

## *Tube 300S Telemetry System*

Part No. 0062030 | 0062040 | 0062150 | 0062160 | 0062050 | 0062170 | 0034330 | 0034340 | 0034350



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## Introduction

This manual is intended to describe the characteristics, operation, and maintenance of the Tube 300S Telemetry System.

## Unpacking and Inspection

All Tube 300 Telemetry Systems contain the following items:

- Tube 300S unit
- Nickel Cadmium rechargeable battery pack
- Stub antenna

You must supply the following items for setup and installation:

- Tube setup/communication cable (part number 0062260)
- Battery charger for the Nickel Cadmium battery pack (part number 0062300) (optional)
- In-Situ instrument and appropriate cable
- TROLL Com Communication Device for connecting your In-Situ instrument to your computer
- Win-Situ 5 Software\* for programming your In-Situ instrument

\* Software can be installed from [www.in-situ.com/software](http://www.in-situ.com/software)

If you did not purchase a SIM card and data plan from In-Situ, you will need these additional items:

- [SIM \(subscriber identity module\) card](#)
- Cellular service plan

Your Tube Telemetry System was carefully inspected before shipping. Inspect the package for any physical damage sustained during shipment. Notify In-Situ and file a claim with the carriers involved if there is any damage. Do not attempt to operate the instrument when damage has occurred.

## Model Number

The model number is printed on the product label affixed to the unit body. The model number states what type of unit you have. Below is an example model number.

T3S-3G-V-1T

The first set of characters determine the product type. "T3" indicates a Tube and "S" indicates a solar-powered unit.

The second set of characters indicate the type of modem installed. "2G" means a 2nd generation cellular device, "3G" means a 3rd generation device.

The single character indicates whether the unit is vented (V) or non-vented (B). Non-vented units have an internal barometric sensor installed.

The final set of characters indicates the instrument connection type. The number equals the amount of connections. An "RT" following the number means Rugged TROLL connection, while a "T" means titanium Twist-lock connection.

Therefore, the example model number means the following:

T3S-3G-V-1T: Tube 300S (solar), 3G, vented, 1 Twist-lock connection

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## **Serial Number**

The unit serial number is printed on the product label affixed to the unit body. This number is important for warranty and service purposes.

## **Safety**

- **Do not connect the battery without an antenna installed.**
- **Never install a battery other than one supplied by In-Situ**
- **Do not submerge the Tube in liquid.**
- **Never attempt to open the Tube while holding it in your hand. Always place the Tube on a flat surface before opening it.**

## General Specifications

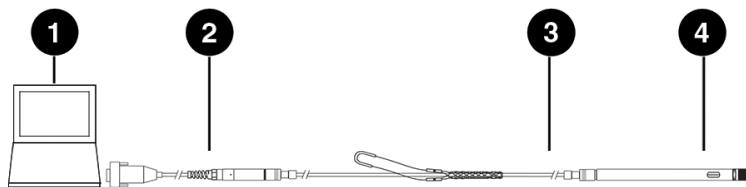
<b>Operating ranges</b>	Temp: -20° to 70° C (-4 to 158° F) Humidity: 95% max. non-condensing
<b>Diameter, maximum</b>	Tube: 7 cm (2.75 in.) Top cap: 7.5 cm (2.95 in.) (with solar panel)
<b>Dimensions</b>	Length: 48 cm (18.9 in.)
<b>Weight with battery</b>	1670 g (3.68 lbs)
<b>Materials</b>	Methacrylate, 5 mm thick
<b>Rating</b>	IP65
<b>Power</b> Internal battery	Solar panels integrated NiCd 7.2 V / 1400 mAh
<b>Instrument compatibility</b>	Aqua TROLL 100/200 Data Logger Aqua TROLL 400 Multiparameter Instrument Aqua TROLL 600 Multiparameter Instrument BaroTROLL Data Logger Level TROLL 400/500/700/700H Data Loggers RDO PRO-X Probe Rugged BaroTROLL Data Logger Rugged TROLL 200 Data Logger TROLL 9500 Multiparameter Instrument
<b>Communication</b> Antenna	GSM quad band—850, 900, 1800, 1900 MHz (GPRS, SMS, email, FTP); 2G or 3G SMA connector with stub antenna or optional external antenna
<b>Sensors</b>	Built-in barometric pressure sensor (non-vented systems only) Built-in temperature system
<b>Warranty</b>	1 year from date of shipment

## Configuring Your Instruments

### Overview

Tube 300S units support a single In-Situ device. You must change communication settings on your device so it can transmit data to the Tube.

### Connecting an In-Situ Instrument to the Computer




1	Laptop or PC
2	TROLL <sup>®</sup> Com Communication Device*
3	RuggedCable <sup>®</sup> System**
4	In-Situ instrument

\* TROLL Com device may be a USB-connect, serial-connect, or direct-connect\*\* model

\*\* RuggedCable is omitted when using a direct-connect TROLL Com

## Changing Instrument Communication Settings

1. Connect to the instrument using Win-Situ 5 software.
2. Click the Device Setup tab .
3. Click **Modbus Setup...**
4. Select the following options:
  - Baud: 9600**
  - Data Bits: 8**
  - Parity Bits: None**
  - Stop Bits: 1**
  - End Of Message Timeout (ms): 1000**
  - End of Session Timeout (ms): 5000**
  - Mode: Modbus-ASCII**
5. Click the checkmark. Click Yes to change the communication settings. Click Yes or No to save these settings as the default for Win-Situ 5.

 You must change Win-Situ Software communication settings to match the instrument communication settings next time you connect the instrument. Change this under **Preferences > Comm Settings**.

Set up and start a log in the instrument if you require data redundancy and your instrument supports internal data logging.

## Changing Instrument Communication Settings - TROLL 9500 Only

1. Open Win-Situ 4 software and follow the steps in the Connection Wizard.
2. Set the baud rate to 9600 and connect to instrument.
3. Right click the TROLL 9500 device in the tree on the left, and select **Edit**.
4. Select **ASCII Mode Preferences**, and click **Next**.
5. Select the following options:
  - Comma delimited**
  - Enable ASCII mode of linear tests**
6. Click **Finish**.
7. For the TROLL 9500 to function, you must set up a log in Win-Situ and choose the same logging interval you have selected in the ANT Tool for the Tube
8. Use the TROLL 9500's serial number as the device address when configuring this system with the ANT Tool.



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## Setting Up a Log

The Tube logs data from instrument directly to the internal SD card. How and when the data is recorded is configured using the Tube set up tool.

If you require data redundancy, program a log on your instrument prior to connecting it to the Tube. Some instruments do not support logs.

Refer to your instrument manual for instructions on setting up a log.

## Configuring the Telemetry Device

### Overview

If you purchased a data plan through In-Situ, you need to open the unit and connect the battery, and then set up the Tube using the configuration software.

If you are using a 3rd party data plan, you will need to install the SIM card prior to setting up the Tube with the configuration software. See "SIM Card" on page 18.

### Opening the Unit

1. Place the unit on a flat surface.

 Never open a Tube 300S unit while holding it in your hand.


2. Remove the plastic top cap from the top of the unit.
3. Unplug the solar panel from the internal housing.
4. Remove the solar panel.
5. Unscrew the retaining ring from the top of the unit.
6. Remove the top ring and pull on the bolt to remove the interior housing.

### Battery

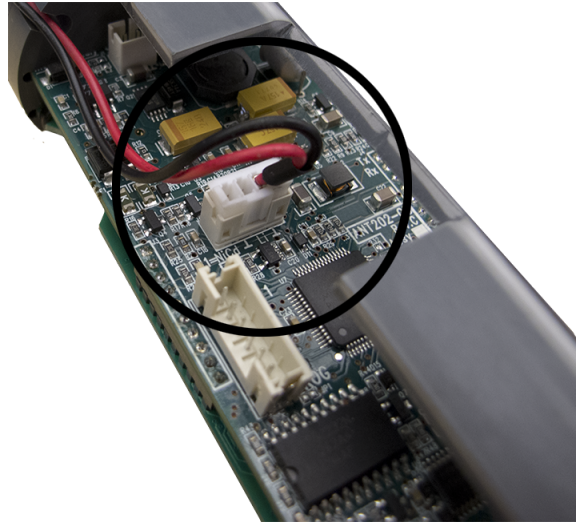
Tube 300S systems have a nickel-cadmium battery pack (PN 0062290) that is rechargeable via solar panel or using the battery charger. Batteries are installed but not connected prior to shipping.

To connect, disconnect, or change a battery pack, follow the steps below.

1. Ensure an antenna is attached to the unit.

 Never connect or disconnect power to the unit without an antenna attached.

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2. Plug in or unplug the battery pack from the circuit board connection shown below.



### Connecting the Tube to the Computer

1. Connect the setup cable to the communication port of the Tube and to the computer.
2. Download the ANT Tube Tool software from [www.in-situ.com/support](http://www.in-situ.com/support)
3. Install and open the ANT Tube Tool software.
4. Select the correct serial port. A serial-to-serial adapter is typically COM1. A USB-to-serial adapter is typically a different COM number.

### Select Connected Probes

1. Connect your instrument to the Tube.
2. Click **Probe and set-point configuration**.
3. Click the **Connected probes** tab.
4. Select the appropriate probe name from the drop down menu, and enter the correct device address as set in Win-Situ 5.


✓ If you have a Tube with a barometric sensor installed inside it, Probe 1 will automatically be listed as "Barometer" and the address will be listed as 100. Do not change this setting.

5. Click **Write probes and set-points**.
6. Close the window.

### Select Probe Parameters for Alarming

1. Click **Probe and set-point configuration**.
2. Click the **Parameters monitoring** tab.
3. Select the connected probe from the drop-down menu, and then select a parameter to monitor. Tube units monitor up to eight total parameters for alarms from the connected probe.

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4. Enter the minimum and maximum values to trigger warnings and alarms. If a parameter is measured outside the Warning levels, the measurement is stored in the log memory even if the Tube is not designated to save that reading. If a parameter is outside the Alarm levels, the reading is stored and an alarm message is sent if the corresponding alarm has been enabled and configured.

 Use the same units for Warning and Alarm levels as the probe was set to use in Win-Situ 5.

5. Select the monitoring mode for Warnings/Alarms.

**Absolute mode:** Warning or Alarm occurs when a single reading is higher or lower than the maximum or minimum level.


**Incremental mode:** Warning or Alarm occurs when the change between two consecutive readings is greater than the Maximum value or less than the Minimum value. The alarm threshold is a slope instead of a fixed value.

For additional information on alarms, See "Alarms - Overview" on page 20.

6. Click **Write probes and set-points**.
7. Close the window.

## Set Level Reference

1. Click **Functional mode and test**.
2. Click **Probes, real-time reading**.
3. Click the **Immediate reading probes** button. Note the units used for level readings.
4. Close the window.
5. Click **Probe and set-point configuration**.
6. Click the **Level reference setting** tab.
7. Select the instrument to change the level reference from the drop down menu.

 The instrument must be connected by cable to the Tube to change the level reference.

8. Select the appropriate level mode in the Parameter Id drop down menu. Refer to your instrument manual for more information on level modes.
9. Click **Save Id parameter**.
10. Enter your level reference value.
11. Click Set the Level reference button.
12. Close the window.

## Set the Site Name and Clock

1. Click **General information, parameters and functional options**.
2. Click the **Information** tab.
3. Enter a site name for your deployment area and click **Set the Site Name**.
4. Click **Set clock** to synchronize the Tube clock with your computer clock.
5. Close the window.

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## Configure Options

1. Click **General information, parameters and functional options**.
2. Click the **Options** tab.
3. "Barometric compensation for level readings" is only changeable if you have a Tube with an internal barometric sensor. Enter a manual value for the density of water if needed.
4. Select "Power supply to the probes" if you are deploying an Aqua TROLL 400, RDO PRO-X probe, or Rugged TROLL 200.
5. Select whether to send data to an email address or to an FTP site.

 Do not alter the settings in the data file settings.

6. Click the **Write options and parameters** button.
7. Close the window.

## Modem Parameters

1. Click **General information, parameters and functional options**.
2. Click the **Communication (1)** tab.
3. Enter the Access point name (APN) in the field under "Access Point". If you purchased a SIM card and data plan through In-Situ, your access point name is:


**For KORE SIM cards:**

c2.korem2m.com (U.S.A.)

vfd1.korem2m.com (outside U.S.A.)


**For EMnify SIM cards:**

em

 If you are using a third-party cellular service provider, you must contact them for your APN.

4. If your cellular service provider requires a user name and password, enter those in the fields under the access point name. In-Situ USA SIM cards do not require a user name or password. In-Situ International SIM cards require a user name and password:  
Username: **KORE**  
Password: **1234**
5. Enter up to 2 phone numbers in the fields under "SMS" to receive Tube status updates and alerts via text messages.
6. If you are using FTP to receive data, fill in all the fields of the FTP parameters section. "CSV" and "TXT" are the only options for file type.

FTP site must support ASCII and PASV data transfer modes.

 The FTP filename **MUST** be unique if you are setting up multiple telemetry units. In-Situ recommends using the telemetry unit serial number for each unit set up.

7. To receive data or alerts using email, click the **Communication (2) tab**. Enter the SMTP server for your email or internet service provider. If your provider requires a user name and password, enter those in the fields under the SMTP server. In-Situ **SIM cards do not provide an SMTP server**.

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✓ Email (SMTP) communications can only be achieved by sending data without SSL encryption.

8. Enter the email address you'd like to receive the email from (must be a valid address), the address to receive email, and a carbon copy address if desired.
9. Click **Write options and parameters**.
10. Close the window.

## Activate Alarms

1. Click **General information, parameters and functional options**.
2. Click the **Alarms** tab.
3. Select the alarms you wish to activate. To activate alarms that are dependent on probe parameter readings, select "Reading from probe out of range."
4. Under the "Alarm options" heading, select whether to send alarms using SMS (text) messages when they occur, then select whether to send alarm statuses each time the Tube sends measurement values. Email alarms require an SMTP server that allows login without authentication.
5. Enter the number of consecutive times a parameter in Absolute alarm mode can exceed its threshold before an SMS message is generated. A value of 1 means an SMS message is generated every time.
6. Enter the number of consecutive times a parameter in Incremental alarm mode can exceed its threshold before an SMS message is generated. A value of 1 means an SMS message is generated every time.
7. Enter the maximum number of text messages to be sent for the same Alarm episode.
8. Enter the maximum number of alarms that can be sent per day.
9. Click **Write alarm parameters**.
10. Close the window.

## Set Probe Reading Schedule

1. Click **Frequency of wake-up events**.
2. Click **Frequency of probe readings and options**.
3. Select how often in minutes the Tube reads the probe. A value of 0 means the Tube never reads the probe, a value of 60 means every hour, and a value of 1440 means a reading every 24 hours.
4. Select how often the Tube saves the readings. A value of 1 means every reading.
5. Select how often the Tube transmits the readings. A value of 1 means every reading.
6. Select the significant digits to be included in the data.
7. Click **Write frequency and options**.
8. Close the window.

## Set Wake Up Events

The Tube can be programmed with up to 8 different wake up periods. A wake up period is when the Tube sends data, sends a status text message, or waits for an external connection.

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✓ Wake Up events are not necessary for most use cases.

1. **wake up events.**
2. Click the **Wake up events** tab.
3. Under "Wake up no. 1," select the amount of time for the Tube to wake up.
4. Select the day of the week for the wake up event.
5. Select the starting time. The Tube cannot be programmed for 12:00:00 AM.
6. Select the type of task for this wake up event. If "Wait for phone connections" is selected, additional options become available.
7. Scroll down to program additional wake up events.
8. When all events are programmed, click **Write frequency and options.**
9. Close the window.

## Restart Device and Test Communications

1. Click **Functional mode and test.**
2. Click the **Probes, real time reading** tab.
3. Press the **Immediate reading probes** button. Ensure all values are appropriate for the current conditions of the instrument. If the readings are all zeros there is a connection issue with your instrument. See "Changing Instrument Communication Settings" on page 8.
4. Click the **Test** tab.
5. Click the **FTP test** button to have a sample data file sent to the FTP site you specified in the previous setup.
6. Click the **Test data email** button to have a sample data file sent to the email addresses you specified in the previous setup.

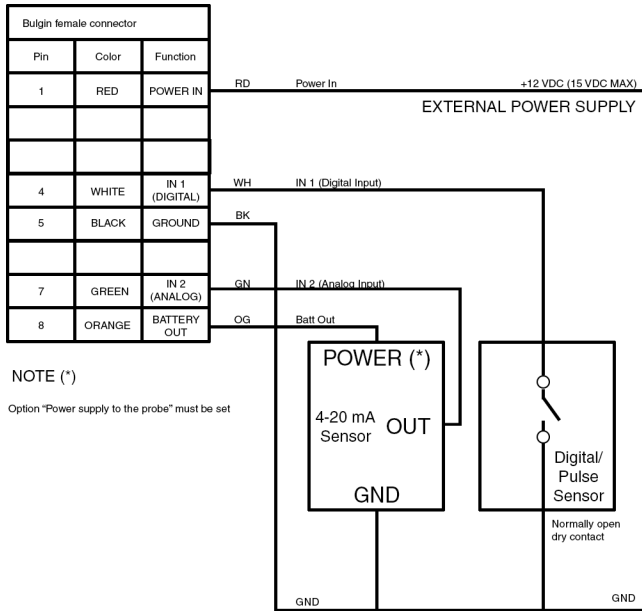
✓ If either the FTP test or email test return error codes refer to the Troubleshooting section.

7. Click the **Status** tab.
8. Click the **Stop device** button.
9. Click the **Start device** button.
10. Close the window.

## Digital, Pulse, and Analog Input

The Tube supports digital, pulse, or analog device input via a stripped-and-tinned cable that connects to the Tube communication port. This device can be set up in the Tube Tool.

## Wiring Diagram



## Connecting the Tube to the Computer

1. Connect the setup cable to the communication port of the Tube and to the computer.
2. Download the ANT Tube Tool software from [www.in-situ.com/support](http://www.in-situ.com/support)
3. Install and open the ANT Tube Tool software.
4. Select the correct serial port. A serial-to-serial adapter is typically COM1. A USB-to-serial adapter is typically a different COM number.

## Input Configuration

1. Click **General information, parameters, and options**.
2. Click the **Options** tab.
  - For a **digital or pulse input**: enter a Parameter name, value of a parameter, and parameter units under **Input 1**.
  - For an **analog input**: enter a Parameter name, high and low values, and parameter units under **Input 2**.

The **Power supply to the probes** checkbox must be checked for analog input devices.



For HydroVu users, the Parameter name and units are directly passed to the cloud. They cannot be changed from HydroVu.

3. Click **Write options and parameters**.
4. Close the window. Click **Probe and set-point configuration**.
5. From an open probe drop down menu, select Digital in, Pulse in, or Analog in.
6. Click **Write Probe and set-points**.

- 
7. Close the window.  
If you require alarming for the input device, continue with steps 8-12.
  8. Click the **Parameters monitoring** tab.
  9. Select the input from one of the probe drop down menus.
  10. Select the parameter from the parameter drop down menus.
  11. Set the Warning and Alarm levels for the parameter, and set the level mode.
  12. Click **Write Probe and set-points**.

✓ Disconnect the communication cable and remember to connect the stripped-and-tinned cable of the device to the Tube before conducting any testing or when deploying the device.

## Field Installation

### Deploy the Tube

Deploy your In-Situ Instrument as described in the Owner's Manual.

The Tube must be deployed in an area that receives direct sunlight for most of the day. In the northern hemisphere, deploy the Tube with the solar panel facing south. In the southern hemisphere, deploy the Tube with the solar panel facing north.

Mount the Tube to a wall using the L-bracket and appropriate fasteners (not included), or use the supplied U-bolts to mount the Tube to a 5.08 cm (2 in.) or smaller diameter pole. When mounting to a pole, In-Situ recommends the pole be secured in cement.

### Improving Signal Quality

Cellular signal depends on several factors, including coverage area, antenna type, and objects in the area that may cause interference.

If your Tube is receiving poor signal or frequently misses transmissions, you can check the following to help determine the cause.

- The well casing may prevent the Tube from sending or receiving transmissions. Consider using an external antenna (PN 0062240) that can be mounted on the top of the well to prevent casing interference.
- Check the cellular provider's coverage area map. Your deployment area may be in a non-coverage area.
- Check the area surrounding your equipment. Objects like trees, electrical wires, and cement walls can affect cell reception. Consider moving the Tube to a different area to test reception.
- If your system cannot be moved, consider using a different type of antenna that can be mounted away from potential interference.

## Troubleshooting

### Troubleshooting Common Issues

#### I Can't Connect

1. Activate the modem and wait 5 seconds. See "Activate the Modem" on page 18.
2. Verify SIM installation. See "SIM Card" on page 18.
3. Verify your SIM has been activated through your service provider.



4. Verify network band type through your service provider (e.g., GSM versus GPRS).
5. Verify signal quality. See "Activate the Modem" on page 18.
6. Verify the current band and network. In-Situ recommends 850/900 MHz dual-band and Automatic, 3G preferred for the Western Hemisphere, and 850/900/1800/1900 quad-band and Automatic, 3G preferred for the Eastern Hemisphere. See "Activate the Modem" on page 1.
7. Conduct an FTP or email test. See "Restart Device and Test Communications" on page 14.
8. Check probe readings:
  1. Click **Functional mode and test**.
  2. Click **Probes, real-time reading**.
  3. Click the **Immediate reading probes** button. Note the units used for level readings.
9. Verify your reading and transmission settings. See "Set Probe Reading Schedule" on page 13.
10. Restart the device. See "Restart Device and Test Communications" on page 1.

✔ Units that have been restored to factory settings must have their batteries unplugged and plugged back in to communicate.

### I Cannot Select Barometric Compensation on my Non-vented Tube

1. Open the ANT Tube Tool.
2. Enter the following characters into the PASSWORD field (case sensitive):  
**p1RLa**
3. Click **Functional mode and testing**.
4. Click the **Sending Commands** tab.
5. Enter the following string into the command to be sent box:  
**@>E97,00,17,05<**
6. Click **Send Command**.

### Error Codes and Messages

Problem	Possible Solutions
The software displays the message, "The Tube didn't reply in the expected time. Please verify if it is connected."	<ul style="list-style-type: none"> <li>· Check connections between the Tube and the computer.</li> <li>· Check the COM selected in the serial port dropdown menu.</li> <li>· Open the Tube and check that the battery is connected.</li> </ul>
NOT_REG	Verify the antenna is installed. Verify signal strength.
Error 305	Check the phone number field for forbidden characters.
Error 515	Wait 15 minutes and resend the SMS.
Error 803	Verify the APN. Verify that the SIM has been enabled. Verify signal strength.
Error 810	Insert a SIM card into the Tube.
Error 811	Enter the SIM PIN number.

<b>Problem</b>	<b>Possible Solutions</b>
Error 812	Verify the APN. Verify that the SIM has been enabled.
Error 813-817	Verify the username and password for the APN.
Error 831	Verify the directory exists & that you have permission to access.
Error 832	Verify the Port number.
Error 833	Verify access to the Port.
Error 840	Someone is already logged in with your credentials.
Error 841	Verify the FTP server, username, and password.
Error 842	Check the FTP server functionality.
Error 861	Username is rejected by the server.
Error 862	Password is rejected by the server.
Error 865	Authentication error.
Error 866	Server is not ready.
Error 867	Email retrieving error.
Error 868	Email size error.
Error 880	Sender email address rejected by server.
Error 881	Recipient email address rejected by server.
Error 882-884	Email error.

## **Activate the Modem**

Activate the modem if the Test FTP functionality returns an error.

1. Click **Functional mode and test**.
2. Click the **Modem, settings, and tests** tab.
3. Click the **Activate modem** button.
4. Select the GSM band for your geographical area and click the **Set GSM band** button.
5. Select whether your network is 2G or 3G and click the **Set network** button.
6. Click the **Verify SIM and PIN** button.
7. Click the **Show signal quality** button if you are near your deployment area.
8. Click the **Deactivate modem** button.
9. Close the window.

## **SIM Card**

Tube 300 units require a SIM card for communication over the wireless network.

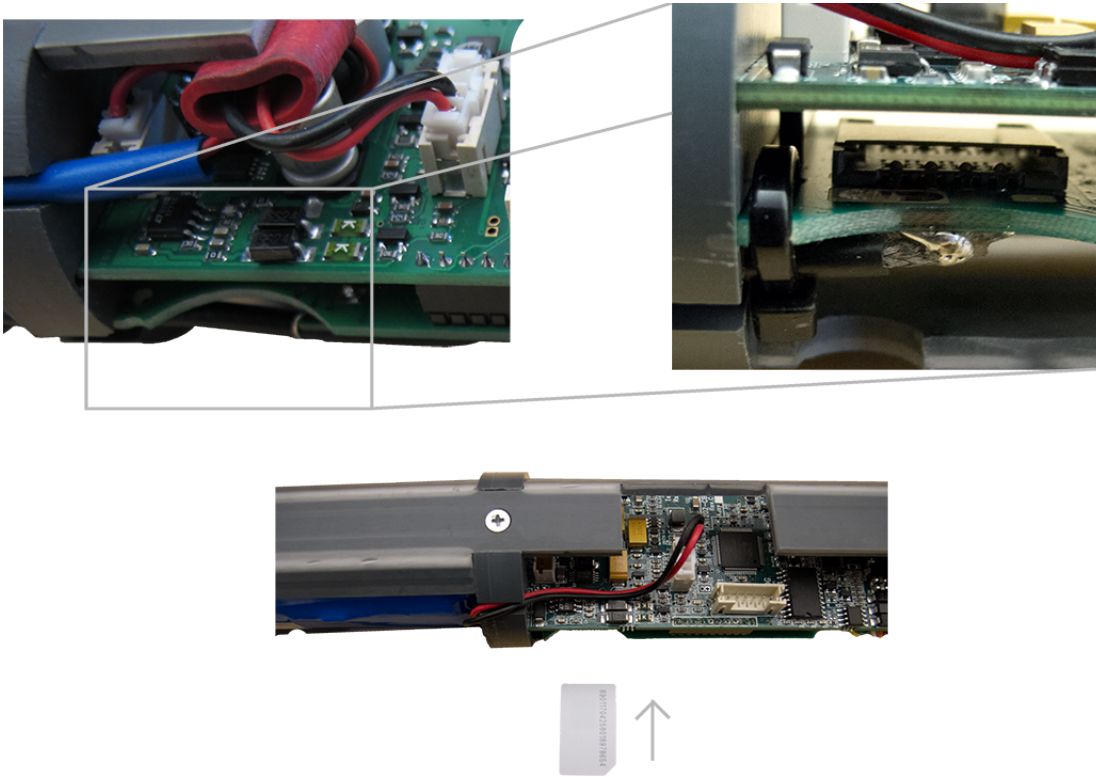
If you are managing your data plan through In-Situ, a SIM card is installed in the equipment prior to shipment.

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If you are managing a data plan through a third party, you must obtain a SIM card from their service provider and install it yourself. Consider if your application requires a static IP address when purchasing the SIM card.

Once a SIM card is obtained, install it in the Tube as shown below.

The SIM card slot is located between the two circuit boards, next to the circular cutout closest to the battery terminal.



1. Align the SIM card so the diagonal cut is facing away from the circuit board and the gold chip is facing the round cut.
2. Gently insert the card into the slot and push in fully.

### **SD Card**

The Tube has a 512 MB SD Mini memory card installed. The system will not function without an SD card.

### **Warranty**

In-Situ warrants the Tube Telemetry System for one year from date of shipment by the end user against defects in materials and workmanship under normal operating conditions. To exercise this warranty contact Technical Support for a Return Material Authorization (RMA) and further instructions. Complete warranty provisions are posted on our website at [www.in-situ.com](http://www.in-situ.com).

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## Obtaining Repair Service

If you suspect your system is malfunctioning and repair is needed, you can help assure efficient servicing by following these guidelines:

1. Call or email In-Situ Technical Support. Have the product model and serial number available.
2. Be prepared to describe the problem, including how the product was used and the conditions noted at the time of the malfunction.
3. If Technical Support determines that service is needed, they will ask your company to fill out the RMA form and pre-approve a specified monetary amount for repair charges. When the form and pre-approval is received, Technical Support will assign an RMA (Return Material Authorization) number.
4. Clean the product as described in the manual.
5. If the product contains a removable battery, remove and retain it unless you are returning the system for a refund or Technical Support states otherwise.
6. Carefully pack your product in its original shipping box, if possible.
7. Mark the RMA number clearly on the outside of the box.
8. Send the package, shipping prepaid, to:

In-Situ  
ATTN: Repairs  
221 East Lincoln Avenue  
Fort Collins, CO 80524

The warranty does not cover damage during transit. In-Situ recommends insurance for all shipments. Warranty repairs will be shipped back prepaid.

### Outside the U.S.

Contact your international In-Situ distributor for repair and service information.

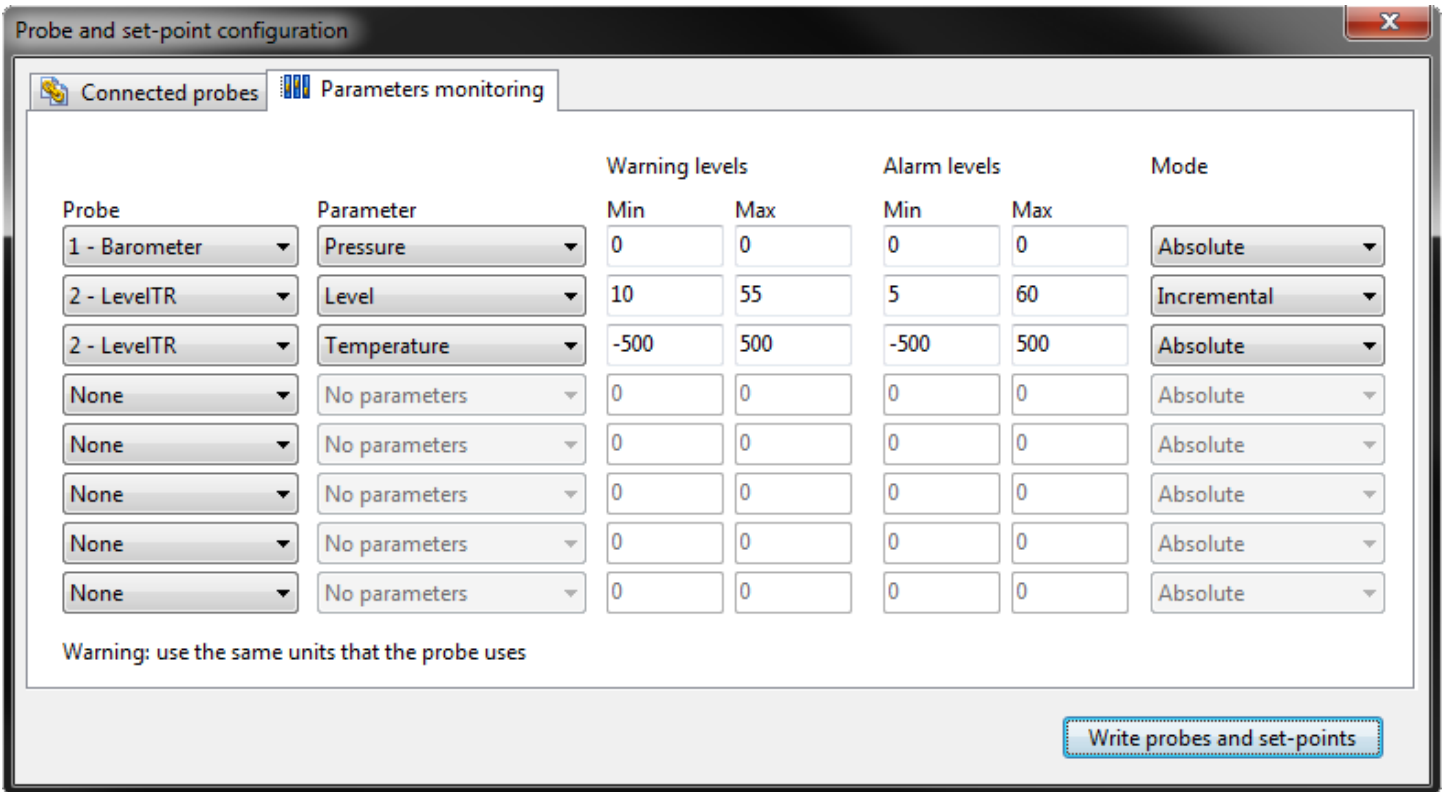
## Appendix - Alarms

### Alarms - Overview

The Tube monitors up to eight parameters that trigger warnings and alarms based on measurement values compared to a set of thresholds. Each alarm must be in either Absolute Mode or Incremental Mode.

When a warning is triggered, the measurement is stored in the log memory even if the Tube is not designated to save that reading. When an alarm is triggered, the reading is stored and an alarm message is sent (if the corresponding alarm has been enabled).

Alarm Mode is set in the Probe and Set-Point Configuration Menu, under the Parameters Monitoring tab.



### Absolute Mode

In Absolute Mode, alarms and warnings occur when a measurement value is less than the minimum threshold value or greater than the maximum threshold value.

Minimum Level Value	Maximum Level Value	Measurement Value	Result
1	15	16	ALARM
1	15	1	OK
1	15	15	OK
1	15	0	ALARM
-2	10	1	OK
-2	10	-3	ALARM
-2	10	-2	OK
-8	-3	-2	ALARM
-8	-3	-5	OK
-8	-3	-9	ALARM
-8	-3	-8	OK

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## Incremental Mode

In Incremental Mode, alarms and warnings occur when the difference between two consecutive measurement values is less than the minimum threshold value or greater than the maximum threshold value. This difference means the alarm threshold is a slope instead of a fixed value.

Minimum Threshold Value	Maximum Threshold Value	Current Measurement Value	Previous Measurement Value	Measurement Delta	Result
10	60	200	150	50	OK
10	60	199	200	-1	ALARM
-50	50	300	260	40	OK
-50	50	300	200	100	ALARM
-50	50	200	240	-40	OK
-50	50	400	500	-100	ALARM
-6000	200	0	1000	-1000	OK
-6000	10	130	110	20	ALARM
-6000	10	130	125	5	OK
-10	8000	150	165	-15	ALARM
-10	8000	1200	0	1200	OK

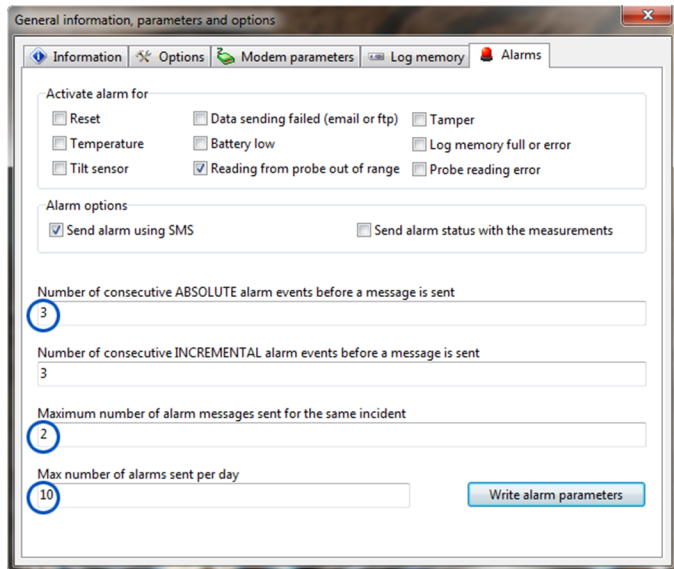
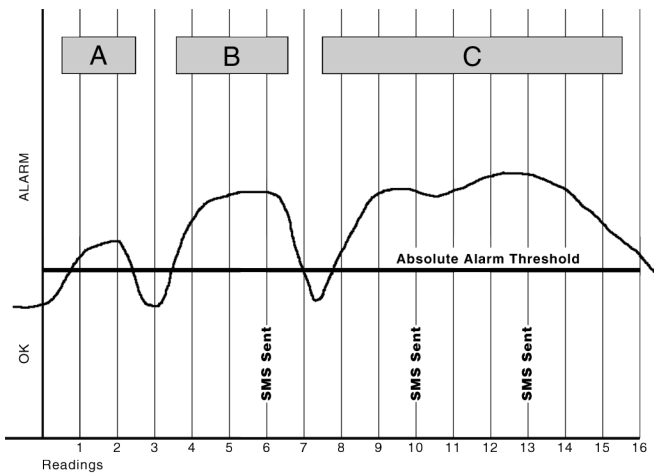
### Tips:

- Minimum Threshold values should be negative, otherwise a decreasing parameter will always generate an alarm.
- Maximum Threshold values should be positive, otherwise an increasing parameter will always generate an alarm.
- Set Minimum Threshold values to large negative numbers to disable alarms for decreasing values (see the green values above).

## Probe Out of Range SMS Alarms in Absolute Mode

The Tube can send SMS (text) messages when alarms are triggered. SMS alarms are enabled in the General Information, Parameters, and Functional Options section on the Alarms tab.

Below is an example situation showing when SMS messages would be sent for the "Reading from Probe Out of Range" alarm with the following settings.



In Absolute Mode, alarms and warnings occur when a measurement value is less than the minimum threshold value or greater than the maximum threshold value.

The example shows three incidents labeled A, B, and C.

**Incident A:** No SMS alarm is sent. Only two consecutive measurements exceed the alarm threshold, while the requirement set above is 3 consecutive measurements.

**Incident B:** An SMS alarm is sent on the third consecutive measurement exceeding the alarm threshold (reading no. 6).

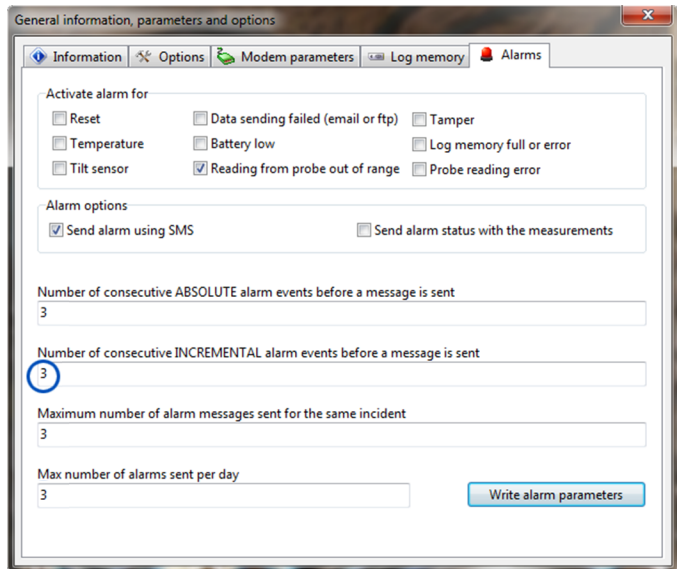
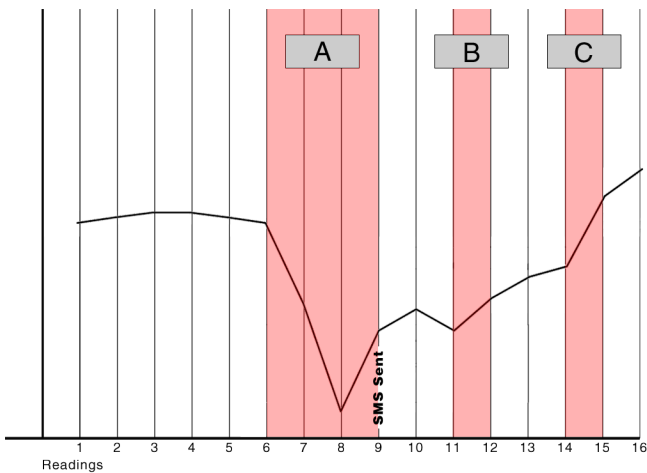
**Incident C:** An SMS alarm is sent on the third consecutive measurement exceeding the alarm threshold (reading no. 8, 9, 10). A second SMS alarm is sent after the sixth consecutive measurement (reading no. 11, 12, 13). While another three consecutive measurements are above the alarm threshold (14, 15, 16), no SMS alarm is sent because the maximum number of messages sent for the same incident is set at 2.

In this scenario, SMS alarms are disabled for the rest of the day after the 10th SMS message is sent.

### Probe Out of Range SMS Alarms in Incremental Mode

The Tube can send SMS (text) messages when alarms are triggered. SMS alarms are enabled in the General Information, Parameters, and Functional Options section on the Alarms tab.

Below is an example situation showing when SMS messages would be sent for the "Reading from Probe Out of Range" alarm with the following settings.



In Incremental Mode, alarms and warnings occur when the difference between two consecutive measurement values is less than the minimum threshold value or greater than the maximum threshold value. This difference means the alarm threshold is a slope instead of a fixed value.

The example shows three incidents labeled A, B, and C.

**Incident A:** An SMS alarm is sent on the third consecutive set of measurements where the delta exceeds the alarm threshold (reading no. 6-7, 7-8, 8-9).

**Incident B:** No SMS alarm is sent. Only one consecutive set of measurements exceed the alarm threshold, while the requirement set above is 3 consecutive measurements.

**Incident C:** No SMS alarm is sent. Only one consecutive set of measurements exceed the alarm threshold, while the requirement set above is 3 consecutive measurements.

In this scenario, SMS alarms are disabled for the rest of the day after the third SMS message is sent.