# SHOUT nano 100 User Guide

Version C

November 7, 2023

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# Revision History

| Revision | Date | Description |
|---|---|---|
| A | 04/30/2023 | Formal Release |
| B | 10/10/2023 | Format Editing |
| C | 11/7/2023 | Updated disclaimer, Electrical Specification |

# Reference Documents

The latest revisions of the NAL documents are available by request via email.

Support@nalresearch.com.

| Reference | Title | Revision/Date |
|---|---|---|
| [1] | AT Commands for Model SHOUT nano 100 | Revision A, 30 May 2023 |
| [2] | NAL GPS Report Version 6 Format | Revision 3, 26 September 2018 |
| [3] | PECOS Message Definition Specification, 200907-001 | Version 1.7 July 29, 2009 |
| [4] | SHOUT App User Guide | Version D, March 31, 2023 |
| [5] | SatTerm for SHOUT nano 100 v9.1.0 | Version A, April 30, 2023 |

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# Acronym List

AES ............................Advanced Encryption Standard

API .............................Application programming interface

AT ..............................Attention

BATT ..........................Battery

BIS .............................Bureau of Industry and Security

BLE.............................Bluetooth Low Energy

BT ..............................Bluetooth

CE ..............................Conformité Européenne

CRUD .........................create, read, update, and delete

DAV ...........................Data After Voice

DISA ...........................Defense Information Systems Agency

DoD ...........................Department of Defense

DSN............................Defense Switch Network

EAR ............................Export Administration Regulations

EMSS .........................Enhanced Mobile Satellite Services

FCC ............................Federal Communications Commission

FDMA .........................Frequency-Division Multiple Access

GNSS..........................Global Navigation Satellite System

GPS ............................Global Positioning System

GPX............................GPS Exchange Format

GSM............................Global System for Mobile Communication

GUI ............................Graphical User Interface

IMEI ...........................International Mobile Equipment Identification

IRDM ..........................Iridium

ISP..............................Internet Service Provider

ISU .............................Iridium Subscriber Unit

Kbps............................kilobits per second

KML ............................Keyhole Markup Language

LED ............................Light Emitting Diode

LEO ............................Low-Earth Orbit

MMC..........................Mission Management Center

NIST ...........................National Institute of Standards and Technology

NOAA.........................National Oceanic and Atmospheric Association

NOC ...........................Network Operations Center

NORTHCOM ...............Northern Command

OFAC..........................Office of Foreign Asset Controls

PMS ...........................PECOS Message Structure

PPP ............................Point-to-Point Protocol

PSTN ..........................Public Switched Telephone Network

RUDICS ......................Router-based Unrestricted Digital Internetworking Connectivity Solution

SBD ............................Short Burst Data

SMA ...........................SubMiniature version A

SMS ...........................Short Message Service

SMSC .........................Short Message Service Center

STAT ...........................Status

TDD............................Time Division Duplex

TDMA ........................Time-Division Multiple Access

TTKT...........................Time To Keep Trying

TTL.............................Transistor–Transistor Logic

USA............................United States of America

USB ............................Universal Serial Bus

UTC............................Coordinated Universal Time

VAC............................Volts (Alternating Current)

VDOP .........................Vertical Dilution of Precision

# 1 Introduction

The SHOUT nano 100 is a pocket-sized, low-cost, low power, Iridium satellite network tracking device. It is designed to relay, via the Iridium satellite network, Global Navigation Satellite System (GNSS) / Global Positioning System (GPS) location data and other critical data, such as emergency messages, geofence data, and callouts from the device, and text messages from the NAL SHOUT smartphone app. It has a rugged housing with embedded Iridium, GNSS, and Bluetooth antennas. This device can easily be carried by a person or attached to high value, untethered or non-powered assets.

The SHOUT nano 100 comprises an Iridium 9603 transceiver module, a GNSS receiver, Bluetooth Low Energy transceiver, low-power microcontrollers, Li-Ion rechargeable battery, and a lightweight, impact resistant plastic chassis with OLED display and embedded antennas. The SHOUT nano 100 can send Short Burst Data (SBD) messages over the Iridium satellite network in NAL Research's defined report formats compatible with NAL 9602-LP, 9602-AB, A3LA series modems, and SHOUT series tracking devices. The SHOUT nano 100 can also transmit in PECOS Message Structure (PMS), which complies with the Blue Force Tracking Data Format Specification as defined in the document PECOS Message Definition Specification, 200907-001 Version 1.7 [3]. When requested by an authorized user, NAL Research can enable the SHOUT nano 100 to utilize the DoD Defense Information Systems Agency (DISA) Enhanced Mobile Satellite Service (EMSS) Gateway when sending over the Iridium satellite network.

> **IMPORTANT**: EMSS-enabled SHOUT nano 100 must first be provisioned (signed up for airtime) with EMSS SBD service before testing or field use. Accessing the DoD EMSS Gateway is not authorized until the SHOUT nano 100 is provisioned. Unauthorized attempts to access the DoD EMSS Gateway result in immediate disabling of the offending device, which must then be returned to NAL Research for repair. See https://emss.pac.disa.mil/home.shtml for more information regarding EMSS service provisioning.

The SHOUT nano 100 is designed with ultra-low power consumption electronics and is capable of delivering uninterrupted service for up to 20 days at one report per hour. Power consumption can be further reduced by using the device's built-in motion sensor and/or

Geofencing features to reduce reporting frequency when a platform is not in motion or is outside an area of interest. In addition to normal tracking, the SHOUT nano 100 also has a real-time clock allowing power-up delay as well as scheduled daily Call Outs.

## 1.1 Device Description

The SHOUT nano 100 comprises a Power button/911, a Light Emitting Diode (LED) Status display, an Iridium antenna, a GNSS antenna, Bluetooth antenna, Bluetooth button/911, and a micro Universal Serial Bus (USB) interface as shown in **Figure 1**. The USB-C interface port is for charging, firmware updates, data collection, and setting parameters using the NAL Research SatTerm application. Using the *Emergency/911* button activates the emergency/911 mode to send an emergency message with an increased reporting rate. For detailed information on the emergency/911 mode, refer to section **2.2 Activate Emergency/911** .
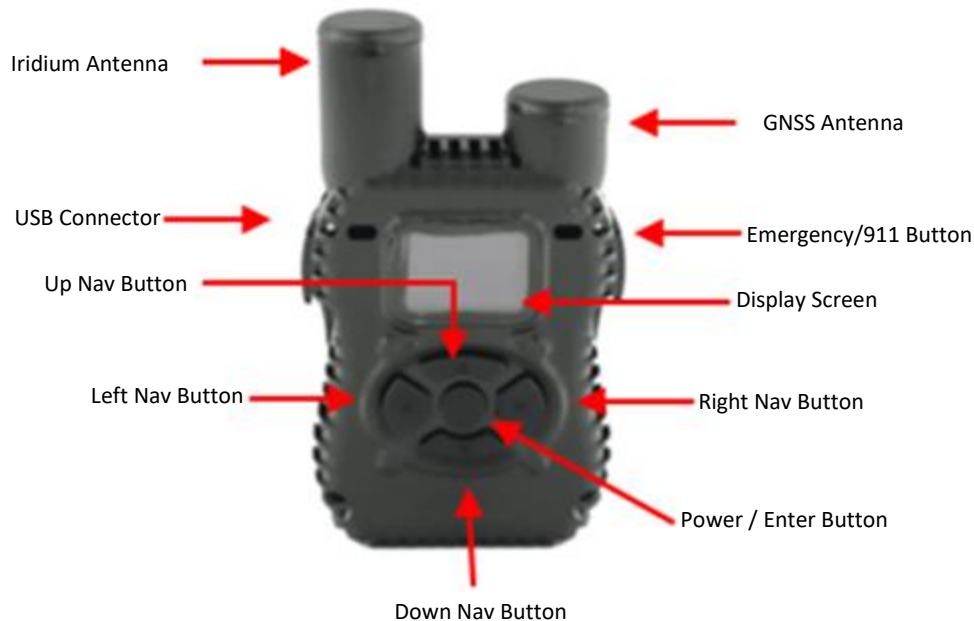


*Figure 1: SHOUT nano 100 External Components*

## 1.2    Accessories



AC Wall Adapter                    USB-A to USB-C Cable

*Figure 2: SHOUT nano 100 Accessories*

# 2 User Interfaces

## 2.1 Power/Enter Button

The SHOUT nano 100 has a single power ON/OFF button (see **Figure 1**). The SHOUT nano 100 can be turned off and on again by momentarily holding down the Power button for two seconds and releasing it. If the device is sleeping, press the **Power/Enter** button for two (2) seconds to wake up/turn on the SHOUT nano 100.  **NOTE**: Upon waking up, the device will not display the *NAL Splash* screen.

## 2.2 Activate Emergency/911

The SHOUT nano 100 has an emergency/911 button (see **Figure 1**) that immediately sends a location report with the Emergency bit set, and thereafter sends location reports at a rate configured in the Emergency Report Rate parameter until the emergency/911 mode is canceled. All text messages sent when the emergency/911 mode is active also have the Emergency flag set.

**ACTIVATE**:

1. Open the emergency cover and press the **Emergency/911** button (see **Figure 3**).
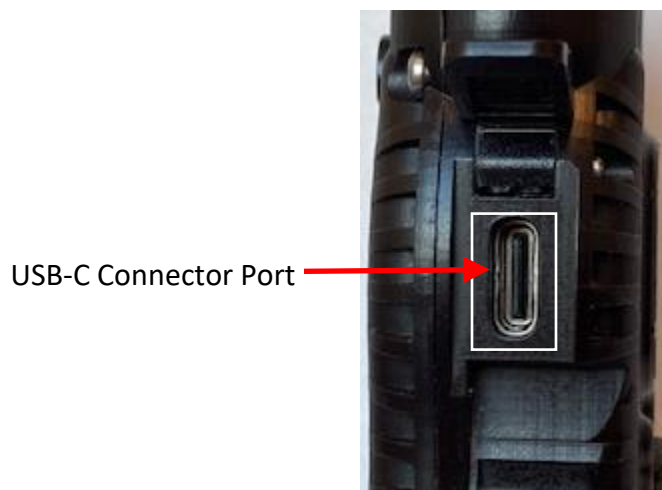


Emergency Button Cover

Emergency/911 Button

*Figure 3: Emergency 911-Activate*

The Status Symbol field on the device to turns "red" (see **Figure 4**).

Status Symbol Field



*Figure 4: Emergency 911-Status Symbol Field*

**DEACTIVATE** See section **7.6 Cancel 911**.

# 2.3 USB-C Connector Port



USB-C Connector Port

*Figure 5: USB Connector Port*

The SHOUT nano 100 USB-C connector port is located on the left side of the chassis, as shown in **Figure 5**. This connector has a rubber O-ring sealed cover required to achieve the IP67 rating of the device.

## 2.3.1 USB Data

The SHOUT nano 100 communicates to computer equipment using the USB-C port located on the left side of the chassis (see **Figure 5**). The USB-C connection allows configuration of and data collection from the SHOUT nano 100 using NAL Research's defined AT commands and NAL's SatTerm console window. These AT commands can be found in the manual AT Commands for Model SHOUT nano 100 [1]; also see section **4.2 Modes of Operation**. NAL Research recommends using the SatTerm (v9.1.0) graphical user interface (GUI) software to configure the SHOUT nano

100, instead of trying to memorize various AT commands. The latest version of this software can be downloaded from the NAL Research website (https://www.nalresearch.com).

## 2.3.2    DC Power Inputs

The device charges in three (3) hours from any USB port. The device does not support fast charging.

# 2.4    Bluetooth

The SHOUT nano 100 utilizes a Bluetooth Low Energy (BLE) transceiver to provide a secondary command interface path alternative to the USB-C connector port. Like the USB port, this interface can connect with SatTerm running on a Windows® PC.  You can also establish a Bluetooth connection with a Bluetooth enabled Android device running the SHOUT nano 100 App (see section **5.1 Pairing the SHOUT nano 100 to Android Device**). For information regarding the SHOUT App, refer to section **6 SHOUT App Overview**.

By default, the Bluetooth interface has a 10-minute idle timer that turns off the Bluetooth interface when there is no data transfer or when the Bluetooth has been disconnected for more than 10 minutes.

# 3   Initial Setup

The sections below describe the initial setup of the SHOUT nano 100 device to operational use.

## 3.1   Prepare Device

Prior to using the SHOUT nano 100, first purchase airtime from NAL Research or arrange with NAL to provision the device for use on the DoD EMSS gateway. An airtime reseller must register the SHOUT nano 100 IMEI number to "point" to a Network Operation Center (NOC) server. This section explains how to set up quickly the SHOUT nano 100 as a tracking device.

1.  Remove the SHOUT nano 100, the wall charger, and the USB cable from the packaging.

2.  Open the SHOUT nano 100 USB-C connector port cover and connect the USB cable's USB-C connector to the USB-C connector port on the SHOUT nano 100 (see **Figure 5**).

3.  Connect the USB-A connector to the wall charger and plug charger into a wall socket.

## 3.2   Start Device

1.  Once the device is fully charged, press the **Power/Enter** button (see **Figure 1**) for two (2) seconds, until the *Home* screen displays (see **Figure 6**). The *NAL Research Splash* screen displays momentarily, then the *Home* screen displays (see **Figure 6**).
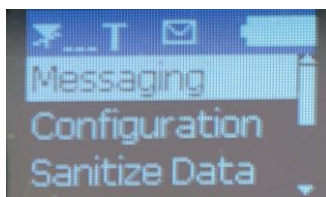


*Figure 6: Home Screen*

**NOTE**: If the device is not used for 10 minutes, the SHOUT nano 100 enters sleep mode. The SHOUT nano 100 can be removed from the sleep mode by pressing the **Power / Enter** button for two (2) seconds.

## 3.3    Charge Device

The SHOUT nano 100 ships with a partially charged battery. Before use, charge the SHOUT nano 100 for one (1) hour. **NOTE:** Upon battery depletion, the SHOUT nano 100 should reach full charge within three (3) hours when continuously plugged in.

1. Plug the wall charger into a 115 Volts (Alternating Current) (VAC) power source.

2. Confirm that power applied to the SHOUT nano 100 USB-C port.

   A charging icon appears in the battery icon, as shown in **Figure 7**.



*Figure 7: Battery Charging Icon*

## 3.4    Pre-Configuration Settings

The SHOUT nano 100 ships with the default settings noted below:

- Report Rate: five (5) minutes

- Emergency Report Rate: five (5) minutes

- Transmit Report Without GNSS Fix: Yes

- Message Format: NAL Message Format Version 6

If you want to change these default settings, the SHOUT nano 100 supports a USB-C connection to a computer with SatTerm software (or any terminal emulator software) to configure its operating profile using NAL Research's defined AT commands. Find these AT commands in the NAL manual AT Commands for Model SHOUT nano 100 [1]. **NOTE**: the Report Rate can also be changed from the SHOUT nano 100 *Home>Configuration* screen.

The required hardware and software to configure the SHOUT nano 100 include:

- A desktop or laptop computer (not provided).

- A USB-A to USB-C cable (provided with the SHOUT nano 100).

- NAL Research's defined AT commands

- SatTerm software or any terminal emulator software

  **NOTE**: To install the SatTerm software on a computer, refer to the SatTerm for SHOUT nano 100 manual [5].

# 3.5    AT Command Mode

For scenarios where computer control of the SHOUT nano 100 is desired, use a computer attached to the SHOUT nano 100 USB interface through a USB-C cable. For example, the SHOUT nano 100 can be turned off using the AT command **^SHUTDOWN**. If the device is sleeping or in low power in between reporting cycles, pressing the **Power/Enter** button turns the SHOUT nano 100 on for 10 seconds. During this time, take the device out of tracking mode and put it into command mode by entering a sequence three pluses, "**+++**". If **"+++"** is not entered within 10 seconds, the SHOUT nano 100 goes back to sleep. See section **4.2 Modes of Operation** for a more detailed description of the command mode, and see the NAL document AT Commands for SHOUT nano 100 [1] for a full list of the AT command capabilities.

# 4 Important Features

## 4.1 Communication Links

The SHOUT nano 100 uses the Iridium network to send its location reports. To use Iridium service, the International Mobile Equipment Identification (IMEI) number must be activated with an SBD service plan through an authorized Iridium reseller or provisioned by NAL on the DoD EMSS Gateway. When an IMEI is provisioned for service, up to five SBD delivery destinations can be specified. These are delivery endpoints for the data transmitted by the SHOUT nano 100 and can be any combination of three types: IP address, email, and IMEI.

## 4.2 Modes of Operation

The SHOUT nano 100 is always in one of two modes: (1) command mode or (2) tracking mode. It can be configured to turn on in one of these modes. The factory-set *Start-up Mode* is tracking mode, which can be changed using the **^START** command. For normal operational tracking scenarios, set the *Start-Up Mode* to tracking mode so that the unit continues tracking after waking up from sleep.
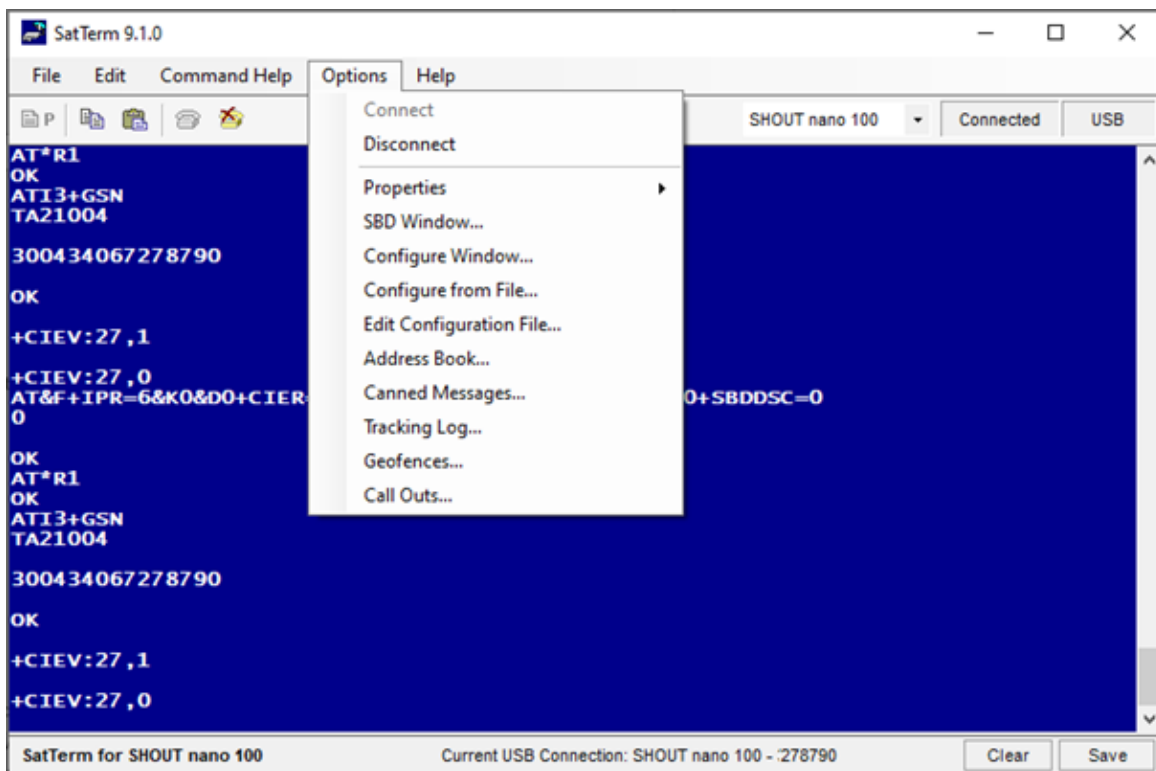


*Figure 8 Options Menu and Configure Window Menu Item*

## 4.2.1    Command Mode

When in command mode, the SHOUT nano 100 accepts AT commands through the USB connection. The command set is detailed in the document <u>AT Commands for SHOUT nano 100</u> [1]. Use the commands to configure the SHOUT nano 100 operating parameters, to allow the SHOUT nano 100 be operated as a modem, and to query the GNSS receiver. Command mode can be switched to tracking mode by the AT command **^TRK**. To switch back, use the escape sequence **+++**.

## 4.2.2    Tracking Mode

When in tracking mode, the SHOUT nano 100 automatically transmits position reports using parameters contained in a tracking profile. Refer to <u>the SatTerm for SHOUT nano 100 Manual</u> [5]. The SHOUT nano 100 can transmit messages in NAL Research's defined report formats and can also transmit messages according to the PECOS Message Structure (PMS) compatible with the US Northern Command (NORTHCOM) Mission Management Center (MMC) server. The PMS complies with the Blue Force Tracking Data Format Specification as defined in the document <u>PECOS Message Definition Specification, 200907-001 Version 1.7</u> [3].

The SHOUT nano 100 tracking mode has configuration parameters that control the reporting capabilities and power consumption. The SHOUT nano 100 can be configured to send reports at an interval ranging from continuous to once every seven (7) days. The SHOUT nano 100 can operate in a low-power mode whereby the device turns off and sleeps between reports.

Tracking may enter the low-power mode while the USB and Bluetooth user interfaces are in use. Use the command **AT^PWRAO** (Power Always On) to keep the SHOUT nano 100 turned on in this situation. This setting prevents the SHOUT nano 100 device from sleeping and greatly increases power consumption; disable this command when finished using the USB or Bluetooth interface. Refer to the document <u>AT Commands for SHOUT nano 100</u> [1] for additional details.

The more commonly used tracking parameters are "Time Between Reports" (**^TBR**), "Time to Keep Trying" (**^TTKT**), and "Callable" (**^CAL**). The following features can also be utilized to further tailor tracking mode to a specific application: "GNSS power" (**^GAO**), "communication link availability" (**^LNK**), "profile selection" (**^TPN**, **^TPT**, **^TPE**), motion detection, and geofencing.

"Time Between Reports" (**^TBR**) and "Time to Keep Trying" (**^TTKT**) adjust how often to send reports and how long the SHOUT nano 100 tries to achieve a successful report transmission. Decreasing the "Time Between Reports" increases data points for more detailed situational awareness and increasing the "Time to Keep Trying" improves the chances of transmission success. Both options also directly affect the SHOUT nano 100 power consumption.

For supporting message-receiving scenarios, referred to as "Callable," the SHOUT nano 100 Iridium modem can be set to be always on by using the **^CAL** command. This configuration prevents the SHOUT nano 100 device from sleeping and greatly increases power consumption.

To facilitate power management and time to acquire location, configure the SHOUT nano 100 to control the power state of the GNSS module. The module can be set to be always on using the command **^GAO**, which prevents the GNSS from turning off after obtaining a valid fix.

While in tracking mode, the SHOUT nano 100 can load tracking profiles dynamically. By default, there are two tracking profiles set aside for normal tracking and emergency tracking. Typically, when tracking mode starts, the tracking profile for normal tracking is loaded, specified by the "Tracking Profile Normal" (**^TPN**) setting. When the emergency mode is triggered, tracking mode switches to using the tracking profile for emergency tracking, specified by the "Tracking Profile Emergency" (**^TPE**) setting. This allows the SHOUT nano 100 to be configured to operate differently when there is an external stimulus.

Tracking mode also loads a different tracking profile if geofences are enabled and the SHOUT nano 100 enters or exits a geofence. Priorities are assigned to the different stimuli and the SHOUT nano 100 only switches to the associated tracking profile if it has a higher priority. Emergency tracking has the highest priority, Geofence is the second highest, and normal tracking is the default.

## 4.3    Call-Outs and Turn-On Delay

Using an onboard real-time clock, the SHOUT nano 100 can be configured to send daily call-out reports at specified UTC times. These call-out reports are in addition to tracking reports sent at a predefined tracking interval and they are indistinguishable from each other. Call-outs can be used as a heartbeat to determine, if the device is still operational (refer to the SatTerm for SHOUT nano 100 Manual [5].

In addition, using the onboard real-time clock, the SHOUT nano 100 can be configured for a turn-on delay. A turn-on delay is set for a specific Coordinated Universal Time (UTC) time and date up to 45 days in the future. When a delay is set and tracking is started, the device remains in its low-power sleep mode until the configured date and time upon which the device will turn on automatically and enter the start-up mode. This is useful for conserving battery power while the tracker is in transit to a destination.

## 4.4    Geofencing

The SHOUT nano 100 can utilize location information from its GNSS receiver to determine whether it has entered or exited the bounds of preconfigured geofences. A geofence is a set of connected latitude and longitude coordinates that defines a region or zone of interest Refer to the SatTerm for SHOUT nano 100 Manual [5]. A geofence is defined by a minimum of three (3) coordinates and a maximum of 50. Multiple geofences can be configured, each with a unique set of tracking parameters that cause the SHOUT nano 100 to change its tracking behavior while in a specific geofence. Each geofence can also be configured to send a report upon entering and exiting the defined geofence region. In addition, geofences can be configured to turn off the Iridium modem for regions that require radio silence.

## 4.5    Motion Detection

The SHOUT nano 100 has a built-in sensor that can reliably detect motion. It is an omnidirectional movement sensor and functions regardless of how the SHOUT nano 100 is mounted or aligned. It is sensitive to both tilt (static acceleration) and vibration (dynamic acceleration). The signal level is fed directly into the SHOUT nano 100 microcontroller to wake the SHOUT nano 100 out of low-power mode when activity is sensed and to transmit a location report. The motion sensor has a variety of settings that impact its detection sensitivity. The motion sensor can be enabled or disabled (refer to the SatTerm for SHOUT nano 100 Manual [5].

## 4.6    Encryption

The SHOUT nano 100 can be configured to encrypt/decrypt all transmitted and received data using 256-bit Advanced Encryption Standard (AES) encryption. To enable encryption, assign a cryptographic administrator for the device to be responsible for modifying the encryption and

decryption keys and setting the device to use encryption (refer to the SatTerm for SHOUT nano 100 Manual [5]. The 256-bit AES encryption algorithms implemented here comply with NIST FIPS 140-2 (see the following documents (https://csrc.nist.gov/publications/detail/fips/140/2/final)):

1. Security Requirements for Cryptographic Modules, FIPS PUB 140-2, US Department of Commerce, National Institute of Standards and Technology (NIST), May 25, 2001

2. Security Requirements for Cryptographic Modules, Annex A: Approved Security Functions for FIPS PUB 140-2, US Department of Commerce, National Institute of Standards and Technology, February 19, 2003)

## 4.7    Remote Updates

Using the configurable, required remote update password, the SHOUT nano 100 can be configured over the air through the remote update option. This allows remote, unattended trackers to be reconfigured without requiring direct access to the device. All of the tracking profile parameters and most of the general parameters can be configured via remote updates (refer to the SatTerm for SHOUT nano 100 Manual [5]. NAL Research provides two software applications that can be used to compose and transmit remote updates: Server for Trackers and Remote Configure. These programs can be downloaded from the NAL Research's website (https://www.nalresearch.com/documentation/). Refer to the software applications for the list of remotely configurable parameters.
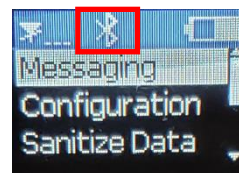
# 5   Pairing the SHOUT nano 100

This section provides instructions on how to pair a SHOUT nano 100. The SHOUT nano 100 can be paired to a device with or without the SatTerm application.

## 5.1   Pairing the SHOUT nano 100 to Android Device (Without SatTerm)

1. Turn on the Android device and install the **SHOUT App**, if not already installed.

2. Enable Bluetooth on the SHOUT nano 100 (see section **7.7 Enable BT Pairing/ Passkey**).

   **IMPORTANT**: The Bluetooth must be enabled on the SHOUT nano 100 before opening the SHOUT App. A 'white' Bluetooth icon indicates Bluetooth is enabled.

3. Open the **SHOUT App** on the  Android device.

   **IMPORTANT:** The SHOUT App performs a filtered scan for "SHOUT"-named devices on its own, and returns unpaired devices first, after attempting to pair with them.  Once paired to the SHOUT nano 100, the SHOUT App remembers the pairing and reconnects to the SHOUT nano 100 device first on start.  For information on the SHOUT App, refer to the SHOUT App User Guide [4].

## 5.2   Pairing the SHOUT nano 100 With SatTerm

The SHOUT nano 100 can be paired to an external device using the SatTerm application. For instructions on how to use the SatTerm application, refer to the SatTerm for SHOUT nano 100 manual [5].

# 6 SHOUT App Overview

The SHOUT nano 100 can communicate with an Android device by running the SHOUT App. The SHOUT App, developed by NAL Research, is available for download from the Google Play Store. This Android application provides all the capabilities of the display screens seen on other NAL Research tracking devices such as the SHOUT nano, and SHOUT ts. These capabilities include device status; text messaging; managing tracking parameters such as reporting rate, reporting format, and geofencing; diagnostic utilities; and configuring the SHOUT nano 100. The SHOUT App User Guide [4] document provides more details regarding the SHOUT App.

# 7 Using the SHOUT nano 100

## 7.1 Home Screen

Immediately after it is powered up, the SHOUT nano 100 momentarily displays the NAL Research logo followed by the *Home* screen, as shown in **Figure 9.**
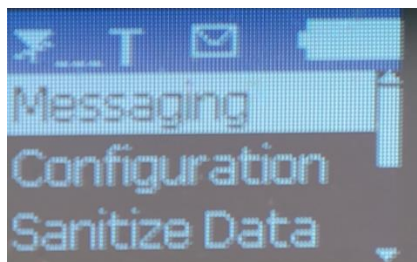


*Figure 9: Home Screen*

The *Home* screen menu displays the following functionalities:

- Messaging

- Configuration

- Sanitize Data

- Cancel 911

- Bluetooth pairing

- Unit Info

Use the keypad arrow buttons to navigate the menu and the **Power / Enter** button to select a desired menu option.

The Device Status Symbols field displays at the top of the *Home* screen. Some symbols do not appear until an event is initiated, such as sending or receiving a message. **NOTE**: Scroll down the *Home* screen to view the remaining functions.

## 7.2 Status Symbols

**Table 1: Status Symbols**

| | |
|---|---|
| ![Iridium off icon] | Denotes the Iridium transceiver is off. The Iridium transceiver is always kept off to preserve battery life, until a message is required to be transmitted. |
| ![Iridium signal icon] | Denotes: (1) the Iridium transceiver is on with real-time signal strength represented by the number to the right of the hash tags. The signal strength can range from the lowest of zero to the highest number: 3. During transmission, the antenna must have a clear view of the sky. The SHOUT nano cannot send reports from inside a building. |
| | No icon displays when the GNSS receiver is off. The GNSS receiver is always kept off to preserve battery life until time, date, or position information is needed.<br><br>Blank: GNSS receiver turned off |
| N<br><br>R<br><br>2<br><br>3<br><br>T | N: No Fix<br><br>R: Dead Reckoning<br><br>2: 2D fix or dead reckoning<br><br>3: 3D fix with HDOP higher than 2.0.<br><br>T: Time Only<br><br>Blank: GNSS receiver turned off |
| ✉ | Denotes one or more unread messages are in the Inbox. |
| ▲ | Denotes one or more messages are in the Outbox ready to be sent, or one or more messages in queue failed to send. |
| ![battery icon] | The battery indicator filled denotes it is fully charged. The battery indicator displayed a charging plug denotes the battery is charging. |

## 7.3 Messaging

The Messaging function allows you to view incoming messages and send canned messages.

### 7.3.1 Inbox

1. Select **Messaging>Inbox**.
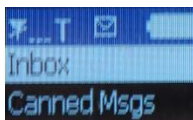
   The *Messaging* window displays.

2. Select the applicable report.

A *Recv'd* message associated with the selected message displays.

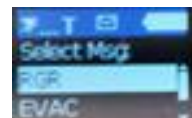3. Scroll down to view the entire message (tracking data).

## 7.3.2    Canned Messages

1. Select **Messaging>Canned Msgs**.

   The *Canned Msgs* window displays.

2. Select the applicable canned message (report).

   A *Recv'd* message associated with the selected

   message displays.

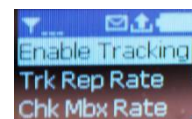3. Scroll the vertical bar to view details of the canned message.

## 7.4    Configuration

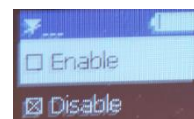The Configuration function allows you to enable tracking, set track report rate, and set check mailbox rate.

## 7.4.1    Enable Tracking

1. Select **Configuration>Enable Tracking**.

   The *Enable/Disable* window displays.

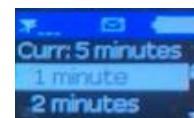2. Select **Enable**.

## 7.4.2    Track Report Rate

1. Select **Configuration>Trk Rep Rate**.

   The *Track Report Rate* window displays.
   The current track report rate displays at the top of the window.

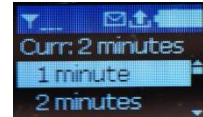2. Select (scroll for) the desired track report rate.

### 7.4.3　Check Mailbox Rate

1. Select **Configuration>Chk Mbx Rate**.

   The *Check Mailbox Rate* window displays.

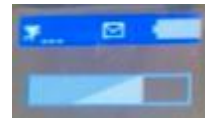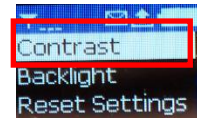   The current check mailbox rate displays at the top of

   the window.

2. Select (scroll for) the desired mailbox rate.

### 7.4.4　Contrast

1. Select **Configuration>Contrast**.

   The *Contrast* window displays.

2. Increase/decrease the contrast using the left/right navigation buttons on
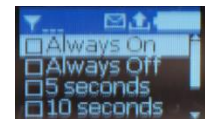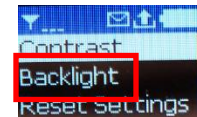   the Shout nano 100 device.

### 7.4.5　Backlight

1. Select **Configuration>Backlight**.

   The *Backlight* window displays.

2. Select (scroll for) the desired duration of the backlight.

### 7.4.6　Reset Settings
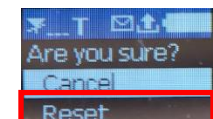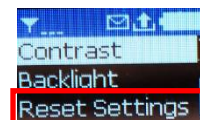
1. Select **Configuration>Reset Settings**.

   A *Confirmation* window displays.

2. Select **Reset**

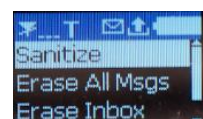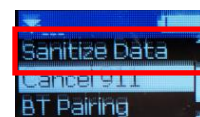   This resets the device to default factory settings.

## 7.5　Sanitize Data

The Sanitize Data function allows you to enable sanitize the device, erase all messages,

inbox messages, and zeroize keys.

1. Select **Sanitize Data** on the Home screen.

   The *Sanitize* window displays.

## 7.5.1  Sanitize

1.  Select **Sanitize**.

    This resets the device to default factory settings
    and also clears all memory and encryption keys.

    A *Confirmation* window displays.

2.  Select **Sanitize**.
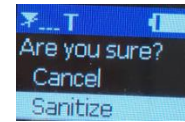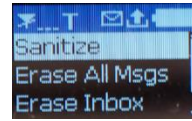
## 7.5.2  Erase All Messages

1.  Select **Erase All Msgs**.

    A *Confirmation* window displays.

2.  Select **Erase**.

    This erases all messages from the device.
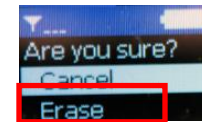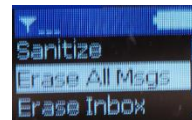
## 7.5.3  Erase Inbox

1.  Select **Erase Inbox**.

    A *Confirmation* window displays.

2.  Select **Erase**.
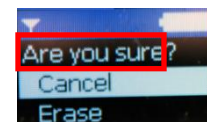
## 7.5.4  Zeroize Keys

1.  Select **Zeroize Keys**.

    A *Confirmation* window displays.

2.  Select **Zeroize.**
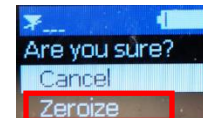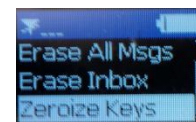
## 7.6  Cancel 911

The Cancel 911 function allows you cancel the 911 message to the NOC, and the device
returns back to normal operations.

1.  Select **Cancel 911** on the *Home* screen.

    A Confirmation window displays.
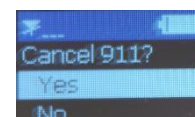
2. Select **Yes**.

A Success message displays.

## 7.7    Enable BT Pairing/ Passkey

The BT Pairing function enables the device to be discovered and paired with another device, which has Bluetooth pairing capabilities.

**NOTE**: Enable Passkey is optional.

1. Select **BT Pairing >Enable BT>Enable**.

BT Pairing is on the *Home* screen.
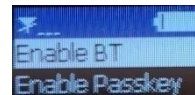
A *Confirmation* window displays.

2. Select **Enable**.

A white Bluetooth icon indicates the SHOUT nano 100 is Bluetooth enabled.

A green icon indicates the SHOUT nano 100 is connected to a Bluetooth device.
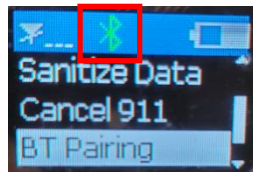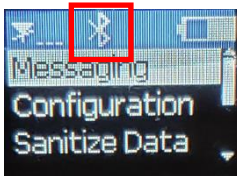
## 7.8    Unit Info

The Unit Info function displays the following data on the device: IMEI, APP firmware version, power firmware version, boot firmware version, and Iridium firmware version.

1. Select **Unit Info** on the *Home* screen. The *Unit Info* window displays.  Scroll down to see all of the data.
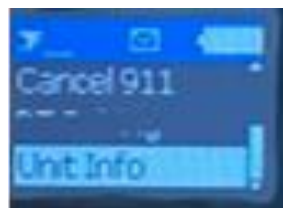
# 8   Technical Support

For technical support, please contact us at:

Phone: 571-833-2169

Email:  support@nalresearch.com

Technical documents are also available to download on NAL Research's website

www.nalresearch.com.

# Appendix A: Standards Compliance

The Iridium 9603 transceiver inside the SHOUT nano 100 is designed to meet the regulatory requirements for approval for the Federal Communications Commission (FCC), Canada, and Conformité Européenne (CE), assuming an antenna with a gain of approximately 3 dBic and adequate shielding. The 9603 transceiver is tested to the regulatory and technical certifications shown in the table below.

| Regulatory Approvals | Radio Tests | EMC Tests | Mechanical/ Electrical Tests |
|---|---|---|---|
| FCC | FCC CFR47 Parts 2, 15, and 25 | EN61000-4-2: 1995/A2: 2001 Part 4.2<br>EN61000-4-3: 2002 Part 4.3<br>EN61000-4-4: 2004<br>EN61000-4-6: 1996/A1: 2001 Part 4.6 | |
| Industry Canada | Industry Canada RSS170 Issue 1, Rev 1, November 6, 1999 | EN55022: 2006 | |
| CE | ETSI EN 301 441 V1.1.1 (2000-05) | ETSI EN 301 489-1 V1.8.1 (2008-04)<br>ETSI EN 301 489-20 V1.2.1 (2002-11) | EN60950-1:2006 Part 1 |

# Appendix B: Export Compliance

The SHOUT nano 100 is controlled by the export laws and regulations of the United States of America (USA). It is the policy of NAL Research to fully comply with all U.S. export and economic sanction laws and regulations. The export of NAL Research products, services, hardware, software and technology must be made only in accordance with the laws, regulations and licensing requirements of the U.S. government. NAL Research customers must also comply with these laws and regulations. Failure to comply can result in the imposition of fines and penalties, the loss of export privileges, and termination of your contractual agreements with NAL Research.

The export and re-export of NAL Research products and services are subject to regulation by the Export Administration Regulations (15 CFR 730-744), as administered by the U.S. Department of Commerce, Bureau of Industry and Security (BIS).

See: https://www.bis.doc.gov/index.php/regulations/export-administration-regulations-ear for further information on BIS and the Export Administration Regulations (EAR). Additional export restrictions are administered by the U.S. Department of the Treasury's Office of Foreign Asset Controls (OFAC). See: http://www.ustreas.gov/ofac for further information on OFAC and its requirements.

# Appendix C: The Iridium Network

The Iridium satellite network is owned and operated by Iridium Communications Inc. It is constructed as a constellation of 66 satellites in low-earth orbit (LEO), terrestrial gateways, and Iridium subscriber units (ISUs). An ISU can either be an Iridium satellite phone or various types of modems. The satellites are placed in an approximate polar orbit at an altitude of 780 km. There are 6 polar planes populated with 11 satellites per orbit constituting the 66-satellite constellation. The near polar orbits of the Iridium constellation provide truly real-time and global coverage from pole-to-pole.
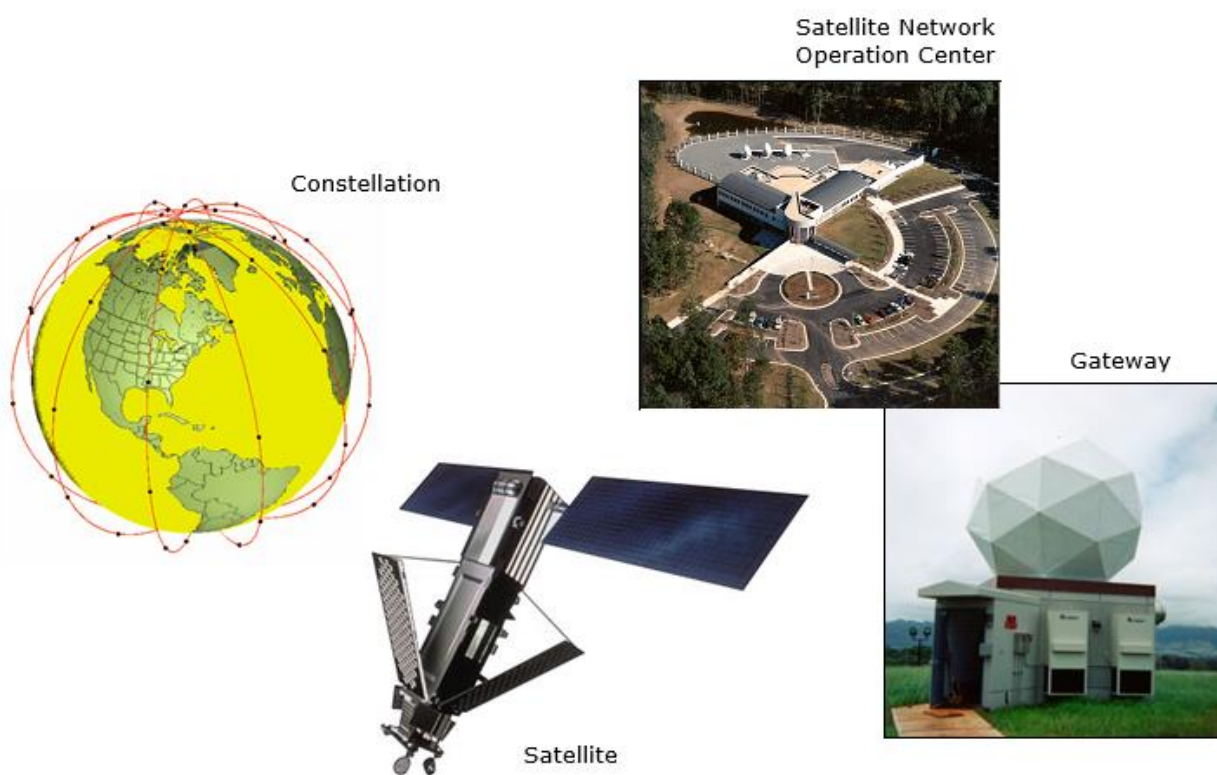


*Figure 10: Iridium Network Major Components*

The Iridium network is designed to operate in the band of 1616.0 to 1626.5 MHz, although the exact frequencies used depend on the local regulating authorities and issued licenses in any particular region. Each satellite projects 48 beams on the surface of earth, which may be viewed as providing coverage cells on the ground similar to terrestrial systems. Each beam is approximately 600 km in diameter. The 66-satellite constellation has the potential to support a total of 3,168 spot beams; however, as the satellite orbits converge at the poles, overlapping

beams are shut down. The satellite footprint is approximately 4,700 km in diameter. Under each footprint, a satellite is power-limited to approximately 1,100 simultaneous circuits.

The Iridium network uses a time division duplex (TDD) method and transmits and receives in an allotted time window within the frame structure. Since the system is TDD, the ISU transmit and receive in the same frequency band. The access technology is a frequency division multiple access/time division multiple access (FDMA/TDMA) method whereby an ISU is assigned a channel composed of a frequency and time slot in any particular beam. Channel assignments may be changed across cell/beam boundaries and are controlled by the satellite. The system provides an average link margin of 13.1 dB.

Although there are multiple gateways, a user is registered to a single gateway. The gateways perform call connection setup and administrative duties such as billing and resource management. The satellite constellation provides connectivity between users, from a user to the Iridium system gateway, and between gateways. Within the Iridium network architecture, the satellites are cross-linked, which allows ISU-to-ISU communication independent of gateway intervention once the call connection is established.

There are currently two commercial Iridium gateways located in Arizona, United States; and Fucino, Italy. The U.S. government owns and operates an Iridium gateway located in Hawaii, United States. Each gateway generates and controls all user information pertaining to its registered users, such as user identity, geolocation, and billing items. The gateway also provides connectivity from the Iridium system to the terrestrial-based networks such as the public switched telephone network (PSTN) or the internet.

## C.1 Iridium Network Data Capabilities

For data communications, the Iridium network supports five different modes of operation as shown in **Figure 11**: dial-up data service, direct internet connection, SBD, short-messaging service (SMS), and router-based unrestricted digital internetworking connectivity solution (RUDICS).
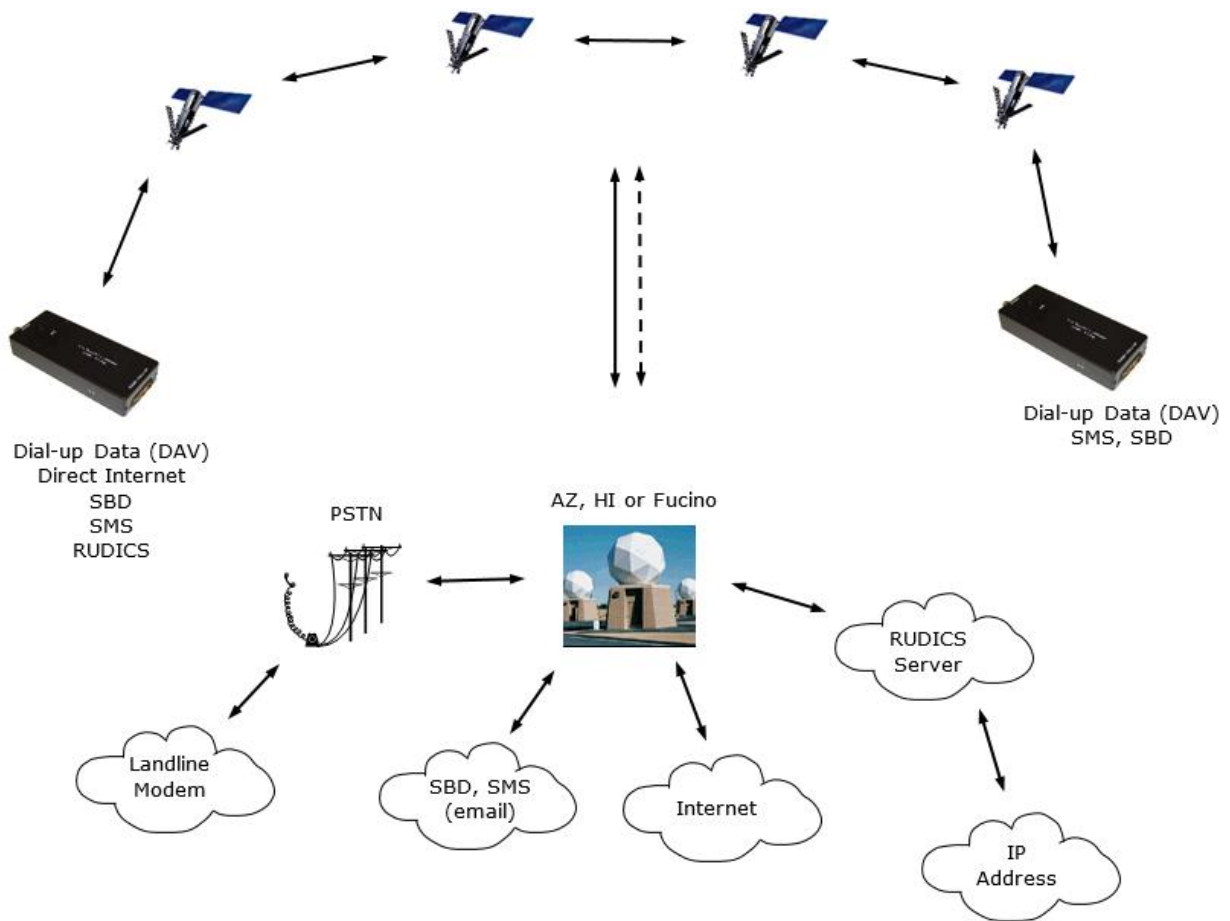
*Figure 11: Iridium Network Data Capabilities*

## C.1.1 Dial-Up Data Service

Dial-up data service provides connectivity through the Iridium satellite network to another Iridium modem, to the PSTN, to the Defense Switch Network (DSN), to a remote LAN (e.g., a corporate network), or to an internet service provider (ISP) at a nominal data rate of 2.4 kilobits per second (kbps). The connection time involving user authentication and handshaking (or modem training) can range from 15 to 30 seconds. For an Iridium-to-Iridium call, dial-up data service offers an additional option known as Data After Voice (DAV). Similar to a voice call, a DAV call is routed directly from one Iridium modem to another Iridium modem without going through the gateway.

The Iridium dial-up data service, as shown in **Figure 12**, functions in much the same way as the PSTN dial-up connectivity. From the perspective of a computer, the Iridium modem is just another external modem. The only difference is that the dialed telephone number must conform to the international dialing pattern used by Iridium. When a data call is placed, the Iridium

modem actually dials and initiates a connection with the Iridium gateway through the Iridium satellite constellation. Because the Iridium modem is requesting to establish a data connection, the switch at the gateway routes the call through another modem. The modem at the Iridium gateway then dials into and connects to another modem at the other end. **Figure 12** illustrates how an Iridium dial-up data service call is routed. The handshaking and protocols established between the modems are independent of the Iridium network.

For those ISU-to-ISU dial-up calls where data transmission delay is critical, such as the application of TCP/IP protocol, DAV should be considered in the design. This option eliminates the Iridium gateway once authentication and registration is completed, allowing ISU-to-ISU communication without the gateway in the loop.
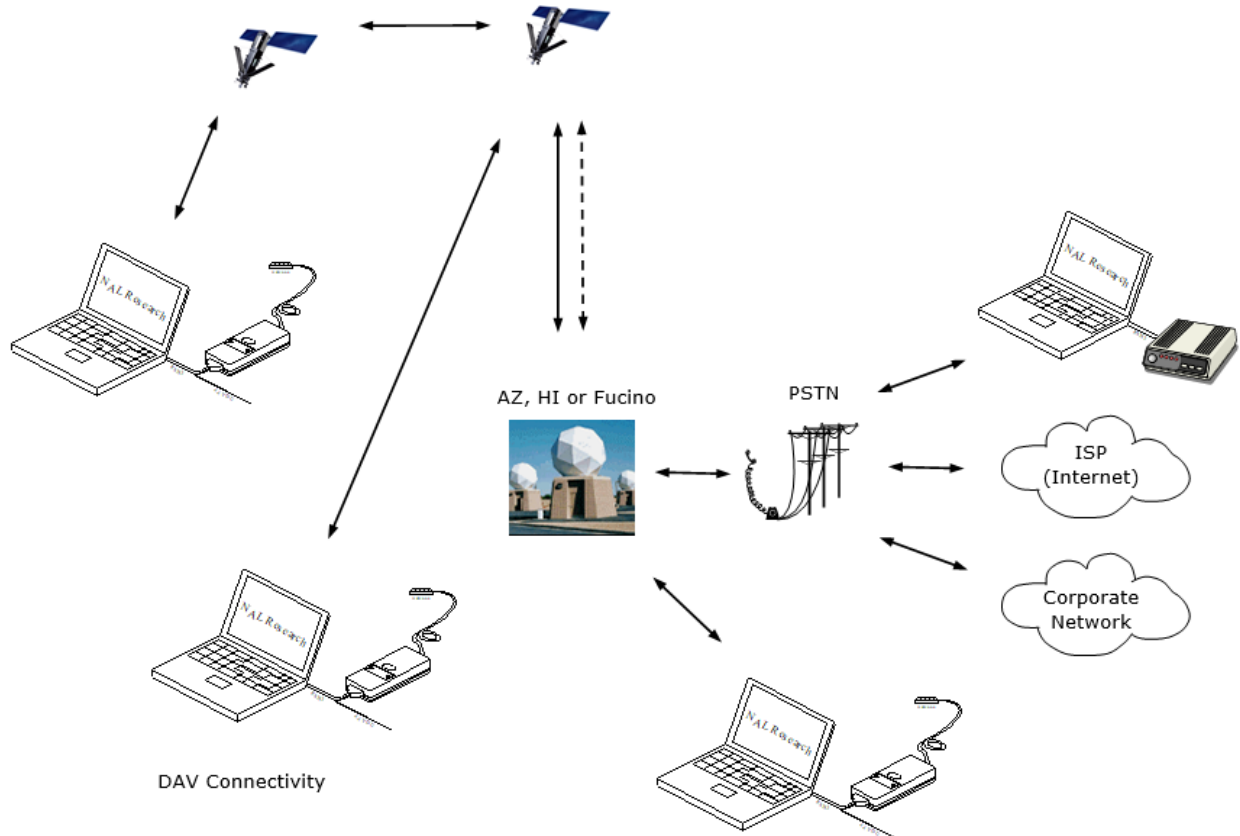


*Figure 12: Iridium Dial-Up Data Service*

## C.1.2 Direct Internet Connection

The Iridium Direct Internet service allows users to connect to the internet via the Iridium gateway without having to sign up with an internet service provider. This service utilizes a dedicated Apollo Server at the Iridium gateway, which provides high-speed connectivity to the

internet and optimizes server-to-Iridium modem communications. The dial-up networking setup is similar to the dial-up networking setup for a landline telephone. The only difference is that the dialed telephone number is an international number provided by Iridium. **Figure 12** illustrates how an Iridium internet call is routed.

Direct Internet service can be enhanced using Windows-based emulated point-to-point protocol (PPP) called the Apollo Emulator. With the use of the Apollo Emulator software instead of Microsoft Windows® dial-up networking, Direct Internet service can reduce connection time and improve data throughput. In addition, the Apollo Emulator offers a feature called Smart Connect™, which manages airtime by seamlessly connecting and disconnecting a user through the Iridium system. Airtime charges accumulate only while the call is connected. Improved effective data throughput is achieved with user-transparent data compression. The channel rate is still 2.4 kbps. However, 10 kbps effective throughput can be achieved depending on content (graphics and images result in lower effective throughput).

## C.1.3 RUDICS Data

RUDICS is an enhanced gateway termination and origination capability for circuit-switched data calls across the Iridium satellite network. When an Iridium modem places a call to the RUDICS Server located at the Iridium gateway, the RUDICS server connects the call to a predefined IP address, allowing an end-to-end IP connection between the host application and the Iridium modem. There are three key benefits of using RUDICS over the conventional PSTN circuit-switched data connectivity or mobile-to-mobile data solutions: (1) elimination of analog modem training time, (2) increased call connection quality, reliability, and maximized throughput, and (3) protocol independence.

## C.1.4 Short Burst Data

SBD is a simple and efficient bidirectional transport capability used to transfer messages with sizes ranging from zero (a mailbox check) to 1960 bytes. SBD takes advantage of signals within the existing air interface but without using the dedicated traffic channels. As a result, small amounts of data can be transferred more efficiently than those associated with circuit-switched data calls. Messages that originate from an Iridium modem can be delivered to a variety of destinations. Commonly, data are delivered across terrestrial communications networks (NIPRNet

and internet) to servers and applications that process data from one or multiple fielded Iridium modems. SBD service also supports the transfer of messages to Iridium modems, where messages may originate from terrestrial sources. Delivery methods and options are initially configured when the Iridium modem is first purchased and may be easily modified via webpages at a later time.

## C.1.5 Short Messaging Service

SMS is a mechanism to deliver short data messages over the Iridium satellite network to the NIPRNet/internet. Iridium SMS incorporates a subset of the GSM SMS features. Each SMS message can be up to 160 text characters (7-bit coded) in length. The text characters are based on a 7-bit alphabet, which is encoded and transmitted as 8-bit data, hence the 140 octet (byte) maximum message size.

SMS is a store-and-forward method of transmitting messages to and from an Iridium modem. The short message from the modem is stored in a central Short Message Service Center (SMSC), which then forwards it to the destination. If the recipient is not available, the SMSC attempts to deliver the SMS message until it is delivered or the validity period expires. SMS supports a limited confirmation of message delivery. The sender of the short message can request to receive a return message notifying them whether the short message has been delivered. With this option, the originator gets a confirmation that the message was delivered to the SMSC. Unlike standard GSM, the Iridium SMS can only acknowledge that the message was delivered to the SMSC and not the end destination.

SMS messages can be sent and received simultaneously while a voice call is in progress. This is possible because SMS messages travel over and above the radio channel using the signaling path, whereas the voice call uses a dedicated "traffic" radio channel for the duration of the call.

## C.2 Iridium Geolocation

The Iridium network makes calculations of the geographical location (geolocation) of an ISU each time a call is placed. The technique employed to determine the geolocation of an ISU is based on measurements of the ISU and satellite propagation delay and Doppler frequency shift. These measurements are used to estimate cosines of spherical angles that identify the ISU's location relative to the satellite by the gateway.

The Iridium network can locate an ISU to within 10 km only about 78% of the time. The so-called error ellipse can have a large eccentricity with the major axis oriented in the azimuth dimension and the minor axis oriented in the radial dimension. The position of the ISU in the radial dimension relative to the satellite can almost always be determined to within 10 km with just one measurement. Errors in the azimuth dimension relative to the satellite are largest along the satellite's ground path and tend to increase with distance from the satellite. Geolocation errors in the east-west dimension, therefore, are sometimes more than 100 times greater than in the north-south dimension.

# Appendix D: SHOUT nano 100 Design Specifications

## D.1 Mechanical Specifications

Dimensions – SHOUT nano 100: ...............................76 x 46 x 18 mm (3.3" x 1.8" x 0.7")

Weight – SHOUT nano 100: ....................................85 g (3.0 oz.)

Enclosure Material: .................................................Hard ABS/PC plastic

Interface Connector: ...............................................USB-C receptacle

Antennas: ................................................................Embedded Iridium, GNSS, and Bluetooth

ON/OFF and Arrow buttons: ...................................Dome push buttons

## D.2 Iridium RF Specifications

Operating Frequency: .............................................1616.0 to 1626.5 MHz

Duplexing Method: .................................................TDD

Multiplexing Method: .............................................TDMA/FDMA

RF TX output power (average): ................................1.6 W

Rx Sensitivity at 50Ω (typical): ...............................–117 dBm

Link Margin–Downlink: ...........................................13 dB

Link Margin–Uplink: ................................................7 dB

## D.3 GNSS Specifications

Type of GNSS Receiver: ...........................................u-blox MAX-8MQ

Receiver Type: .........................................................72-Channel GPS L1 C/A, SBAS, QZSS, GLONASS

Update Rate: ...........................................................4 Hz

Accuracy: ................................................................Position: 2.5 meters (8.2 feet) CEP

Position SBAS: 2.0 meters (6.6 feet) CEP

Acquisition (typical): ...............................................Hot starts: 1 second

Aided starts: 2 seconds

Cold starts: 29 seconds

Sensitivity: ..............................................................Tracking: –166 dBm

Reacquisition: –160 dBm

Cold starts: –148 dBm

Operational Limits:.....................................................Altitude: 50,000 meters (164,000 feet)

Velocity: 500 m/s (1,640 feet/second)

Dynamics: ≤ 4 g

As long as power is provided to the SHOUT nano 100, the GNSS receiver provides real-time clock functionality and stores ephemeris data in its memory before turning off (sleeping between reports). The ephemeris data are valid up to two hours and can be used in future startup to improve time-to-first-fix.

## D.4 Bluetooth RF Specifications

Operating Frequency: ..............................................2.4 GHz

Protocol:..................................................................Bluetooth Low Energy v4.0

Data Rate: ...............................................................2.178 Mbps

Power Output: ........................................................+10 dBm

Sensitivity:...............................................................-93 dBm

## D.5 Electrical Specifications

Internal Battery Type: ..............................................Rechargeable Li-Polymer 2000mAh 3.7V

SHOUT nano 100 Charging Power: ……………………. 4W

SHOUT nano 100 Charging Supply Voltage: ..............+5 Volts DC

Supplied Charger Output Power:…………………………… 10W @ 5V

## D.6 Environmental Specifications

Design Operating Temperature Range: .....................–20°C to +60°C (–4°F to +140°F)

Charging Temperature Range:...................................–0°C to +45°C (+32°F to +113°F)

Engineered to Meet Ingress Protection:....................IP67

Operating Humidity: ................................................≤ 75% RH

## D.7 Data I/O Specifications

Short-Burst Data Mobile-Originated:........................340 bytes per message (Iridium)

Short-Burst Data Mobile-Terminated:.......................270 bytes per message (Iridium)

Multi-Interface Connector:.......................................USB-C

Software Interface: ....................................................AT commands via USB

## D.8 Related Hardware

AC Power Adapter:...................................................LA-3098 (100–240 VAC, 47–60 Hz input)

12 V Car Adapter:....................................................LA-7021 (12 VDC car battery input))
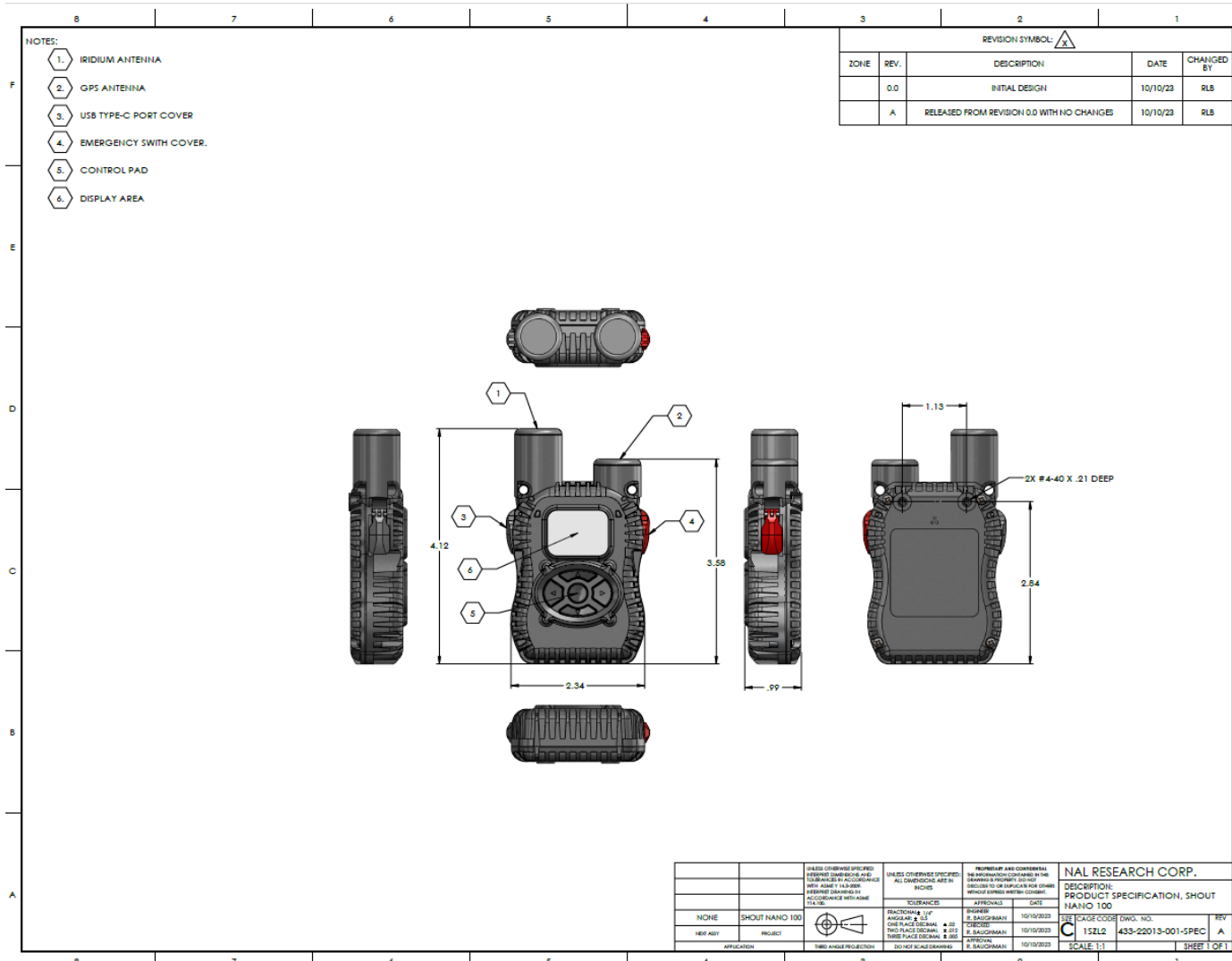
# Appendix E: SHOUT nano 100 Mechanical Drawing



*Figure 13: SHOUT nano 100 Mechanical Drawing*