

# Technical Note

## SDI-12 Commands and Level TROLL<sup>®</sup> 400/500/700 Responses

The In-Situ<sup>®</sup> Inc.'s Level TROLL 400/500/700 Data Loggers support the SDI-12 Version 1.3 commands and the extensions listed below. Data recorders that support SDI-12 Version 1.3 can usually send standard commands to an SDI-12 "sensor", like the Level TROLL 400/500/700, automatically. Additional information may be found in an SDI-12 reference, such as those listed at the end of this document. Or consult your SDI-12 data recorder documentation.

### Sensor SDI-12 Defaults

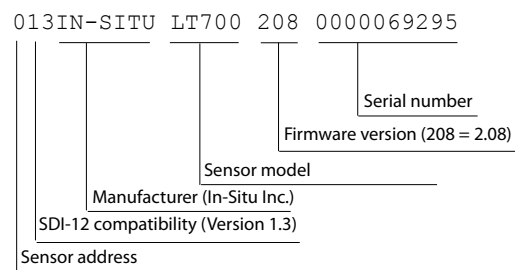
The Level TROLL 400/500/700 Data Loggers support software-changeable addresses. Level TROLL Data Loggers leaves the factory with the following SDI-12 settings:

Sensor SDI-12 address: 0  
Pressure units: PSI  
Temperature units: degrees Celsius

### Sensor Identification

In response to the "send identification" command, the Level TROLL 700, for example, will respond as follows:

```
013IN-SITU LT700 208 0000069295
```



SDI-12 V1.3 Command Set		
Name	Command	Response
Address Query	?!	a<CR><LF> The wildcard address '?' character is only supported for the Address Query command. It is ignored as an invalid address for all other commands.
Acknowledge Active	a!	a<CR><LF> The device supports the basic address characters in the range '0' to '9' and the extended address characters in the ranges 'A' to 'Z' and 'a' to 'z'. All other characters are ignored as an invalid address. The default address is '0'.
Change Address	aAb!	b<CR><LF> Where 'a' is the current address and 'b' is the new address
Send Identification	al!	a13IN-SITU LT700 vvv xxxxxxxxxxxx<CR><LF> where: vvv = device firmware version * 100 (208 = 2.08) xxx = 10-digit device serial number with leading zeroes
Start Verification	aV!	a0001<CR><LF> One result is available immediately for reading by the Send Data command.
Send Data	aD0!	a+n<CR><LF> where: n = lower 16 bits of device status (0-65535) as described in the "Device Status" section of this document.
Additional Data	aD1! ... aD9!	a<CR><LF> No values are returned after an additional data command.

### SDI-12 V1.3 Command Set

Name	Command	Response
Start Measurement Start Measurement CRC	aM! aMC!	a001n<CR><LF> n parameters will be available for reading by the Send Data command within 1 second. A service request (a<CR><LF>) will be sent when the parameters are ready. The number of parameters returned and their order is determined by the SDI-12 configuration file or the XO extended command. The default value for n is 2.
Send Data	aD0!	a<values><CR><LF> or a<values><CRC><CR><LF> The number and type of parameters returned is determined by the SDI-12 configuration file. The default values are pressure in PSI followed by temperature in °C.
Additional Data	aD1! ... aD9!	a<CR><LF> or a<CRC><CR><LF> No values are returned after an additional data command.
Additional Measurements Additional with CRC	aM1! ... aM9! aMC1! ... aMC9!	a0000<CR><LF> No additional measurements are available.
Send Data	aD0!	a<CR><LF> or a<CRC><CR><LF>
Additional Data	aD1! ... aD9!	No values are returned after an additional measurement command.
Start Concurrent Start Concurrent CRC	aC! aCC!	a001nn<CR><LF> nn parameters will be available for reading by the Send Data command within 1 second. No service request will be sent when the parameters are ready. The number of parameters returned is determined in the same manner as a start measurement command.
Send Data	aD0!	a<values><CR><LF> or a<values><CRC><CR><LF> The number and type of parameters returned is determined by the SDI-12 configuration file in the same manner as a start measurement command.
Additional Data	aD1! ... aD9!	a<CR><LF> or a<CRC><CR><LF> No values are returned after an additional data command.
Additional Concurrent Additional with CRC	aC1! ... aC9! aCC1! ... aCC9!	a00000<CR><LF> No additional concurrent measurements are available.
Send Data	aD0!	a<CR><LF> or a<CRC><CR><LF>
Additional Data	aD1! ... aD9!	No values are returned after an additional concurrent measurement command.
Continuous Measurement Continuous with CRC	aR0! ... aR9! aRC0! ... aRC9!	a<CR><LF> a<CRC><CR><LF> The continuous measurement mode is not supported.

## SDI-12 Extended Commands

Name	Command	Response
ISCO Compatibility	aXPR0!	<p>alxlxlxlx&lt;CR&gt;&lt;LF&gt;                      where each lx is a character pair identifying the parameter and units for each measurement. The number of lx pairs will equal the number of data values returned for the Start Measurement and Start Concurrent commands. The following pairs are supported (all other units return "??").</p> <p>Pressure, PSIA = "d0"                      Pressure, PSIG = "d2"                      Pressure, mmHg = "d3"</p> <p>Temperature, °C = "A0"                      Temperature, °F = "A1"</p> <p>Level, meters = "I0"                      Level, feet = "I1"</p>
ISCO Additional	aXPR1...aXPR9!	<p>a&lt;CR&gt;&lt;LF&gt;                      No values are returned after an additional ISCO compatibility command.</p>
Communication Diagnostics	aXCD!	<p>a+A+C&lt;CR&gt;&lt;LF&gt;                      where:                      A = contents of Modbus device address register 49200                      C = contents of Modbus serial communication configuration register 49201</p>
Set Pressure Units	aXPUnn!	<p>a0001&lt;CR&gt;&lt;LF&gt;                      where nn is the pressure units ID: 17 = PSI (default), 19 = Kpa, 20 = bar, 21 = mbar, 22 = mmHg, 23 = inHg, 24 = cmH2O, 25 = in H2O.</p> <p>One result is available immediately for reading by the Send Data command.</p>
Send Data	aD0!	<p>a+s&lt;CR&gt;&lt;LF&gt;                      where: s = command status, 1 = command successful, 0 = invalid units ID or an attempt to change units while the device is logging.</p>
Additional Data	aD1! ... aD9!	<p>a&lt;CR&gt;&lt;LF&gt;                      No values are returned after an additional data command.</p>
Set Temperature Units	aXTUnn!	<p>a0001&lt;CR&gt;&lt;LF&gt;                      where nn is the temperature units ID: 01 = °C (default), 02 = °F.</p> <p>One result is available immediately for reading by the Send Data command.</p>
Send Data	aD0!	<p>a+s&lt;CR&gt;&lt;LF&gt;                      where: s = command status, 1 = command successful, 0 = invalid units ID or an attempt to change units while the device is logging.</p>
Additional Data	aD1 ... aD9!	<p>a&lt;CR&gt;&lt;LF&gt;                      No values are returned after an additional data command.</p>
Set Level Units	aXLUnn!	<p>a0001&lt;CR&gt;&lt;LF&gt;                      where nn is the level units ID: 33 = mm, 34 = cm, 35 = meters, 37 = inches, 38 = feet (default).</p> <p>One result is available immediately for reading by the Send Data command.</p>
Send Data	aD0!	<p>a+s&lt;CR&gt;&lt;LF&gt;                      where: s = command status, 1 = command successful, 0 = invalid units ID or an attempt to change units while the device is logging.</p>
Additional Data	aD1! ... aD9!	<p>a&lt;CR&gt;&lt;LF&gt;                      No values are returned after an additional data command.</p>
Set Level Mode	aXLMnn!	<p>a0001&lt;CR&gt;&lt;LF&gt;                      where nn is the level parameter ID: 03 = depth (default), 04 = level from top of casing, 05 = level in elevation.</p> <p>One result is available immediately for reading by the Send Data command.</p>
Send Data	aD0!	<p>a+s&lt;CR&gt;&lt;LF&gt;                      where: s = command status, 1 = command successful, 0 = invalid units ID or an attempt to change the mode while the device is logging.</p>
Additional Data	aD1! ... aD9!	<p>a&lt;CR&gt;&lt;LF&gt;                      No values are returned after an additional data command.</p>

## SDI-12 Extended Commands

Name	Command	Response
Set Output Sequence	aX0nnn!	a0001<CR><LF> where nnn = 1 to 3 characters (P = pressure, T = temperature, L = Level) in the required output order.  One result is available immediately for reading by the Send Data command.
Send Data	aD0!	a+s<CR><LF> where: s = command status, 1 = command successful, 0 = invalid parameter characters.
Additional Data	aD1! ... aD9!	a<CR><LF> No values are returned after an additional data command.
Set Specific Gravity	aXSGpd.d!	a0001<CR><LF> where: pd.d = specific gravity p = polarity sign (+ or -) d = 1 to 7 digits (0 to 9) . = decimal point (optional)  One result is available immediately for reading by the Send Data command.
Send Data	aD0!	a+s<CR><LF> where: s = command status, 1 = command successful, 0 = invalid parameter characters or an attempt is made to change the specific gravity while the device is logging.
Additional Data	aD1! ... aD9!	a<CR><LF> No values are returned after an additional data command.
Zero Pressure	aXPZ!	a0011<CR><LF> One value will be available for reading by the Send Data command within 1 second. A service request (a<CR><LF>) will be sent when the parameter is ready.
Send Data	aD0!	a+s<CR><LF> where: s = command status, 1 = command successful, 0 = invalid parameter characters.
Additional Data	aD1! ... aD9!	a<CR><LF> No values are returned after an additional data command.
Set Level Reference	aXLRpd.d!	a0011<CR><LF> where: pd.d = reference level in current units p = polarity sign (+ or -) d = digits (1 to 7) . = decimal point (optional)  One value will be available for reading by the Send Data command within 1 second. A service request (a<CR><LF>) will be sent when the parameters are ready.
Send Data	aD0!	a+s<CR><LF> where: s = command status, 1 = command successful, 0 = invalid parameter characters.
Additional Data	aD1! ... aD9!	a<CR><LF> No values are returned after an additional data command.
Reset to Factory Defaults	aXRST!	a0901<CR><LF> One value will be available for reading by the Send Data command within 90 seconds. A service request (a<CR><LF>) will be sent when the parameter is ready.
Send Data	aD0!	a+s<CR><LF> where: s = command status, 1 = command successful, 0 = cannot reset while logging.
Additional Data	aD1! ... aD9!	a<CR><LF> No values are returned after an additional data command.

## Device Status

The device status register holds general status information. Each set bit represents a status value. There are a limited number of standardized predefined status values that all devices will support. These predefined status values are contained in the lower register. The upper register is reserved for device specific status values.

### Device Status Bit Values

Bit	Category	Description
0	Alarm	Sensor high alarm
1	Warning	Sensor high warning
2	Warning	Sensor low warning
3	Alarm	Sensor low alarm
4	Warning	Sensor calibration warning
5	Alarm	Sensor malfunction
6-7	N/A	Reserved
8	Status	Power management disabled
9	Status	Device off line
10	Alarm	Device hardware reset occurred
11	Alarm	Device malfunction
12	Status	No external power
13	Warning	Low battery – battery capacity < 5%
14	Warning	Low memory – data log memory capacity < 5%
15	N/A	Reserved
16-31	N/A	Available for device-specific status

Bits 0-7 of the device status register are reserved for sensor status. These bits are the logical OR of bits 0-7 of the sensor status register in each sensor connection.

Bits 8-15 of the device status register are reserved for common device status. Any bit in this range that is not applicable to a device will be set to zero.


Bits 16-31 of the device status register are available for device-specific status. Any bit in this range that is not utilized by a device will be set to zero.

## SDI-12 Configuration File

The device's SDI-12 configuration file may be edited with a serial connection and Win-Situ® 5 Software. Change the device's SDI-12 address and specify the parameter reporting order for SDI-12 communications in the **SDI-12 Setup** dialog box (see below).

1. While connected to a device in Win-Situ 5, click the **Setup** tab, then click the **SDI-12 Setup** button. A dialog box, like the one below, will open.



2. Address Character. The device's current SDI-12 address is shown (factory default: 0). Enter the desired address character to change the address.
3. Select the sensor to report. All sensors supported by the connected device are available in the drop-down list.
4. Select the parameter to report. All parameters supported by the selected sensor are available in the drop-down list.
5. Click Add to add the parameter to the Output Order. Repeat for all desired parameters. If you wish to change the reporting order, select a parameter in the list and click the up arrow or the down arrow to change its position in the output order list.
6. Click OK  when done. The software will write the SDI-12 configuration to the device.

## References

1. SDI-12, A Serial-Digital Interface Standard for Microprocessor-Based Sensors, version 1.3. SDI-12 Support Group, Logan, Utah, January 12, 2009. Available at [www.sdi-12.org](http://www.sdi-12.org).
2. In-Situ Modbus Communication Protocol. Available at [www.in-situ.com](http://www.in-situ.com).



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