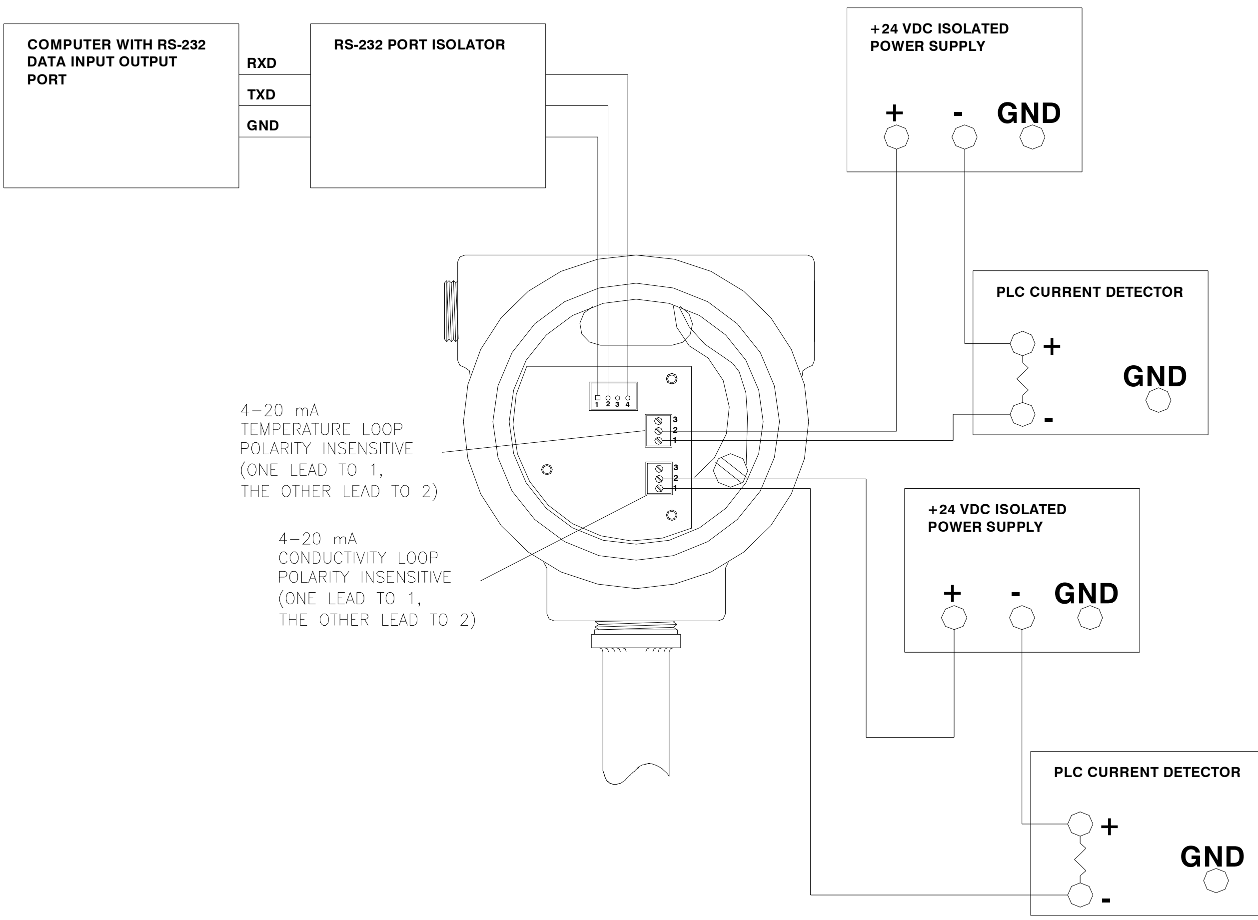
Example 3
JF-1A Conductivity Current Device Loop, with a secondary Temperature Current loop, and a connection for a serial data link:

As in example 1, a 24 VDC isolated power supply supplies loop power and a 250 ohm sense resistor is used to sense the current in the conductivity loop (convert the current to a voltage in the PLC). As in example 1 the JF-1A derives its power for its operation from the loop current supply. Note both the supply and loop current detector are normally isolated from ground.

As in example 2, a second fully isolated 24 VDC supply is needed for the temperature current loop. This is required as the conductivity current loop has established a “virtual” common voltage point. If the user is to establish another connection between the two loops then the virtual loop connection is corrupted and neither loop current will be correctly set by the JF-1A, and, under extreme circumstances may result in damage to the JF-1A current output devices.

Finally a third connection is made through an RS-232 isolator to allow connection to the RS-232 data port. The isolator again prevents the data ground from interfering with the virtual ground needed by the two current loops operating at the same time.

Note: the power is not needed to be applied to the power pin on the 4 wire connector as power for the instrument operation is already provided via the Conductivity Current Loop.



November 22, 2010

JF-1A FUEL CONDUCTIVITY SENSOR
Technical Application Note 10-007

Method of Adjustment Current Loop Output Settings

Background

In some applications of the JF-1A the user desires to change the range of either the current or temperature output current loops. The standard settings are Conductivity Loop 4 – 20 mA representing a Conductivity of 0 – 500 pS/M and Temperature Loop 4 - 20 mA represents -20°C to 60°C.

(Note the output current adjustment/calibration is fully independent of the sensor fluid calibration adjustment which will not be effected)

Warning: Prior to connecting serial ports or other equipment to the JF-1A sensor carefully follow the instructions in: "Application Note 10-006 Power/Ground Requirements for JF-1A, when 4-20 mA and Serial Data Ports are used simultaneously" to avoid electrical damage to the JF-1 Sensor.

Section 1.0 Method of Adjustment 4-20 mA output span JF-1 Sensor:

Conductivity:

The JF-1 Sensor can be used with fuel conductivities from 0 – 2000 pS/M (Note JF-1A-MA 0 – 200,000 pS/M). Normally the sensor has the 4-20 mA output scaled for a specific range which allows the user to optimize the interface for a specific application. The procedure below should be followed if the user elects to change the range for a specific application. The JF-1 is nominally set for 0 – 500 pS/M representing the output range of 4 – 20 mA. This is detailed in Table 1.

Table 1

Reading	Current mA	Voltage 100 ohm Sense	Voltage 250 Ohm Sense
0	4.0	0.4	1.00
125	8.0	0.8	1.25
250	12.0	1.2	2.50
375	16.0	1.6	3.75
500	20.0	2.0	5.00

Section 2.0 Current Loop Calibration using DVM and Reference Resistors:

Note: if the user can read conductivity values directly from his PLC then it is better to calibrate directly from Conductivity Reading at the sensor to Conductivity Reading by the PLC, in this way all errors of reference resistor, A/D's etc. are completely incorporated. If you are calibration the current loop output directly to your PLC proceed to Section 3.0.

Equipment Required:

f) JF-1 Serial Test Cable FSI P/N B440-079
g) Serial Data Communicating Device, set for operation at 9600 baud, 1 stop, 8 data, No parity
h) 100 ohm or 250 ohm sensing resistor
i) Digital Multi Meter with 0.001 VDC resolution.
j) Power supply +24.0 VDC

Procedure:

a) Connect the probe to the power supply as detailed in the manual in series with either the 100 or 200-ohm sense resistor.

b) Select the range of operation the 4 – 20 ma output is to represent, as example; say we want 20 mA to equal 1000 pS/M and 4 mA to Equal 0 pS/M.

c) Connect the serial cable to the test jack on the JF-1 Sensor. On the PC press enter and confirm connection is made by the receipt of a single line of data from the JF-1 Sensor. (Or turn the unit on add see the turn on banner being received).

d) Place the unit in open mode using the "***O" command followed by the enter key. Verify the unit is in OPEN MODE by pressing an additional entering key, the JF-1 will respond with the words "OPEN MODE".

e) Read the current full scale value of the current output DAC, enter the request "DAF" the unit will return "DAF=585, where "585"is the current setting, one can assume the full scale range is 500, note the DAF value represents a "scaling" factor and will not exactly be equal to the range.

f) As we are changing the range to 1000 pS/m full scale we can make an initial assumption the DAF value will need to ~ 20% higher than the span of interest, i.e. DAF=1000*1.2= 1200. This value is temporarily entered into DAF by sending "DAF=1200".

g) To test this value we need only to set conductivity to our desired full-scale value by sending "Cond=1000" to the JF-1 unit.

h) Read the Digital Voltage Meter output that should be connected across either the 250 or 100-ohm sense resistor. The voltage should equal 5.00 +/- 0.01 volt for the 250-ohm resistor, or 2.00 +/- 0.005 volts for the 100-ohm sense. If this is not attained DAF needs to adjusted, increase the value of DAF if the voltage is high, decrease the value if the voltage is low. Repeat Step 6 then Step 7 until the correct voltage (current is attained). ***(Note the unit will <u>not</u> automatically update the output after a change in DAF is made, the user***

must re-send the "Cond=1000" each time an adjustment is made to change the current output.)

i) After steps 5 – 6 are complete the user should now check the "low end of the range to ensure the slope adjustment has not resulted in "significant errors of the low end.

j) To test this value we need only to set conductivity to our desired full-scale value by sending "Cond=0" to the JF-1 unit.

k) Read the Digital Voltage Meter output that should be connected across either the 250 or 100-ohm sense resistor. The voltage should equal 1.00 +/- 0.01 volt for the 250-ohm resistor, or 0.40 +/- 0.005 volts for the 100-ohm sense. ***(Note the user may be required to disconnect the serial port connections to attain the zero value, this is due to the amount of current consumption required by the connected computer serial port).*** If this is not attained DA0 needs to adjusted, increase the value of DA0 if the voltage is low, increase the value if the voltage is low. DAO is set using the DAO=XXX, where XXX is the new entry. Repeat Step9 unit the correct voltage (current is attained).

l) Full scale can then again be checked using the entry again of the full-scale values, when complete unit is ready.

m) Store the values in the internal EEPROM using the "***E" command. The when complete will respond with a carriage return.

n) Return the unit to RUN MODE using the "***R" command.

Section 3.0 Current Loop Calibration directly to PLC readout of Conductivity:

Equipment Required:

k) JF-1 Serial Test Cable FSI P/N B440-079
l) Serial Data Communicating Device, set for operation at 9600 baud, 1 stop, 8 data, No parity
m) PLC Connected to JF-1A Current Output with ability of the operator to read the value directly in pS/M from the PLC.

Procedure:

a) Connect the probe to the PLC.

b) Select the range of operation the 4 – 20 ma output is to represent, as example; say we want 20 mA to equal 2000 pS/M and 4 mA to Equal 0 pS/M.

c) Connect the serial cable to the test jack on the JF-1 Sensor. On the PC press enter and confirm connection is made by the receipt of a single line of data from the JF-1 Sensor. (Or turn the unit on add see the turn on banner being received).

d) Place the unit in open mode using the "***O" command followed by the enter key. Verify the unit is in OPEN MODE by pressing an additional entering key, the JF-1 will respond with the words "OPEN MODE".

e) Read the current full scale value of the current output DAC, enter the request "DAF" the unit will return "DAF=585, where "585"is the current setting, one can assume the full scale range is 500, note the DAF value represents a "scaling" factor and will not exactly be equal to the range.

f) As we are changing he range to 1000 pS/M full scale we can make an initial assumption the DAF value will be approximately 20% higher than the range of interest, so we will enter a new value of DAF = 1000 * 1.2 = 1200, This value is temporarily entered into DAF by sending "DAF=1200".

g) To test this value we need only to set conductivity to our desired full-scale value by entering into the JF-1A the value we want it to output in equivalent current. This is done by entering “Cond=1000” to the JF-1 unit.

h) Read the PLC reading, this reading should equal 1000 pS/M. If this is not attained DAF needs to adjusted, increase the value of DAF if the reading is low, decrease the value if the voltage is high. After each new entry of DAF you **MUST** reenter the “Cond=1000” to change the sensor output after each change in the DAF value. Repeat until the same reading on the PLC is obtained as entered by the COND command.

i) After steps 5 – 6 are complete the user should now check the “low end of the range to ensure the slope adjustment has not resulted in “significant errors of the low end.

j) To test this value we need only to set conductivity to our desired 4 mA value by sending “Cond=0” to the JF-1A unit.

k) Again read the PLC output and verify a 0 pS/M reading. If this is not attained DA0 needs to adjusted, increase the value of DA0 if the Reading is low, decrease the value DA0 if the reading is high ***(note you may need to disconnect the serial port due to the additional current consumed in by some computer serials ports if a Zero value cannot be attained).*** Remember to reenter “COND=0” after each adjustment of the DAO value is made to update the sensor output.

l) Full scale can then again be checked using the entry again of the full-scale values, when complete unit is ready.

m) Store the values in the internal EEPROM using the "***E" command. The when complete will respond with a carriage return.

n) Return the unit to RUN MODE using the "***R" command.

Section 4.0 Method of Adjustment 4-20 mA output span JF-1 Sensor:

General Temperature:

The JF-1 Sensor can be used in temperatures outputs from -20˚C to 100˚C*. Normally the sensor has the 4-20 mA output scaled for a specific range which allows the user to optimize the interface for a specific application. The procedure below should be followed if the user elects to change the range for a specific application. The JF-1 is nominally set for -20˚C - 60˚C representing the output range of 4 – 20 mA. This is detailed in Table 2 below:

*WARNING: CONSULT THE SAFE USE MANUAL FOR SAFE AMIBENT OPERATING CONDITIONS FOR THE JF-1A SENSOR. THE TEMPERTURE RANGE LISTED ABOVE IS THE THORETCAL RANGE OF THE TEMPERATURE ELECTONICS, NOT THE SAFE USABLE RANGE.

Table 2

Reading	Current mA	Voltage 100 ohm Sense	Voltage 250 Ohm Sense
-20	4.0	0.4	1.00
0	8.0	0.8	1.25
20	12.0	1.2	2.50
40	16.0	1.6	3.75
60	20.0	2.0	5.00

Detail Instructions to Change Output Temperature Current Range Representation:

Note: if the user can read temperature values directly from his PLC then it is better to calibrate directly from Temperature Reading at the sensor to Temperature Reading by the PLC, in this way all errors of reference resistor,

A/D's etc. are completely incorporated. If you are calibration the current loop output directly to your PLC proceed to Section 5.0.

Section 4.0 Temperature Current Loop Calibration using DVM and Reference Resistors:

Equipment Required:

n) JF-1 Serial Test Cable FSI P/N B440-079
o) Serial Data Communicating Device, set for operation at 9600 baud, 1 stop, 8 data, No parity
p) 100 ohm or 250 ohm sensing resistor
q) Digital Multi Meter with 0.001 VDC resolution.
r) Power supply +24.0 VDC

Procedure:

1) Connect the probe to the power supply as detailed in the manual in series with either the 100 or 200-ohm sense resistor to the temperature loop terminals.

2) Power the JF-1A either from the conductivity loop or from the 4 –wire connection port (Note the power supply must be isolated from the supply which is used to run the sensor see application not 10-006).

3) Select the range of operation the 4 – 20 ma output is to represent, as example; say we want 20 mA to equal 50˚C and 4 mA to Equal 0˚C.

4) Connect the serial cable to the test jack on the JF-1 Sensor. On the PC press enter and confirm connection is made by the receipt of a single line of data from the JF-1 Sensor. (Or turn the unit on add see the turn on banner being received).

5) Place the unit in open mode using the "***O" command followed by the enter key. Verify the unit is in OPEN MODE by pressing an additional entering

key, the JF-1 will respond with the words “OPEN MODE”.

6) Read the current offset value TRL, enter the request “TRL” the unit will return “TRL=-20, where “-20”is the current setting, as we want to change the lowest value to b 0˚C we need to change TRL to = 0, enter the comment “TRL=0”, store using the ***E command.

7) Read the current full scale value of the current output TDAC, enter the request “TDAF” the unit will return “TDAF=83.5 (typically), where “83.5”is the current setting, one can assume the full scale range is 60, note the TDAF value represents a “scaling” factor and will not exactly be equal to the range.

8) As we are changing the range lower by ~20% to 0˚C to 50˚C full scale we can make an initial assumption the TDAF value will need to be lower, i.e. TDAF=65.5. This value is temporarily entered into TDAF by sending “TDAF=65.5”.

9) To test this value we need only to set conductivity to our desired full-scale value by sending “Temp=50” to the JF-1 unit.

10) Read the Digital Voltage Meter output that should be connected across either the 250 or 100-ohm sense resistor. The voltage should equal 5.00 +/- 0.01 volt for the 250-ohm resistor, or 2.00 +/- 0.005 volts for the 100-ohm sense. If this is not attained TDAF needs to adjusted, increase the value of TDAF if the voltage is high, decrease the value if the voltage is low. Repeat Step 6 then Step 7 until the correct voltage (current is attained). ***(Note the unit will <u>not</u> automatically update the output after a change in TDAF is made, the user must re-send the “Temp=50” each time an adjustment is made to change the current output.)***

11) After steps 6 - 10 are complete the user should now check the “low end of the range to ensure the slope

adjustment has not resulted in “significant errors of the low end.

12) To test this value we need only to set conductivity to our desired full-scale value by sending “Temp=0” (the new selected value of TRL) to the JF-1 unit.

13) Read the Digital Voltage Meter output that should be connected across either the 250 or 100-ohm sense resistor. The voltage should equal 1.00 +/- 0.01 volt for the 250-ohm resistor, or 0.40 +/- 0.005 volts for the 100-ohm sense. If this is not attained TDA0 needs to adjusted, increase the value of TDA0 if the voltage is low, increase the value if the voltage is low. TDAO is set using the TDAO=XXX, where XXX is the new entry. Repeat these unit the correct voltage (current is attained).

14) Full scale can then again be checked using the entry again of the full-scale values, when complete unit is ready.

15) Store the values in the internal EEPROM using the “***E” command. The when complete will respond with a carriage return.

16) Return the unit to RUN MODE using the “***R” command.

Section 5.0 Temperature Current Loop Calibration directly to PLC readout of Temperature:

Equipment Required:

s) JF-1 Serial Test Cable FSI P/N B440-079
t) Serial Data Communicating Device, set for operation at 9600 baud, 1 stop, 8 data, No parity
u) PLC Connected to JF-1A Current Output with ability of the operator to read the value directly in pS/M from the PLC.

Procedure:

17) Connect the probe to the PLC.

18) Select the range of operation the 4 – 20 ma output is to represent, as example; say we want 20 mA to equal 50˚C and 4 mA to Equal 0˚C.

19) Connect the serial cable to the test jack on the JF-1 Sensor. On the PC press enter and confirm connection is made by the receipt of a single line of data from the JF-1 Sensor. (Or turn the unit on add see the turn on banner being received).

20) Place the unit in open mode using the "***O" command followed by the enter key. Verify the unit is in OPEN MODE by pressing an additional entering key, the JF-1 will respond with the words "OPEN MODE".

21) Read the current offset value TRL, enter the request "TRL" the unit will return "TRL=-20, where "-20"is the current setting, as we want to change the lowest value to b 0˚C we need to change TRL to = 0, enter the comment "TRL=0", store using the ***E command.

22) Read the current full scale value of the current output TDAC, enter the request "TDAF" the unit will return "TDAF=83.5, where "83.5"is the current setting, one can assume the full scale range is 60˚C, note the TDAF value represents a "scaling" factor and will not exactly be equal to the range.

23) As we are changing he range to 50˚ C full scale we can make an initial assumption the TDAF value will be approximately ~20% less than the range of interest, so we will enter a new value of TDAF = 63.5, This value is temporarily entered into DAF by sending "DAF=63.5".

24) To test this value we need only to set temperature to our desired full-scale value by entering into the JF-1A

the value we want it to output in equivalent current. This is done by entering “Temp=50” to the JF-1 unit.

25) Read the PLC reading, this reading should equal 50˚C. If this is not attained TDAF needs to adjusted, increase the value of TDAF if the reading is low, decrease the value if the voltage is high. After each new entry of TDAF you MUST reenter the “TEMP=50” to change the sensor output. Repeat until the same reading on the PLC is obtained as entered by the TEMP command.

26) After steps 5 – 6 are complete the user should now check the “low end of the range to ensure the slope adjustment has not resulted in “significant errors of the low end.

27) To test this value we need only to set conductivity to our desired 4 mA value by sending “TEMP=0” to the JF-1A unit.

28) Again read the PLC output and verify a 0˚C reading. If this is not attained TDA0 needs to adjusted, increase the value of TDA0 if the Reading is low, decrease the value TDA0 if the reading is high**.** Remember to reenter “TEMP=0” after each adjustment of the TDAO value is made to update the sensor output.

29) Full scale can then again be checked using the entry again of the full-scale values, when complete unit is ready.

30) Store the values in the internal EEPROM using the “***E” command. The when complete will respond with a carriage return.

31) Return the unit to RUN MODE using the “***R” command.