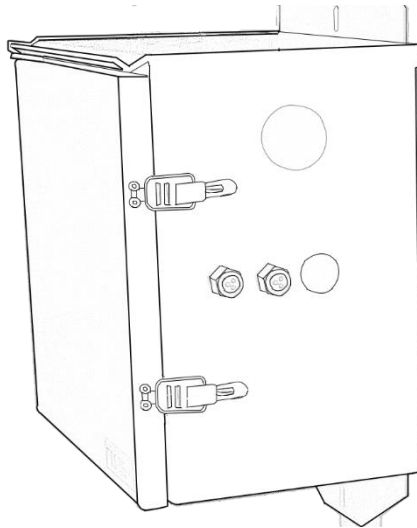




EXTREME ENVIRONMENTS. EXTREMELY RELIABLE.



WP-ENCL-MINI with LT1

Installation and Quick Start Guide

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GENERAL

This guide is meant as a ready reference to set up an LT1-CELL or an LT1-GOES in a Mini enclosure. Details of an LT1 can be found on the FTS Support website (<http://support.ftsinc.com/>) in the following manuals:

- LT1 (Cell/GOES) Operator's Manual (700-LT1-Man)
- FTS360 and FTS360 Config App (FCA) User Manual (700-FTS360-Man)¹

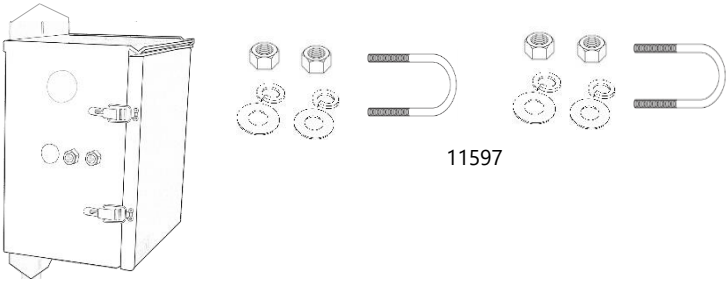
LT1-Cell and LT1-GOES systems are set up exactly the same, with the exception of the placement of the telemetry antennas. LT1-Cell systems come equipped with a dual cellular/GPS antenna; LT1-GOES systems require an externally mounted satellite antenna and the GPS antenna.

The enclosure clasps can be locked with standard padlocks (not included).

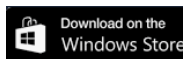
SYSTEM COMPONENTS

Individual components that are shipped will vary in accordance with your order. Each station will consist of an enclosure, an LT1 variant, the telemetry, and a power source. Prior to assembling, examine the shipment and confirm all the ordered parts arrived and are undamaged.

1) ENCLOSURE


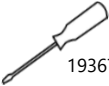

ENCLOSURE-	
ITEM	PART #
Enclosure complete with: <ul style="list-style-type: none">• LT1 Ground Cable 1 (attached in enclosure)• LT1 Ground Cable 2 (attached outside of enclosure)• 2 x U-Bolts with mounting hardware	WP-ENCL-MINI 19465 19484 19480
	






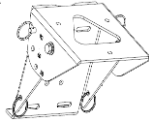
¹ Download at



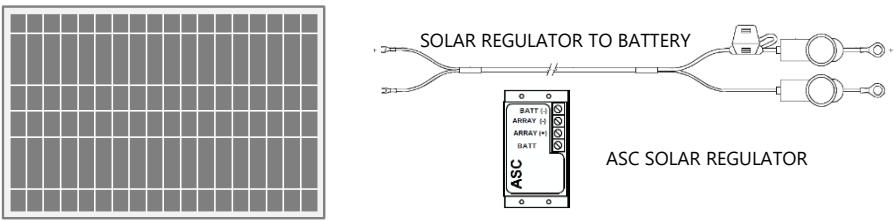
2) LT1 AND TELEMETRY

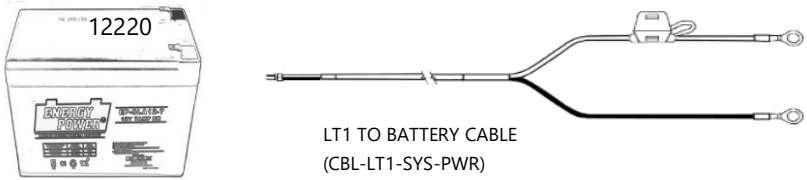
You will have different equipment dependent upon if you ordered an LT1-CELL or LT1-GOES

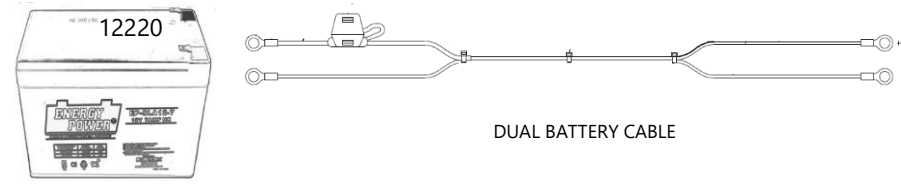
LT1-CELL/LT1-CELL-VZ	
ITEM	PART #
LT1- CELL or LT1-CELL-VZ complete with: <ul style="list-style-type: none"> • 4 pin power terminal block • 8 pin data terminal block • 4 GB SD Card (inserted) Slot Screwdriver Integrated Cellular/GPS antenna OPTIONAL: SIM card (inserted) with purchase of FTS cellular plan	LT1-4PIN LT1-8PIN 19100 19367 18682
LT1-CELL   19367  18682 GPS/ CELL-ANTENNA-	

LT1-GOES	
ITEM	PART #
LT1-GOES complete with: <ul style="list-style-type: none"> • 4 pin power terminal block • 8 pin data terminal block • 4 GB SD Card (inserted) Slot screwdriver SMA to N bulkhead cable GPS antenna EON2 antenna and cable EON2 aimable mount	LT1-4PIN LT1-8PIN 19100 19367 20514 GPS-ANTENNA-WP GOES-ANTENNA-EON2-K EON2-AIMABLE-MOUNT
LT1-GOES   19367  GPS-ANTENNA-WP  Q-RING SMA to N bulkhead cable (GOES-GPS-BNDL only)  EON2 GOES ANTENNA  EON2 aimable mount	

3) POWER SOURCE

SOLAR-PANEL	
ITEM	PART #
20W solar panel complete with: <ul style="list-style-type: none"> • mounting bracket and hose clamps • ASC Solar Regulator • Solar Regulator to battery cable assembly with 2 amp fuse 	SPS-20W-ASC 11560 12841
 <p>The diagram illustrates the solar panel system components. On the left is a rectangular solar panel with a grid of cells. To its right is the ASC Solar Regulator, a small rectangular device with terminals labeled 'BATT (+)', 'ARRAY (+)', 'BATT (-)', and 'BATT (-)'. A cable assembly, labeled 'SOLAR REGULATOR TO BATTERY', connects the regulator to the solar panel. The cable has a fuse and connects to the regulator's 'ARRAY (+)' and 'BATT (-)' terminals. The other end of the cable has two terminals for connection to the battery.</p>	

BATTERY	
ITEM	PART #
12 Volt battery LT1 to battery cable with 5 Amp fuse	12220 CBL-LT1-SYS-PWR
 <p>The diagram shows a 12V battery with '12220' printed on its top. To the right is a cable assembly labeled 'LT1 TO BATTERY CABLE (CBL-LT1-SYS-PWR)'. The cable has a fuse and connects to the battery's positive terminal. The other end of the cable has two terminals for connection to the LT1 system.</p>	

DUAL BATTERY OPTION	
ITEM	PART #
12 Volt battery Dual battery cable	12220 CBL-DUAL-BAT
 <p>The diagram shows a 12V battery with '12220' printed on its top. To the right is a cable assembly labeled 'DUAL BATTERY CABLE'. The cable has a fuse and connects to the battery's positive terminal. The other end of the cable has four terminals for connection to the dual battery system.</p>	

REQUIRED TOOLS AND EQUIPMENT

The following tools are required to mount the LT1 System on a pole mount:

- | | | |
|--|--|---|
| <input type="checkbox"/> ¼" flathead screwdriver | <input type="checkbox"/> 5/16" socket wrench | <input type="checkbox"/> 9/64" hex driver |
| <input type="checkbox"/> #1 Phillips screwdriver | <input type="checkbox"/> 7/16" socket wrench | <input type="checkbox"/> Voltmeter |
| <input type="checkbox"/> 6/8" wrench (or adjustable) | <input type="checkbox"/> 7/64" hex driver | <input type="checkbox"/> Cable ties |

Tools and equipment as required to install pole assembly (if not already installed), mount antennas, and install the earth ground system. Locks to secure the enclosure (optional).

PRIOR TO PROCEEDING TO THE FIELD

IMPORTANT! Prior to proceeding to the field the following MUST be completed

THE ADMINISTRATOR MUST:

- Initialize FTS360 (<https://360.ftsinc.com/signup> or login if FTS initialized FTS360 on your behalf)
- Create a Technician account for the field technician

THE FIELD TECHNICIAN MUST:

- Be invited to Join FTS360 by Administrator
- Download the FCA onto the smart device that will be used in the field (available in the Apple App Store or Google Play. Search for FTS360Config)
- CELL only: Provision the SIM card. Ensure the APN for the SIM card is entered (Go to the FTS Config App's dashboard and select "Cellular" to view/input APN information).
- GOES only: get assigned NESDIS, channels, broadcast times from NOAA/METEOSAT
- Test the LT1*
- Log onto the FTS360 Config App, synchronize with FTS360. **DO NOT LOGOUT**
- Ensure the SD Card and, for cellular units, the provisioned SIM card are inserted
- Bring the required tools/locks

* Details of testing the LT1 are found in the LT1 User's Manual (700-LT1-Man)

SITE SELECTION

Select a site which allows for installation of the supporting structure which is oriented so that the solar panel will have maximum sun exposure and antennas will not be blocked by geographical features, excessive tree canopy, or other obstructions.

MOUNTING THE ENCLOSURE

- 1) Position the enclosure on the pole, slide the U-bolts around the mast and through the mounting bracket holes. Place a flat washer, a split ring washer and a hex nut on the U-bolt posts and then tighten.
- 2) Mount the ASC solar regulator to the back of the enclosure to the left of the DIN rail using the installed bolts on the back panel
- 3) Place the battery in the bottom of the enclosure

MOUNTING THE SOLAR PANEL

Position the solar panel on the pole for maximum sun exposure and secure with the clamps.



DO NOT ATTACH THE SOLAR PANEL CABLE TO THE SOLAR POWER REGULATOR AT THIS TIME!

Electrical connections to the regulator should be done in the correct sequence to prevent any damage to the system.



GROUNDING THE SYSTEM

An external earth ground wire **MUST** be attached between the earth grounding system and the exterior grounding lug on the back of the enclosure to provide protection from lightning and other electrostatic discharge.

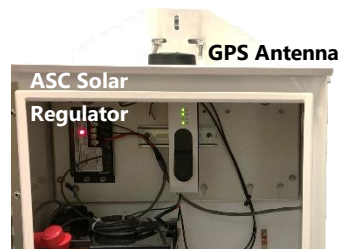
IMPORTANT! FTS recommends that you consult a qualified professional to ensure adequate earth ground protection is installed for the site and that all local regulations are met.

INSERTING THE CABLES

Sensor and solar panel cables should be fed through either of the cable glands located on the side of the enclosure. Each gland is capable of holding three cables. Loosen the gland nut, feed the cables through and tighten the nut.



5



Vent cover

Sensor/solar panel Cable
Glands

GOES antenna
Cable Gland

If a GOES unit, remove the GOES antenna cable gland cover. Remove the hex nut and washer from the SMA to N bulkhead cable (part #20514) and insert through the cut out, replace and tighten the washer and hex nut.

GPS/CELL ANTENNA

- 1) Unscrew the split nut from the GPS antenna and slide out from the cable(s). (Note that the dual GPS/Cell antenna for LT1 Cell systems will have two cables).
- 2) Feed the cables(s) through the cutout in the top of the enclosure, seat the antenna, and secure in place with the split nut.
- 3) Attach the GPS and Cell cables to their respective jack(s) on the LT1.
- 4) For GOES units, attach the SMA to N bulkhead cable GOES antenna cable to the GOES jack on the LT1.
- 5) Remove the terminal blocks from the LT1 (for ease of making power and sensors connections)
- 6) Mount the LT1 on the DIN rail.

LT1-GOES SYSTEMS

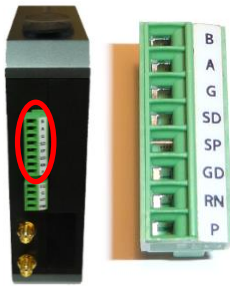
- 1) Mount the EON2 aimable mount in its desired location and secure the EON2 antenna to the platform. Aiming information can be found on the FTS Support website under Product Documentation>Antennas: https://s3.amazonaws.com/Product_Technical_Bulletin/700-AN-128.pdf
- 2) Connect the EON2 GOES antenna cable to the SMA to N bulkhead cable on the side of the enclosure

CONNECTING SENSORS

Sensors are connected via the 8 pin data terminal block. The LT1 can accommodate one NMEA device, either two SDI-12 sensors (four if a V2 model), and a rain gauge. If two or more SDI-12 sensors are being connected, they must have their wires spliced and use the same pins designated for SDI-12 sensors. Additionally, if more than two devices are being connected, a ground terminal will have to be shared. Optionally, an external connector block can be mounted on the back panel for easy expansion.

Connector block size	Part #
3 position	17905
8 position	20793
12 position	11465

Once sensors are connected to the 8-pin terminal block it can be inserted into the LT1.



B	RS485/NMEA negative
A	RS485/NMEA positive
G	Signal ground
SD	SDI-12 data
SP	SDI-12 power out
GD	Power ground
RN	Discrete counter in (Rain Gauge)
P	RS485/NMEA power out

CONNECTING SDI-12 SENSORS

Connect the SDI-12 power wire (+) to the **SP** pin, the SDI-12 data wire to the **SD** pin, and the ground wire to either the **GD** or the **G** pin.

CONNECTING A TIPPING BUCKET (RAIN GAUGE)

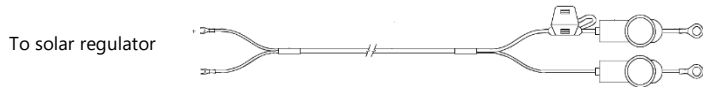
Connect the signal input wire to the **RN** pin, and the ground wire to either the **GD** or the **G** pin.

POWER CONNECTIONS

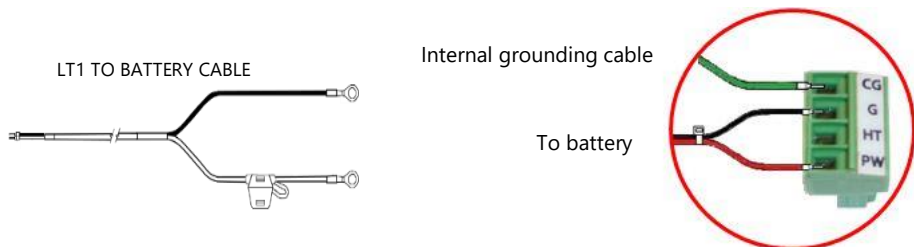
The LT1 SYSTEM is powered through a battery which maintains its charge through a solar panel and regulator. Remove the LT1 power terminal block in order to make connections. Upon completion of wiring, insert the power terminal block to supply power to the system.

IMPORTANT! Power connections must be made in the order indicated to prevent damage to the station and equipment.

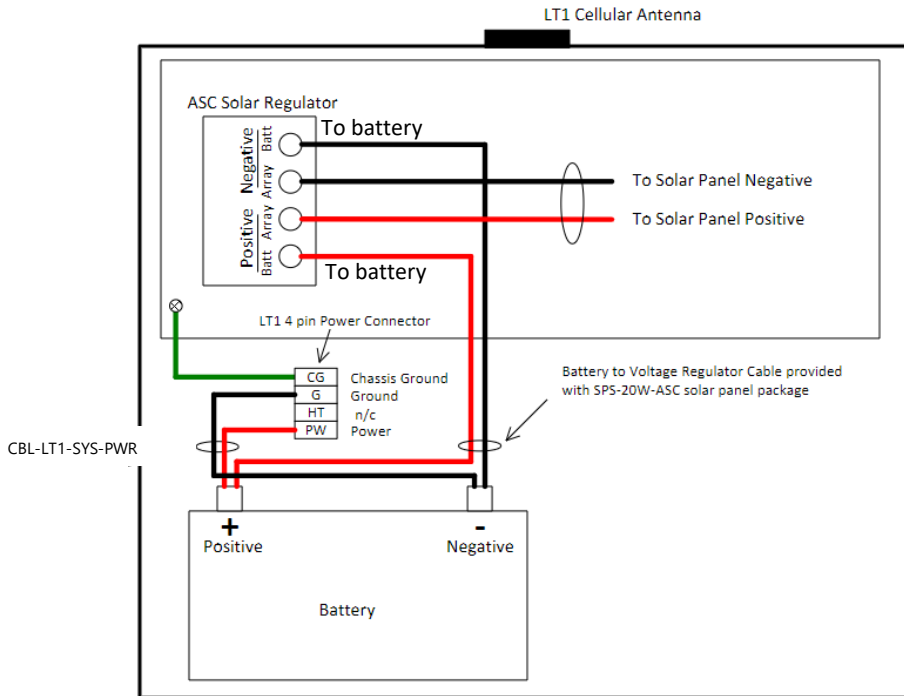
- 1) Connect the internal grounding cable to the CG pin on the power terminal block.
- 2) Connect the Solar Regulator to Battery cable (12841) to the ASC solar panel (black to Negative Bat, red to Positive Bat)



- 3) Connect the LT1 to Battery cable (CBL-LT1-SYS-PWR) and internal grounding cable to the LT1 terminal block as shown (black to the G pin, red to the PW pin).







- 4) Connect the red (positive) wire from the LT1 to Battery cable (CBL-LT1-SYS-PWR) cable to the Positive pole on the battery.
- 5) Place the red (positive) wire from the Solar Regulator to Battery cable (12841) the positive pole of the battery and secure the cover.
- 6) Place the black (negative) wire from the LT1 to Battery cable (CBL-LT1-SYS-PWR) to the Negative pole on the battery.
- 7) Place the black (negative) wire from the Solar Regulator to Battery cable (SPS-20W-ASC) on the negative pole of the battery and secure the cover.
- 8) Connect the Positive and Negative wires, in that order, from the solar power to the ASC Solar regulator
- 9) Insert the terminal block into the LT1. The LT1's LEDs will power up and display green lights. See the LT1 LED Status Indicators in the following section. Details of solar regulator charging light indicators can be found in the Trouble Shooting section.



LT1 LED STATUS INDICATORS

Once power is supplied, the LT1 will boot up, and establish a GPS fix. The green LEDs indicate the status of the system.





When power is first supplied or someone connects to the station:

	System Status	<p>Blinking every second: System OK</p> <p>Off: System powered down/failure</p>
	Telemetry Status	<p>Solid On: System OK</p> <ul style="list-style-type: none"> • Cellular: module powered and communicating to MCU*, cellular link established • GOES: transmitter enabled and valid configuration <p>Blinking: Cell: Obtaining network connection GOES: no GPS fix/potential invalid configuration</p> <p>Off: System powered down/no link/fault</p>
	BLE Status	<p>Solid On: BLE connection established</p> <p>Blinking: System OK (module powered and communicating to MCU*, module broadcasting beacon signal)</p> <p>Off: system powered down/no beacon signal transmission/fault</p>
	GPS Status	<p>Solid On: System OK (module powered and communicating to MCU*, fix established)</p> <p>Blinking: Obtaining GPS fix</p> <p>Off: System powered down/fault</p>

*MCU= microcontroller unit

Low Power Mode:

Three minutes after being disconnected from the FTS360 Config App, the unit will enter low power mode:

	System Status	Blinks once every 10 seconds: System OK
	Telemetry Status	Off
	BLE Status	Off
	GPS Status	Off

NOTE: When in low power mode, a fault is not indicated if the Telemetry, BLE and GPS status lights are off. If you suspect a fault, use the FTS360 Config App to connect to the station and observe the LEDs.

CONFIGURING WITH THE FTS360 CONFIG APP

Detailed information on FTS360 and the FTS360 Config App can be found in the FTS360 User Manual (700-FTS360-Man)

A. CONFIGURE SENSORS

Once connected to the LT1 and powered, use the FTS360 Config App to add and configure the sensor for the station.

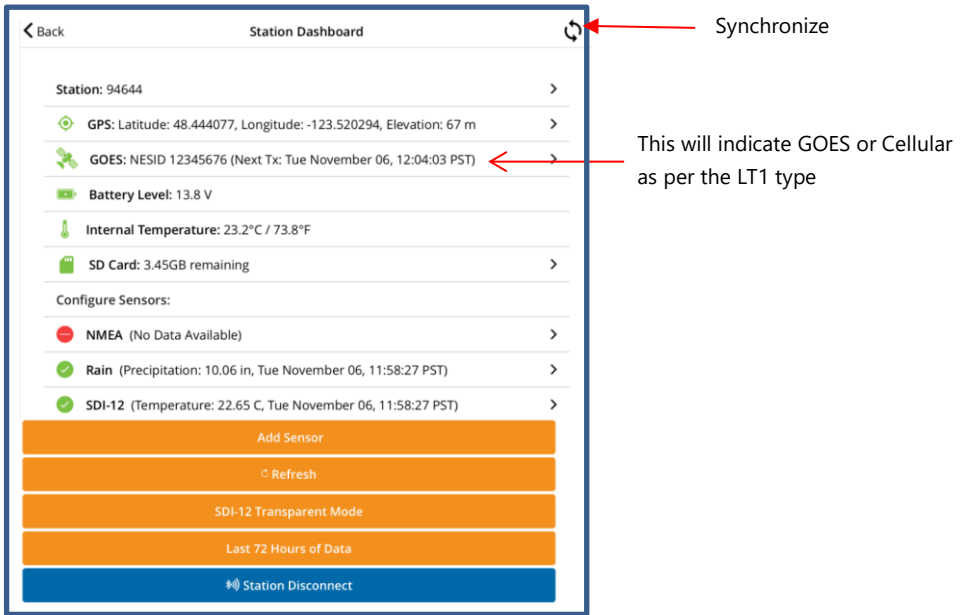
1) Connect to Station

- Open the FTS360 Config App. It should automatically discover any Stations within range. If the station is not discovered, press the “Scan” bar.

The first time a station is connected to the FTS360 Config App, it’s identified by its serial number.



- Select “Connect” to display the Station Dashboard



2). Add and configure sensors: NMEA or Rain (tipping bucket) sensors have their own lines. To add an SDI-12 sensor, select the Add Sensor bar.

3) Select the desired sensor from the Sensor Type drop down list and edit fields as necessary. Save.

HINT: Custom library items created by your agency are listed first, followed by default library items.

3). Test the sensor(s): Select the Test Sensor bar. This will trigger a reading by the sensor and the data point(s) will display.

NOTE: New sensors should always be tested prior to leaving the site to ensure they are operating as desired.

B. CONFIGURE TELEMETRY

Select the Telemetry line on the station Dashboard.

CELLULAR SETTINGS

The APN and Carrier settings must be filled in. If an FTS cellular plan was purchased, the cellular settings are already configured. For customers who have not purchased an FTS cellular plan, the settings are often automatically sent to the station via the inserted SIM; however, if your provider requires this information to be input manually, do so in this screen. After entering the APN and Carrier, select the Commission button.

CONFIGURE GOES/EUMETSAT STATION SETTINGS/MESSAGE

GOES/EUMETSAT stations must have the telemetry and message format configured

- 1) Select the arrow on the GOES line to open the Station GOES Settings screen. Fill in the fields with your provided satellite information.

NOTE: information on this sample screen is for demonstration purposes only:

- 2) Select **Configure Transmitted Message**

The image displays two screenshots of the 'Station GOES Settings' application interface. The left screenshot shows the main settings screen with a red bracket and the number '1' pointing to the 'Configure Message Transmission' button at the bottom. The right screenshot shows the same screen with a red arrow and the number '2' pointing to the 'Configure Message Transmission' button at the bottom.

Station GOES Settings (Left Screenshot):

- Transmitter Configuration: NESDIS ID (red box), Network: GOES, Satellite: West
- Transmission Speed: 300 bps, Channel: 0 (red box), Power Level (dB): 32
- Transmission Schedule: First Transmission Time (h:mm:ss): 00:00:00, Transmit Interval (h:mm:ss): 00:00:00
- Random Messages: Transmission Speed: 300 bps, Channel: 0, Power Level (dB): 32, Retries: 1
- Transmission Window Length: 10 seconds, Message Centering (checked), Send 'no data' if empty (checked)
- Fail Safe: Antenna (true north): OK, Inclination: 33°, Bearing: 195°
- Buttons: Transmission Disabled (red), Configure Message Transmission (blue)

Station GOES Settings (Right Screenshot):

- Transmission Speed: 300 bps, Channel: 195, Power Level (dB): 38
- Transmission Schedule: First Transmission Time (h:mm:ss): 00:25:00, Transmit Interval (h:mm:ss): 01:00:00
- Random Messages: Transmission Speed: 300 bps, Channel: 0, Power Level (dB): 38, Retries: 1
- Transmission Window Length: 10 seconds, Message Centering (checked), Send 'no data' if empty (checked)
- Fail Safe: Antenna (true north): OK, Inclination: 18°, Bearing: 124°
- Buttons: Transmission Enabled (green), Configure Message Transmission (blue, red arrow), Cancel (grey), Save Changes (orange)
- Footer: GOES Transmitter G6 Version: 1

3) Select Data Format type from the drop-down menu

4) Add Field: select the parameters (data points) to be included in the transmitted message

Fields will be transmitted in shown order. Use arrows to adjust list order.

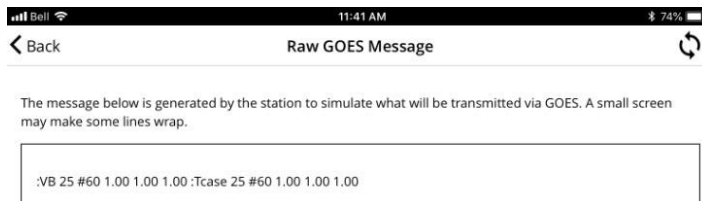
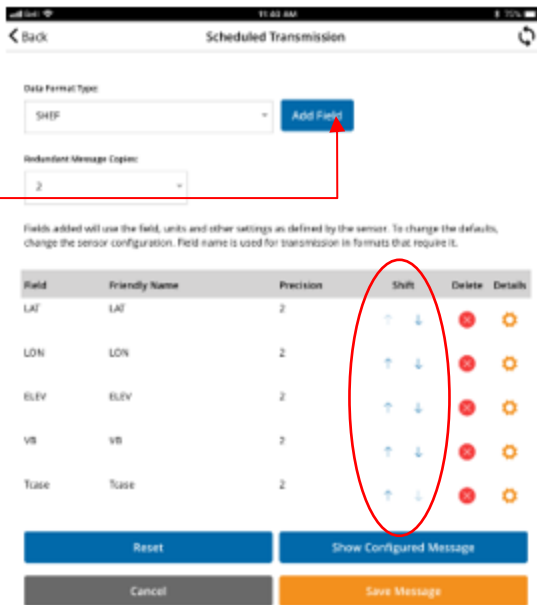
Delete only removes the field from the message.

Fields can be viewed and amended using the Details cog.

5) Save Message

6) Show Configured Message: This shows a sample message to ensure format is as required.

NOTE: if there is insufficient data generated to completely fill all fields, simulated data (1.00) will be inserted where needed



RANDOM TRANSMISSIONS AND ALERTS

Random transmissions are transmissions that are made outside of the scheduled transmission window and are sent when an alert condition is detected. Once the scheduled transmission is setup, the option to input your assigned Random Transmission channel information will be available on the Station GOES Settings page.

After setting up the random message transmission parameters, select the "Configure Message Transmission" button and then select the "Add an Alert Condition" option.

Define the condition using the drop-down menus and then define the Message (data format and add the fields which include the data you want transmitted. Save Message

C. SYNCHRONIZE AND DISCONNECT

1). Synchronize the FCA with FTS360: Select the Sync Data feature to save changes made in the field with FTS360. If the site does not have Internet access, perform a sync as soon as you have internet access.

IMPORTANT! Until synchronization occurs:

- changes made to a station working offline will not be reflected in FTS360. New data transmitted will be stored but not displayed until synchronization.
- if it is a new station, other users in your agency will not be able to access the station

2). Disconnect: Select the "Disconnect" button on the FTS360 Config App screen

If you move out of range of the LT1, it will automatically disconnect. Any changes made that were not saved before an inadvertent disconnection will have to be repeated and saved.





TROUBLESHOOTING

A. LT1









LED Status Indicators: ○ = On ● = Off N/A –not applicable (can be on, off, or blinking)

* = Blinking once every 10 seconds ** = Blinking every second

The following LED patterns indicate Normal Operation:












				Indicates	Comment
**	○	○	○	System OK	This is the state when power is first applied once all connections are made or when initially connecting to the station using the FTS360 Config App (unit operating normally, no faults).
*	●	●	●	Low Power Mode	Sending a command (such as the connect, add sensor, or any editing command) will illuminate the lights as indicated above.








The following LED patterns indicate faults:

				Indicates	Solution
●	●	●	●	No power to the LT1	1) Check battery connections 2) Confirm wire connections to the terminal block and terminal block firmly seated
●	●	●	●	Battery fully discharged	1) Replace battery 2) If being used with a solar panel and regulator, check connections to ensure battery being charged
○ or ●	N/A	N/A	N/A	SD card not inserted	Power off the LT1. Insert SD card or confirm inserted SD card is properly seated and locked.
**	**	N/A	N/A	CELL: No cellular connection	It can take 1-20 minutes (or longer) to get an initial cellular connection based on numerous factors such as geographical location, carrier, if the signal has to roam etc. If after a reasonable time based on the above factors, the cellular LED is still blinking try the following: 1) Check Cellular antenna connection 2) Confirm SIM card is inserted correctly 3) SIM card not activated. Call cell plan provider to activate.
				Indicates	Solution

**	**	N/A	N/A	GOES/ Meteosat: No transmission possible	1) No GPS time fix: Wait for GPS time fix 2) Invalid configuration so transmission not possible. Review configuration
**	N/A	N/A	**	Unable to obtain a GPS fix	1) Check GPS antenna connection 2) GPS satellite signals may be blocked or weak a) Check for physical obstructions such as cliff faces and move GPS antenna to unobstructed area 3) Check Cellular connections (GPS cannot get a fix if cellular module cannot connect to the base stations
For > 5 minutes					
**	N/A	○	N/A	Before you connect: Someone else is connected	1) If possible, request the other party to disconnect; or 2) Power cycle the LT1 (remove and replace the power terminal block) to disconnect active BLE connections. This will terminate all other BLE connections.

B. FTS360 CONFIG APP HEALTH ICONS

INDICATOR	ICON	MEANING/COMMENTS
GPS:		GPS Fix not established.
		GPS fix established. Followed by latitude, longitude and elevation.
Cellular: (LT1-CELL units only)		No signal detected. Check antenna.
		Online. Strong signal (RSSI > -69)
		Online. Poor signal (RSSI ≥ -69)
		Extremely weak signal (RSSI ≤ -109)
GOES (LT1-GOES units only)		GOES message configured. Ready to transmit as scheduled.
		GOES message configured but no GPS signal. Unable to transmit as scheduled (time signal comes from GPS).
		GOES message not configured or failsafe tripped
		G6 information not available
Battery Level:		Battery charging

		Battery fully charged
		Battery discharging with Battery Level: indicated
		Battery critical
Internal Temperature:		Internal temperature within operating range. Followed by the internal temperature
		Internal temperature outside of operating range.
SD Card		SD card installed. Followed by remaining space on card.
		SD card not installed

C. SOLAR ARRAY SYSTEM

Normal Conditions:

1	“ALWAYS CHARGING” or “NEVER CHARGING”	Depending on your system, it may be normal for the ASC to go for long periods with constant charging or long periods with no charging. The function of the ASC is to prevent over-charging of the battery. Therefore, it will charge continuously when the battery voltage is low and stop all charging as long as the battery voltage is high.
2	BATTERY WATER LOSS	It is normal for vented batteries to need some water from time to time. Minor water loss is not a problem, just top the level up when needed. Excessive water loss (a quart or more in a period of a month) may indicate a more serious problem.
3	BATTERY GASSING	In vented batteries, some gassing is good. Gassing stirs up the battery acid and allows the battery to fully charge. A little bubbling in the batteries is not necessarily a problem.
4	TEMPERATURE	Temperature can affect the performance of batteries. They will tend to over-charge easier when hot, and will not have as much capacity when cold. Temperature can also affect the performance of the solar panels. The charging current can be substantially higher in cold conditions. When sizing the system, consider the current at cold conditions.

Problem Conditions

1	SYSTEM IS NOT SIZED CORRECTLY	<p>The system batteries will tend to be under-charged if the solar array is too small, or if the battery bank is too small, or if the usage is too high. Some systems contain small hidden loads that can slowly draw down the battery.</p>
2	PROBLEMS WITH SOLAR PANELS	<p>Solar panel output is dependent upon the amount of sun energy reaching the panel. This can be seriously affected by the angle of the panel (as in winter months), minor shading, high level haze (barely visible) and dust on the panel. At the time of installation, a solar array can have an incorrect series-parallel configuration for the proper system voltage and current. A panel can also become less productive or defective over time.</p> <p>TEST: Disconnect the ASC from the panel and measure the voltage at panel (+) and panel (-). In sunny conditions, this should be 18-24 volts*. A lower value could indicate a problem with the panel. To check the panel's current output, contact a local solar dealer.</p>
3	PROBLEMS WITH BATTERIES	<p>At the time of installation, a battery bank can have an incorrect series-parallel configuration for the proper system voltage and current. A battery can also go bad and unable to maintain a charge. If the battery is going bad, a little charging or discharging will cause a large change in the battery voltage. A battery short somewhere can also reduce the battery voltage.</p> <p><u>Battery Undercharged:</u></p> <p>1) <u>System not sized correctly</u> - Try charging the battery with another charging source (engine alternator, generator or AC battery charger). If the batteries are OK and hold the charge, an increase in the number batteries and panels may be needed to support the usage. Look for small hidden loads that may be draining the battery.</p> <p>2) <u>Problem with the Batteries</u> - The batteries could be configured incorrectly or be going bad.</p> <p>3) <u>A Cold Battery</u> - Cold temperatures can affect the battery charging. If the battery is cold much of the time, the battery's long-term performance and life may suffer.</p> <p>4) <u>Solar Panel Problem</u> - Panel may be dirty, not aligned or other problem. A panel problem would not drain the battery of power.</p> <p>5) <u>ASC Controller Problem</u> - A problem may exist with the charging input from the controller. This would stop the daily re-charging of the battery. A defective ASC would not drain the battery of power.</p> <p><u>Battery Overcharged:</u></p>

		<p>1) <u>Normal Battery Condition</u>: The batteries may not be over-charging but only be experiencing normal water loss and normal levels of gassing.</p> <p>2) <u>A Problem with the Batteries</u> - The batteries could be configured incorrectly.</p> <p>3) <u>A Hot Battery</u> – high ambient temperature can cause batteries to overcharge</p> <p>4) <u>Non-compatible Batteries</u>: The batteries may be a type that are not compatible with this system and require a lower full-charge voltage. Check battery specifications.</p> <p>5) <u>Other Charging Sources</u>: Another charging source could be the cause. Some 110 volt battery chargers are not well regulated and could over-charge batteries if left unattended.</p>
4	BAD CONNECTION: PANEL	The solar panel connection to the controller may be weak or completely out. Problems can be found at the ASC connection (ARRAY (+) & ARRAY (-) terminals), both panel connections (“+” or “-”) or fuses and unsoldered crimp connectors in these lines. Also, wire that is too small for the length of the run may cause a problem.
5	BAD CONNECTION: BATTERIES	The battery connection to the controller may be weak or completely out. The ASC needs to read an accurate battery voltage to regulate the charging correctly. Therefore, you need to minimize the voltage drop from the battery. Problems can be found with the ASC connection {BATT (+) and BATT (-) terminals} , both battery terminals (“+” or “-”) or fuses and unsoldered crimp connectors in these lines. Also, wire that is too small may cause a voltage drop.
6	CONTROLLER MISWIRED	This may include reversing the polarity from the panels or batteries, or switching the array and battery connections. This may also include a deviation from the wiring instructions, such as bypassing connections by using jumpers or by connecting to battery (-) at some place other than the battery itself.
7	CONTROLLER DEFECTIVE	The ASC may no longer be functional. A defective unit can overcharge the battery or stop all charging. A faulty unit cannot <i>drain</i> a battery. It may have been exposed to high voltage or current, or reverse polarity from the batteries, o

ASC SOLAR REGULATOR

SOLAR REGULATOR INDICATORS			
INDICATORS	BATTERY VOLTAGE	NOTE	
Charging Light	On	Low voltage (9-13.2 volts)	1
	Off	Low voltage (9-13.2 volts)	2
	Turns off too soon	Moderate voltage (13.2-14 volts)	3
	On	High voltage (14.4-15 volts)	4
	Off		5
	On at night		6
	Turning on and off rapidly		7
	ASC buzzing		8
	ASC hot		9

Note 1 - A continuous low-voltage condition with good charging during the day would indicate that the controller is functional but one of the following problems exists:

- A system sizing problem. *See Problem Conditions #1.*
- A problem exists with the solar panels. *See Problem Conditions #2*
- A problem exists with the batteries. *See Problem Conditions #3*

Note 2 - A low-voltage condition with no charging during the day would indicate one of the following:

- The system has no panel input. *See Problem Conditions #4*
- The ASC is defective. *See Problem Conditions #7*

Note 3 - A moderate voltage condition where the charging appears to stop too soon (below 14.0 volts*) would indicate one of the following:

- The ASC has a bad battery connection. Somewhere in the battery connection there is a voltage drop that causes the controller to sense a higher battery voltage than what actually exists. *See Problem Conditions #5*
- The ASC is defective. *See Problem Conditions #7*

Note 4 - A high voltage condition with additional charging would indicate one of the following:

- The battery voltage may be just under the charge termination set-point and has not shut off yet. *See Normal Conditions #1*
- The ASC is defective. *See Problem Conditions #7*

Note 5 - A high voltage condition (over 14.5 volts*) with the solar charging terminated during the day would indicate the controller is functional but the batteries are being over-charged by a second charging source. Other charging sources should feature their own charge regulation.

Note 6 - The "CHARGING" light can be on (bright to dim) at night if the panels are under even very low levels of light (moonlight or streetlights). The "CHARGING" light on brightly at night could also indicate one of the following:

- The controller is miswired. *See Problem Conditions #6)*
- There is a blocking diode located within the solar panels or in the panel connection. This is not a serious problem but should be removed if possible.
- The ASC is defective. *See Problem Conditions #7*

TEST: Disconnect the panel (ARRAY (+)), if the light goes off, then it may be possible that the panel is receiving enough light for a slight charge, or a diode exists in the connection.

Note 7 - The "CHARGING" light going on and off rapidly may indicate one of the following:

- A normal condition. When the battery is fully charged, and the array can provide a lot of charge current, the controller can pulse on and off rapidly, particularly when there is current being used by a load. This is a normal operating condition and is not a problem.
- A bad battery (one that is unable to maintain a charge). *See Problem Conditions #3*
- A bad battery connection - *See Problem Conditions #5.*




TEST: Take a voltage reading at the battery with an accurate meter. If the voltage reading stays steady while the "CHARGING" light on the ASC continues to go on and off, then suspect a bad battery connection. If the voltage here also moves up and down rapidly, this may indicate a normal condition or indicate the battery bank is bad or too small.

Note 8 - The buzzing sound is caused by the controller switching on and off very rapidly and indicates a bad battery connection. *See Problem Conditions #5.*

Note 9 - The ASC may get warm during normal operation. If the unit gets too hot to touch, consider it defective. *See Problem Conditions #7*

TECHNICAL SUPPORT

If you have any questions, please do not hesitate to contact FTS Service & Support.

	<p>Monday – Friday 7:00 a.m. – 4:00 p.m. PST Except Canadian statutory holidays</p> <p>Local (Victoria, B.C.): 250.478.5561</p> <p>North America (toll free): 1.800.548.4264</p> <p>International: (country exit code)+ 1.250.478.5561</p>
	<p>E-mail: service@ftsinc.com</p>
	<p>Technical Support Portal: http://support.ftsinc.com</p>