Model 1000 Terminal Unit

Manufactured by Electrolab, Inc.

Description:

The Model 1000 Terminal Unit (Digital to Analog Converter) is a solid state stand-alone device which polls the Model 1000 Digital level sensor and outputs a 4-20 mA analog signal for use by other field data collection equipment. The intent is to enable the superior accuracy of the Model 1000 level sensor to be used in a system which has only analog inputs. The Converter can poll up to 32 (v1.04 and earlier), 16 (v1.06 and later) Model 1000 Digital Level Sensors and output up to 8 analog signals based upon data received from these sensors. Not all analog channels need to be used. The analog signal can output the data from the level or temperature from a particular sensor.

Communications:

The Converter communicates to the Digital level sensors by means of an RS485 4-wire serial link set to 9600, N, 8, 1. The data obtained from the sensors is then converted to an analog signal and put out on one of eight analog channels. The analog loop from the channel can be set up to either source power, or be powered by the host unit. The unit is programmed through a standard RS232 serial cable with RTS/CTS connected to a computer running a terminal emulation software program. Software version 1.06c allows for communications to the sensor to be Even or No parity or a combination of each, allowing for communications to earlier generations of digital level sensors. Note that this applies only to level sensor RS485 communications and not to the Terminal Unit's RS232 communications.

Wiring connections:

The converter requires a power supply of 12 to 15 volts DC connected to J1. To connect the converter to the sensor, connect the sensor data receive lines to the converter data transmit lines, J6 and the sensors data transmit lines to the converter data receive lines. The sensor 12 volt supply and ground will connect to the converters sensor power output. The shield of the communications cable needs to be connected to the EARTH terminal, but only at one end of the cable to avoid a ground loop.

For an analog loop which is powered by the converter, jumper the terminals V+ and LOOP+. The output signal is from the LOOP-, connected to the data collection device Analog (+). The Analog (-) from the data collection device goes back to the converters V- terminal.

For an analog loop which is powered by the data collection device, the (+) line from the collection device goes to the LOOP+ terminal, and the LOOP- terminal goes to the collection device (-) terminal.

Programming

To program the Model 1000 Terminal Unit, connect a standard serial cable from a computer to the RS232 connector on the Converter. On the computer, run a terminal program, like PROCOMM or Hyperterm. Set the configuration to ANSI BBS, 9600 baud, No parity, 8 data bits, 1 stop bit and RTS enabled. Enter configuration programming commands from the Protocol Manual to set up the parameters.

If using Hyperterm, set the port settings to 9600,N,8,1 with Hardware flow control. Emulation should be set to ANSI and select "Send line ends with line feeds" and "Echo typed characters locally" under ASCII setup for ASCII sending.

When initially installing a sensor, the sensor must be calibrated for specific gravity of the fluid and float combination. After the installation is complete and the Model 1000 Terminal Unit has polled the sensors, pressing the "Press to read button" will cycle through and display the level of each sensor. Comparing the level displayed to the level measured calculate the level offset to be programmed into the sensor. Add to or subtract from the level displayed so that the level displayed matches the level measured.

Connect a computer running a terminal emulation software program to the RS-232C port on the 4-20 mA converter. The converter board senses a change in RTS/CTS lines and disables the auto-polling of the Model 1000 level sensor. With the terminal emulation software running, set the parameters to ANSI-BBS 9600, N, 8, 1, hardware handshaking. Typing U00OL? will result in a response of the level offset programmed into unit number one such as:

U00OL+0000C6691

To enter the new level offset type in the unit number followed by OL and the number to offset the level by, such as:

U00OL150

The sensor will respond with U00OLOKC78f5

This will result in a level offset of 1.50" programmed into the sensor.

Diagnostics:

Typing G420C will result in a response of the number of Analog Output channels that are configured such as:

420C1

Typing G420C1 results in a response of the configuration of the analog output channel 1, such as:

420C1U00L1IV4M0.000V20M59.500

Referring to the Configuration Protocol for Model 1000 Terminal Unit document will indicate that the above message addresses Channel 1, Model 1000 level sensor unit number U00, Level 1 set for inches, with a value for 4ma of 0.000" and a value for 20ma of 59.500". These values will vary depending on how long your sensors are, number of floats used and what you want the 4ma and 20ma range to be.

By default the 4-20 mA board is programmed to poll the Model 1000 level sensors every 60 seconds upon power up with 12 vdc. If a level sensor is incorrectly wired, not communicating, or not powered the Analog Output will remain or default to 4 mA. If the sensor fails to respond, the 4 to 20 mA program will time-out and retry. Successful communications with the sensor will result in a response from the sensor of :

UuuDlll.llFtttEeeeeWwwwwCcccc
or
UuuDlll.llDlll.llFtttEeeeeWwwwwCcccc (dual float)

The Model 1000 protocol document breaks the message down to Unit number 00 with a depth D of lll.ll in inches (second Dlll.ll represents the bottom float) followed by a temperature F of ttt in degrees F. E represents errors, 0000 is no errors, 1000 is can't result level. Possible explanations for E1000 are no float on sensor, float exceeded the level of measurement, or float is not oriented correctly (the line on the float must be aligned with the guide rod on the side of the sensor, or if the tube is square aligned with the marks on the corner of the tube bottom or flange). Variables following the C are the CRC-16 checksum.

Upon successful communications with the level sensor the Analog Output will update with a value corresponding to the level received from the level sensor. The sensor will then be polled for updated level and temperature every 60 seconds.

If the Model 1000 Terminal Unit is configured for a display and "polling sensor U00" or any other unit number remains displayed, this is a possible indication of noisy signals on the RS485 line. Try terminating the transmission lines by connecting a resistor of about 120 ohms across the RX+ and the RX-, also across the TX/RX+ and the TX/RX-. This may need to be done at the sensor as well as the Model 1000 Terminal Unit. Also make sure the shield wire is grounded only at one end of the cable.

Should a channel fail to output a value corresponding to the level or temperature for which it is programmed, check to see if the sensor is communicating. Check for 12 vdc to the sensor, check the wiring and if necessary the fuse board in the sensor head. If using the intrinsically safe barrier board ISB1010 also check for continuity from input to output. Correct all problems found and check the system again. If the sensor is responding correctly and there are no errors reported from the sensor, disable the channel in question. Program the parameters

of the disabled channel to a channel that is not in use and rewire the new output, swap 4-20ma module to the new channel. Cycle power and the system should be operational again, if not try a new module.

Model 1000 Terminal Unit

4 to 20 ma conversion.

Up to 8 channels of 4 to 20 mA. conversion are available when the optional plug in modules are installed. Each channel is configurable to transmit a level or temperature from a sensor unit. All eight channels do not need to be installed. Installed channels do not have to be installed from 1 to eight. Outputs are forced to 4 mA or 1VDC if reading is below min scale and 20mA or 5 VDC if above maximum scale.

User programmable features:

1. Sensor poll interval in seconds
2. Minimum and maximum output levels.

G4 output modules.

Two on board digital outputs are available with the optional G4 modules installed. **Version 1.06 and later allow for an 8 digital output expansion board**. Each channel can be mapped to a level or temperature. The on/off criteria for each channel is programmable. A channel turns on when a monitored input value is less than (LT), equal to (EQ) or greater than (GT) a programmed trigger value. The off behavior is programmed in the same way. The on or off behavior can be disabled by selecting not applicable (NA) instead of LT, EQ or GT. A user reset button forces an immediate polling of all sensor units and all outputs are updated according to the programmed criteria. For example:

Channel 1 controls a pump, channel 2 latches an alarm signal.

Channel 1	ON	U01	LEVEL	GT	120.00”
Channel 1	OFF	U01	LEVEL	LT	12.00”
Channel 2	ON	U01	LEVEL	GT	120.00”
Channel 2	OFF	---	--------	NA	---------

When the level reported by sensor U01 reaches 120.00” channel 1 turns on a pump and channel 2 turns on an alarm signal. The level falls below 12.00” and the pump turns off. However, because the OFF behavior of channel 2 is disabled, the alarm signal remains latched ON. The user must press the reset button S2 to force the alarm signal off.

Push to read display.

An optional 4 line by 20 character display is available. An external sealed push button activates the display and forces a poll of all sensors. The first screen has 2 lines of user defined text (lease & well information). The third line shows date and time. The fourth line displays the software version and battery condition. There is a screen of information following for each sensor installed. Each screen has the following information:

Line 1 - 10 character user defined label, 3 character sensor unit number.

Line 2 - top float level, volume in barrels of upper fluid
Line 3 - if 2 floats: bottom float level, volume in barrels of lower fluid
Line 4 - up to 4 temperature readings

Each screen is displayed for a user-defined number of seconds. All the screens are repeated a user-defined number of times before the display goes blank. If the button is pressed any time, the display will advance to the next screen. There may be a slight delay while the sensor for the next screen is polled.

Mechanical specifications.

- NEMA 4 or 4X enclosure 12x10x6".
- Display window with flush mount push button.
- ISB1010 barrier board mounted inside enclosure, if no expansion board.

Electrical specifications:

- Operating temperature is -40 to 85 degrees centigrade.
- If equipped with a Liquid Crystal Display, operating temperature is 0 to 70 degrees centigrade.
- Internal Humidity: 20 to 90 percent, non-condensing
- Wiring recommended :16-22 AWG at J1, J6 J12, J13
- Main board current consumption with display:

Standby 85 mA
while polling one sensor 135 mA
while polling and displaying with backlite 250 mA
sleepmode (PTR only) 9 mA
20 mA maximum per analog output module (variable but continuous)
60 mA per sensor maximum during polling

- 4-20 mA conversion accuracy (except as limited by sensor and protocol resolution):

resolution	16 bits
monotonicity	16 bits min
integral nonlinearity	+/- 0.01% of FS max
offset (4mA)@25 deg C	+/-0.1% of FS max
offset drift	5 ppm of FS/deg C max
total output error (20mA) 25 deg C	+/-0.2 % of FS max
total output drift	+/-50 ppm of FS/deg C max
Vcc supply sensitivity	50 nA/mV typical

Power and Control from RTU, connector J1:

- 10 to 16VDC input to pin 2 and GND to pin 3.
- Maximum input current protected to 1 Amp, derated for temperature.
- Over voltages and over currents will trip fuses that reset during power down.
- Power control lines on pins 4 and 5 are for a momentary dry contact, duplicating the front panel press-to-read button.
- Earth connections are provided at pins 1 and 6 for transient voltage protection.

Model 1000 sensor communication, connector J6:

- Nominal 12 VDC output on pin 2 and GND on pin 3.
- Output voltage range is 1 volt less than input voltage at 1 Amp.
- Over voltages and over currents will trip fuses that reset during power down.
- Earth connection is provided at pin 1, for cable shield connection.
- RS485 connections:
  R+ to Transmit + on sensors
  R- to Transmit - on sensors
  T- to Receive - on sensors
  T+ to Receive + on sensors

Optional digital outputs, connector J12:

- Digital outputs are available with user-provided G4 modules at pins 1 and 2, and at 3 and 4
- No voltage is provided at these pins, and voltages applied to these pins through loads are not to exceed 48VDC/120VAC / 1A

Spare output connector (J13):

- Nominal 12 VDC output.
- Combined sensor and output current maximum is set to 1 Amp.
- User-provided fuse is placed in socket F3.
- **Not yet defined for software support**

RS232 connector (J14):

- Available for laptop communications
- Jump J15 1&2 for DTR, 2&3 for RTS
- Jump J16 1&2 for DSR, 2&3 for CTS

Front panel option connector (P1):

- 34 pin ribbon cable.
- Pins 33 and 34 are spliced to the front panel switch.
- The other pins drive the LCD including back light power.

1-8 analog output connectors:

- If only 1 channel is used, a balancing dummy module should be used to help support the hold down plate.
- Modules are keyed to prevent reverse installation and are intended only for this controller.

Hardware configuration jumpers:

- Jumper J2 is factory preset to enable low power reset to the controller.
- Jump J15 1&2 for DTR, 2&3 for RTS
- Jump J16 1&2 for DSR, 2&3 for CTS
- Jumpers J7-J11 are factory preset timing switches for different LCD circuits
- Jumpers J4 and J5 are factory preset to match memory configuration.
- Jump J3 2&3 to provide self turn off with "push to read" start, jump 1&2 for 4 to 20 mA application.
- Jumper J17 is factory preset to bypass the battery current measurement resistor.