Lat-Lon Solar Tracking Unit (STU)
With Sensor Options

User's Guide and Installation Instructions

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X15500
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LAT-LON, LLC, A Geotab Company
2300 S. Jason Street
Denver, CO 80223
877-300-6566 Phone 303-531-5754 Fax
www.lat-lon.com

LEGAL INFORMATION

EXPORT CONTROLS
This product contains commodities, technology or software that fall within the Export Administration regulations. Diversion contrary to U.S. law is prohibited.

FCC NOTICE: This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
• Reorient or relocate the receiving antenna.
• Increase the separation between the equipment and receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.
• It is strongly recommended that the TV be plugged into a separate wall outlet.
This equipment has been verified to comply with the limits for a class B computing device, pursuant to FCC Rules. In order to maintain compliance with FCC regulations, shielded cables must be used with this equipment. Operation with non-approved equipment or unshielded cables is likely to result in interference to radio and TV reception. The user is cautioned that changes and modifications made to the equipment without the approval of manufacturer could void the user's authority to operate this equipment.

RF Exposure Notice: The antennas used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be located or operating in conjunction with any other antenna or transmitter.

ISED Notice: This device complies with ISED Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

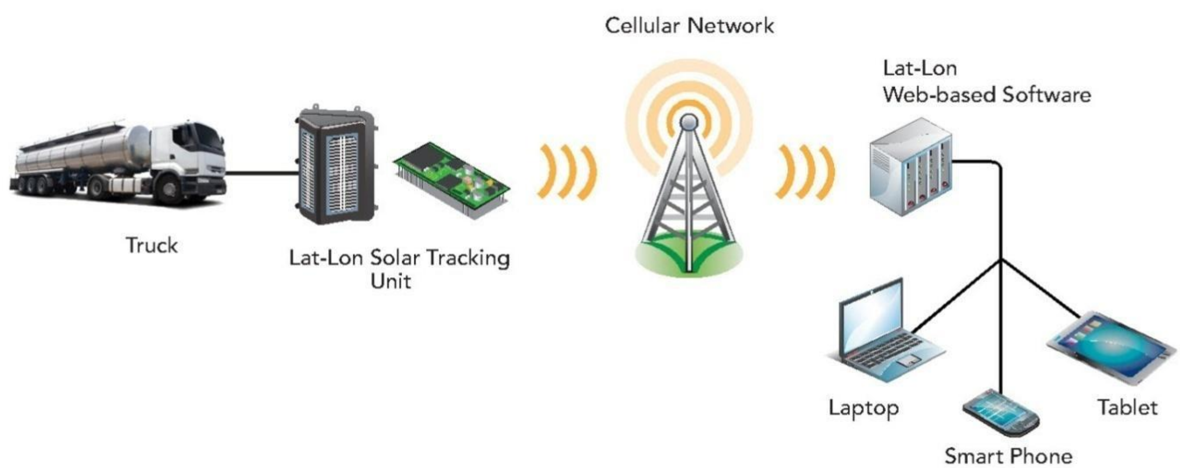
Contents

STU BASIC INFORMATION

SYSTEM OVERVIEW

The Lat-Lon Solar Tracking Unit (STU) is a wireless data system that monitors several parameters on a trailer, railcar, locomotive or any other asset including GPS data, and sends that data from most any location worldwide to Lat-Lon's database and website. The cellular modem communicates via the GSM or CDMA digital cellular network. The STU is configured to transmit on a near real-time basis.

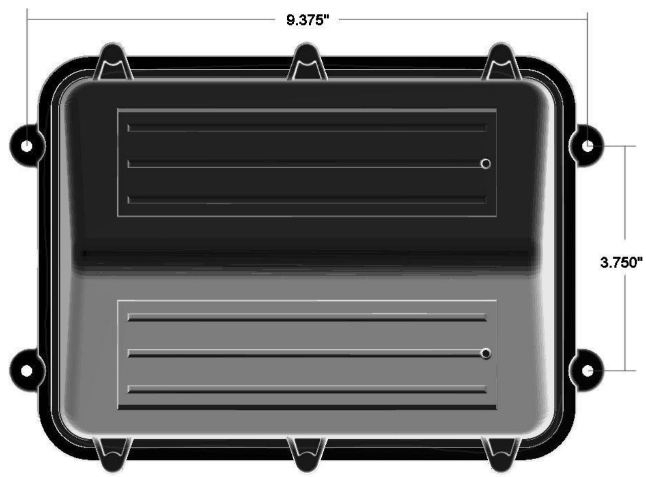
Notes on GPS:
GPS receivers such as the STU use the GPS satellite system to get their latitude and longitude (position) as well as exact time. GPS satellites transmit data to GPS receivers on earth. There is no two-way communication between satellites and receivers. GPS receivers must have a clear, unobstructed view of the sky in order to see satellites to get location and time information. Satellites must be in the "line of sight" of the unit. Nearby obstructions like buildings, trees or tunnels can obstruct the sky view and degrade or prevent GPS reception.



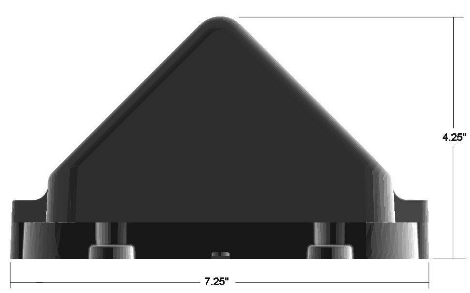
HARDWARE

Included Hardware

The STU is a self-contained unit (triangular box 9.75” x 7.25” x 4.25”) that includes everything that is required to track an asset. The unit contains an internal GPS receiver, a data communications cellular modem and an internal rechargeable battery. Some STUs also include an external 9v battery that is meant to “boost” the charging of the unit but is not required for operation.



STU top view



STU end view

BACKGROUND INFORMATION

STU Operation

The STU is designed to be outside on an asset in a vertical orientation either on the side of the asset or horizontal on the top. The STU has an internal GPS antenna that must have a clear view of the sky. The optimal mounting (due to the internal antenna placement) is for the unit to be horizontal (solar panels facing the sky), but this is not required. You want to mount it so that it has access to as much sky as possible.

The unit gets its power to operate from the sun. Solar power is used to keep the internal batteries and power system charged. The ideal position is one that optimizes the chance of getting direct sunlight sometime during the day.

Once the unit is installed (or put outside in the sun) it should start reporting within an hour or two. It can report up to every 10 minutes while moving (Moving Timed) and every hour while stopped (Timed). The Moving Timed reports are over the air programmable but cannot be set more frequently than every 10 minutes while moving. The Timed Reports are also over the air programmable in intervals of 1 hour. This means that it will start reporting every 1 hour from the hour/minute that it wakes up. If the unit cannot get out a message, then the unit will store the message and try to send it out at the next report time. The two possible reasons that a message will not be sent immediately are:

1. The unit cannot communicate with a cell tower
2. The power of the unit has dropped below its normal operation threshold

Communication requires enough proximity to a cell tower for adequate signal strength and the ability of the unit to reach the Lat-Lon website for validation that the message was received.

STU Power

During shipping the internal battery of the STU rapidly drains because the unit attempts to establish a GPS fix and cellular communications without the solar voltage input. Therefore, the STU will most likely have a depleted battery when received.

NOTE:
The STU will most likely have a lot of saved messages in its queue when it arrives. This is due to it being charged during testing and then put in a box. You can clear the message queue through the administration part of the Lat-Lon website. Please consult the Website Manual.

To initialize the unit, place the STU outdoors where it can get a GPS fix with a good view of the sky. Placing the STU in direct sunlight is the quickest way to charge the internal battery. We recommend getting the unit in the sun at least one full day prior to your scheduled usage. The internal battery can take up to 3 days in good sun to fully charge.

The power level of the STU is reported in each message as “BATT_VOLTS”.
“SOLAR_INPUT_VOLTAGE can also be used to determine whether the unit is getting sun or not. The tables below describe the meaning to these values.

NOTE: if the Batt_Volts are above 3.51v, the unit disconnects from its internal batteries and runs completely on solar power. This allows us to save the battery energy for when needed and allows us to maintain a long battery life. The less battery cycles, the longer lifespan of a battery.

Description	**BATT_VOLTS**
Battery is discharged	< 3.0V
Partially charged	3.1-3.3V
Fully charged	3.4-4.5V

Description	**Solar_Current_Input**
No sun on the solar panels	0
Full sun on the solar panels	200-255

It is important to note that keeping a STU inside for a long period of time will cause a slow degradation of the internal batteries. So, if possible, always keep the unit(s) outside.

9V Charging Option (available only on units with Magnet Mounting Option)
On average it will take the STU (not in the sun) approximately 1 hour to power up with a 9V battery.

Note:
The 9V battery helps speed up the start-up time of the STU but is not required for normal STU functionality. The unit requires sun to start reporting. The 9v battery is only intended to help boost the unit’s charge.

There are several options for 9V batteries. The most common battery, available at grocery and drug stores etc. use alkaline chemistry. The advantage of the alkaline 9V battery is that it is commonly available, inexpensive and can be shipped by air, the downside is that it has less energy than the more advanced Lithium battery. We have an inventory of Lithium Ultralife 9V batteries that have the highest amount of energy storage available. We provide one of these at the time of initial purchase, but additional batteries can be purchased separately.

GPS Module
The Lat-Lon system has high sensitivity WAAS GPS that has a position accuracy of 2.5 meters CEP (Circular Error Probable). This equates to 6.25 meters 95% of the time.

The STU can achieve different qualities of location fix. It reports this quality level by reporting how many satellites were used in the solution. The more satellites used, the better the location precision. Solutions with less than six satellites may be less accurate and solutions with only three satellites may have degraded location and/or speed precision.

STU Reporting Types
The STU will report 5 ways as follows:

1. Timed report (default=every2 hours) – over the air programmable - up to every hour when not moving
2. Move Begin or Move End messages
3. Move Timed (default=every 60 min) – over the air programmable - up to every 10 minutes
4. Sensor Alarms (dependent on if any sensors purchased)

    Timed Reports – A message to update the location of the STU and asset to which it is attached when stationary.
    Move Begin Reports – A message to update the location of the STU and to report that the STU has started moving.
    Move End Report – A message to update the location of the STU and to report that the STU has stopped moving.
    Move Timed Report – A message to update the location of the STU while it is moving.
    Sensor Alarms – A message to alert you of a sensor alarm. Messages include: Impact Alarm, Deceleration Alarm, RF Trigger, Digital 1 Alarm, Digital 2 Alarm, Temperature Alarm

STU Data

The STU will report the data listed below. For a full list of data fields please review the website/administration manual. Additional information will be reported if sensors were purchased.

1. Message origination date/time (time stamp from the STU for the event)
2. Unit/Asset name
3. Message type
4. Latitude and longitude
5. Speed
6. Elevation
7. Course
8. Nearest Town, state/province, country (Geography)
9. System voltage
10. Messages in queue
11. Firmware version

STU MOUNTING INSTRUCTIONS

Items Provided
STU unit (triangular box 9” x 7.25” x 4.25”)

Items Needed
Lift, ramp or other approved system able to reach mounting location

Installation Procedure

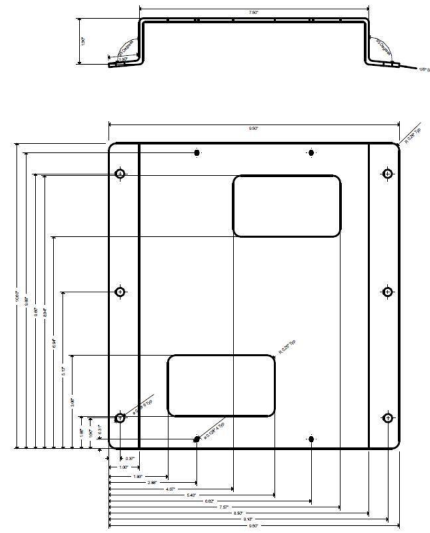
1. Remove the STU from its delivery box
2. We HIGHLY RECOMMEND putting the STU outside in direct sun as soon as possible to allow for solar charging of the internal batteries (even if you are not installing right away). If the internal batteries are depleted, then the STU will require at least 2 to 3 hours in the sun to start reporting and up to 3 days to charge its internal batteries fully.
   NOTE: if your unit has magnetic mount then it also has a choice for a 9volt battery installation on the back of the unit. See the information on page 6 regarding 9v battery options.
3. Determine mounting location on an asset. A suitable mounting location has the following:

   A. Provides exposure to the sun; with no shadows on solar panels.
   B. Provides a relatively flat surface for attaching system.
   C. Is high enough so that the unit is out of reach.
   D. Due to transmission of RF signal we suggest installing the STU with a clear view in front of it. However, we understand this is not always possible therefore, a good rule of thumb would be to have at least 6 feet of clearance in front of the STU in order to avoid reception problems.
   E. Unit can be placed lying down on top of the asset or placed on the front, back or side of the asset. Note the black sticker is the TOP, if placing the unit on the front, back or side of the asset.
   F. **It is not recommended to install a magnetic mount unit on the front or back of a non-cushioned railcar due to the possibility of the unit falling off during a large impact event.**

4. Using standard safety procedures, access mounting location with a lift or ladder and attach unit with #10 self drilling screws or bolts. If attaching to the top of a fiberglass trailer, it is recommended to through bolt the unit. (Bolting on the unit is only needed if magnetic mount was not purchased). See additional mounting options below.

<u>IMPORTANT: if you bolt the unit down, we recommend that you DO NOT also silicon around the unit. This inhibits the unit’s vent from “breathing” properly and can cause the unit to pull in water from the outside.</u>

If your unit is magnetically mounted, please do not screw through mounting tabs. This could cause damage to the mounting tabs because the magnets prevent the tabs from being flush with the mounting surface.



SADDLE PLATE AND LOW-PROFILE SADDLE PLATE OPTION(S):
If mounting the unit using the saddle plate option, attach the unit to the asset or car using the 6 mounting holes in the feet of the plate.

If mounting the unit using the saddle plate option with double sided sticky tape, it is very IMPORTANT that you clean the surface first (preferably with denatured alcohol). The surface must be clean for the tape to adhere correctly.

Peel off the sticky tape protective layer and press on to the asset. If installing in cold weather, below 32 degrees, then warming the area or keeping the tape/STU warm before attaching unit is IMPORTANT for adhesion.

Screwing down the saddle plate or low-profile saddle plate:
#14 x 1” self-drilling screw is optimal

NOTE: It is up to the customer to choose the correct length of screw if mounting to a tank car (length depends on the space between the outer tank shell and the inner tank)

OTHER OPTIONS:

Mounting the unit directly with screws (with no mounting plate)
STU Size: 9” x 7.25” x 4.25”
Weight: 2 lbs.

NOTE:
It is recommended that you use a screw no larger than a #10 x ¾ self-drilling screw (depending on application). If a screw is used that is too large, it is possible to damage the plastic which can weaken the integrity of the mounting tab.

IMPORTANT: if you bolt the unit down, we recommend that you DO NOT also silicon around the unit. This inhibits the unit’s vent from “breathing” properly and can cause the unit to pull in water from the outside.

OPTIONAL SENSORS:

STU with WIRED TEMPERATURE SENSOR

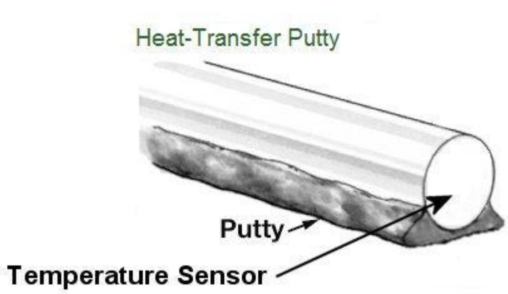
Please follow the instructions (pages 9 and 10) for mounting the STU. The process for mounting the wired temperature sensor depends on the application.

Wired Sensor Specifications
Temperature Sensor: 2” x .25” O.D. x .21” I.D. stainless steel tubing
STU Wiring: 18-gauge pigtail (1 red, 1 black)
Temp Sensor Wiring: 22-gauge (1 red, 1 black)
No polarity.

IMPORTANT FACTS:

1. The wired probe (stainless steel tubing) needs to lay flat on the surface you want to read temperature
2. Mount temperature probe using double sided tape (for more of a non-permanent mount). Make sure that the temperature sensor is touching whatever you are reading the temperature of.

   OR: McMaster 3568K1 Heat Transfer Putty for a permanent mount (specific putty used is optional).
   a. Mold putty around the temperature probe and stick it directly to the tank
   b. Wait 6 hrs. for putty to harden (Sets to a rock-like hardness in 24 hours)
   c. Confirm probe is well seated against the asset once putty has hardened



STU with WIRED DIGITAL / DOOR SENSOR

Please follow the instructions for mounting the STU (pages 9 and 10). The process for mounting the wired door sensor(s) depends on the application.

The Lat-Lon digitals must be completely isolated. No external voltage can be applied to them. They are just an open/closed circuit. When you make the loop (complete the circuit) the digital shows closed. When you break the circuit the digital shows open.

Door Sensor (purchased from Lat-Lon) Specifications
Honeywell Door Sensor: 2”x2”x36” (white wires)
Wiring: 18-gauge wiring (1 red and 1 black wire)

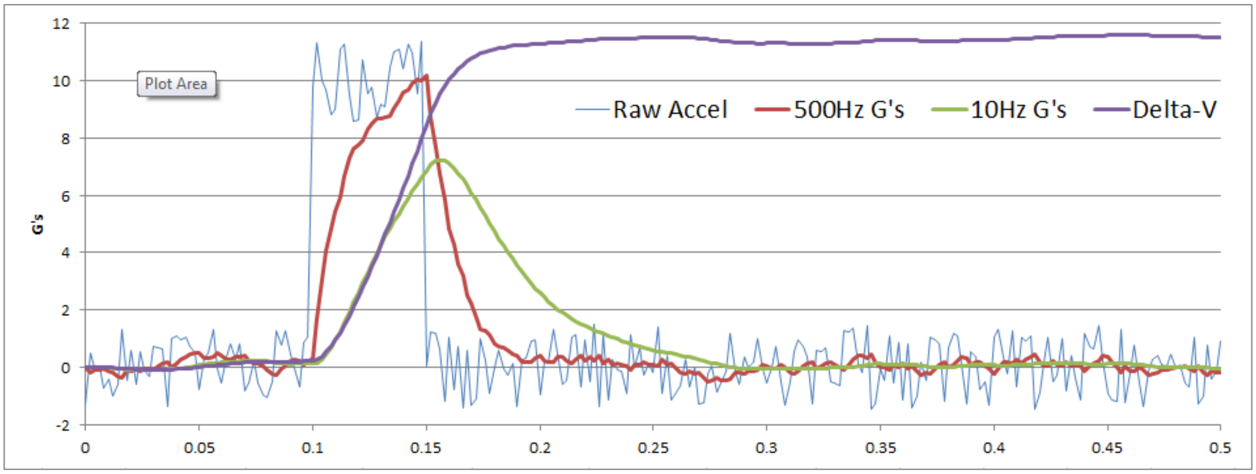
1. Splice and connect each wire. White to red and white to black.
   - A quick way to do this is to use insulated butt connectors.
2. If this connection is going to remain outside in the weather, you will need to weatherproof it by using something like heat shrink over your connection.

IMPACT DETECTION OPERATION

Overview
The STU can be equipped with an optional 16G 3-axis accelerometer. If equipped, the accelerometer includes three 10Hz first-order analog filters, one on each of the X, Y and Z axes. The outputs of each axis are sampled 200 times per second (Hz) in order to detect the beginnings of an impact. If one of these 200 Hz samples exceeds a threshold of 0.5 G's, the sampling rate increases to 500Hz for up to 0.5 seconds to precisely capture the impact event with high resolution. If any thresholds are exceeded, then a GPS message with an impact data summary and detailed graph is created.

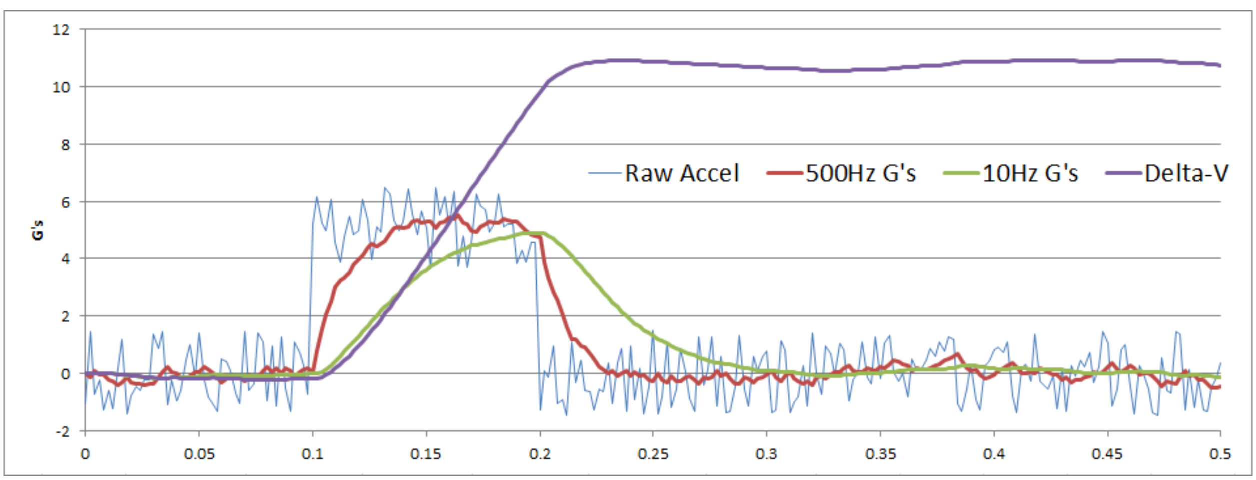
A long-term averaging of the X, Y and Z axis outputs provides a "zero" value for each axis to avoid the need of a zero-value calibration or mounting orientation. Two derived parameters are also generated during an impact event. The first parameter is a mathematically averaged value of acceleration in each axis. This is referred to as the 10Hz G value which is reported by the unit. The second parameter is an integration (summation) of each axis' acceleration to create an "area under the curve" which becomes the change in velocity or delta-V. Thresholds for creating a message can be set on the 500Hz G value, 10Hz G averaged value and/or the delta-V across all three axes. These thresholds can be changed over-the-air via the Lat-Lon website (see the Website Manual for more information).

Below is an EXAMPLE ONLY chart of a high G force, short interval impact. The peak acceleration sampled (after going through the analog 10Hz filter) at 500Hz is 10G's (red plot). The peak acceleration calculated with the 10Hz mathematical filter is 7G's (green plot). Because of the relatively short duration of the impact, the 10Hz mathematically averaged value is substantially less than the 500Hz sampled maximum. The difference between the two filtered values (500Hz and 10Hz) will be large during this type of "shock" impact. The thin, light blue plot is the unfiltered output of the accelerometer which contains a lot of vibration noises that are filtered by the analog 10Hz filter. The analog 10Hz filter consists of a resistor feeding the signal into the top of a grounded capacitor which acts to smooth the signal enough to allow for sampling without picking up all the high-frequency noise. The delta-V (purple plot) goes from zero to about 11 MPH during the impact. One G of acceleration over a one-second interval of time will result in a change of speed of 22 MPH. In the plot below we have 10 G's of acceleration for 0.05 seconds which gives 11 MPH of delta-V.



The delta-V measures the net change in speed associated with the impact event. For a railcar coupling to another railcar, the delta-V will be approximately the approach speed between the two cars. This becomes less true if the car being hit moves after being hit. In this case the change in speed is less than the approach speed because the approaching car did not come to a stop, but only slowed down during the impact. The delta-V can therefore give a window into the approach speed of the railcar prior to the impact. In general, it will underreport the speed because the impacted railcar will be moved by the impacting railcar and not stop it completely.

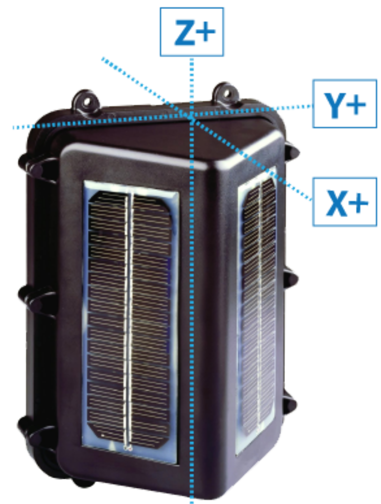
In the EXAMPLE ONLY chart below the impact is a lower G force, longer interval impact than the previous example. The peak acceleration measured at 500Hz is 5G and the peak acceleration calculated with the mathematical 10Hz filter is also nearly 5G. This means that the impact lasted long enough for the 10Hz mathematical filter to "catch up" with the 500Hz sampling values of 5G. The delta-V rises to the same value of about 11 MPH because the G's is half of the previous example, but the duration is twice as long.



The potential for damage to a load is dependent on both how high the acceleration is and how long it lasts. Very short duration high-G shocks cannot transmit their energy into the load because the lading, straps, mounting pallets and so forth "soak up" the shock by sliding, stretching and compressing the various dunnage and packing materials. If the impact lasts longer, then the dunnage reaches its limits to absorb the change in motion between the railcar and the goods being shipped. At that point the straps, airbags and various packing materials begin to impart large forces onto the shipped product.

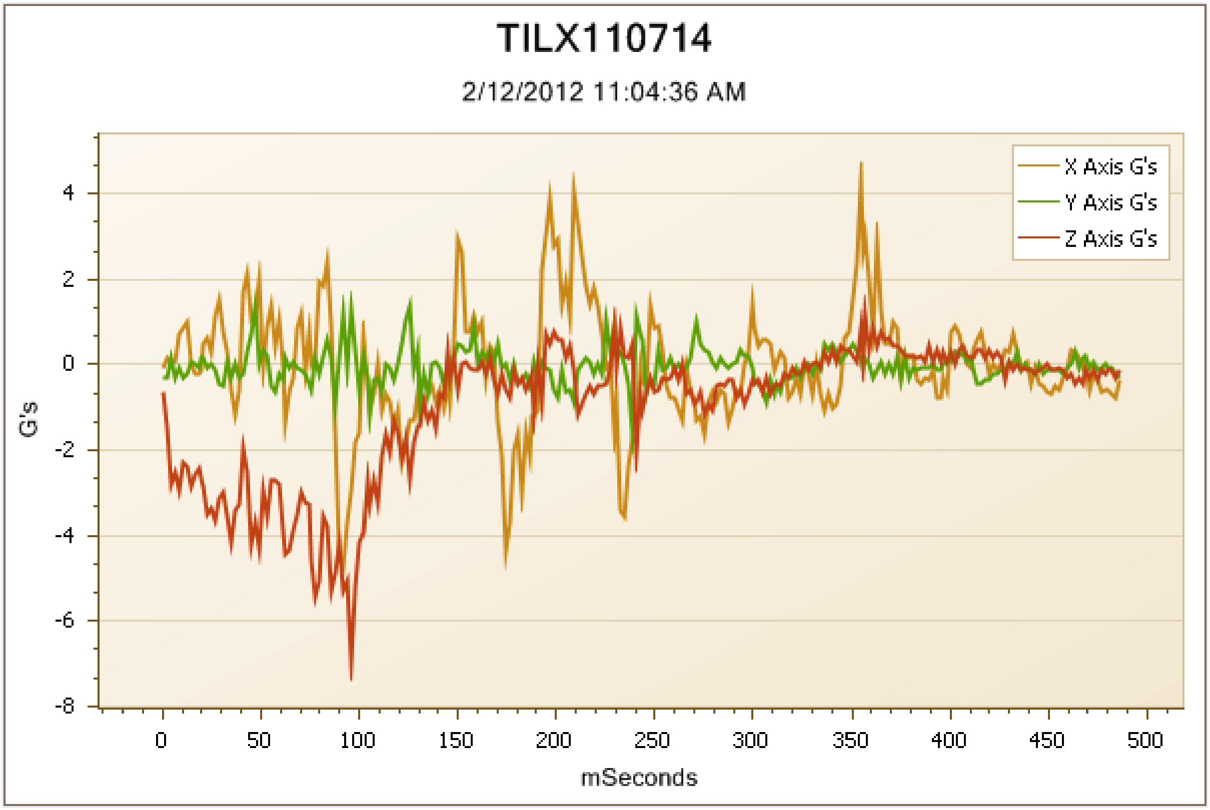
Alarm Event
An impact ALARM can be sent to your email address, or text message cell phone (contact the administrator of the Lat-Lon account within your company to have this set up).

The ALARM event will give you the following information:
Time of the event
GPS coordinates, including nearest town
X axis acceleration (10Hz and 500Hz filtering) and delta-V (MPH)
Y axis acceleration (10Hz and 500Hz filtering) and delta-V (MPH)
Z axis acceleration (10Hz and 500Hz filtering) and delta-V (MPH)
(The direction of the impact occurs by seeing which axes shows a higher value)



Impact Coordinates
The Lat-Lon STU/I uses these coordinates (see picture) to report its impacts.

Impact Charts
Lat-Lon charts the impact for you. You will be able to see the entire impact event, direction the impact occurred and duration of the impact. Below is an actual impact from a tank car where the Z-axis is the longitudinal axis of the car (along-track) and the X-axis is the vertical axis of the car (upward). One can see the red plot stay well below zero for about 150 milliseconds. The peak 500Hz G value in the X-axis is about a negative 7G's. Although the message will transmit an accurate delta-V value, one can make a quick estimate looking at the X-axis plot below. One can say the average acceleration during the 150mS impact period is about 2.5 G's. Hence 2.5G times 0.15 seconds times 22 MPH comes out to about 8 MPH. One can also see quite a bit of vertical accelerations up and down in the brown plot. In this axis, the net delta-V is somewhat small because the ups cancel the downs. The green plot is the side-to-side (lateral) orientation of the car and has less activity which is expected.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250
300
350
400
450
500

WIRELESS SENSORS

- Dimensions: 3.02" x 2.02" x 1.02"
- Weight: 4 oz.
- Frequency: 2.4GHz
- Transmission:
  Mesh RF: Every 10 seconds
  X100 RF: Every 1 min for tilt and every 4 min for temperature
- Run Time: 5-10 years depending on settings
- Range: see below

Specifications

Antenna – keep as free from other objects as possible
Power Reed Switch – a magnet here will put the sensor to sleep, the LED light will stop blinking

Lat-Lon STUs have 2 different wireless sensors options:

1. Mesh RF – up to 31 sensors per STU. Serial numbers are 16 digits long.
   Range = 100 feet line of sight to other sensors or 200 feet line of sight to STU
2. X100 RF – up to 3 sensors per STU. Serial numbers are 4 – 6 digits long.
   Range = 100 feet line of sight to STU

Each Mesh RF or x100 RF sensor can measure:

1. Tilt in two different axes (X and Y)
2. Door/hatch open/close via magnetic reed switch
3. Temperature (external wired temp sensor coming out of RF)
4. Its own internal battery voltage

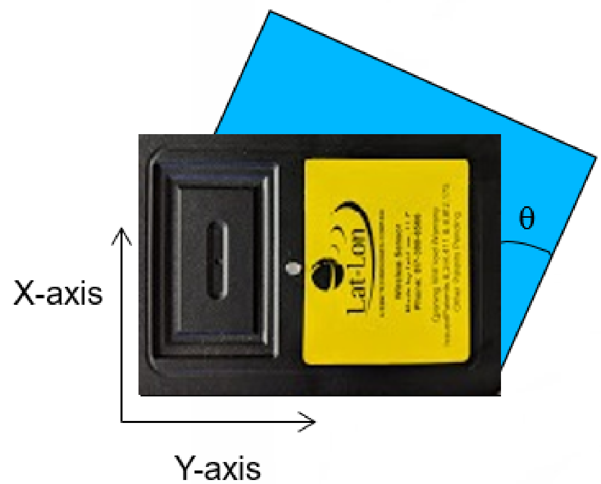
Reed Switch
The digital reed switch works by losing and gaining an applied magnetic field. This change of state can tell whether the door/hatch was opened or closed. It can be useful if the door hinge is vertical where the tilt sensor cannot detect the opening.

Tilt
When installing the sensor on a hatch, please read the instructions below carefully. The analog tilt values for alarming on open and closed hatch have already been set by Lat-Lon (per the orientation in our instructions on PAGE 25 below).

Tilt Analog Values:
When the hatch is closed and the sensor is lying flat the analog value = 500 (X), 500 (Y)
When tilted at 45 degrees the analog value = 510 (X), 400 (Y)
When tilted at 90 degrees (i.e. hatch is open) = 510 (X), 460 (Y)
The open/closed hatch alarm is set for the Y axis at a value of 400.

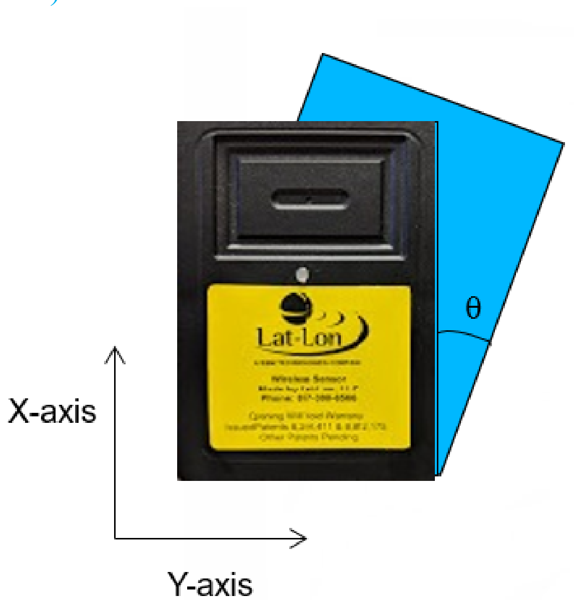
ADDITIONAL TILT TECHNICAL INFO – MESH SENSORS (Mesh sensors have 16 digit serial numbers):

- Change in X or Y reading is approximately 143 per G* (scale factor)
- Zero-G reading is approximately 510*
- If Y-axis reports 520 with RF sensor shown at left (sitting on left side), then it will report 520 + 143*sin(q) as it tilts
- If X-axis reports 370 with RF sensor shown at left (sitting on left side), then it will report 513 - 143*cos(q) as it tilts
- To calculate a change in tilt angle given a change in Y-reading:
  q = sin-1 (DY/143)
- To calculate a change in tilt angle given a change in X-reading:
  q = cos-1 (DX/143)
- If a sensor is mounted as shown at left, use Y-axis to compute angles. If it is mounted on the bottom, use X-axis to compute angles.



* Scale factor and zero-G reading will vary from part to part

ADDITIONALTILT TECHNICAL INFO – x100 RF SENSORS (x100 sensors have a 6-digit serial number):



- Change in X or Y reading is approximately 143 per G* (scale factor)
- Zero-G reading is approximately 510*
- If Y-axis reports 520 with RF sensor shown at left (standing on end), then it will report 520 + 143*sin(q) as it tilts
- If X-axis reports 370 with RF sensor shown at left (standing on end), then it will report 513 - 143*cos(q) as it tilts
- To calculate a change in tilt angle given a change in Y-reading:
  $q = \sin^{-1}(DY/143)$
- To calculate a change in tilt angle given a change in X-reading:
  $q = \cos^{-1}(DX/143)$
- If a sensor is mounted as shown at left, use Y-axis to compute angles. If it is mounted on its side, use X-axis to compute angles.

* Scale factor and zero-G reading will vary from part to part

MESH RF and X100 SENSOR INSTALLATION

It is recommended that Mesh RF Sensors have a direct line of sight to a STU or another Mesh RF Sensor. Mesh sensors can send their communications through other sensors and/or directly to the STU.
**100-foot line of sight to a sensor or 200-foot line of sight to the STU.

It is recommended that x100 RF Sensors have a direct line of sight to the STU. These sensors can only send their communications DIRECTLY to a STU.
**100-foot line of sight to a STU.

General Installation

1. RF Sensors have a serial number and are keyed to a specific STU. Make sure you mount the correct RF Sensors with the correct STU. This “match” can be found as a label on the STU, your packing slip or through the Administration/Units/Configuration part of the website.

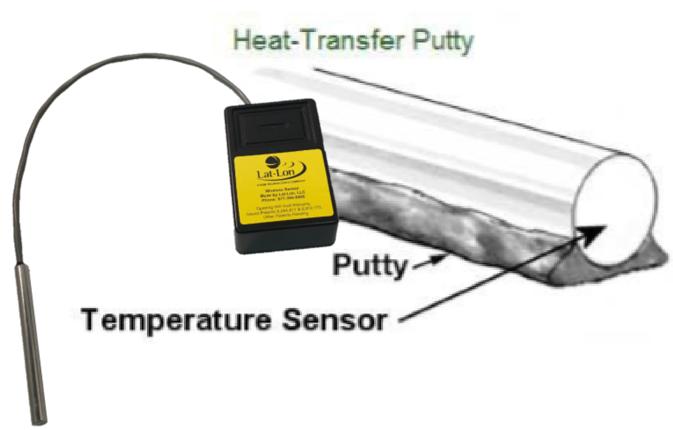
   NOTE: If a mistake in the pairing of sensor to STU is made during installation, please call Lat-Lon. It can be changed over the air.

2. RF sensors can be mounted in several ways. The recommended way is to use silicone and wire ties.
3. Clean the back of the RF Sensor with alcohol to remove grease or oil.
4. Clean the area that the RF Sensor will attach to by removing any grease or oil.
5. Apply Dow Chemical 995 Structural Silicone to back side of the RF Sensor and press on. Press so that the silicone makes contact but not so hard that the silicone squeezes out.
6. Wire tie the RF Sensor to keep it in place while silicone dries. Duct tape or a hose clamp can be used in place of wire ties if needed. Restraint should be applied for at least 12 hours.

Installation of RF Sensor with Wired Temp Probe
(for Mesh and x100 sensors)

If the RF Sensor has an external temperature probe, then mount as follows.

Note that installation depends on the asset you are mounting on. So, please call Lat-Lon with any questions.



When deciding on a location to install the wireless sensor, be aware of the range of the sensor to the STU (information on Page 17 of this manual).

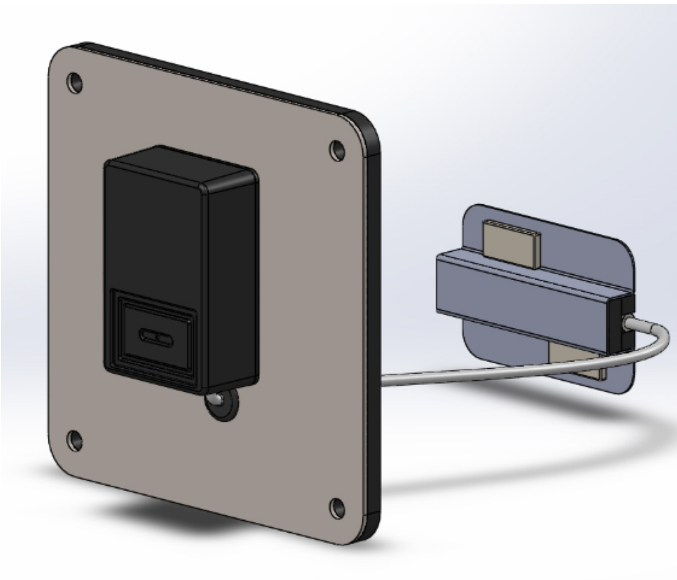
1. Clean asset surface
2. Glue or silicone RF Sensor to asset

Mount temperature probe using McMaster 3568K1 Heat Transfer Putty

1. Mold putty around the temperature probe and stick it directly to the asset
2. Wait 1 hr. for putty to harden (Sets to a rock-like hardness in 24 hours)
3. Confirm probe is well seated against asset once putty has hardened

See next page for Tank Car Temp Probe Installations.

For Tank Car installations, Lat-Lon has an option for using our temperature probe mounting plate below. See Option 1 (for 1 wireless sensor) and Option 2 (for 2 wireless sensors)



OPTION 1:

The Lat-Lon tank car temperature probe mounting plate is designed to be installed on double walled insulated tank cars.

When installing the temperature probe against the inner tank, we supply the following:

- Double-sided thermal tape (not intended to hold the probe to the tank. Only intended for help with heat transfer)
- Structural Silicone – to hold the probe to the tank (Dow Corning 995 Silicone Structural Adhesive)
- Bracket with magnets
- Thermistor probe

When deciding on a location to install the wireless sensor, be aware of the range of the sensor to the STU (information on Page 17 of this manual). We recommend installing the sensor no further down the tank car than ½ of the way down (3 o'clock). And installing the STU on top of the tank car (directly above).

NOTE:
It is recommended that the RF sensor is mounted with the temp wiring on the bottom on the outside of the tank (see picture above). This helps prevent water from running directly down the temperature sensor wiring into the sensor.

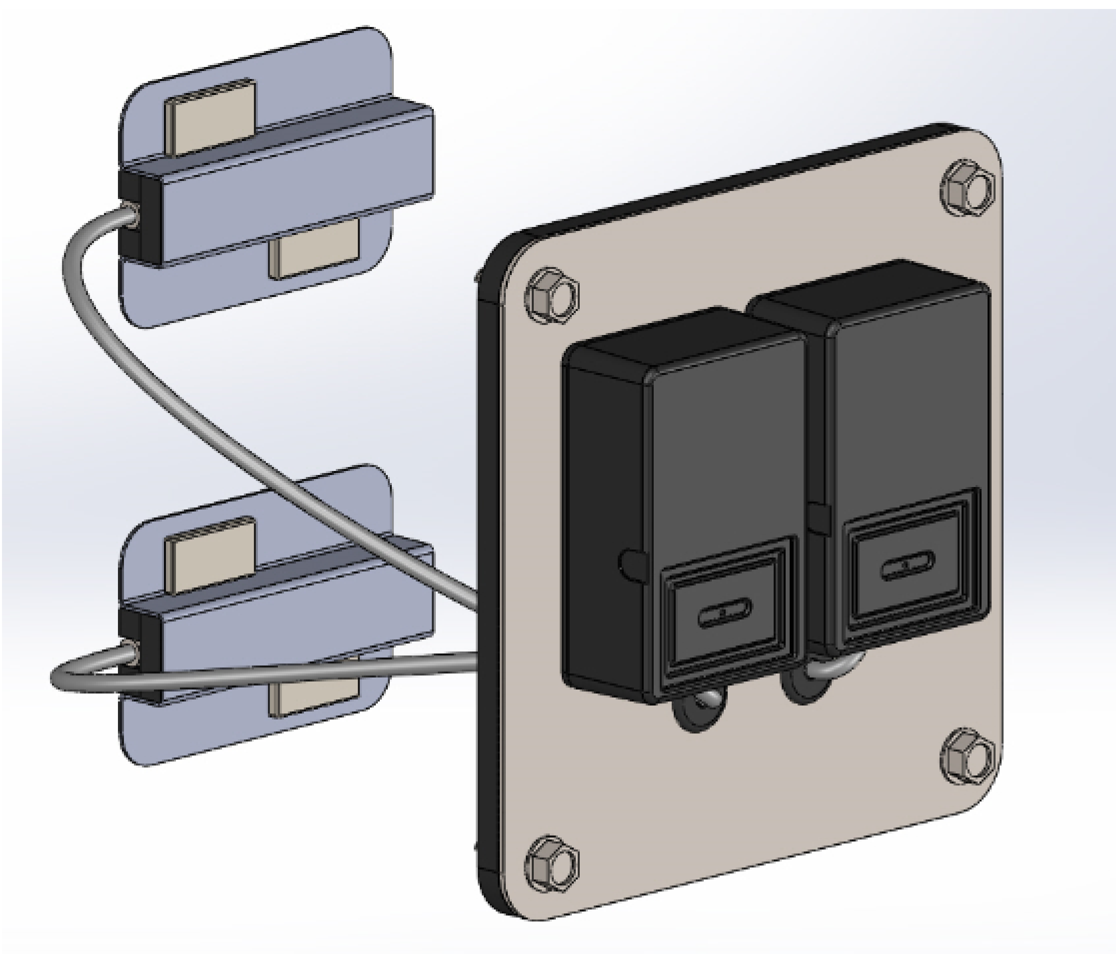
1. Cut 4" – 5" diameter access hole where temperature probe is to be placed on the tank car. Remove any insulation material so that the probe can reach the inner tank.
2. Grasp the bracket assembly on the spine portion and flip such that the bottom flange surfaces are shown as well as the double-sided thermal tape (See Figure 1).
3. Apply structural silicone to both of the flange surfaces as shown in Figure 1 below. NOTE: If the structural silicone is provided by Lat-Lon, it will either be in a small baggie (where you can cut off the corner and squeeze it out), or an entire tube of silicone will be provided.
4. Remove blue covering for thermal tape.

5. Place the bracket assembly on the temperature measuring surface (inner tank) horizontally in line with the tank car. The two magnets should hold the bracket in place as the silicone adheres.
6. Replace any insulation that was removed.
7. Install the plate and sensor on the outside tank. The 6” x 6” plate comes with a gasket to help seal it to the tank. However, for complete water/weather tightness, we recommend you also silicon around the plate.

OPTION 2:

IF INSTALLING TWO (2) WIRELESS TEMPERATURE SENSORS ON 1 TANK:
Lat-Lon recommends installing both wireless sensors on 1 side of the tank, as high up as possible (around 1 or 2 o’clock). Both wireless sensors will be installed on 1 plate (see picture below).

- Cut a hole in the tank (per #1 above)
- Feed the temperature probe and wiring down, in between the tanks, to desired temperature monitoring location.
- Cut a 2nd hole in the tank at that location (follow #2 - #6 above).
- Install the cover plate provided (follow #7 above).



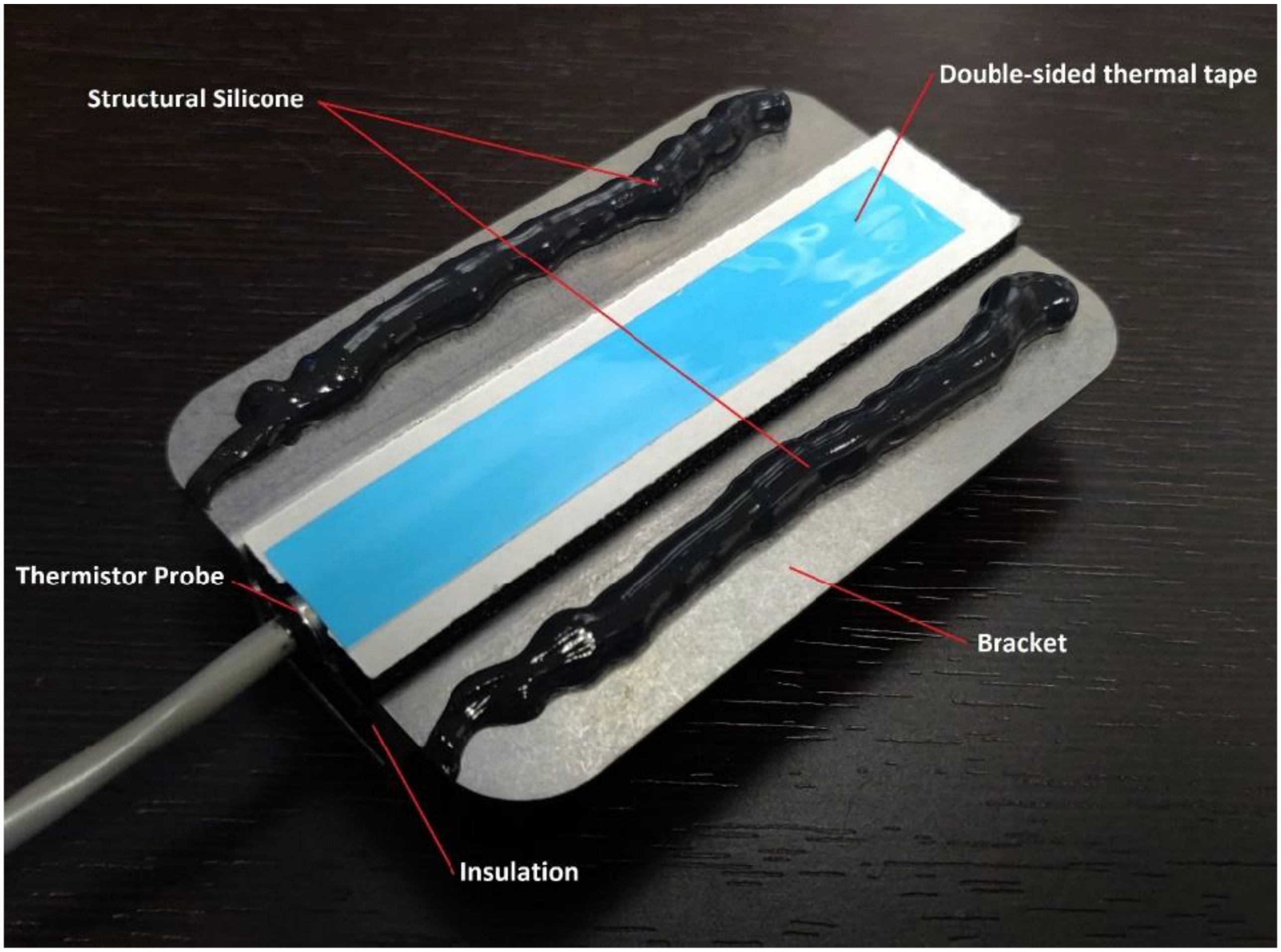


Figure 1: Application of structural silicone to bracket

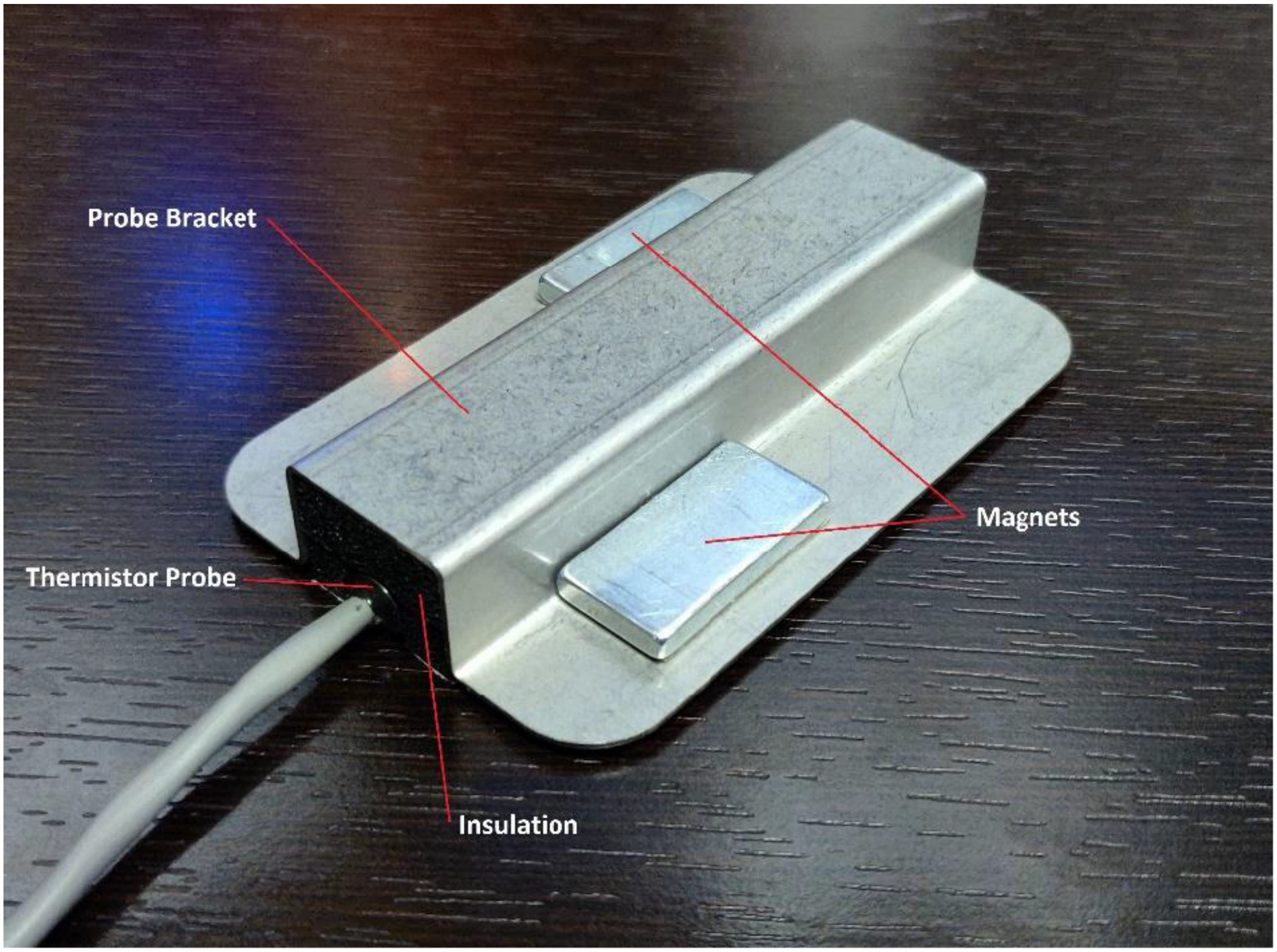


Figure 2: Top side of thermistor bracket

Hand Brake Install (for Mesh and x100 sensors)
The Mesh RF Sensor should be mounted to the bell crank so that when the hand brake is applied it rotates towards the Mesh RF Sensor's upper right corner.

The second option is to use the pivot mounting plate with a cable attached to the chain as shown in the following picture.

Hatch Sensor Install (for Mesh and x100 sensors)

The tilt sensor is intended for sensing hatches that open when hinged horizontally. The axis of the Mesh RF Sensor must be aligned longitudinally. The sensor must be installed on the outside of the hatch so that the STU can receive its transmissions.

1. Clean the bottom of the RF Sensor with soap and water or denatured alcohol to remove finger or other oils.
2. Apply structural silicone or 3M double-sided sticky tape to the back of the RF sender and press onto the middle of the lid (see picture below). The yellow label should be closest to the hinge side of the hatch.
3. If gluing (with silicone), use duct tape, to hold the RF sensor in place while the glue cures.

PRESSURE SWITCH

A pressure switch can be added to any STU or wireless sensor. It is wired to Digital 1. So, alarm message would read "Digital 1 Alarm". This means that the pressure has dropped below 1psi (standard). There will be an external wire and connector coming from the STU (length TBD). Other levels of psi switches are available. We also send a "Digital 1 Alarm" when the switch is initially pressurized.

Message Type: Digital 1 Alarm
Pressure Switch: Alarm under 1psi (will also alarm when pressurized)
Pressure Switch: Normally OPEN

Attributes	Values
Media	Air, Motor Oils, Transmission Fluids, Jet Fuels and other similar hydrocarbon media: Water
Pressure Set Point Range	0.5-150 psi
Factory Setting	0.5-1 psi
Contact Arrangement	SPST-NO, NC
Material	Base: Brass Cover: Glass Reinforced Polyester
Connection	1/4" NPT (Male)
Terminals	1/4" blade

PRESSURE SWITCH INSTALLATION

Please follow the installation instructions for the STU or STU with Impact. It is up to the customer to feed the wiring from the STU or wireless sensor to their pressure valve and hook up with the pressure switch.