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Description

The RU Flex 2100 Digital Level Sensor is a solid-state device that measures and reports fluid levels and temperatures in storage tanks. It is called a digital sensor because it reports the information in a serial bit stream. The sensor uses a float embedded with magnets to sense the top of a fluid level(s). There is a temperature sensor mounted inside the tube fourteen inches from the bottom. When the sensor is polled for data, a series of microprocessors read and determine the position of the float(s) along the sensor tube. The main microprocessor then calculates the level and temperature and returns the data in a serial stream or Modbus RTU format, dependent on the format of the request.

Communications

The serial communication protocol is RS485 2-wire or 4-wire, field selectable via jumpers on the fuse board. The default baud rate is set to 9600, N, 8, 1. In 4-wire mode, one pair of wires is strictly for transmitting and another pair is for receiving. For 2-wire mode, only one pair of wires is needed for both transmit and receive. Two wires are needed for the power supply, therefore 4-wire communications require a 3-pair cable while 2-wire communications require a 2-pair cable.

Wiring Connections

The sensor requires a power supply of 5.6 to 13 volts DC. To connect the sensor communication lines to the telemetry equipment, connect the sensor data receive to the RTU data transmit and the sensors data transmit to the RTU data receive for 4-wire RS485 communications. For 2-wire RS485 communications, connect TX/RX+ from the sensor to TX/RX+ on the receiving equipment and TX/RX- from the sensor to TX/RX- on the receiving equipment. The voltage supply can be connected to a switched output so power is applied only during sensor polling.

Standard Installation

To install the sensor, follow the simple steps below while referring to the assembly diagram in Figure 2 at the end of this manual.

Sensor Assembly

1. Install the 2-inch hub sensor-grip and either the 4” x 2” or 3” x 2” reducer based on the port size of the tank.
2. Remove the ground screw from the stainless steel sleeve on the sensor. With proper orientation, slide this assembly onto the top stainless steel sleeve of the sensor and hand-tighten the cord grip nut so that the assembly does not slide down.
3. Slide the two-piece shaft collar clamp over the stainless sleeve.
4. Open the GR housing. Remove the sensor pigtail and attach the round connector to the sensor flange connector, feeding the white connector through the 1” port. Attach the
GR housing to the sensor. Do not twist the pigtail wires during assembly.
5. Plug the white connector into the fuse board.
6. If not already installed, attach float(s) to the sensor tube using the float hardware provided. The float carrier is designed to match the proper orientation of the switches.
7. Verify the float(s) move freely along the length of the flexible tube.
8. It is recommended that you use the HHC-1000 or laptop running terminal software to verify the sensor configuration and that the sensor is providing a level reading.

Installation

1. Carry the flexible sensor and the bottom weight separately up to the top of the tank.
2. Attach the weight to the bottom of the sensor tube while supporting the sensor so as to not allow excess stress on the sensor.
3. Once the weight is secured, lower the sensor through the tank port, being careful to control the sensor while uncoiling it into the tank.
4. When the sensor weight reaches bottom, loosen the cord grip nut and lower the cord grip assembly to the tank port, while holding the sensor from slipping further into the tank.
5. Screw the reducer bushing into the port. Raise the sensor up to make sure there is no slack in the sensor while the weight still touches the bottom of the tank. Raise and lower the sensor a couple of times to feel the position of the weight.
6. Tighten the cord grip to secure the sensor from sliding down.
7. Rest the two-piece shaft collar clamp at the top of the cord grip and tighten the bolts using a ¼” hex wrench to prevent the sensor from slipping over time.

Caution: Make sure power is off before proceeding.

Electrical Connection

1. Feed the external cable/wires through the open port on the side of the housing.
   Unplug the gray, 6-position connector from the internal fuse board.
2. Using the white depressor tool, install the six wires (4-wire communication) or four wires (2-wire communication) as directed in the connection (hook-up) diagram in Figure 3.
3. Plug in the connector and replace the side cover.
DLS Calibration Procedure - Setting the Initial Offset

The Model 2100 Digital Level Sensor is designed to provide an accurate and dependable level measurement for oil and water levels in production tanks. The only calibration required is to set the level offset value in the DLS. This can be done in the DLS or at the EFM, RTU, or PLC by determining the difference of the level between the electronic reading and the actual fluid level in the tank, measured with an approved gauge line. Once the level offset is entered in either the DLS or SCADA system, the level offset will be added to the raw value of the DLS to provide an accurate fluid level.

The level offset is determined by reading the DLS with the HHC-1000 Hand-Held Communicator while simultaneously gauging the level in the tank. For best results, the tank should not be in active production so that the fluid is not agitated at the time of reading. If it is not possible to isolate the tank, then it is recommended to take several readings of both the DLS and gauge line to make sure the readings are consistent.

**Note:** If there is no fluid in the tank, the level offset cannot be determined.

**Note:** Due to the height of the weight, the typical offset will be 2 to 4 inches above the height of the weight. This is due to the mechanical connection between the tube and the weight, as well as how the float(s) move in the tank.

**Note:** The level offset is always added to the raw value. If a mistake is made when entering the level offset, reset the offset value to zero before proceeding to avoid large swings in readings. If there is an offset programmed in the DLS and the actual level is not correctly displayed, simply changing the offset value will not include the previous offset value.

For example, if a 9.50” offset is in the DLS and the DLS is still reading ¾” below actual level, the true offset should be 9.75”. If you add a ¼” offset, the level reading will be 9.50” below actual level. Resetting the level offset to zero will make it easier to determine the correct offset value.

**Procedure**

**Important Note:** After installing the RU Flex 2100 DLS and before setting the initial offset, allow the sensor to rest in the tank for 10-15 minutes. This will allow the sensor to relax and straighten out. Colder weather environments and longer sensors should rest the full 15 minutes.

Loosen the two-piece shaft collar clamp and cord grip and lift the sensor up and down a few times before resetting the sensor in the tank and retightening the cord grip and two-piece shaft collar clamp. You are now ready to set the initial offset.

1. Using the Hand-Held Communicator (HHC-1000), connect to the DLS and take initial readings of level and temperature. Refer to the HHC -1000 User Manual for instructions.
2. If readings are providing both water and oil levels, then verify that the two readings are more than 3” apart. If the difference is less than 3”, the two floats will be touching and a valid offset cannot be determined.
3. Verify that the water level is above the point where the bottom weight connects to the sensor tube. If the water is below the connection, then the water float is at the
bottom of the sensor and the level offset cannot be determined.

4. Using a gauge line, measure the actual level in the tank and note the level. Subtract the electronic reading from the gauged level to determine the level offset value.

**For example**, if the actual level is 156.25” and the DLS reading is 146.50”, then the offset value will be 9.75” (156.25-146.50=9.75).

5. To program the level offset in the DLS using the HHC-1000, go to the “Set Points” menu and then to the “Level” menu. Press F2 in the “Level” menu to bring up the level offset screen.

6. To set the total fluid level offset, enter a value of 1 for the top float and then enter the offset value. If the value is less than one, enter the decimal value, then press “Enter.”

7. To set the water-interface level offset, enter a value of 2 for the bottom float, then enter the offset value and press “Enter.”

8. To verify that the offset is correct, return to the main screen and read the level and temperature values to verify the DLS is reading correctly.

9. Once the level offsets are entered, there is no further calibration required unless the DLS is removed and reinstalled in another tank.

**Testing and Troubleshooting**

If the sensor fails to respond or does not report an accurate level, several things could be at fault. See the list of symptoms below for help in diagnosing the problem.

Sensor does not respond:

**Sensor is new and recently installed:**
- The sensor wiring is incorrect: Check the sensor connection (hook-up) diagram.
- Wrong baud rate: (Factory default is 9600)
- Wrong protocol: (Factory default is N81)
- There is insufficient voltage: The sensor needs at least 5.6 VDC.

**Sensor has been in service for some time but is not working:**
- There are corroded connections or damaged cables.
- Blown fuse or shorted suppressor on the barrier board (if equipped). Check the fuses with a continuity tester.
- There is possible damage to sensor electronics.
Sensor sends inaccurate level or temperature:
- An incorrect level or temperature offset is programmed into sensor, RTU, or host.
- An incorrect number of floats are programmed. Check the sensor protocol list to reprogram the sensor with the correct information.
- Sensor is HLS Option (v3.16) with float on. Not programmed for High Level.

Sensor sends temperature but not level:
- If the sensor reports error code 1, the float is not on the sensor in the correct orientation. The white mark on the float must be on top of the strip on the side of the sensor (rigid sensors only).
- An incorrect number of floats are programmed. Check the sensor protocol command list to reprogram the sensor with the correct information.
- Sensor has an HLS float installed and is not programmed for High Level.

Digital Level Sensor Protocol

Command syntax
- Uppercase characters denote literals in the command and response streams.
- Lowercase characters represent data fields in the command and response streams. Further explanation of data field structure is provided as necessary with each command.
- All commands are terminated with carriage return <cr>.
- All responses are terminated with Cccc (cccc=16 bit CRC field in hexadecimal) followed by a carriage return linefeed pair <cr><lf>. All alpha hexadecimal characters are lowercase.
- The prefix to all commands and responses is Uuu where uu is the unit number (00-31). The unit number is the identity of the level sensor to which a command is addressed or which generates the response. ‘*’ may be used as a wild card character for either digit in the unit number field ‘uu’. The responding level sensor will always convert wildcard characters to the actual unit number.
- Commands, which modify a level sensor configuration, always return the command string and ‘OK’ if successful. ‘EEerr’ replaces ‘OK’ if there is a problem storing the configuration data in the level sensor EEPROM.

Data Request Commands

Report Level and Temperature
Uuu?
UUU = a two-digit unit number from 00 to 31 (‘*’ may be used as a wildcard for either digit)

Note: Do Not use the wildcard ‘***’ if connected to more than one level sensor, as all sensors will respond simultaneously.

Response: UuuDlll.lFtttEeeeWwwww
uu = unit number
lll.l = level in inches (repeated for sensors with 2 floats)
ttt = temperature in degrees F
eee = error number
0 = No errors
1 = No float detected
2 = One float is out of range on a two-float sensor
3 = Too many groups
4 = (reserved)
5 = Transmit to slave processor for level failed
6 = Transmit to slave processor for temperature failed
7 = Receive from slave processor of level failed
8 = Receive from slave processor of temperature failed
9 = No slave processors responding

**Note:** If errors 5 through 9 occur and persist after power cycling, the sensor should be returned for repair.

www = warning number
0 = No warnings
1 = Possible level degradation
2 = Possible level degradation due to level offset

Under normal circumstances the warning field is 0. It will display 1 if the sensor is configured for two floats and only one group of switches is detected (i.e., only one float is present or both floats are abutted).

**Note:** The number of decimal places in a data field implies nothing about the accuracy of the data, i.e., levels are not accurate to 0.01 inches.

*Report Level and Temperature Continuously (Factory Diagnostics)*
**Uuu??**
Response: **Same as above**, except continuously, with internal module configuration and reported individual switch activation and groups of activated switches.

**Note:** The unit must be powered down before it will respond to other commands.

*Report 4-20mA Output Level (Version 3.09 and Higher)*
**Uuu?M**
Response: **UuuMhhhhEeeeeeWwwww**
uu = unit number
hhhh = hex value 0x0000-0xFFFF eeee = error number
0 = No errors
1 = No float detected
2 = One float is out of range on a two-float sensor
3 = Too many groups
4 = (reserved)
5 = Transmit to slave processor for level failed
6 = Transmit to slave processor for temperature failed
7 = Receive from slave processor of level failed
8 = Receive from slave processor of temperature failed
9 = No slave processors responding
**Note:** If errors 5 through 9 occur and persist after power cycling, the sensor should be returned for repair.

www = warning number
   0 = No warnings
   1 = Possible level degradation
   2 = Possible level degradation due to level offset

**Report Temperature Only**

Uuu?T
Response: UuuFxxEEeeewwww
xx= temperature

**Configuration Commands**

**Assign Unit Number**

UuuNnn
uu = unit number (from 00 to 31)
nn = new unit number

**Note:** Unit number 00 is not valid in Modbus RTU mode

Response: UuuNOK
uu = newly assigned unit number

**Assign Unit Number to Sensor With the Corresponding Serial Number** *(Version 3.15 and Higher)*

UssssssssNnn
ssssss = seven-digit serial number
nn = two-digit unit number
Response: UuuNOK
uu = new unit number
UuuEEerr  Write to EEPROM failed

**Set Baud Rate**

UuuBbbbbb[b][pds]

b bbbb[b] = 1200, 9600, 14400, 19200, or 38400, (9600 is default); 57600 (v3.15 and higher)
pds = parity, data length, stop bit (pds options)
   N81 (default) E71
   O71
For example, to program Unit 00 to 9600 E 7 1 would be U00B9600E71

**Note:** It is not necessary to power down the Model 2100 before this command takes effect. The Model 1000 must have power cycled for this command to take effect.

Response: UnnBOK
**Set Number of Floats**

UuuFn

uu = unit number

n = float number (1 or 2 – Standard; 11 or 12 – 1/8” Resolution; 11 – Single Float; 12 – Dual Float)

Response: UuuFOK

**Set Level Offset**

UuuLOslll Sets the offset for the level sensor

uu = unit number

slll = sign and offset with two implied decimal places

**Note:** If two floats, assign the same offset to both

Response: UuuOLOOK

**Set Level Offsets for Individual Floats**

UuuL[1|T]Oslll.ll Sets the top float offset.

Example of setting top level offset for Unit 00 to 2.25 inches - U00L1O2.25

UuuL[2|B]Oslll.ll Sets the bottom float offset. *(Dual Float Sensor only)*

Example of setting bottom level offset for water interface to 1.75 inches - U00L2O1.75

uu = unit number

slll.ll = sign and offset with two implied decimal places. The Plus (+) sign is assumed. The Minus (-) must precede the offset value if required. If no decimal places are required, then you do not need to add to value.

**Note:** "O" in the command is the letter O and not the number zero

Response: UuuLOOK

**Set Temperature Offset**

UuuOFssoo

uu = unit number

ssoo = -99 to 99 (optional sign)

Response: UuuOFOK

**Set Multiple Temperature Sensor Offsets**

UuuTnOsso,o

uu = unit number

n = temperature sensor identifier (1-8, 1 is at top) so.o = -9.9 to 9.9 degrees (optional sign)

Response: UuuTnOOK

**Set Receive to Transmit Delay**

UuuRmmm

uu = unit number

mmm = milliseconds (50 to 250). The default is 127ms.

Response: UuuROK
Set 4-20mA Poll Period
UuuMPPppp
uu = unit number
pppp = seconds (Default is 30 seconds)
Response: UuuMPOK

Note: Poll Periods less than 20 seconds may shorten the life expectancy of the 4/20mA converter board. The relay (which power cycles the sensor to reduce power consumption) is rated for 10,000,000 cycles.

Set 4-20mA Minimum (4mA) Range
UuuMINmm.mm
uu = unit number
mm.mm = level for 4mA output (Default is 00.00)
Response: UuuMINOK

Set 4-20mA Maximum (20mA) Range
UuuMAXmmm.mm
uu = unit number
mmm.mm = level for 20mA output in inches (Default is 240.00") Example: For 20-foot long sensors = 240.00
Response: UuuMAXOK

Set the Level Error Setting (Version 3.09 and Higher)
UuuSETERRx
uu = unit number
x = 0 will set the level error report to be 999.99. This is the default setting.
x = 1 will set the level error report to be 000.00.
Response: UuuSETERROK

Set the Modbus 16 Bit Unsigned Integer, 32 Bit or 2 X 16 Bit Floating Point Mode
UuuIFxxxx
uu = unit number
xxxx = 1007 will set the 16 bit Unsigned integer mode. This is the default setting.
xxxx = 1008 will set the 32 bit floating point mode.
xxxx = 1009 will set the 2x16 bit floating point mode (v3.14 and higher).
Response: UuuIFOK

Force Sensor to Enter Boot Load Mode (Version 3.15 and Higher, (Future Use)
UuuFB
uu = two-digit unit number
Response: none

Enter High Level Electronic Shut Down (ESD Mode) (Version 3.15 and Higher)
UuuESDONn
uu = unit number
n = one-digit number from 1-3 which represents the number of level request commands that will respond with the maximum level without cycling power. After this
number, the sensor reverts to normal operation

**Note:** If power is cycled, then the count reverts back to the programmed number of polls.

Response: **UuuESDONOK**  ESD mode was successfully activated

---

**Exit High Level Electronic Shut Down (ESD Mode) (Version 3.15 and Higher)**

**UuuESDOFF**

Response: **UuuESDOFFOK**  ESD mode exit successfully

**Note:** UuuESDON0 also turns off ESD mode

---

**Configuration Request Commands**

**Report Number of Floats**

**UuuF?**

Response: **UuuFn**

uu = unit number
n = number of floats (1 or 2 – Standard; 11 or 12 – 1/8” Resolution; 11 – Single Float; 12 – Dual Float).

**Report Level Offsets**

**UuuLO?**

Response: **UuuL1Osn.nnL2Osnn.nn**

uu = unit number
snn.nn = sign and offset with two implied decimal places

**Report Temperature Offset**

**UuuOF?**

Response: **UuuOFsff**

uu = unit number  s = sign
ff = temperature offset (degrees F)

**Report Multiple Temperature Offsets**

**UuuTO?**

Response: **UuuTnOs0.0**

TnOs.n repeated for additional temperature sensors
uu = unit number
n = temperature sensor (1-8, 1 is top sensor)
s = sign
0.0 = temperature offset

---

**Report Switch Distance**

**UuuD?**

Response: **UuuDd**

uu = unit number
d = distance between switches as integral tenths of an inch (e.g., 5 = 0.5 inches, 10 = 1 inches)
UuuR?
Response: UuuRmmm
uu = unit number
mmm = delay

Report Total Switches
UuuS?
Response: UuuSssss
uu = unit number
ssss = total number of switches in the sensor

Report Receive to Transmit delay
UuuR?
Response: UuuRmmm
uu = unit number
mmm = delay in milliseconds

Report 4-20mA Configuration
UuuMC?
Response: UuuPppppL1_4MAll.ll_20MAhhh.hh
uu = unit number
Ppppp = Polling period in seconds
L1 = Data source is top float
_4MAll.ll = Level to output 4 mA
_20MAhhh.hh = Level to output 20 mA

Report Serial Number
UuuSN?
Response: UuuSNxxxxxxx
uu = unit number
xxxxxxx = serial number.

Report Unit Number Corresponding to Serial Number (Version 3.15 and Higher)
UsssssssN?
sssssss = seven-digit serial number
Response: UsssssssNuu
uu = unit number

Report sensor Health Status (version 3.15 and higher)
UuuH?
uu = two-digit unit number
Response:
grp0=ttt-bbb--grp1=ttt-bbb
grp3=ttt-bbb--grp4=ttt-bbb
UuuDIII.II[DIII.II]Fttt[Fttt......]EeeeeWwwww
BATTERY-VOLTAGE:vv.vV
If sensor works in normal operation parameters the message will be
UuuSENSOR-OK

Error, one or more of the following error messages
NO-SWITCH-CLOSED
ONLY-ONE-GROUP-FOUND-ON-A-TWO-FLOAT-SYSTEM
TOO-MANY-GROUPS-TO-RESOLVE-THE-LEVEL
NO-FLOAT-CONFIGURED
TRANSMIT-TO-PIC-PROCESSOR-FOR-LEVEL-FAILED
RECEIVE-FROM-PIC-PROCESSOR-FOR-LEVEL-FAILED
TRANSMIT-TO-PIC-PROCESSOR-FOR-TEMP-FAILED
RECEIVE-FROM-PIC-PROCESSOR-FOR-TEMP-FAILED

Warning, one or all of the following warning messages:
WARNING!-POSSIBLE-LEVEL-DEGRADATION
WARNING!-POSSIBLE-LEVEL-DEGRADATION-DUE-TO-OFFSET

Report the Level Error Setting (Version 3.09 and Higher)
UuuSETERR?
Response: UuuSETERR=x
uu = unit number
x = 0 is set for level error report to be 999.99 (default)
x = 1 is set for level error report to be 000.00

Report the Modbus 16 bit Unsigned Integer, 32 bit or 2 x 16 bit Floating Point Mode
UuulF?
Response: UuulF=x
uu = unit number
x = 0 is set for 16 bit Unsigned integer mode. This is the default setting.
x = 1 is set for 32 bit floating point mode.
x = 2 is set for 2x16 bit floating point mode (v3.14 and higher)

Report Battery Voltage
UuuBV?
Response: UuuBVvv.vV
uu = unit number
vv.v = battery voltage in volts
Modbus Registry Map

Read/Write functions are given in Table 1. The read only functions in the holding registry are referenced in Table 2 and Table 3. The sensor warnings codes are provided in Table 4. The error codes are given in Table 5.

Table 1. Read/Write Registers

<table>
<thead>
<tr>
<th>Configuration Registers</th>
<th>Register Read/Write</th>
<th>Address</th>
<th>No. Reg.</th>
<th>Notes</th>
<th>Integer Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD ON: 0 = ESD off</td>
<td>40106</td>
<td>105</td>
<td>1</td>
<td>R/W</td>
<td>16 bit Unsigned (v3.15 and higher)</td>
</tr>
<tr>
<td>1 to 3 = ESD ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assign Sensor unit number</td>
<td>40107</td>
<td>106</td>
<td>1</td>
<td>Default value is 1</td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>Select 16 bit unsigned integer (0) or 32 bit floating point (1) for registers that hold top float, bottom float, and temperature or 2x 16 bit floating point (2)</td>
<td>40108</td>
<td>107</td>
<td>1</td>
<td>Factory setting: 16 bit unassigned integer (see Note for advanced users)</td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>Set baud rate (1200, 9600, 14400, 19200, 38400) (57600 v3.15 and higher)</td>
<td>40109</td>
<td>108</td>
<td>1</td>
<td>Factory setting: 9600</td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>Set parity: 78 (N) = No parity</td>
<td>40110</td>
<td>109</td>
<td>1</td>
<td>Factory setting: 78</td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>79 (O) = Odd parity 69 (E) = Even parity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set data bit: 8</td>
<td>40111</td>
<td>110</td>
<td>1</td>
<td>Factory setting: 8</td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>Set stop bit: 1</td>
<td>40112</td>
<td>111</td>
<td>1</td>
<td>Factory setting: 1</td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>Rx to Tx delay [ms]: 50 to 250</td>
<td>40113</td>
<td>112</td>
<td>1</td>
<td>Factory setting: 127</td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>Set number of floats: 1, 2, 11, or 12.</td>
<td>40114</td>
<td>113</td>
<td>1</td>
<td>Factory setting: 1</td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>Level error report: 0 or 1</td>
<td>40115</td>
<td>114</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>K factor x 100: 10 to 1000 bbls/in</td>
<td>40116</td>
<td>115</td>
<td>1</td>
<td>Factory setting: 167</td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>Top level offset x 100: -9999 to 9999</td>
<td>40117</td>
<td>116</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Signed</td>
</tr>
<tr>
<td>Bottom level offset x 100: -9999 to 9999</td>
<td>40118</td>
<td>117</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Signed</td>
</tr>
<tr>
<td>Temperature offset1 x 10: -99 to 99</td>
<td>40119</td>
<td>118</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Signed</td>
</tr>
<tr>
<td>Temperature offset2 x 10: -99 to 99</td>
<td>40120</td>
<td>119</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Signed</td>
</tr>
<tr>
<td>Temperature offset2 x 10: -99 to 99</td>
<td>40121</td>
<td>120</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Signed</td>
</tr>
<tr>
<td>Temperature offset4 x 10: -99 to 99</td>
<td>40122</td>
<td>121</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Signed</td>
</tr>
<tr>
<td>Temperature offset5 x 10: -99 to 99</td>
<td>40123</td>
<td>122</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Signed</td>
</tr>
<tr>
<td>Temperature offset6 x 10: -99 to 99</td>
<td>40124</td>
<td>123</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Signed</td>
</tr>
<tr>
<td>Temperature offset7 x 10: -99 to 99</td>
<td>40125</td>
<td>124</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Signed</td>
</tr>
<tr>
<td>Temperature offset8 x 10: -99 to 99</td>
<td>40126</td>
<td>125</td>
<td>1</td>
<td>Factory setting: 0</td>
<td>16 bit Signed</td>
</tr>
</tbody>
</table>

**Sensor Description Registers**

<p>| Serial number high | 40127 | 126 | 1 | Read only | 16 bit Unsigned |
| Serial number medium high | 40128 | 127 | 1 | Read only | 16 bit Unsigned |
| Serial number medium low | 40129 | 128 | 1 | Read only | 16 bit Unsigned |
| Serial number low | 40130 | 129 | 1 | Read only | 16 bit Unsigned |
| Version number | 40131 | 130 | 1 | Read only | 16 bit Unsigned |
| Number of modules: 1 to 8 | 40132 | 131 | 1 | Read only | 16 bit Unsigned |
| Number of switches | 40133 | 132 | 1 | Read only | 16 bit Unsigned |
| Switch distance x 10: 5 or 10 | 40134 | 133 | 1 | Read only | 16 bit Unsigned |
| Number of temperature sensors: 1 to 8 | 40135 | 134 | 1 | Read only | 16 bit Unsigned |
| Sensor status: 0 or 1, 0 = Good 1 = Sensor errors or low battery | 40136 | 135 | 1 | Read only | 16 bit Unsigned (v3.15 and higher) |
| Group 0 top | 40137 | 136 | 1 | Read only | 16 bit Unsigned (v3.15 and higher) |</p>
<table>
<thead>
<tr>
<th>Group</th>
<th>Value</th>
<th>Reserved</th>
<th>Description</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 0 bottom</td>
<td>40138</td>
<td>137</td>
<td>Read only</td>
<td>16 bit Unsigned (v3.15 and higher)</td>
</tr>
<tr>
<td>Group 1 top</td>
<td>40139</td>
<td>138</td>
<td>Read only</td>
<td>16 bit Unsigned (v3.15 and higher)</td>
</tr>
<tr>
<td>Group 1 bottom</td>
<td>40140</td>
<td>139</td>
<td>Read only</td>
<td>16 bit Unsigned (v3.15 and higher)</td>
</tr>
<tr>
<td>Group 2 top</td>
<td>40141</td>
<td>140</td>
<td>Read only</td>
<td>16 bit Unsigned (v3.15 and higher)</td>
</tr>
<tr>
<td>Group 2 bottom</td>
<td>40142</td>
<td>141</td>
<td>Read only</td>
<td>16 bit Unsigned (v3.15 and higher)</td>
</tr>
<tr>
<td>Group 3 top</td>
<td>40143</td>
<td>142</td>
<td>Read only</td>
<td>16 bit Unsigned (v3.15 and higher)</td>
</tr>
<tr>
<td>Group 3 bottom</td>
<td>40144</td>
<td>143</td>
<td>Read only</td>
<td>16 bit Unsigned (v3.15 and higher)</td>
</tr>
</tbody>
</table>
Table 2. Holding Registers

<table>
<thead>
<tr>
<th>Sensor Data</th>
<th>Register</th>
<th>Address</th>
<th>No. Reg.</th>
<th>Values</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Float 1 (Top Float)</td>
<td>43991</td>
<td>3990</td>
<td>1</td>
<td>Read Only</td>
<td>Total Fluid Level in Tank</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned integer or 32 bit floating point</td>
</tr>
<tr>
<td>Float 2 (Bottom Float)</td>
<td>43992</td>
<td>3991</td>
<td>1</td>
<td>Read Only</td>
<td>Water Interface Level in Tank</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned integer or 32 bit floating point</td>
</tr>
<tr>
<td>Oil Level in Tank (top to bottom)</td>
<td>43993</td>
<td>3992</td>
<td>1</td>
<td>Read Only</td>
<td>Oil Level in Tank (top-bottom)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned integer or 32 bit floating point</td>
</tr>
<tr>
<td>Total Volume (top level x K_factor)</td>
<td>43994</td>
<td>3993</td>
<td>1</td>
<td>Read Only</td>
<td>Total Volume (top level x K factor)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned integer or 32 bit floating point</td>
</tr>
<tr>
<td>Oil Volume (top level – bottom level) x K_factor</td>
<td>43995</td>
<td>3994</td>
<td>1</td>
<td>Read Only</td>
<td>Oil Volume</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned integer or 32 bit floating point</td>
</tr>
<tr>
<td>Water Volume (bottom level x K_factor)</td>
<td>43996</td>
<td>3995</td>
<td>1</td>
<td>Read Only</td>
<td>Water Volume</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned integer or 32 bit floating point</td>
</tr>
<tr>
<td>Temperature1</td>
<td>43997</td>
<td>3996</td>
<td>1</td>
<td>Read Only</td>
<td>Temperature1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned integer or 32 bit floating point</td>
</tr>
<tr>
<td>Temperature2</td>
<td>43998</td>
<td>3997</td>
<td>1</td>
<td>Read Only</td>
<td>Temperature2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned integer or 32 bit floating point</td>
</tr>
<tr>
<td>Temperature3</td>
<td>43999</td>
<td>3998</td>
<td>1</td>
<td>Read Only</td>
<td>Temperature3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned integer or 32 bit floating point</td>
</tr>
<tr>
<td>Temperature4</td>
<td>44000</td>
<td>3999</td>
<td>1</td>
<td>Read Only</td>
<td>Temperature4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned integer or 32 bit floating point</td>
</tr>
<tr>
<td>Temperature5</td>
<td>44001</td>
<td>4000</td>
<td>1</td>
<td>Read Only</td>
<td>Temperature5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16 bit Unsigned</td>
</tr>
<tr>
<td>Sensor Data</td>
<td>Register</td>
<td>Address</td>
<td>No. Reg.</td>
<td>Values</td>
<td>Type</td>
</tr>
<tr>
<td>------------------------------</td>
<td>----------</td>
<td>---------</td>
<td>----------</td>
<td>----------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Float 1 (Top Float)</td>
<td>45001</td>
<td>5000</td>
<td>2</td>
<td>Read Only</td>
<td>Total Fluid Level in Tank Floating point upper two bytes (v3.14 and higher)</td>
</tr>
<tr>
<td></td>
<td>45002</td>
<td>5001</td>
<td></td>
<td>Read Only</td>
<td>Total Fluid Level in Tank Floating point lower two bytes (v3.14 and higher)</td>
</tr>
<tr>
<td>Float 2 (Bottom Float)</td>
<td>45003</td>
<td>5002</td>
<td>2</td>
<td>Read Only</td>
<td>Water Interface Level in Tank Floating point upper two bytes (v3.14 and higher)</td>
</tr>
<tr>
<td></td>
<td>45004</td>
<td>5003</td>
<td></td>
<td>Read Only</td>
<td>Water Interface Level in Tank Floating point lower two bytes (v3.14 and higher)</td>
</tr>
<tr>
<td>Oil Level in Tank (top to bottom)</td>
<td>45005</td>
<td>5004</td>
<td>2</td>
<td>Read Only</td>
<td>Oil Level in Tank(top-bottom) Floating point upper two bytes (v3.14 and higher)</td>
</tr>
<tr>
<td></td>
<td>45006</td>
<td>5005</td>
<td></td>
<td>Read Only</td>
<td>Oil Level in Tank(top-bottom) Floating point lower two bytes (v3.14 and higher)</td>
</tr>
<tr>
<td>Total Volume (top level x K)</td>
<td>45007</td>
<td>5006</td>
<td>2</td>
<td>Read Only</td>
<td>Total Volume(top level x K factor) Floating point upper two bytes</td>
</tr>
<tr>
<td>Factor</td>
<td>Register</td>
<td>Offset</td>
<td>Function</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
<td>--------</td>
<td>----------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>Total Volume (top level x K factor)</td>
<td>45008</td>
<td>5007</td>
<td>Read Only</td>
<td>Total Volume(top level x K factor) Floating point lower two bytes (v3.14 and higher)</td>
<td></td>
</tr>
<tr>
<td>Oil Volume (top level – bottom level) x K factor</td>
<td>45009</td>
<td>5008</td>
<td>Read Only</td>
<td>Oil Volume (v3.14 and higher) Floating point upper two bytes</td>
<td></td>
</tr>
<tr>
<td>Water Volume (bottom level x K factor)</td>
<td>45010</td>
<td>5009</td>
<td>Read Only</td>
<td>Oil Volume (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature1</td>
<td>45013</td>
<td>5012</td>
<td>Read Only</td>
<td>Temperature1 (v3.14 and higher) Floating point upper two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature2</td>
<td>45015</td>
<td>5014</td>
<td>Read Only</td>
<td>Temperature2 (v3.14 and higher) Floating point upper two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature3</td>
<td>45017</td>
<td>5016</td>
<td>Read Only</td>
<td>Temperature3 (v3.14 and higher) Floating point upper two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature4</td>
<td>45019</td>
<td>5018</td>
<td>Read Only</td>
<td>Temperature4 (v3.14 and higher) Floating point upper two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature5</td>
<td>45021</td>
<td>5020</td>
<td>Read Only</td>
<td>Temperature5 (v3.14 and higher) Floating point upper two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature6</td>
<td>45023</td>
<td>5022</td>
<td>Read Only</td>
<td>Temperature6 (v3.14 and higher) Floating point upper two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature7</td>
<td>45025</td>
<td>5024</td>
<td>Read Only</td>
<td>Temperature7 (v3.14 and higher) Floating point upper two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature8</td>
<td>45027</td>
<td>5026</td>
<td>Read Only</td>
<td>Temperature8 (v3.14 and higher) Floating point upper two bytes</td>
<td></td>
</tr>
<tr>
<td>Water Volume (bottom level x K factor)</td>
<td>45011</td>
<td>5010</td>
<td>Read Only</td>
<td>Water Volume (bottom level x K factor) Floating point upper two bytes (v3.14 and higher)</td>
<td></td>
</tr>
<tr>
<td>Water Volume (bottom level x K factor)</td>
<td>45012</td>
<td>5011</td>
<td>Read Only</td>
<td>Water Volume (bottom level x K factor) Floating point lower two bytes (v3.14 and higher)</td>
<td></td>
</tr>
<tr>
<td>Temperature1</td>
<td>45014</td>
<td>5013</td>
<td>Read Only</td>
<td>Temperature1 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature2</td>
<td>45016</td>
<td>5015</td>
<td>Read Only</td>
<td>Temperature2 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature3</td>
<td>45018</td>
<td>5017</td>
<td>Read Only</td>
<td>Temperature3 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature4</td>
<td>45019</td>
<td>5018</td>
<td>Read Only</td>
<td>Temperature4 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature5</td>
<td>45020</td>
<td>5019</td>
<td>Read Only</td>
<td>Temperature5 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature6</td>
<td>45021</td>
<td>5020</td>
<td>Read Only</td>
<td>Temperature6 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature7</td>
<td>45023</td>
<td>5022</td>
<td>Read Only</td>
<td>Temperature7 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature8</td>
<td>45024</td>
<td>5023</td>
<td>Read Only</td>
<td>Temperature8 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature9</td>
<td>45025</td>
<td>5024</td>
<td>Read Only</td>
<td>Temperature9 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature10</td>
<td>45026</td>
<td>5025</td>
<td>Read Only</td>
<td>Temperature10 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature11</td>
<td>45027</td>
<td>5026</td>
<td>Read Only</td>
<td>Temperature11 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
<tr>
<td>Temperature12</td>
<td>45028</td>
<td>5027</td>
<td>Read Only</td>
<td>Temperature12 (v3.14 and higher) Floating point lower two bytes</td>
<td></td>
</tr>
</tbody>
</table>
Table 4. Warning Codes

<table>
<thead>
<tr>
<th>Binary Value (for 16 bit Unsigned)</th>
<th>Warning Code</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No warnings</td>
<td></td>
</tr>
<tr>
<td>Bit 0</td>
<td>1</td>
<td>Possible level degradation</td>
</tr>
<tr>
<td>Bit 1</td>
<td>2</td>
<td>Possible level degradation due to level offset</td>
</tr>
<tr>
<td>Bit 4</td>
<td>3</td>
<td>High Level float missing (v3.16 and higher)</td>
</tr>
</tbody>
</table>

Table 5. Error Codes

<table>
<thead>
<tr>
<th>Binary Value (for 16 bit Unsigned)</th>
<th>Error Code</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No errors</td>
<td></td>
</tr>
<tr>
<td>Bit 0</td>
<td>1</td>
<td>Can’t resolve level reading or no float is detected</td>
</tr>
<tr>
<td>Bit 1</td>
<td>2</td>
<td>One float is out of range on a two float sensor</td>
</tr>
<tr>
<td>Bit 2</td>
<td>4</td>
<td>Too many groups</td>
</tr>
<tr>
<td>Bit 3</td>
<td>8</td>
<td>Not used</td>
</tr>
<tr>
<td>Bit 4</td>
<td>16</td>
<td>Transmit to slave processor for level failed</td>
</tr>
<tr>
<td>Bit 5</td>
<td>32</td>
<td>Transmit to slave processor for temperature failed</td>
</tr>
<tr>
<td>Bit 6</td>
<td>64</td>
<td>Receive from slave processor for level failed</td>
</tr>
<tr>
<td>Bit 7</td>
<td>128</td>
<td>Receive from slave processor for temperature failed</td>
</tr>
<tr>
<td>Bit 8</td>
<td>256</td>
<td>No slave processor responding</td>
</tr>
</tbody>
</table>

**Notes for advanced users:** Writing 1007 at register address 107 will set register 107 to “0”, and will set the device registers that hold top float, bottom float, and temperature to 16 bit Unsigned integer. Writing 1008 at register address 107 will set register 107 to “1”, and will set the device hold registers 43991(3990) to 44007(4006) to 32 bit floating point format. Writing 1009 at register address 107 will set register 107 to “2”, and will set the device hold registers 45001(5000) to 45034(5033) to 2 x 16 bit floating point format. Reading register 107 will return “0” for 16 bit, “1” for 32 bit floating point, and “2” for 2 x 16 bit floating point format.
RU Flex 2100 DLS Specifications

**Measurement Length:**
Available from 2 to 48 feet in length

**Tubing Material:**
UHMW-PE

**Float:** Nitrophyl/stainless steel
One float used for single liquid level measurement; two floats used for 2 liquids
Two-piece floats for field installation and replacement
Designed to fit through a 3-inch NFPT tank port

**Level Measurement Increments and Accuracy:**
1/8-in. resolution; +/- 3/16-in. accuracy
1/4-in. resolution; +/- 1/8-in. accuracy
1/2-in. resolution; +/- 1/4-in. accuracy
+/- 0.1% repeatability

**Coiled Diameter:**
Approximately 36-inch diameter (will vary slightly with the length of the sensor)

**Operating Temperature Range:**
-40° C to +85° C

**Temperature Measurement:**
First sensor 14” from bottom
Up to 8 temperature sensors available with desired spacing: optional
+/- 1.5° C accuracy

**Power Requirements:**
5.6 VDC to 13 VDC

**Power Consumption:**
15mA nominal
20mA maximum

**Pressure:**
40 psi: standard

**Communication:**
RS485
Two- or four-wire communications
Baud rate and parity programmable (up to 57600 baud on v.3.15 and higher)
4-20mA signal available when connected to digital-to-analog converter board
Wireless capable

**Protocol:**
Modbus RTU 16 bit unsigned integer*
**Anchor Weight:**
3 in. diameter; required weight can vary based on sensor length

**Wiring:**
18 AWG recommended for digital circuits

**Classification:**
Class I, Div .1, Group D Hazardous Locations (when connected to an approved intrinsically safe barrier)

**Certification:**
ANSI/UL-913, 7th Edition
CAN/CSA C22.2, No. 157

Modbus RTU 32 bit floating point*
Modbus RTU (2x 16 bit) for alternate 32 bit floating point**
Serial data via ASCII

*Note Modbus RTU available in version 3.13 and higher.
**Available in version 3.14 and higher.
RU Flex 2100 DLS Illustrations

Figure 1: RU Flex 2100 DLS coiled (on left) and straightened (on right).
3.) Feed this connector into the aluminum top housing.

1.) Screw this connector into the end of the Sensor Connectors for field wiring.

2.) Place pipe dope on the threads and screw the top housing down on the to the Sensor.

PT-1000

1/4-20 Socket Head 316SS

2100 FUSE BOARD

JUMPER FOR 2-WIRE

4.) Connect the 6-pin connector here after the top is secured.

Figure 2. RU Flex 2100 Sensor Assembly Diagram
INSTALLATION NOTES AND STANDARD REFERENCES

1. Complete installation to be in accordance with all provisions of FEDERAL AND STATE LAWS AND RULES,cock and regulations.

2. Wiring methods used for system grounding conductors shall comply with all provisions of section 250 of the National Electrical Code. Resistant should be 5 ohms or less.

3. Intrinsically safe systems must comply with section 250.56 of the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

4. Section 250.96 of the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

5. Wiring and cable selection must be in accordance with the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

6. Maintain working space in pull boxes, junction cabinets and enclosures per section 250.122 of the National Electrical Code.

7. Installation should only be made in accordance with the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

8. General requirements for grounding systems employing one or more electrodes should comply with section 250.56 of the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

9. Certified grounding systems employing one or more electrodes should comply with section 250.56 of the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

10. Certified grounding systems employing one or more electrodes should comply with section 250.56 of the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

11. Certified grounding systems employing one or more electrodes should comply with section 250.56 of the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

12. Certified grounding systems employing one or more electrodes should comply with section 250.56 of the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

13. Certified grounding systems employing one or more electrodes should comply with section 250.56 of the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

14. Certified grounding systems employing one or more electrodes should comply with section 250.56 of the National Electrical Code. In any case, the maximum of 25 ohms resistance should be less or more.

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Figure 4a. Control Drawing 2191-001
**NON-HAZARDOUS (UNCLASSIFIED) LOCATION**

**CLASS I, DIVISION 1, GROUP D HAZARDOUS LOCATION**

**MODEL**
2100 LEVEL SENSOR

**TEMPERATURE RATING**
T4

**TEMPERATURE RANGE**
-40 TO +80°C

**OPERATING VOLTAGE**
5.6 TO 13 VDC

**VMAX**
13 VDC

**IMAX**
300mA

**CMAX**
0.0024 F

**LMAX**
0.04 H

Associated apparatus output current must be limited by a resistor such that the output voltage-current plot is a straight line drawn between open-circuit voltage and short-circuit current.

Associated apparatus may be in a Division 2 or Zone 2 location if so approved.

Selected associated apparatus must be third party listed as providing intrinsically safe circuits for the application, and have Voc or Vt not exceeding Voc or Vt of the intrinsic safe equipment, and the Po of the associated apparatus must be less than or equal to the Pmax of the intrinsically safe equipment, as shown in Table 1.

Capacitance and inductance of the field wiring from intrinsically safe equipment to the associated apparatus shall be calculated and must be included in the system calculations as shown in Table 1. Capacitance, Ccable, plus intrinsically safe equipment capacitance, Ci must be less than the marked capacitance, Ca shown on any associated apparatus used. The same applies for inductance (Lcable, Li and La respectively), where the cable capacitance and inductance per foot are not known the following values shall be used: Ccable = 60pF/ft., Lcable = 0.2µH/ft.

Associated apparatus must be third party listed as providing intrinsically safe circuits for the application, and have Voc or Vt not exceeding Voc or Vt of the intrinsic safe equipment, and the Po of the associated apparatus must be less than or equal to the Pmax of the intrinsically safe equipment, as shown in Table 1.

If Po of the associated apparatus is not known, it may be calculated using the formula Po = (Voc*Is) / 4

Associated apparatus must be installed in accordance with its manufacturer's control drawing and Article 504 of the National Electrical Code (ANSI/NFPA 70) for installation in the United States, or Section 18 of the Canadian Electrical Code for installation in Canada.

When required by the manufacturer's control drawing, the associated apparatus must be connected to a suitable ground electrode per the National Electrical Code (ANSI/NFPA 70) or the Canadian Electrical Code, or other local installation codes, as applicable. The resistance of the ground path must be less than 1 ohm.

Associated apparatus must not be used in combination unless permitted by the associated apparatus certification.

Control equipment must not use or generate more than 25V rms or dc with respect to earth.

CAP ALL UNUSED PORT FITTINGS ON THE EXPLOSION PROOF HOUSING.

CONNECT GROUND STRAP FROM HERE TO EARTH GROUND

**TABLE 1:**

<table>
<thead>
<tr>
<th>U.E. Equipment (Voc or Vt)</th>
<th>Associated Apparatus (Voc or Vt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is or Ii</td>
<td>Po</td>
</tr>
<tr>
<td>Ci + Cable = Ca</td>
<td>Li + La</td>
</tr>
</tbody>
</table>

Associated apparatus output current must be limited by a resistor such that the output voltage-current plot is a straight line drawn between open-circuit voltage and short-circuit current.

Associated apparatus may be in a Division 2 or Zone 2 location if so approved.

Selected associated apparatus must be third party listed as providing intrinsically safe circuits for the application, and have Voc or Vt not exceeding Voc or Vt of the intrinsic safe equipment, and the Po of the associated apparatus must be less than or equal to the Pmax of the intrinsically safe equipment, as shown in Table 1.

Capacitance and inductance of the field wiring from intrinsically safe equipment to the associated apparatus shall be calculated and must be included in the system calculations as shown in Table 1. Capacitance, Ccable, plus intrinsically safe equipment capacitance, Ci must be less than the marked capacitance, Ca shown on any associated apparatus used. The same applies for inductance (Lcable, Li and La respectively), where the cable capacitance and inductance per foot are not known the following values shall be used: Ccable = 60pF/ft., Lcable = 0.2µH/ft.

Associated apparatus must be third party listed as providing intrinsically safe circuits for the application, and have Voc or Vt not exceeding Voc or Vt of the intrinsic safe equipment, and the Po of the associated apparatus must be less than or equal to the Pmax of the intrinsically safe equipment, as shown in Table 1.

If Po of the associated apparatus is not known, it may be calculated using the formula Po = (Voc*Is) / 4

Associated apparatus must be installed in accordance with its manufacturer's control drawing and Article 504 of the National Electrical Code (ANSI/NFPA 70) for installation in the United States, or Section 18 of the Canadian Electrical Code for installation in Canada.

When required by the manufacturer's control drawing, the associated apparatus must be connected to a suitable ground electrode per the National Electrical Code (ANSI/NFPA 70) or the Canadian Electrical Code, or other local installation codes, as applicable. The resistance of the ground path must be less than 1 ohm.

Associated apparatus must not be used in combination unless permitted by the associated apparatus certification.

Control equipment must not use or generate more than 25V rms or dc with respect to earth.

CAP ALL UNUSED PORT FITTINGS ON THE EXPLOSION PROOF HOUSING.

**Figure 4b. Control Drawing 2191-002**
Part Numbering System

The sample below is the part number for a 20 ft. sensor with ¼ inch resolution, one temperature sensor, and a single float going into a tank with a 4-inch port and being wired up as two-wire RS485.

![Part Numbering System Diagram]

**Figure 4. RU Flex 2100 DLS Part Numbering System**

In addition to the information provided within the part number, other information is necessary when ordering:

1. **Total Tube Length**: Default is Measurement Length plus 18 inches.
   Note: If installing in a dome-top tank, like a fiberglass tank, you will need to order a sensor that is 1’ longer than the tank height to accommodate the extra height the dome adds.

2. **Baud Rate and Parity desired**: Default is 9600, N, 8, 1. If other baud rate and parity are required, please specify.

3. **Unit Numbers Required**: If ordering more than one sensor for a location you may have the level sensors pre-addressed with the required unit numbers prior to shipment for the tanks on that location. Example: If there are 3 tanks on one location, then specify that the level sensors be addressed U01, U02, and U03. Alternate numbering sequences may be chosen. If no unit numbers are specified, then default will be Unit 01.
Contact Information

For further information or for assistance, please contact:
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