



GMC GUARDIAN MOBILITY CORPORATION

Guardian Sentinel™ Globalstar Edition

Installation Guide & User Manual

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NOTICE

This equipment complies with the FCC RF Exposure Limits.
A minimum of 20 centimeters (8 inches) separation between the device and the user and all other persons should be maintained.

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15 Capella Court. • Unit 116
Ottawa, Ontario, Canada, K2E 7X1
www.guardianmobility.com

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About this guide

Welcome to the Guardian Sentinel, and thank you for purchasing this device. This guide is designed to help the user assemble, configure and use the unit for all of their tracking and monitoring applications.

The target audience of this manual includes Guardian Sentinel installers and end-users who would like to learn about the operation of these devices. This document includes information on:

- The components of the Guardian Sentinel device and its accessories
- Connecting the Guardian Sentinel to external sensors and monitoring devices.

I C O N K E Y		Icons commonly used in this manual are shown in the key on the left.
	Important Information	
	Optional Configurations	
	Software Configuration	
	Reference Information	

The Guardian Sentinel - Globalstar Custom Version

The Guardian Sentinel unit has been preconfigured for Globalstar applications. The Globalstar Sentinel units are all GPS enabled with two (2) digital inputs and scheduled to transmit every four (4) hours.

This document has been customized for the Globalstar application. Additional information regarding the full Guardian Sentinel models and capabilities is in the Appendices.

Introduction to the Guardian Sentinel

The Guardian Sentinel

The Guardian Sentinel satellite communication and connectivity platform is designed for monitoring applications including remote fixed and mobile assets. The technology is built around a simplex transmitter delivering low speed data packets via the low-earth orbit (LEO) Globalstar satellite network. The location-enabled Sentinel GPS utilizes a low power global positioning system (GPS) receiver module delivering accurate, power efficient GPS acquisition.

The Guardian Sentinel GPS transmits data at pre-scheduled times and based on alerts from external sensors. The data is sent to the Globalstar satellite network where is it forwarded to the end user.

The unit includes a battery compartment as a fully self contained, ready-to-use, and easily installed device. The platform is also architected to support configuration modifications for specific requirements. The entire system (enclosure, electronics, and batteries) is designed to have the minimum footprint and be as small as possible. This device is designed to operate unattended for years at a time.

- GPS capability
- Highly sensitive receiver to allow acquisition of GPS position in traditionally difficult reception environments
- Supports two (2) digital inputs sensors
- Flexible battery and external power options
- Battery level warning
- Internal and external antennae options
- -30°C to +60°C operating range
- Portable, rugged, weatherproof external housing (NEMA 4x and IP 65 certified industrial packaging)
- Design provision to allow the select integration of customer's electronic circuitry to be packaged in the Guardian Sentinel's sealed compartment
- Lowest total cost of ownership among satellite transmission charges devices

Parts Descriptions

The Guardian Sentinel integrates the satellite transmitter antenna, GPS antenna, battery holder, and interfaces into a compact design. The dimensions and weight (without batteries) of the units are as follows:

	Full Enclosure
Length	176 mm
Width	179 mm
Height	48 mm
Weight	650 g

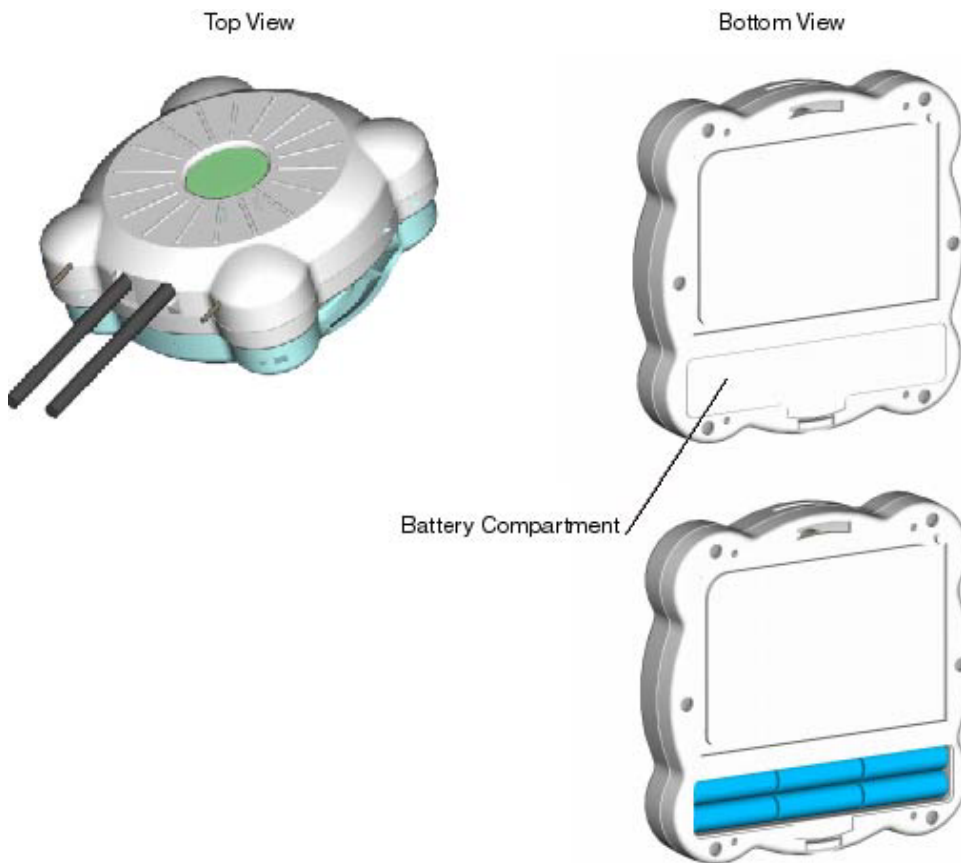


Figure 1: Guardian Sentinel hardware

Parts List and Description

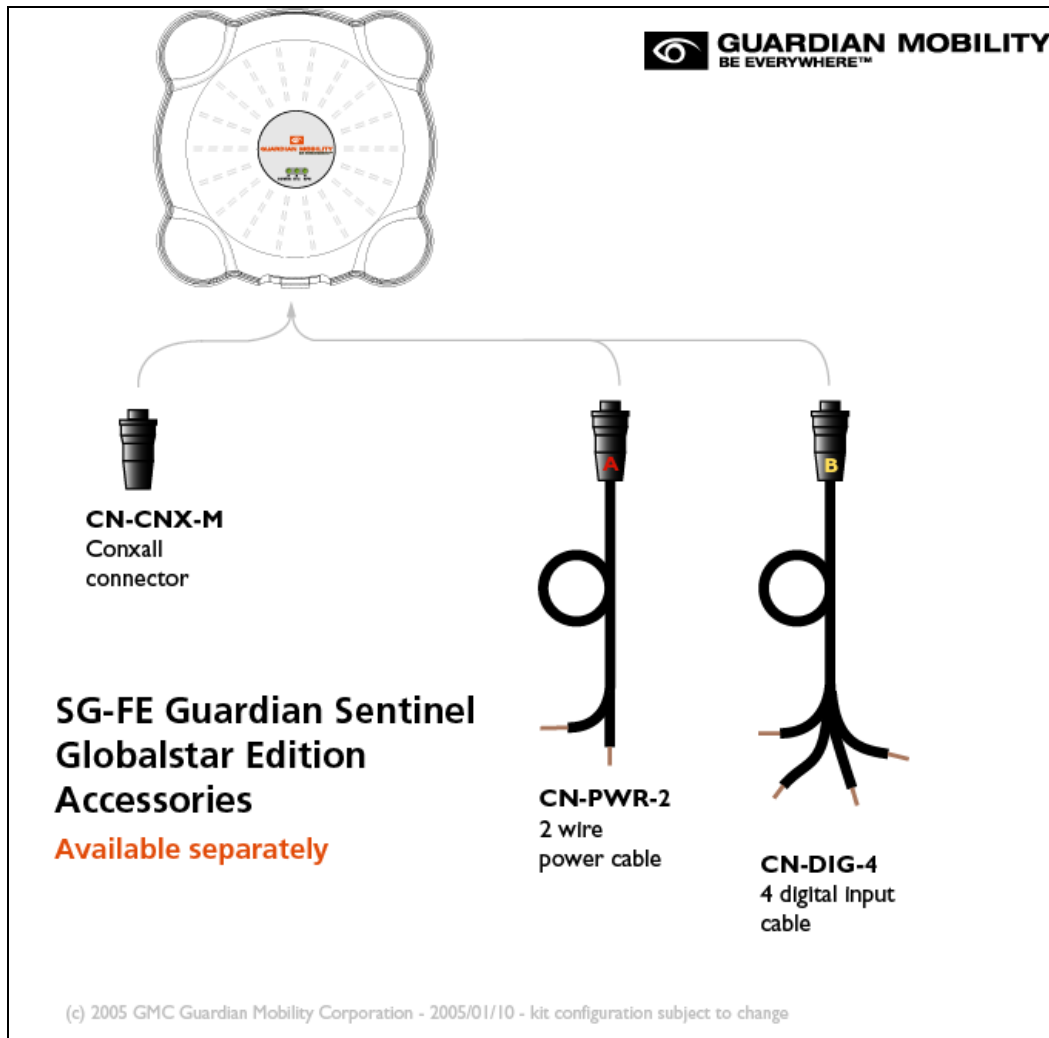


Figure 2: Full-enclosure parts list

CN-PWR-2 - Power extension cable: This cable is an extension of “port A”. It is a Conxall connector on one end, and bare wire (2 leads) at the terminating end. The wires can be connected to a custom power supply.

CN-DIG-4 - Digital extension cable: This cable is an extension of “port B”. It is a Conxall connector on one end, and bare wire (4 leads) at the terminating end. These wires can be connected to the digital inputs.

CN-CNX-M – Conxall connector: This is an IP65/NEMA4x rated connector that can be used to create custom cables.

Setting up the Guardian Sentinel

Setup Overview

Setting up, installing, configuring and testing the Guardian Sentinel consists of the following:

- Understanding the different parts of the Guardian Sentinel
- Ensuring that the Guardian Sentinel is operating correctly

This manual will guide you through the hardware and setup of the Guardian Sentinel.

What You Will Need

- Guardian Sentinel
- Power source (batteries or external power)
- Custom cables for connecting external sensors (if applicable)

Power Requirements

The Guardian Sentinel can be powered either by batteries or external power sources. The power requirements are 9 - 15 VDC with the capability of providing 350 mA of continuous current. The supported battery option is 6 AA batteries of various chemistries.



Battery life will be determined by battery chemistries, transmission frequency, and the temperature.

The Guardian Sentinel is also configured with a built-in battery warning system that warns the user when the battery level is reaching low levels. The unit will trigger transmissions when the battery level is low. The unit will start transmitting a low battery transmission when the batteries reach 7.5V. The number of remaining transmissions will vary based on battery type and conditions.

Power Consumption Profile

The Guardian Sentinel will operate in sleep mode while monitoring inputs or between scheduled transmissions. When a transmission is initiated, the Sentinel will switch to operating mode while acquiring the GPS signal and between satellite (STU) transmissions. A Guardian Sentinel will transmit a message once with two retries, with 120-180 second delay between each transmission. The unit will initiate a burst transmission for 1.4 seconds per 9-bytes of data in each transmission. During this burst interval, the unit operates in STU burst power.

The power consumption of the Guardian Sentinel is based on the following characteristics:

- Sleep power: <1mA at 12V
- Operating power: 30mA at 12V
- STU burst power: 350mA at 12V

A power consumption timeline is shown below for a GPS enabled Guardian Sentinel:

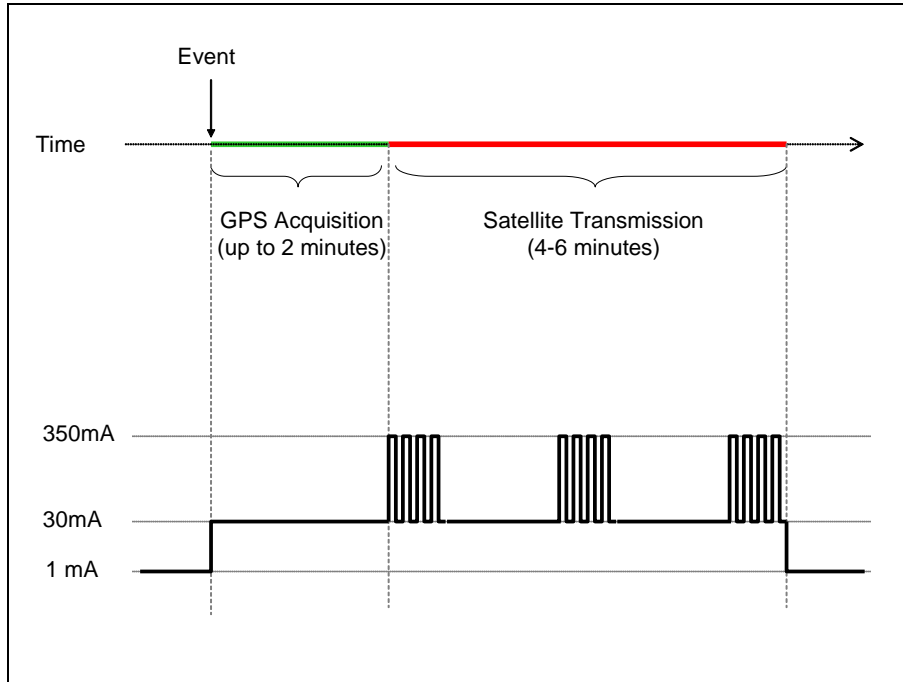


Figure 3: Power Consumption Profile

Connector Diagram

The Guardian Sentinel has two connectors that are used to power and program the unit. They are also used to connect external sensors.



Up to two (2) digital sensors can be connected to the Guardian Sentinel

The following diagrams illustrate the pin-out of the male connectors on the Guardian Sentinel. The female connector is a mirror of this image:

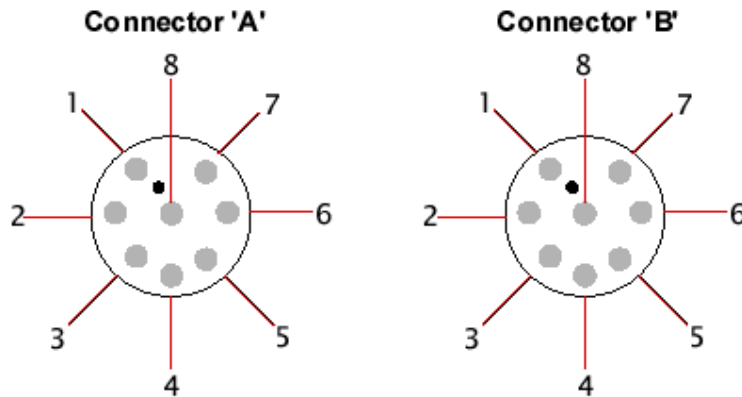


Figure 4: Guardian Sentinel connector pin-outs (male)

Pin	Connector 'A' Pin Description
1	Power
2	Ground
3	Do not connect
4	Unused
5	Unused
6	Unused
7	Unused
8	Unused

Pin	Connector 'B' Pin Description
1	Digital input 1
2	Digital input 1 return
3	Digital input 2
4	Digital input 2 return
5	Unused
6	Unused
7	Unused
8	Unused

Table 1: Guardian Sentinel connector pin descriptions

LED Behaviour Description

Guardian Sentinels have three LEDs (light emitting diodes) which indicate what the unit status. The three LEDs represent the following:

1. CONFIG – Configuration LED
2. STU – Satellite Transmitter LED
3. GPS – Global Positioning System LED

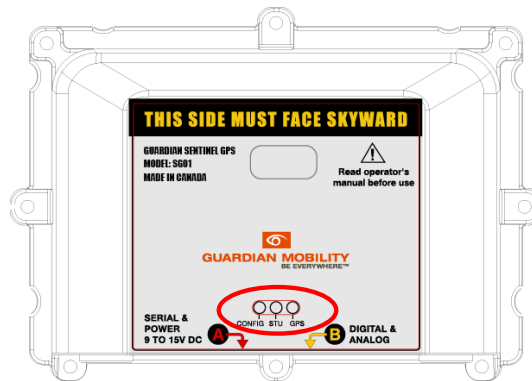


Figure 5: Guardian Sentinel LEDs

When the unit is first powered all three LEDs light up for an instant. After, the *STU* LED lights up for a couple of seconds while the *STU* initializes. The *GPS* LED blinks as the unit begins acquiring GPS position. After it gets a valid GPS position, or the GPS timer times out, the unit begins transmitting. During this time, the *STU* LED blinks once every 15 seconds until it is done. The transmission period varies between 4 to 6 minutes with the standard pre-configuration which transmits a message three times.

Digital Input Port

The Guardian Sentinel has been configured to use two (2) digital input ports that can be connected to external devices. The only acceptable states are a high or a low state. The ports are connected to opto-couplers and thus are two-wire, current sensing inputs. The unit is able to respond to changes in input state. The minimum voltage required to detect a change in state is 5 Volts and the maximum voltage is 30 Volts. The pulse duration should be approximately 1 second to be detected by the Sentinel.

The Guardian Sentinel has been preprogrammed to transmit a message on a rising edge. The Sentinel will not respond to digital events while the *STU* is transmitting.



Figure 6: Digital Input Detection

Triggers for Transmissions

The Guardian Sentinel will transmit in 4 different scenarios:

- 1) Power on
- 2) Scheduled event
- 3) External event
- 4) Low battery

Power-On Transmission

The Guardian Sentinel transmits a message on power-up.

Scheduled Events

The Guardian Sentinel has been pre-programmed to transmit every 4 hours. The scheduled transmission will include the data for active sensors, and will include the unit location.

The Guardian Sentinel will start the interval timer from the time the unit is powered on.

External Events

The Guardian Sentinel will transmit digital, analog and serial events when they occur.

Low Battery

When the battery pack is running low, the Guardian Sentinel will continue to send transmissions with the low battery flag set.

Power up Sequence

Once all external sensors are attached and power is applied to the Guardian Sentinel, the following sequence occurs:

- 1) Interval timer begins
- 2) GPS acquires almanac (5-15 minutes)
- 3) GPS acquires location (up to 2 minutes)
- 4) Power on transmission (4-6 minutes)
- 5) Unit transmits on scheduled events and external triggers

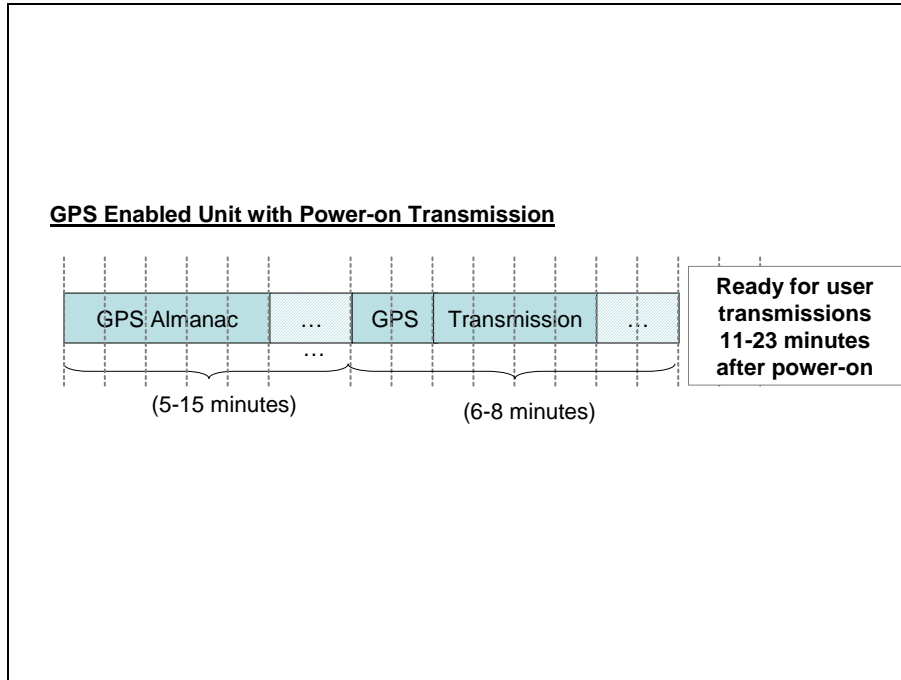


Figure 7: Power-on Sequence



Before the first transmission, the Guardian Sentinel GPS must be left on for a period of 15 minutes in order to allow the unit to orient itself and update its GPS almanac.

Appendix A: System Specifications

Satellite Transmitter Operating Frequency	1611.25 MHz to 1618.75 MHz
RF Testing	FCC Part 15, 25, ETSI and Industry Canada
GPS Receiver Operating Frequency	1575.4 MHz (L1)
Time To First Fix (TTFF)	45s cold; 35s warm
Standby Power Consumption	<1 mA @ 12V
Transmit Mode Power Requirements	~350 mA @ 12V
GPS Acquire Power Requirements	~25 mA @ 12V
Operating Temperature Range	-30°C to +60°C
Power Supply Requirements	9-15V input voltage Support from 1mA to 350 mA continuous current @ 12V
Battery Support (full-enclosure only)	6x AA batteries
Antenna	Integrated patch antennae, passive
Satellite Visibility Angle Range	25° above horizontal
Serial Payload Size	134 bytes
Message Format	9 to 144 byte messages

Appendix B: Guardian Mobility Portfolio

The Guardian Sentinel Product Family is a portfolio of solutions available from Guardian Mobility (GMC) for satellite based data communications. The following list summarizes the different models available:

Guardian Tracer: Ideal for locating and monitoring valuable assets in remote locations, such as trailers, railcars, boats, cargo containers, and construction equipment, the Guardian Tracer is an affordable, dependable, GPS enabled satellite transmitter. Tracer units automatically provide critical location and status data of key assets in near real time to your location. Available at a fraction of the price of other satellite solutions, the Tracer is small, easily installable and re-deployable amongst multiple assets. The Tracer is power-efficient, can run on AA batteries, and can interface to a variety of analog, digital and serial sensors.

Guardian Skytrax: For aircraft owners, fleet operators and agencies who need better flight information for increased efficiency, enhanced safety, accurate billing or legal reasons, the Guardian Skytrax transmits flight data information in near real-time to trace aircraft flight path with maximum accuracy and a minimum number of transmissions.

Unlike other aircraft systems, the Guardian Skytrax is inexpensive to acquire and operate, operates independently from aircraft systems, and sends position data in near real time to your operations centre or desktop. Guardian Skytrax offers the most cost effective and precise flight path tracking solution in the marketplace today.

Guardian Sentry: The Guardian Sentry wireless data communications solution is designed for remote, redundant or backup security applications. Unlike traditional security systems, the Guardian Sentry uses satellite communications to deliver alarm messages from security panels or individual security sensors directly to central monitoring stations or your desktop. The technology is an excellent fit in areas where wireline telephone or cellular service is not available.

Please check the Guardian Mobility website at <http://www.guardianmobility.com> for more details on these products.

Appendix C: System Architecture Overview

Product Architecture

The Guardian Sentinel has a modular architecture which enables the unit to be customized for different analog inputs, digital inputs, digital outputs, and serial communications. The Sentinel composes the following primary components:

- Satellite transmitter
- GPS receiver
- Microcontroller
- Antenna
- Input/Output Ports
- Power supply or external power interface

Satellite Transmitter

The satellite transmitter is used for communicating with the Globalstar satellite system. It transmits information such as Guardian Sentinel unit ID, GPS location, time of day and customer payload data that is sent to the Guardian Mobility's secure server.

GPS Receiver

The Guardian Sentinel (optionally) incorporates a GPS receiver. Messages will include the GPS time, latitude and longitude. Internally, the Sentinel GPS monitors all NMEA standard parameters, and transmits a subset of that data. Other fields which are not presently transmitted include velocity, bearing, altitude, HDOP/VDOP, and number of satellites in view.

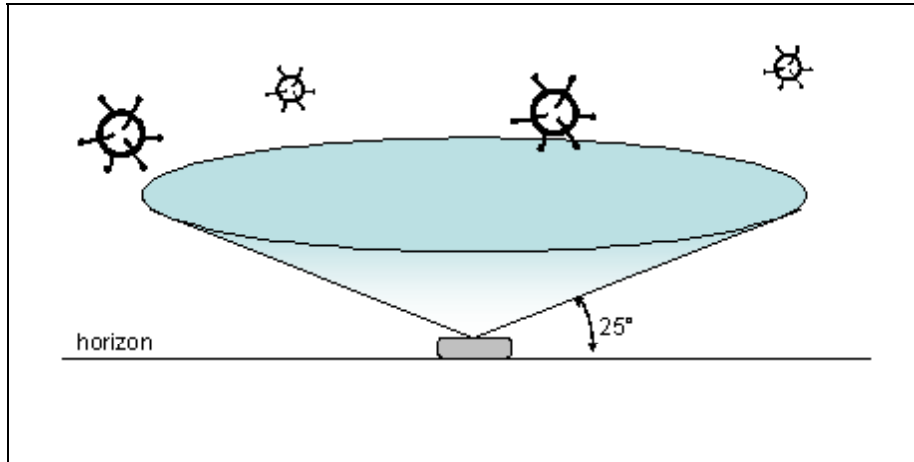
Microcontroller

The microcontroller on the Guardian Sentinel is responsible for many functions including:

- Power management to ensure maximum battery life
- Acting as an interface between I/O ports, satellite transmitter and GPS receiver
- Storing user preference and product configuration details
- Signaling the satellite transmitter to transmit when cued
- Scheduling and executing timed input port readings and transmissions
- Monitoring battery life

Antenna

There are two passive patch antennas on the internal antenna board. The GPS antenna is tuned to receive at the 1575 MHz L1 GPS band while the other is tuned to transmit at the 1615 MHz center line frequency of the satellite transmitter. To maximize the operation of the patch antennas, the unit must be oriented in a horizontal position with a clear view of the sky. The antennas have visibility of the entire sky 25 degrees above the horizon.



External antenna options are also available. For more information, contact a Guardian Mobility representative.

Input/Output Ports

The Guardian Sentinel is capable of sending small amounts of data from external devices or sensors. These can be connected to the Sentinel in three ways:

- Digital input/output port
- Analog input port
- Serial connection port (RS-232)

Digital Input Port

The Guardian Sentinel can be custom configured to have up to eight (8) digital input ports that can be connected to external devices. The only acceptable states are a high or a low state. The ports are connected to opto-couplers and thus are two-wire, current sensing inputs. The unit is able to respond to changes in input state. The minimum voltage required to detect a change in state is 5 Volts and the maximum voltage is 30 Volts.

Digital Output Port

The Guardian Sentinel can support up to four (4) digital outputs which can be used to power subtending equipment. Since the digital output ports can have a significant effect on battery

life, it is not recommended to use these ports without an external power source. For more information, contact a Guardian Mobility representative.

Analog Input Ports

There are three analog inputs on the Guardian Sentinel which may be custom configured to be connected to external devices. Analog inputs are connected directly to one of the analog to digital (A/D) converter. The maximum allowed input voltage is 3.3 volts. The measurement resolution of the port is 3.2 mV. If there is a requirement for analog input voltages greater than 3.3 volts, custom scaling circuits will be required. Please contact your Guardian Mobility representative for more information.

The Guardian Sentinel can be programmed to respond to changes in input voltage at the analog ports or to take a reading at predetermined times.

Serial Connection Port

There are two RS-232 serial ports on the Guardian Sentinel (GPS) that may be connected to external devices.

Appendix D: Satellite Communications

Packet Repetition and Multiple Copies

There is no acknowledgement of packet reception back to the satellite transmitter in the field. To ensure packet reception, the Guardian Sentinel transmits the same message 3 times to increase its delivery success.

The Globalstar back office server will collect all retransmissions and duplicate packets per message but only send one single message with all its constituent packets back to the Guardian Mobility BackOffice. Retransmitted packets do not incur additional transmission charges.

Coverage Statistics

For a successful communication at least one satellite must be simultaneously in view of both the satellite transmitter and a terrestrial gateway. The Guardian Sentinel system is designed to operate when a satellite is at a minimum elevation angle of 25° (to be revised) and the gateway is at a minimum elevation angle of 10°.

There are two gateways that service all of North America up to the 70° latitude and part of Mexico. The North American gateways are located in Smith Falls, Ontario, Canada and High River, Alberta, Canada. The gateway in Ogulbey, Turkey serves Turkey and areas to the south and east, including the eastern Mediterranean, Egypt, Lebanon and Iraq. European regions are covered by a gateway in Toulouse, France.

For additional coverage inquiries, please contact a Guardian Mobility technical support representative.

Each gateway service area is illuminated by multiple beams from multiple satellites. Since only one satellite beam needs to be present over a given remote terminal unit to achieve communication link, there is a very high probability that data will be received by the gateway. The probability is further increased by the retransmission of message packets.

Message Privacy

Due to the characteristics of the CDMA signal, the system is very immune to eavesdropping. In addition, Guardian Mobility encrypts the message before it is passed to the satellite transmitter. The encrypted message is decrypted by the Guardian Mobility BackOffice prior to processing the information.

Message Data

The following information about each Guardian Sentinel transmission will be available to the customer:

- Unique ID of the Guardian Sentinel (ESN)
- Time of transmission
- Message reception time (GMT time)
- Low battery warning
- Payload data sent by external devices (analog, digital and RS-232)
- Latitude and longitude position (Guardian Sentinel GPS only)
- Sensor status information

Services by Guardian Mobility enable this data to be visible on the Guardian Mobility BackOffice, and to forward information to the Customer via e-mail, SMS or XML. Please contact Guardian Mobility at 613-225-8885 for information about these services.

Appendix E: Certification

Globalstar Certification

Certified Globalstar VAR provider.

CSA (Canadian Standards Association) Certification

Guardian Mobility is currently pursuing CSA approval for the complete product.

FCC Certification

The satellite transmitter (modem) in the Guardian Sentinel products currently meets FCC approval for use as communication devices. The FCC ID is RZTGMSG01.

Industry Canada (IC) Certification

The satellite transmitter (modem) in the Guardian Sentinel products currently meets Industry Canada approval for use as communication devices. The Industry Canada Technical Acceptance Certificate number is IC: 4835A-GSENSSTU.

Appendix F: Warranty

Licensors warrants that the Device excluding the battery will perform substantially in accordance with specifications for a period of 360 days from the date of shipment of a Device by Licensor to Licensee, or for a period of 180-days from activation in end-user application, whichever occurs first. The limited warranty on the Portable Location Device is void if the Device's environmental housing has been opened or tampered with in any way. If the Portable Location Devices do not so perform during such period, Licensor will use commercially reasonable efforts to replace the faulty device, at no cost to Licensee (other than reasonable travel expenses to the Licensee's site, if necessary). This shall be Licensee's sole remedy for such failure.

Appendix G: Acronyms

ASCII	American Standard Code of Information Interface
CTS	Clear to Send
ESN	Electronic Serial Number
GPS	Global Positioning System
HTTP	Hyper Text Transport Protocol
I/O	Input/Output
LPG	Liquefied Petroleum Gas
RTS	Request to Send
SCADA	Supervisory Control and Data Acquisition
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
STU	Satellite Transmitter Unit
XML	Extended Markup Language

