Installation Guide
Savi Networks EV-LSE-01
ISO Container Door Tag
with GPS/GPRS and Sensors

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Documentation for Savi Networks EV-LSE-01 ISO Container Door Tag with GPS/GPRS and Sensors

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Savi Tag EV-LSE-01 ISO Container Door Tag with
GPS/GPRS and Sensors International Regulatory
Approvals Compliance Notice

Declaration of Conformity

Hereby, Savi Technology, Inc., 351 E. Evelyn Avenue,
Mountain View, CA 94041-1530 declares that the Savi
SensorTag EV-LSE-01 ISO Container Door Tag with Sensors
are in compliance with the essential requirements and other
relevant provisions of Directive 1999/5/EC.

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Warning

This is a Class A product. In a domestic
environment this product may cause radio
interference in which case the user may be required
to take adequate measures.

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Federal Communications Commission (FCC) Notice

The Federal Communications Commission has established technical standards regarding radio frequency energy emitted by computer devices. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference with radio/TV reception. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Warning: Changes or modifications to this equipment that are not expressly approved by Savi Technology could void the warranty and the authority to operate this equipment. Savi Technology is not responsible for radio/TV interference caused by using unauthorized cable or by making unauthorized changes to this equipment.

Federal Communications Commission (FCC) Label Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:
• This device may not cause harmful interference, and
• This device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications not expressly approved by Savi for compliance could void the user's authority to operate the equipment.

The label statement corresponds to the following devices:

Device	Model	FCC ID
Radio Tag	Savi Tag EV-LSE-01	WXK-EVLSE01-V1

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About Savi Networks EV-LSE-01 ISO Container Door Tag

Savi Networks® EV-LSE-01 ISO Container Door Tag with GPS/GPRS and Sensors is a high performance active RFID tag that works with Savitrak software to track and monitor the security status of containers as they move through the global supply chain. This device is fully compatible with fixed and portable Savi readers and features up to 300 feet (91.44 meters) of omni-directional line-of-sight range. In addition, EV-LSE-01 Tag utilizes GPS receiver to report and recorded asset location using GSM/GPRS cellular network.

Rechargeable Lithium Ion battery life is typically 90 days between the charges. The EV-LSE-01 tag is available with 128K of programmable memory. It includes a door clamp and external antennas. Using the door clamp, you affix the tag to the left door of an ISO-compliant container.

Note: Savi Networks EV-LSE-01 ISO Container Door Tag only supports ISO 668: 1995(E) Series 1 freight containers.

Features

◆ 433 MHz, active RFID technology with up to 300-foot (91.44-meter) range for monitor, wake-up, RF write/read
◆ 123 KHz receiver for slot level, portal, or chokepoint tag wake-up and short range commissioning (12 feet [3.7 meters] or less)
◆ GPS Receiver for asset real time location
◆ GSM/GPRS quad band modem for worldwide communication with cellular networks
◆ Small form factor, ideally suited for shipping containers
◆ Rugged, weatherproof design
◆ Powered by a rechargeable Lithium Ion battery
◆ Intrusion detection sensors for monitoring door and light status
◆ Temperature, humidity, and shock sensors for monitoring the internal environment of a container
◆ 128KB nonvolatile memory for logging up to 4500 GPS location records and up to 5000 sensor data records

Description

Savi Networks EV-LSE-01 ISO Container Door Tag

Arm position when tag is activated

Intrusion Detection Sensors

The EV-LSE-01 tags include door and light sensors. The door sensor monitors the amount of pressure between the door and the device. If the door is open and the device has not been electronically unsealed, the device sends a message to the monitoring software indicating that the device has been tampered. It also writes the time and date of the tamper to an event log. The device also includes a light sensor that triggers an alarm if light is detected inside the container.

Environmental Sensors

The environmental sensors on the EV-LSE-01 tags monitor the temperature and humidity within the container. You can set the maximum and minimum values, and if the temperature or humidity rises above or falls below this range, the device writes the time and date of the breach to the event log. For example, if you are shipping a product that needs to be kept at temperatures between x and y degrees, you can set the EV-LSE-01 tag to record the date and time whenever the temperature breaches the maximum or minimum value.

Tamper-Protection Plate

The tamper-protection plate's right angle flaps are bent to extend and protect the gap behind the plate as well as the tag plate. This plate prevents anyone from inserting a foreign object in an attempt to hold the tag plate in the closed position.

RFID Communication Module

The communication module is positioned on the outside of the container and operates at 433 MHz. This enables the Savi Networks EV-LSE-01 to communicate back to the Savi network with excellent RF performance in both heavy metal and non line-of-sight environments.

GPS/GPRS Communication Modules

The GPS receiver communication module is positioned on the outside of the container and it periodically turns on to acquire the location information which gets logged and subsequently reported through GPRS module to Savi software application. The GPRS modem is a quad band radio that supports worldwide deployment on GSM/GPRS cellular networks. The GPS acquisition period and GPRS reporting intervals are user programmable and can support wide range of asset tracking deployment scenarios. By defaults the unit will acquire GPS fix (asset location) every 30 min and will report it automatically via GPRS network every 4 hours. The periodic reports will include all unreported GPS fixes collected by the tag as well as container status such as door position, environmental sensor status, alarms, tamper, tag battery charge and tag health status.

For More Information

Guides to Read

For information about using:

◆ Signposts, see the *Savi Signpost SP-65X Series Installation Guide*

◆ Fixed readers, see the *Savi Fixed Reader SR-650-101 Installation Guide*

◆ Mobile readers, see the *Savi Mobile Reader SMR-650 for the Intermec 751G/A Mobile Computer and PC User Guide*

Contacting Savi Global Support Services

If you cannot find the information you need, contact Savi Global Support Services.

◆ Check www.savi.com/services/su.contact.shtml for contact information.
◆ Send email to help@savi.com.
◆ Call 1-888-994-SAVI (North America only) or 1-650-316-4760 between 9 a.m. and 5 p.m. Pacific time.

When you contact Savi Global Support Services by telephone or email, have the following information available:

◆ Contact information (company name, your name, email, and phone number)
◆ Problem description
◆ Product type, Model ID
◆ Software version
◆ Serial number or license information

Installing Savi Networks EV-LSE-01 ISO Container Door Tag

Required Tools and Materials

Before you begin installation, make sure the following materials are available:

◆ Savi Networks EV-LSE-01 ISO Container Door Tag with GPS/GPRS

◆ Mobile hand-held device with SMR-650 reader and Savi application

◆ Wall Adapter
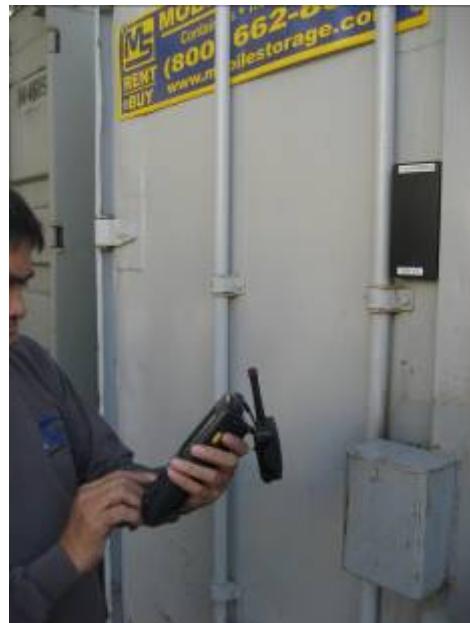
WARNING!!!

The antenna used for GSM transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Tag commissioning

You can commission Savi Networks EV-LSE-01 ISO Container Door Tag using Savi software (e.g. TSS 2.5.1) that operates on a mobile device, such as the Intermec® 741G/A or 751G/A Mobile Computer with an attached Savi® Mobile Reader SMR-650. You can purchase the software and mobile device separately. Please refer to HH TSS documentation for details on commissioning and activating the tag.

The EV-LSE-01 Tag is factory shipped in an inactive mode in order to preserve battery charge.
In inactive mode the EV-LSE-01 tag powers down all sub functional blocks (GPS, GPRS, UHF RX) except for the LF and UHF beacon communication links.

In order to activate the tag which has been previously placed in an inactive mode a user has to position the door arm forward into operational position (arm extended away from the tag body). Unscrew the red connector from the mid-line connector and replace with the green dust-cover. This powers on the unit. Screw in the red cover to the threaded retainer along the left side of the unit.

When the tag is activated it will acknowledge performed activation with series of short beeps and immediately enable all functional blocks (GPRS, GPS, UHF RX, UHF TX and LF).
Note that this will only activate the tag while commissioning of the tag (Container ID association, Sensor configuration, Locking) still needs to be performed using Savi HH software application.

Before installing the tag it is highly recommended to verify tag operational status and the battery charge. To verify that tag is fully operational and ready for deployment, use the wall adapter or reset plug to perform power on test by following below procedure.

1. Insert the power plug from the wall adapter into the charging jack on the back of the unit (remove green dust cap if necessary).
2. Wait 1-2 seconds and then remove that plug from the tag.
3. Wait for about 10 sec and then count numbers of beeps heard from the tag.

Based on the number of the beeps and the pattern (3 or 4 beeps) the following is the status of the tag:

	OK	Failed module or insufficient battery charge
GPRS Module RFID Module	1st short beep	1st long beep
GPS Module	2nd short beep	2nd long beep
Sensor Module	3rd short beep	3rd long beep
Battery Voltage	4th short beep -> voltage above 4.1V	4th long beep -> voltage below 3.3V No 4th beep -> voltage between 3.3–4.1V

Note that if the tag voltage is below 3.3V it will automatically disable GPS and GPRS functionality for the rest of the journey.

Note that the EV-LSE-01 Tag comes equipped with a Reset plug which can be inserted within the charger cap when stored for prolonged period of time. Inserting the plug into the charger cap will completely turn off the power from the Tag (except for the real time clock) and thus preventing any possible transmission or battery drainage.

Removable Dust Cover

Removable Reset Plug
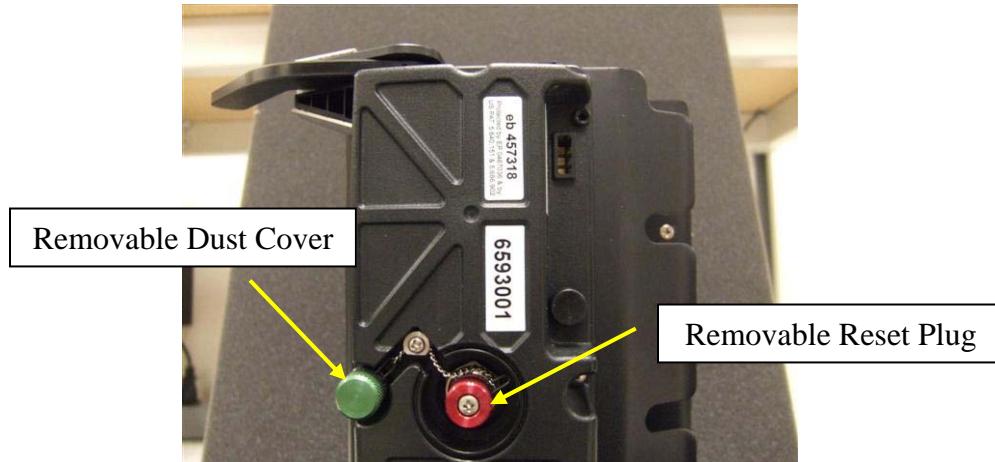
When the Reset plug is removed from the Tag (note that the same will happen if a wall adapter plug is removed) it will first perform a power up sequence and then attempt 5 times to acquire the GPS fix and immediately report the tag status via GPRS Server. This allows user to immediately verify tag operation, the round trip communication and associated configuration parameters.

The following table shows major Tag states with corresponding operational status for each individual sub-functional block.

	POWER OFF (via reset plug)	INACTIVE (via door arm sequence)	ACTIVE *NORMAL MODE*	ACTIVE *DEEP SLEEP*
GPRS	OFF	OFF	ON	ON
GPS	OFF	OFF	ON	ON
RFID – LF	OFF	ON	ON	ON
RFID – UHF Beacon	OFF	ON	ON	ON
RFID – UHF RX	OFF	OFF	ON	OFF
SENSORS	NO CHANGE	NO CHANGE	NO CHANGE	NO CHANGE

Tag de-commissioning

After the journey a tag needs to be decommissioned using the mobile device with appropriate Savi application (e.g. TSS 2.5.1). Please refer to software user manual for step by step decommissioning process. The above process usually requires that tag is disassociated with the asset and removed physically from the container. This process requires user to end journey by unlocking the tag before being physically removed from the container's door.

After successful end of journey process the tag will continue to report it s location and status so that tag can be located even after it is being removed and disassociated from the asset. If the tag needs to be fully disabled the following procedure outlines the steps of placing the tag into the inactive mode in order to disable GPS, GPRS and UHF beacons during long term storage or when shipped via air freight.

1. Make sure that the tag is not locked (decommissioned) and the wall adapter plug is removed from the tag's power jack.
2. Turn the door arm all the way back (storage position).
3. Wait up to 10 seconds for the beeper to turn on.
4. While the beeper is on (up to 3 seconds), turn the door arm all the way to the front (beeper should be off when the door arm is moved to the front).
5. Wait up to 3 seconds for the beeper to turn on.
6. While the beeper is on (up to 3 seconds) turn the door arm all the way back again.
7. The beeper will momentarily turn off and then subsequently acknowledge procedure with three times with two short beeps before entering deep sleep mode.

Note that the tag might be busy communicating with GPRS server while attempting this procedure. In such case tag will not be able to immediately respond and the user is advised to wait a few minutes before attempting another shut down procedure.

Also note that when the wall adapter plug is inserted into the tag's power jack it automatically shuts down the power to the tag and immediately size any operation.

In case that user utilizes the deep sleep mode function within Savi software application a tag will only disable the UHF RX function (it will not responded to UHF interrogation by the reader) while GPS and GPRS functionality will stay active unless disabled through already described door arm shutdown procedure.

Charging the Tag Battery

Savi Networks EV-LSE-01 ISO Container Door Tag is equipped with non-volatile memory, which means stored data is not lost when the battery is fully depleted.

1. Turn the plug cover counter clockwise.

2. Plug wall adapter into the standard AC outlet.

3. Plug the wall adapters' plug into the power jack on the back of the tag.
   Charging of fully depleted battery may take from 4-6 hours. In order to check whether the battery if fully charged remove the plug
   and wait for the tag to complete power up sequence.
   After approximately 10 seconds the Tag will beep with 3 or 4 consecutive beeps. The fourth beep indicates battery charge state. If the fourth beep is short then the battery is full. If the fourth beep is long then the battery is low and needs to be recharged. If the fourth beep is missing (only 3 beeps heard) the battery is not fully charged. If the battery is not fully charged reconnect the wall adapter plug back into the units and wait until tag reports fully charged battery status.

4. After completing the battery charging process follow the below procedure to place a plug cover back onto the unit.
   Make sure the plug cover is completely closed and that it is not cross-threaded. Insert the red cover to completely power-off the tag, or insert the green dust cover to allow normal operation while protecting the connector contacts from contamination.

Tag Placement

Savi Networks recommends that you fit the Savi Networks EV-LSE-01 ISO Container Door Tag above the door bracket and on the left-hand door of the container. The recommended mounting location for the tag is shown in the following photos.

1. Open the right door of the container.

2. Align the device with the bracket on the right door, if possible.

3. Using both hands, secure the device on the *left* door until it is flush.

4. Move the door sensor to the left and ensure that the lever is fully extended before closing the container door.

5. Close the right door.

6. Seal the tag using the software on your mobile device. The door sensor recognizes when the right door is closed and when the container is dark.

7. After successfully sealing the tag, insert the container's bolt into the hasp.

Savi Networks EV-LSE-01 ISO Container Door Tag Specifications

Specification	Description
Physical characteristics	**Tag** Height: 10.75 inches Width: 6 inches Depth: 5 inches
Total weight of tag	2 lb 12 ounces (1.25 Kg)
Environment	**Temperature:** -20ºC to +60ºC operating; -40ºC to +85ºC storage **Humidity:** 100% non-condensing **Altitude:** Maximum altitude = 40,000 feet (12,192m); MIL-STD-810E Method 500.3, Procedure I
RFID receiver/transmitter	**Ultra High Frequency transceiver:** **Frequency:** 433.92 MHz **Modulation:** FSK, deviation +/- 50 KHz **Data rate:** 27.8 Kbps **Data coding:** Manchester **Communication range (unobstructed):** Typical range is up to 300 feet (91.44 meters) line-of-sight when mounted on a container and communicating with a Savi Fixed Reader SR-650-101. Typical range is 300 feet (91 meters) line-of-sight when mounted on a container and communicating with a Savi MobileReader SMR-650P-110 and SMR-650P-111 or Savi Mobile Reader SMR-650-212. **Maximum transmit power:** -7.4 dBm (0.18mW) typical; -2.4 dBm (0.6 mW) with ground reflection (uncommon) **Air protocol:** Savi EchoPoint Air Protocol 2.2 (32-bit tag identification supported)
GSM/GPRS radio module	**GSM quad band radio:** **Frequency:** 850MHz and 1900MHz (US Cellular Network); 900MHz and 1800MHz (Intl. Cellular Network) **Modulation and Data coding:** as per GSM standard
GPS radio module	**GPS receiver:** **Frequency:** 1575MHz **Modulation and Data coding:** as per GPS communication specification

Specification	Description
LF receiver (downlink)	**Low Frequency receiver (downlink)**
	Frequency: 123 KHz
	Modulation: ASK On-Off Keying
	Data rate: Average 1.6 Kbps, 50% duty cycle
	Data coding: Pulse Width Modulation
	Communication range: Up to 3 feet (1.0 meter) from Savi MobileReader SMR-650P-110 and SMR-650P-111 or Savi Mobile Reader SMR-650-212 Up to 12 feet (3.66 meters) from Savi Signpost (models SP-600-xxx and SP-65x-xxx)
	Air protocol: Savi EchoPoint Air Protocol 1.1
Network	**Wireless:** RF read/write capable with Savi software that operates on a mobile device
	Wired: Serial read/write capable via Savi Networks Write Cable STA-1030
Memory	On board non-volatile 128K memory and 32K sensor data memory for up to 4500 GPS location records and up to 5000 sensor records

Specification	Description
Hardware compatibility	Savi Mobile Reader SMR650P (model SMR-650P-xxx)
	Savi Mobile Reader SMR-650 (models SMR-650-xxx)
	Savi Fixed Reader SR-650
	Savi Signpost SP 65x series
Antenna	Internal loop antenna
Shock and vibration	**Shock:** MIL-STD-810E Mechanical Shock, Transit Drop Methods 516.4
	Vibration: MIL-STD-810E Method 514.4, Category 10
Protection type	Sealed to IP 54
	ISO 1496 weatherproofing requirements
Power	**Battery type:** Li-Ion rechargeable 13.8Ah @ 3.7V, user non replaceable
	Battery life: min 90 days between charges (400 charge cycles)
	Power management: UHF sleep mode prevents unwanted collections, enabled/disabled by LF link
	Diagnostics: Reports low tag battery status, diagnostic data
Regulatory approvals	**Radiated emission (intentional):** U.S. emission standards as contained in FCC Part 15 and European Community emission standards as contained in EN 300 220 (433 MHz)
	Electromagnetic immunity: ESD compliance Exposed to 8 kV air discharge or 4 kV contact discharge in accordance with EN 301 489-1
	Radiated emission (unintentional): U.S. emissions standards as contained in FCC Part 15 and European Community emission standards as contained in EN 301 489-1
	Safety approval: U.S UL 1950; European EN 60950
	Markings: Savi logo, product model and serial number, EMC compliance (FCC/EN)

Specification	Description
Sensors	**Door sensor:** Senses the right side of the container door in the closed or open position
	Light sensor: Senses light coming through the door
	Temperature sensor: Integrated temperature takes readings every five minutes (default; use Savi software to adjust settings). Mounted in its own compartment to isolate it from other circuit boards
	Humidity sensor: Integrated humidity sensor takes readings every five minutes (default; use Savi software to adjust settings). Mounted in the same compartment as the temperature sensor
	Shock sensor: Senses shock in the container above a set threshold
Mounting	Contains a door clamp that clips onto the left-side door of a container
Software	EchoPoint FTMobile, EchoPoint EK-650, and Savi SmartChain Transportation Security System (TSS), Savi SmartChain Site Manager 5.6, GPRS Server, SaviTrak 1.0
Accessories	Wall Adapter, Savi Write Cable