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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:

- a) JF-1 Serial Test Cable FSI P/N JF-1A-TC
- b) Serial Data Communicating Device, set for operation at 9600 baud, 1 stop, 8 data, No parity
- c) 100 ohm or 250 ohm sensing resistor
- d) Digital Multi Meter with 0.001 VDC resolution.
- e) 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 250-ohm sense resistor.
- 2) 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.
- 3) 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 and see the “turn on banner” being received).

- 4) Place the unit in open mode using the “***O” command followed by the enter key. Verify the unit is in OPEN MODE by again pressing the ENTER key, the JF-1 will respond with the words “OPEN MODE”.
- 5) 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.
- 6) 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”.
- 7) 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.
- 8) 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 be 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 not 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.)*
- 9) 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.
- 10) 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.



- 11) 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 be adjusted, increase the value of DA0 if the voltage is low, increase the value if the voltage is high. DA0 is set using the DAO=XXX, where XXX is the new entry. Repeat Step 9 until the correct voltage (current is attained).
- 12) Full scale can then again be checked using the entry again of the full-scale values, when complete unit is ready.
- 13) Store the values in the internal EEPROM using the “***E” command. The unit when complete will respond with a carriage return.
- 14) Return the unit to RUN MODE using the “***R” command.

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

Equipment Required:

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

Procedure:

- 1) Connect the probe to the PLC.
- 2) 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.
- 3) 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 and see the turn on banner being received).



- 4) 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”.
- 5) 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.
- 6) As we are changing the 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”.
- 7) 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.
- 8) Read the PLC reading, this reading should equal 1000 pS/M. If this is not attained DAF needs to be 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.
- 9) 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.
- 10) 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.
- 11) Again read the PLC output and verify a 0 pS/M reading. If this is not attained DA0 needs to be 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.

- 12) Full scale can then again be checked using the entry again of the full-scale values, when complete unit is ready.
- 13) Store the values in the internal EEPROM using the “***E” command. The when complete will respond with a carriage return.
- 14) 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 AMBIENT OPERATING CONDITIONS FOR THE JF-1A SENSOR. THE TEMPERATURE RANGE LISTED ABOVE IS THE THORETICAL 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:

- i) JF-1 Serial Test Cable FSI P/N B440-079
- j) Serial Data Communicating Device, set for operation at 9600 baud, 1 stop, 8 data, No parity
- k) 100 ohm or 250 ohm sensing resistor
- l) Digital Multi Meter with 0.001 VDC resolution.
- m) 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 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 $\sim 20\%$ 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 not 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. TDA0 is set using the TDA0=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:

- 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) 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 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 the 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 be 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 be 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 TDA0 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.