



LocataLite User's Manual

Model: ASY-010007-1



v8r0
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CHAPTER 1 INTRODUCTION

This document is a guide for installing and operating a LocataLite Model: ASY-010007-1 as part of a LocataNet. Once configured the LocataNet provides a reliable, high-accuracy positioning service independent of GPS or any other external positioning system.

LocataLite devices provide a high degree of configuration flexibility allowing use in wide range of operational scenarios. Locata suggests users spend time reading the documentation to assist in achieving an optimal configuration of LocataLite devices and networks.

1.1. Scope

This document covers the interfaces, installation, operation, and troubleshooting of LocataLites based on hardware version 2¹ running software v8r0. Earlier LocataLite hardware revisions and software releases are not covered in this document.

Additional sources of documentation are provided for LocataNet users as listed in the References section. Of particular note are the *Rover User Manual* which provides complete coverage of LocataLite devices, and the *LocataNet User Manual* which covers recommended network configurations, site installation considerations, and other matters external to the LocataLite housing itself.

1.2. System Overview

The Locata network provides a means of precisely geo-locating stationary or mobile user navigation receivers (Rovers) within an operational area. Stationary LocataLite transmitters provide signal coverage within this area which may span up to thousands of square kilometers in size. Rovers calculate positions by measuring precise times of arrival of the signals broadcast by LocataLites in view.

Each LocataLite transmits up to four signals across two frequencies in the license-free 2.4 GHz S-band using two physically separated antennas. All LocataLites in a given network are time-synchronized to a designated Master LocataLite which may in turn may use either its own internal timing or may synchronize itself, and therefore the entire network, to an outside time source such as a GPS time receiver. This arrangement of signals provides the advantages of both spatial and frequency diversity to network users. Rover devices use the signals broadcast by LocataLites to position fully autonomously using either code- or carrier-based techniques.

¹ Hardware version 2 LocataLites have seven LEDs along one long edge.

1.3. Compatibility

LocataLites running software earlier than v8r0 are not compatible with units running v8r0 software. When upgrading to v8r0 software from a version lower than v8r0, all LocataLites in a given network must be upgraded together. Likewise the setup and configuration files used with v8r0 software are not compatible with those of previous versions of software.

1.4. Document Overview

1.4.1. Organization

Chapter 2 presents the characteristics of the LocataLite, including physical characteristics, the LED flashing schemes, and connections to the LocataLite. Chapter 3 presents the information necessary to install and configure the LocataLite. Chapter 4 discusses operating the LocataLite, while Chapter 5 presents tips for troubleshooting and Chapter 6 discusses maintenance. Appendix A presents serial message definitions in common use with the LocataLite. Appendix B provides a further reference for configuration options by including the contents of a standard Rover configuration file.

1.4.2. Document Conventions

This document uses the Courier New font, such as `config.txt`, to refer to files, directories, or parameters.

It uses the Courier New font with a grey highlight, such as `IO_PORT_NMEA` or `115200` to refer to parameter values.

Code, command, or data output examples are shown in a grey box in courier new font, as for example:

```
$GPGSA,A,3,04,05,,,,,,,,,,,,,2.5,1.3,2.1*39
```

1.5. Regulatory Information

FCC Statement and Declaration: Locata Corporation declares that this device complies with Part 15 of the FCC Rules and Regulations. Operation of this device is subject to the following two (2) conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

FCC Caution: Any changes or modifications made to this device that are not expressly approved by the manufacturer may void the user's authority to operate the equipment.

Professional Installation and Antenna Notice: To comply with FCC regulations, this device must be professionally installed in accordance with Reference 2, must be used in conjunction with a Locata-approved antenna as per Section 1.5.2 and a Locata-approved LAN cable as per Section 2.4.4.

FCC Modular Approval: This device has been granted Modular Approval, with the condition that the device must:

- Be professionally installed in accordance with Reference 2,
- Follow labeling requirements detailed in Section 1.5.1,
- Used in conjunction with a Locata-approved antenna as per Section 1.5.2,
- Used in conjunction with a Locata-approved LAN cable as per Section 2.4.4.

FCC RF Radiation Exposure Statement: This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must be at least 20 cm from the user and must not be co-located or operating in conjunction with any other antenna or transmitter.

1.5.1. FCC Guidelines for Devices Containing a Transmitter Module

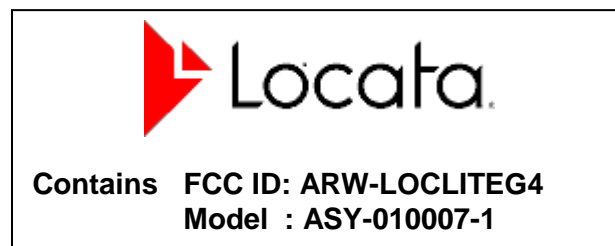
The following is an extract from FCC PART 15 UNLICENSED MODULAR TRANSMITTER APPROVAL, DA 00-1407, Released: June 26, 2000, Section 6 describing labeling requirements for devices containing a modular transmitter.

Section 6. The modular transmitter must be labeled with its own FCC ID number, and, if the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a

label referring to the enclosed module. This exterior label can use wording such as the following: “Contains Transmitter Module FCC ID: XYZMODEL₁” or “Contains FCC ID: XYZMODEL₁.” Any similar wording that expresses the same meaning may be used. The Grantee may either provide such a label, an example of which must be included in the application for equipment authorization, or, must provide adequate instructions along with the module which explain this requirement.

In the latter case, a copy of these instructions must be included in the application for equipment authorization.

Figure 1, Sample FCC ID label for devices containing a LocataLite



1.5.2. External Antenna Integration

This device must be used in conjunction with a patch antenna presenting a 50 ohm load impedance at the frequency of operation and exhibiting a maximum gain of less than +5.0 dBi. The antenna must be fitted with a male SMA connector and professionally installed in accordance with Reference 2. Operation of this device with any other type of antenna is strictly prohibited.

1.6. References

1.6.1. Locata References

1. Locata Corporation, Rover User's Manual, Locata-Rover-UserManual-v8r0, 16 May 2014
2. Locata Corporation, LocataNet Manual, v1 Draft, unreleased.
3. Locata Corporation, Locata Signal Interface Control Document, ICD-LOC-100E, 29 January 2014
4. Locata Corporation, Locata Binary Messaging Protocol Interface Control Document (LBMP ICD), v2.32, 29 January 2014.
5. Locata Corporation, Locata DTM File Format Specification, v1.2, 2 December 2013.

1.6.2. External References

6. Vaisala, PTU300 website. <http://www.vaisala.com/instruments/products/ptu300.html>
7. SigNav, ICD 'SGN1-0020-NMEA-ICD-v2.7.pdf'
8. Symmetricom, TSC 4400 website.
<http://www.symmetricom.com/products/gps-solutions/gps-time-frequency-receivers/TSC-4400/>
9. Symmetricom, TSC 4400 – GPS Disciplined Rb Oscillator Manual
<http://www.symmetricom.com/link.cfm?lid=4407>
10. Novatel OEM 4 User Manual – Volume 2, Command and Log Reference. OM-2000047 Rev 18
<http://www.novatel.com/assets/Documents/Manuals/om-20000047.pdf>

CHAPTER 2 LOCATALITE CHARACTERISTICS

2.1. Device Overview

The LocataLite is the positioning signal transmitting element within a Locata network. Once configured and powered on, it will begin transmissions automatically (after TimeLoc to the Master in the case of Slave LocataLites), and operates continuously and unattended for extended periods of time.

Each LocataLite transmits four low-power RF signals, one on each of two frequencies from each of two transmitter antenna ports. The LocataLite's transmissions are also pulsed: each LocataLite transmits for a 100 microsecond pseudo-randomly assigned period once in each 1 millisecond interval, and is silent for the remaining 900 microseconds.

A number of peripherals can support LocataLite operations though none are required for standard operation. A GPS receiver can supply GPS timing (as pulse per second and serial timing messages) to a Master LocataLite for network synchronization to GPS time. A survey grade GPS receiver can supply antenna coordinates to LocataLites to support a self-survey capability. A meteorological station can supply atmospheric data to a LocataLite to allow estimation of tropospheric delay factors. Guidelines for using these peripherals are included in Reference 2.

You can communicate with the LocataLite for health, status, and control using a binary interface over an Ethernet or serial port.

The following sections discuss LocataLite installation, configuration, and operation in more detail.

2.2. Operational Modes

Each LocataLite in a LocataNet operates as either a Master or Slave device. There is only one Master in a given network and the remaining LocataLites act as Slave devices. In general the LocataLite that is best placed to provide a timing reference for the network should be designated as the Master LocataLite. That is, the Master should be that LocataLite having the shortest paths to all other LocataLites, including using the fewest TimeLoc hops where necessary. This arrangement provides the cleanest TimeLoc performance operationally however there may be other reasons to select an alternate Master device, such as accessibility or elevation.

Two different Master modes are provided to cater for scenarios where a network is intended to operate fully autonomously or synchronized in time with GPS.

Mode #	Details
Master	Device acts as master time reference to which all other LocataLite devices in the network synchronize.
Master with GPS Sync	Device acts as master time reference to which all other LocataLite devices in the network synchronize. Master Device synchronizes with an external GPS time reference creating GPS synchronization across the network. Allows Rovers to compute navigation solutions based on Locata measurements only or by combining measurements from other navigation systems (eg GNSS such as GPS, INS).
Slave	Device synchronizes with network time reference provided by the Master LocataLite.

Table 1, Rover operational modes

The operational mode of a LocataLite is selected through the configuration file 'Device_Type' parameter. Refer to Appendix B for further details on the LocataLite configuration file.

2.3. Physical Layout

The LocataLite is enclosed within an aluminum package measuring 134 x 241 x 28 mm and weighing 1.4kg. LocataLites are sealed units with no internal setting or adjustment. Operators should not open the LocataLite case as this will void the warranty.

The LocataLite provides 9 electrical sockets comprising three digital sockets and 7 LEDs on the front panel, along with a further three digital and three RF sockets on the rear panel. Figure 2 shows the LocataLite front face including status LEDs.



Figure 2, the LocataLite

2.4. Electrical Interface

LocataLite installation requires three coaxial antenna cables, a power cable, and an Ethernet or serial cable. Master LocataLites using the GPS sync feature also require a coaxial cable to connect the PPS input signal and a serial cable from the GPS clock reference. LocataLites equipped with meteorological stations will require a serial cable connecting the meteorological station to the LocataLite.

Figure 3 and Figure 4 illustrate the long edges of the LocataLite, where the serial, RF, power, and auxiliary interfaces are found. All pin descriptions that follow show the LocataLite connector as seen from the outside of the device. Pin 1 is marked by a semicircle with pin numbering continuing counterclockwise.

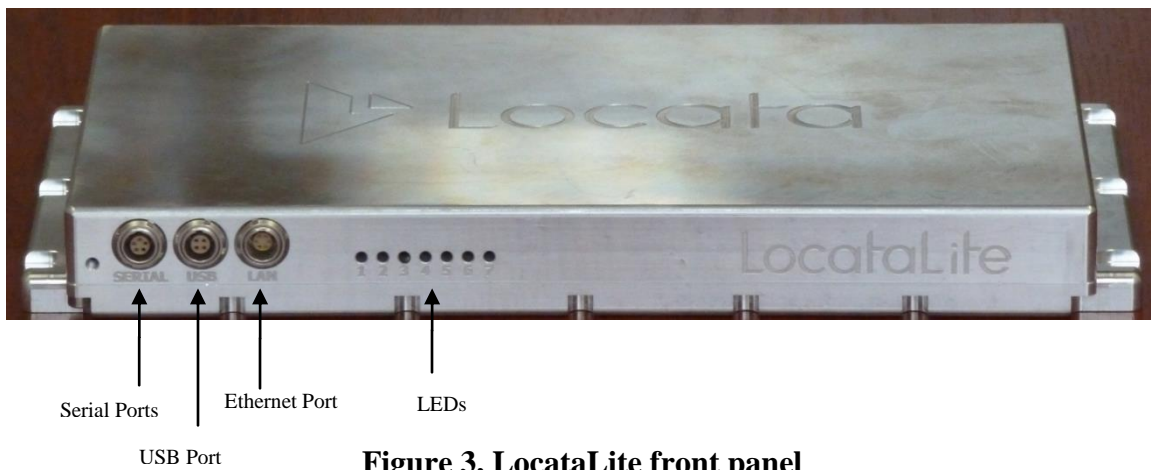


Figure 3, LocataLite front panel

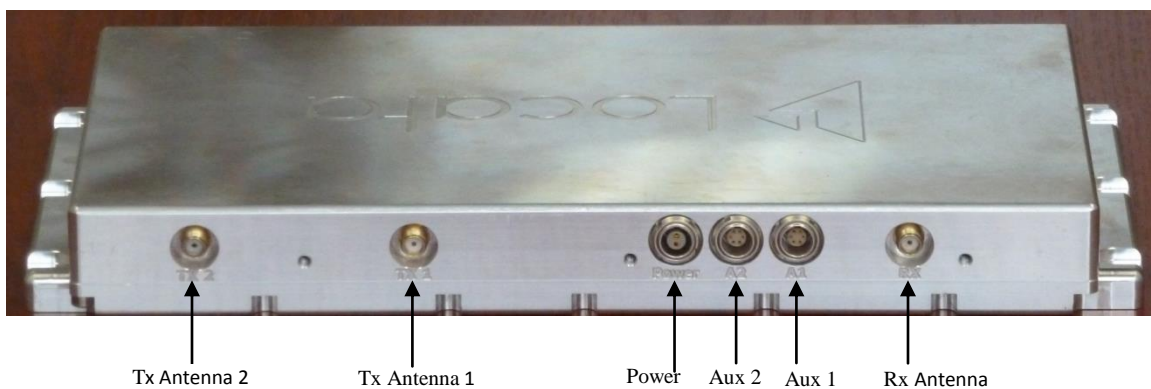



Figure 4, LocataLite rear panel

2.4.1. Power Interface

The LocataLite requires 12-28 volts DC for operation, and consumes approximately 40 watts. Supplied power should not exceed 29 volts DC. The LocataLite power connection at the LocataLite case accepts a 2-pin LEMO connector (part number FGG.0B.302). Power cable conductors should be sized to provide the power necessary for the LocataLite, to sustain the maximum current draw safely, and provide no more than a three percent conductor voltage drop round-trip from the DC power source.

Table 2, Power connector pin assignments

Pin #	Assignment
1	V _{dc} positive
2	V _{dc} ground



2.4.2. RF Interfaces

Antennas must be connected to the LocataLite using male SMA connectors. The optimal antenna type will vary based on the application and environment. See Reference 1.5.2 and Reference 2 for antenna and antenna cabling recommendations.

Operators should use an SMA torque wrench when connecting antennas to the LocataLite to ensure a reliable connection without damaging the device. Also note the recommendations in Reference 2 regarding antenna placement, cabling, and proper coupling between the LocataLite receive and transmit antennas.

2.4.3. RS-232 Interfaces

The LocataLite makes two EIA/TIA-232 and V.28/v.24 compliant RS-232 serial ports, COM1 and COM2, available using a single 5-pin LEMO connector (LEMO part number FGG.0B.305) at the connector marked “Serial”. These ports can be used to connect peripherals such as GPS receivers or MET stations to the LocataLite, or for you to communicate with the LocataLite directly. Each port only implements transmit and receive data lines at line levels of ± 5 volts relative to ground. The LocataLite with its serial cables is configured as DCE.

If it is necessary to use both RS-232 ports simultaneously, it will be necessary to employ a Y-cable bringing out COM1 and COM2 to separate serial connectors. Assuming DB-9 socket serial connectors are used, TX1 and RX1 at the LEMO socket go to pins 2 and 3 respectively of DB-9 #1, and TX2 and RX2 at the LEMO socket go to pins 2 and 3 respectively of DB-9 #2. Pin 1 of the LEMO socket, GND, would be wired to pin 5 of both DB-9 sockets.

Table 3, RS-232 interface connector pin assignments

Pin #	Assignment
1	GND
2	TX1
3	RX1
4	RX2
5	TX2



2.4.4. LAN (Ethernet) Interface

Use a CAT5 cable terminated in a LEMO part number FGG.0B.306 LEMO connector to connect to the LocataLite's Ethernet interface. This interface supports 10 and 100 Megabits/second and 1 Gigabits/second data rates.

Table 4, LAN connector pin assignments

Pin #	Assignment
1	ext clock -
2	Tx+
3	Tx-
4	Rx-
5	Rx+
6	Ext clock + ²



Figure 5 illustrates the required Ethernet cable wiring. Note that this connection requires a shielded cable.

² 10-20 MHz clock

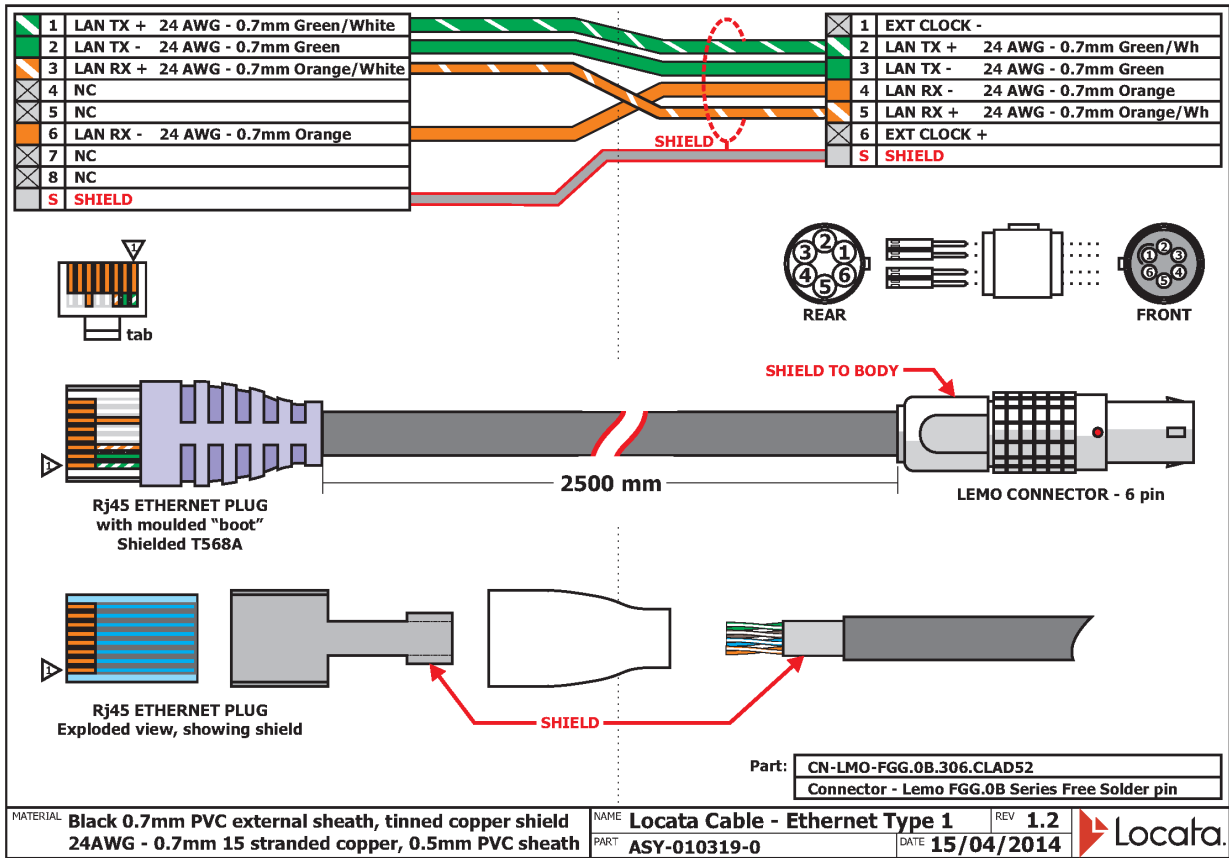


Figure 5, Shielded Ethernet cable design


2.4.5. USB Interface

The LocataLite has provision for a USB interface and acts as a USB host device. This interface complies with USB1.1 and USB 2 standards.

The USB port is presently inoperative. Its implementation is reserved for a future release.

Table 5, USB connector pin assignments

Pin #	Assignment
1	D-
2	GND
3	V _{cc}
4	D+



2.4.6. Auxiliary Port Interfaces

Two Auxiliary ports are available for specific supplemental connections. The following subsections describe their present configurations. Other uses are possible in future for specific applications.

All inputs must be differential. Many signal sources such as the PPS output on a GPS receiver will be single ended. To convert from single ended to differential signal Locata recommends using the adapter shown in Figure 8, “recommended single-ended to differential conversion circuit” on page 37.

You can access these ports using a LEMO 6-pin connector, part number FGG.0B.306. Each Auxiliary port can supply up to 0.8 Amps of current at 5 volts.

Aux-1

The Aux-1 port presently supports both a one-pulse-per-second timing input (to which the LocataLite can optionally synchronize) and a 100 microsecond wide one-pulse-per-second output. This port is wired in accordance with the following table:

Table 6, Aux-1 connector pin assignments

Pin #	Assignment
1	PPS input
2	PPS input (inverted)
3	GND
4	+5v output
5	PPS output
6	PPS output (inverted)



Aux-2

The Aux-2 port presently provides a 1 microsecond wide measurement epoch pulse and a second 100 microsecond wide one-pulse-per-second output. This port is wired in accordance with the following table:

Table 7, Aux connector pin assignments

Pin #	Assignment
1	Measurement epoch output pulse
2	Measurement epoch output pulse (inverted)
3	GND
4	+5v output
5	PPS output
6	PPS output (inverted)



2.5. LED Status Indicators

LocataLites have 7 LEDs on the front edge of the device next to the LAN connector.

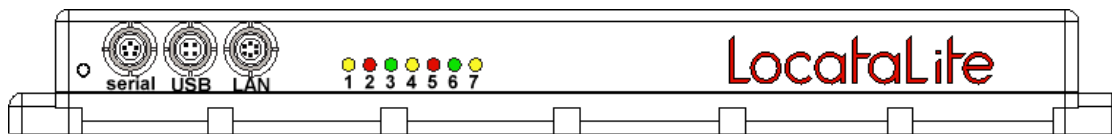


Figure 6, The LocataLite showing the LEDs

The LEDs are provided to indicate the health and status of the device alerting operators of error and warning conditions. The role of each LED is shown in Table 8.

Table 8, LED purposes

LED #	Colour	Purpose
1	Yellow	Logging status
2	Red	Network synchronisation status
3	Green	Health & Tracking status
4	Yellow	Position Self-Survey status
5	Red	Application status
6	Green	Device status
7	Yellow	Heartbeat

All LEDs communicate using one or more of the flashing sequences shown in Table 9.

Table 9, LED sequences

Sequence number	Sequence Name	Flashing (F)/ Occulting (O)	Description
1	Off	-	OFF
2	dit	F	80ms ON, 1920ms OFF
3	dah	F	240ms ON, 1760ms OFF
4	dit-dit	F	80ms ON, 240ms OFF, 80ms ON, 1600ms OFF
5	dit-dah	F	80ms ON, 240ms OFF, 240ms ON, 1440ms OFF
6	dah-dit	F	240ms ON, 240ms OFF, 80ms ON, 1440ms OFF
7	dah-dah	F	240ms ON, 240ms OFF, 240ms ON, 1280ms OFF
8	dit-dit-dit	F	80ms ON, 240ms OFF, 80ms ON, 240ms OFF, 80ms ON, 1280ms OFF
9	dit-dit-dah	F	80ms ON, 240ms OFF, 80ms ON, 240ms OFF, 240ms ON, 1120ms OFF
10	occulting dah	O	240ms OFF, 1760ms ON
11	occulting dah-dah	O	240ms OFF, 240ms ON, 240ms OFF, 1280ms ON
12	2Hz flashing	F	240ms ON, 260ms OFF
13	5Hz flashing	F	100ms ON, 100ms OFF
14	On	-	ON

The typical steady state operating condition for all LEDs is either solid OFF or solid ON, with the exception of LED 7 – Heartbeat which briefly occults every two seconds. Flashing sequences on the other LEDs typically indicate a warning, fault or non-steady state operating condition that may require attention.

2.5.1. LED 1 – Logging Status

LED 1 indicates whether the receiver is logging to memory, and if so, the memory status.

Table 10, LED 1, logging status

State	LED Flashing Sequence	State Description
	LED 1 (yellow)	
Logging disabled	OFF	Logging to internal memory is disabled
Logging disabled (Disk > 80% full)	dah	Logging to internal memory is disabled and internal memory is nearly full
Logging enabled (Disk > 80% full)	occulting dah	Logging to internal memory is enabled and internal memory is nearly full
Warning – Disk full	5Hz flashing	Internal memory is full, logging cannot be enabled
Logging Enabled	ON	Logging to internal memory is enabled

2.5.2. LED 2 – Network Synchronization

LED 2 indicates how well the device is synchronized to the network's time and frequency.

Table 11, LED 2, network synchronization status

State	LED Flashing Sequence	State Description
	LED 2 (red)	
Not Sync'd to Network Time	OFF	The LocataLite is not synchronised to network time. When LED 2 is OFF this implies that the device is the network MASTER.
Coarse alignment	dah	The LocataLite is synchronised to within 1 μ s of network time
Fine alignment	dah-dah	The LocataLite is synchronised to within 100ns of network time
High phase event	5Hz Flashing	The LocataLite has experienced a high phase event and dropped briefly out of TimeLoc
Synced to Network	ON	The LocataLite is synchronised to the network (i.e. TimeLoc)

2.5.3. LED 3 – Health and Tracking Status

LED 3 shows the tracking status of the device.

Table 12, LED 3, health & tracking status

State	LED Flashing Sequence	State Description
	LED 3 (green)	
No channels allocated	OFF	No channels have been allocated for acquisition or tracking
Attempting acquisition	dit	The device is attempting to acquire signals
1+ signals tracked	dah	The device is tracking one or more signals
Acquired reference	dah-dit	The device has acquired a TimeLoc reference signal
Acquired self	dah-dah	The device has acquired itself for TimeLoc purposes
Broadcasting bad health	5Hz flashing	The device has acquired signals ok but has bad health
Broadcasting good health	ON	The device has good health

2.5.4. LED 4 – Position Self-Survey Status

LED 4 shows the position self-survey status of the device.

Table 13, LED 4, position self-survey status

State	LED Flashing Sequence	State Description
	LED 4 (yellow)	
Self-survey disabled	OFF	Self-survey is disabled
Initial survey in progress	dit-dit	Self-survey is enabled and the initial survey is in progress. Position currently unknown
Full survey in progress	dit-dah	Self-survey is enabled and the initial survey is complete. Full self-survey in progress.
Movement detected	5Hz flashing	Self-survey is enabled and movement has been detected.
On-going monitoring	ON	Self-survey is enabled and the full survey is complete. On-going monitoring for movement is in progress.

2.5.5. LED 5 – Application Status

The following table defines the behaviour for LED 5. This LED indicates warnings and error conditions present in the application. The LED can only display one error at a time. If multiple errors are present in the system, the LED will only report the highest priority condition. The priorities listed are 1 (highest) to 10 (lowest).

Table 14, LED 5, application warnings and errors

State	LED Flashing Sequence	Priority	State Description
	LED 5 (red)		
No warnings or errors	OFF	–	No errors or warnings are currently active
Error – Config file missing	5Hz Flashing	1	No config.txt file could be found
Error – Invalid config parameter	2Hz Flashing	2	An invalid parameter was found in the config.txt file
Error – No DHCP Server	dit-dit-dit	3	Ethernet connected but no DHCP server could be found.
Error – AGC initialisation failure	dit-dit-dah	4	Failed to initialise AGC hardware component
Warning – Ext Time Missing	dah-dit	5	External time source could not be detected (serial message from GPS is missing)
Warning – Ext Time Bad	dah-dah	6	External time quality was bad (in serial message from GPS)
Warning – Ext PPS Missing	dit	7	External PPS could not be detected
Warning – Ext PPS Bad	dah	8	External PPS quality was bad
Warning – Ext Position Missing	dit-dit	9	External position source could not be detected (serial message from GPS is missing)
Warning – Ext Position Bad	dit-dah	10	External position quality was bad (in serial message from GPS)
Boot in progress	ON	–	The system is performing its boot sequence

2.5.6. LED 6 – Device Status

LED 6 provides warning and error information about the system health and status. Only one warning or error may be displayed at a time. If multiple warnings or errors are present in the system only the highest priority condition will be reported. The priorities listed are 1 (highest) to 10 (lowest).

Table 15, LED 6, device status

State	LED Flashing Sequence	Priority	State Description
	LED 6 (green)		
Device is a SLAVE or ROVER	OFF	–	Standard operating condition (SLAVE LocataLite and Rover)
Device is a MASTER	ON	–	Standard operating condition (MASTER LocataLite)
Low Voltage	dit	–	Insufficient or low voltage to start up (all other LEDs are off)
System Boot Sequence	Single ON flash. Duration of pulse varies	–	The system is progressing through its boot sequence. The longer the ON period the further through the process. Turns OFF and starts LED7 once the CPU is started.
Error – over voltage	dit-dah	1	High voltage has been detected on the supply rail
Error – over temperature	dit-dit-dah	2	The device is over its maximum operating temperature System will reset if the temperature reaches its extreme value.
Error – under temperature	dit-dit-dit	3	The device is under its minimum operating temperature
Error – clock	dah-dit	4	The clock reference is not operating, or the external frequency reference source has been lost (not currently implemented)
Error – system failure	5Hz flashing	5	Failure of the system (DDS, FPGA, watchdog failure, system upgrade failure or immediate maintenance required)
Error – failsafe mode	2Hz flashing	6	The system needs to be reprogrammed
Error – system maintenance required	dit-dit	7	Maintenance required at earliest convenience. System working with diminished stability and functionality

2.5.7. LED 7 – Heartbeat Indication

This LED provides a system heartbeat.

Table 16, LED 7, heartbeat indications

State	LED Flashing Sequence	State Description
	LED 7 (yellow)	
Error – crash	OFF	System Boot Sequence (at power up), or Fatal System Error (crash) once running
Error – crash	ON	Fatal System Error (crash)
Error – system shutdown	2Hz flashing	System has stopped due to failure (voltage or temperature limit failure). System will attempt to restart in 20 seconds.
Error – internal storage corruption	5Hz flashing	System has irrecoverable internal storage corruption
Error – system upgrade failure	dit-dit	System failed to upgrade
Error – application stopped	dit	The Rover / LocataLite application has stopped responding.
Booting	dit-dah	CPU is booting (or rebooting)
Reprogramming	dit-dit-dit	System is reprogramming
Normal operation	Occulting dah	Standard operating condition

CHAPTER 3 LOCATALITE INSTALLATION

3.1. Physical Installation

See Reference 2 for recommendations regarding the physical installation of a LocataLite, including environmental housings, heat sinks, antennas, and power sources. See also Section **Error! Reference source not found.** and its subsections in this manual for Regulatory Information, FCC Guidelines for Devices Containing a Transmitter Module, and External Antenna Integration. This document assumes that the LocataLite has been installed in accordance with this reference.

3.2. Network Configuration

See Reference 2 for recommendations for installing a network of LocataLites.

3.3. LocataLite Configuration File

A configuration file resident on the LocataLite's internal flash memory contains the parameters needed to configure the LocataLite for operation. The file is located in the root ftp directory. The file is named "config.txt" by default but can be renamed by adding a prefix so long as it continues to match the pattern "*config.txt".

A wide range of configuration parameters are available using this file. Documentation describing each parameter is provided within the file itself, a copy of which is provided in Appendix B. The file can be modified using any standard PC text editor then copied back to the device via FTP.

Refer to Section 5.2 for troubleshooting configuration file issues.

3.4. Communications Interface Configuration

3.4.1. Ethernet Interface

The LocataLite provides an Ethernet interface via the LAN port. This interface may be used to connect to the LocataLite using the standard File Transfer Protocol (FTP) or the Locata Binary Messaging Protocol (LBMP).

It is highly recommended that an Ethernet connection be available to LocataLites as this simplifies system configuration, software upgrades, and general operations. Note that this connection requires a shielded cable as per Figure 5.

The following 5 properties define the Ethernet configuration:

1. IP mode, as either DHCP mode or static IP mode,
2. IPv4 address, when in static IP mode,
3. IPv4 net mask, when in static IP mode,
4. Default gateway address, and
5. Device name (hostname).

Ethernet Configuration via Config Files

Ethernet configuration parameters (aside from hostname) are stored in a dedicated configuration file which lives in the root FTP directory. The file is named "ethernet_config.txt" by default but can be renamed by adding a prefix such that it still matches the pattern "*ethernet_config.txt".

The following is an example of the file contents required to set the LocataLite into DHCP mode.

```
# Ethernet configuration: DHCP
iface eth0 inet auto
```


The following is an example of the contents of an `ethernet_config.txt` file required to set the LocataLite into static IP mode with an IPv4 address of 192.168.1.111.

```
# Ethernet configuration: static
iface eth0 inet static
address 192.168.1.111
netmask 255.255.255.0
gateway 192.168.1.1
```

Users can query or change the Ethernet configuration using the FTP interface, the serial ports and the Ethernet port itself via LBMP commands. See Appendix A for details on how to do this.

Device Name

The device name (or hostname) is an identifier for the LocataLite. Users can set this property in the `hostname.txt` file which is located in the FTP root directory. The file contains ASCII text specifying the desired hostname. The contents of the file must adhere to the following rules:

1. contain 1 to 63 characters
2. use only the characters 'a' to 'z' (hostname is case insensitive), '0' to '9', '_', or '-', and
3. start with one of the characters 'a' to 'z'

Ethernet Configuration via Communication Protocols

An alternate method for Ethernet configuration is by using communication protocols. Two protocols provide support for this purpose, binary LBMP and ASCII NMEA, and allow users to query existing and set new Ethernet configurations. This alternate means of setting an Ethernet configuration is particularly useful where the user does not know or has corrupted the existing configuration.

For serial ports running the LBMP protocol the LBMP query (0xC001) and configuration (0xB002) commands are provided. See Reference 4 for complete LBMP message definitions. The NMEA \$GPLOC,ETH message/command can be used to set Ethernet configurations on serial ports not running the LBMP protocol. See Appendix A.2.1 for details.

When setting the Ethernet configuration using a serial connection changes will typically take effect within a few seconds. Any existing open FTP or LBMP socket sessions will be terminated when the Ethernet configuration is changed.

Default Configuration

By default Locata ships the LocataLite with a fixed static IP address and netmask. These are:

```
# Ethernet configuration: static
iface eth0 inet static
address 192.168.1.111
netmask 255.255.255.0
gateway 192.168.1.1
```

By default a LocataLite has the hostname `locata_tx`. If no hostname file is present the system will default to `locata_tx`.

3.4.2. COM Port Interface

You can connect external devices to the LocataLite using the serial COM ports. A portion of the `config.txt` file designates what types of serial ports are enabled and which ports they use. Users must select the communication baud rate using the `COMPORT_1_BAUD` and `COMPORT_2_BAUD` configuration file parameters (in `config.txt`), and use the `COMPORT_1` and `COMPORT_2` parameters to set the type of interface to be used over each of the com ports. Both NMEA and LBMP interfaces are supported:

NMEA Protocol

The NMEA interface sends both standard and proprietary ASCII sentences following the NMEA-0183 format. See Appendix A for a detailed description of each of the recognized NMEA sentences used by the Rover.

Locata Binary Message Protocol

The proprietary Locata Binary Messaging Protocol (LBMP) provides users with much more information than NMEA messages can accommodate. Locata does not provide commercial software for decoding and displaying LBMP content. See Reference 4 for a detailed description of the LBMP.

Note that users must not allocate a single protocol to multiple COM ports.

3.5. Determining the Current Configuration

On boot the device will output basic configuration information in a fixed manner regardless of specific configuration settings. This feature ensures that users are able to determine the communications interface configuration if previously unknown, and use this to access the device for reconfiguration and operation.

At boot the device will display a welcome message including the following basic configuration information:

- Device type
- Device name
- System version
- COMM port 1 configuration
- COMM port 2 configuration
- Ethernet port (IP) configuration

The information is initially output from both serial ports at a fixed baud rate of 115,200 baud regardless of the configuration settings. Where a serial port has been configured using a different baud rate the information will be output a second time using the configured rate.

By default Locata ships the LocataLite with a fixed static IP address and netmask. These are:

```
# Ethernet configuration: static
iface eth0 inet static
address 192.168.1.111
netmask 255.255.255.0
gateway 192.168.1.1
```

3.6. Optional LocataLite Configurations

3.6.1. GPS Synchronization (“GPS Sync”)

You can synchronize the Master LocataLite’s timing to a one-pulse-per-second timing source, whether GPS or another source. This will cause the entire network to operate synchronized to this time source.

The LocataLite receives PPS timing signal using Auxiliary port 1 and the date, time and PPS quality information using one of the COM ports.

The LocataLite supports the following clock sources for the purpose of synchronizing to GPS time and frequency:

1. SigNav uTev0 GPS receiver;
2. Any Leica/NovAtel GPS receiver supporting the ‘#TIMEA’ message;
3. Symmetricom TSC 4400 (see reference 8 for more information on this device);

You should connect the GPS receiver to the LocataLite using whichever COM port has been allocated as `IO_PORT_GPS` in the `config.txt` file. Connect the PPS signal from the GPS receiver to the LocataLite using port A1.

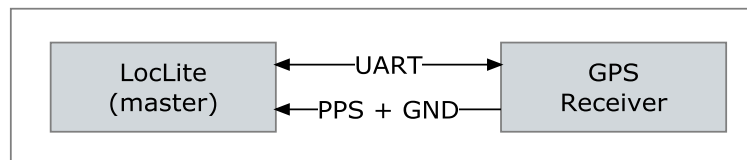


Figure 7, GPS Sync connection

Configure the GPS receiver to automatically output a serial message giving the date, time and validity of the PPS for transmission to the COM port in use. This message should be output at the 1Hz rate preferably within 200ms of the pulse.

Many PPS sources output a 0–5V active high pulse. If this is the case the PPS must be converted to a differential signal for input to the Aux 1 port using an in-line converter designed per the following circuit.

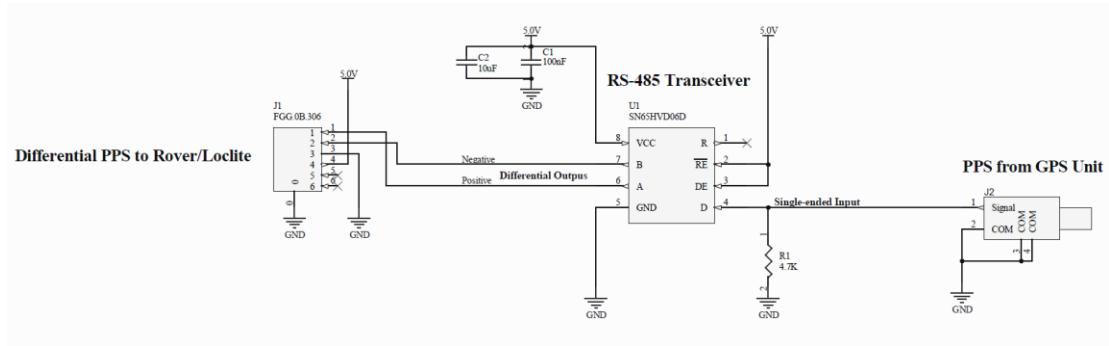


Figure 8, recommended single-ended to differential conversion circuit

Using the SigNav uTevo for GPS Sync

The following configurations apply when using the uTevo GPS timing source.

LocataLite Configuration

Configure the following options in the `config.txt` file.

```
Device_Type = MASTER_WITH_GPS_SYNC;
COMPORT#3 = IO_PORT_GPS;
COMPORT_#_BAUD3 = 115200B;
GPS_Receiver_Type = uTevo;
```

GPS Setup/Configuration

The default internal uTevo configuration is appropriate for GPS sync.

If necessary you can issue a factory reset command (clear & reset) to the uTevo to return it to its default configuration. This command is:

```
$PSGNC,CAR\r\n
```

Serial Message

The NMEA style SSR message provided by the uTevo supplies the time, date and PPS validity information which the master LocataLite uses. You can find the definition of the SSR message in Appendix A.

PPS

The “Timing” port shown in the following image supplies the uTevo PPS output.

³ This may be COMPORT1 or COMPORT2 as appropriate.



Figure 9, uTev0 panel

Using the Symmetricom TSC-4400 for GPS Sync

The following configurations apply when using the Symmetricom GPS timing source.

LocataLite Configuration

Configure the following options in the `config.txt` file.

```
Device_Type = MASTER_WITH_GPS_SYNC;  
COMPORT#4 = IO_PORT_GPS;  
COMPORT_#_BAUD4 = 38400B;  
GPS_Receiver_Type = TSC4400;
```

GPS Setup/Configuration

The TSC4400 has a number of configuration files that need to be configured appropriately for operation with the LocataLite. For information on how to change the configuration files please refer to Reference 9. In the following three files, set the values provided here:

`novalog.nml`

```
LOGDATA = 15  
LOGFILES = 100  
CARRIER_SMOOTHING = 60  
COMMAND = "log GPGSV ontime 1"
```

`realtime.nml`

```
BAUD = 38400
```

⁴This may be COMPORT1 or COMPORT2 as appropriate.

```
COMMAND = "log GPGSV ontime 1"  
COMMAND = "log timea ontime 1"
```

startup.cfg

```
ANTENNA_POSITION = AUTO  
AUTO_POS_PERIOD = 12  
ANTENNA_DELAY = 2.688e-9  
MAS_ANGLE = 10  
REFERENCE = INTERNAL  
EXTERNAL_REF = NONE  
STEER_MODE = CLOCK  
OUTPUT_FREQ = 10.0  
COM_MODE = REALTIME  
REALTIME_IP_LOGGING = TRUE  
NOVALOG_CFG = /mod/lim/novalog.nml  
REALTIME_CFG = /mod/lim/realtime.nml  
TIMESCALE_CFG = /mod/lim/internalRb.cfg  
ERROR_LOG = /dev/null  
COMPRESS_LOGS = TRUE
```

Serial Message

The #TIMEA message provided by the TSC 4400 supplies the time, date and PPS validity information which the master LocataLite uses.

You can find the definition of the #TIMEA message in Reference 10.

PPS

The TSC 4400 PPS output can come from the any of the 4 PPS ports shown in the following image.

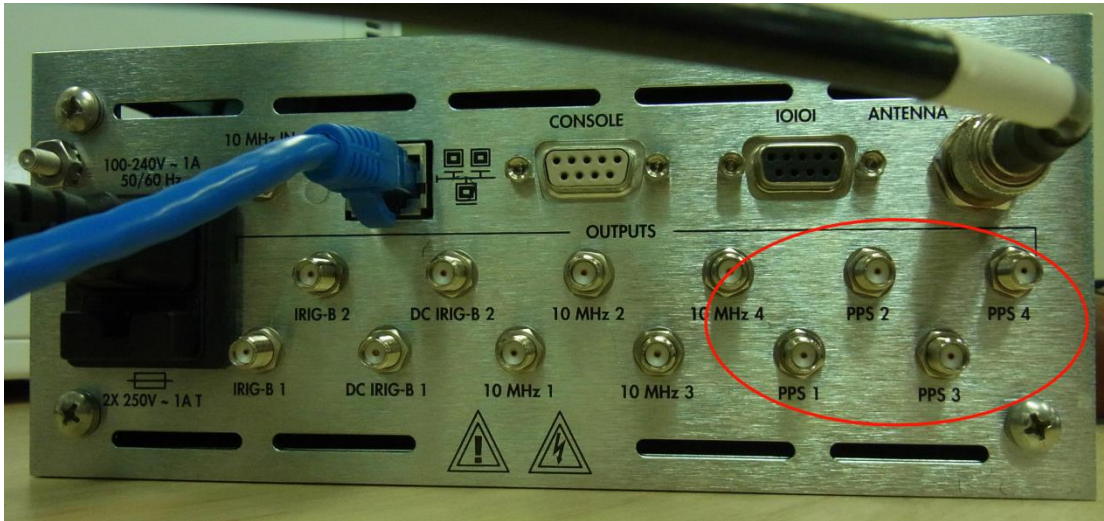


Figure 10, TSC-4400 rear panel

3.6.2. Interfacing a Meteorological Station to a LocataLite

The LocataNet supports the Vaisala PTU300 MET station. See reference 6 for more details on this device.

The MET station should be connected to the LocataLite via whichever serial port has been allocated as `IO_PORT_MET` in the `config.txt` file.

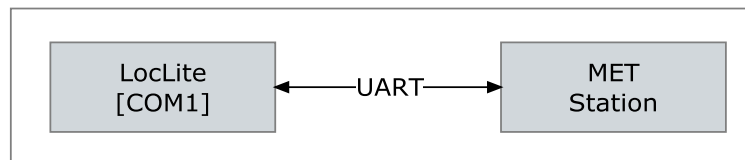


Figure 11, LocataLite interconnection with a MET station

The MET station should be configured for serial communications at the same baud rate as specified for the serial port it is connected to as specified in the `config.txt` file. A baud rate of `115,200` baud is recommended. See the Vaisala user manual (ref 6) for configuration details.

The LocataLite can be configured to communicate with the attached MET station in three different ways via the `config.txt` file.

```
met_station_polling = 2;
```

The default value of '2' instructs the LocataLite to configure the MET station once, every time the LocataLite starts up, to automatically generate the required information at

a rate of 1Hz. No further communication from the LocataLite is then made to the MET station.

The value of '1' instructs the LocataLite to poll the MET station at 1Hz to request data using the command:

```
*0100P9\r\n
```

The value of '0' instructs the LocataLite to not communicate with the MET station at all. This may mean that the MET station will not contribute any useful information if it has not previously been configured by a LocataLite using the value of '2' for `met_station_polling`. This option is useful only in situations where communication between the LocataLite and MET station can only be unidirectional, but does require that the MET station have been previously configured and that configuration saved.

3.6.3. Setting up LocataLite Self-Survey

You can install a Leica RTK GPS survey receiver at a LocataLite site for accurate, automatic LocataLite antenna surveys. This receiver provides its own location data to the LocataLite. The LocataLite then calculates a surveyed position for its antennas using known offsets from the GPS receiver antenna. The survey GPS receiver uses one of the LocataLite's two serial ports to provide position data to the LocataLite.

Connect the GPS receiver to the LocataLite using whichever COM port has been allocated as `IO_PORT_GPS` in the `config.txt` file.

Configure the COM port speed in the LocataLite's `config.txt` file. Configure the GPS receiver to match the LocataLite COM port speed prior to connecting it to the LocataLite.

Set the `config.txt` parameter `SelfSurvey_enabled` to `ON`.

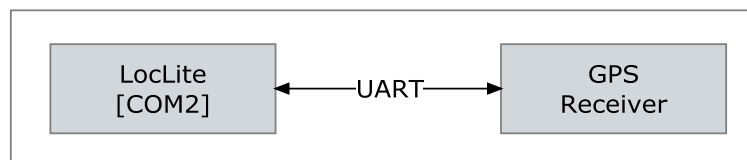


Figure 12, LocataLite-GPS interconnection for self-survey

LocataLites with self-survey enabled will send a request over the allocated COM port at boot to schedule TPV message output at 1Hz from the attached GPS receiver. The LocataLite uses this TPV data to determine its antenna positions.

You can use any Leica RTK GPS receiver that supports the TPV output schedulable via the \$PLEIQ,TPV message to support self-survey.

A LocataLite with self-survey enabled will output the TPV scheduling request once every 10 seconds until it receives a TPV response. This allows the LocataLite and GPS receiver to power up in any order.

Be sure to position the GPS receiver antenna on a vertical line with the LocataLite antennas as shown in the figure below. There should be no horizontal offset between the four antennas. The vertical offsets shown in the figure are all positive.

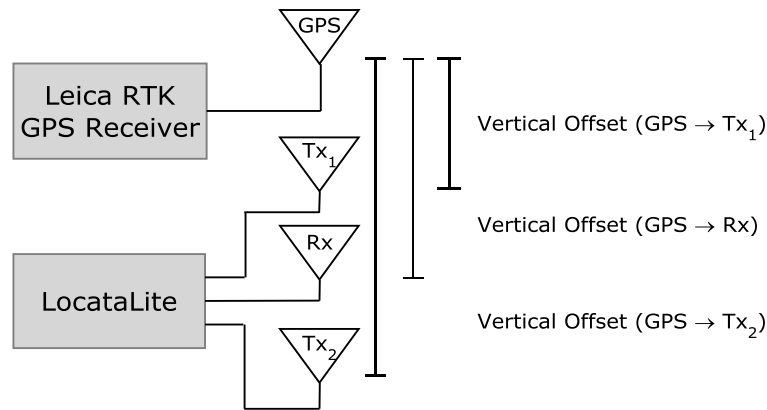


Figure 13, Permissible arrangement of antennas when self-surveying

Self-Survey Operation

The GPS self-survey feature performs the following sequence of events at boot.

1. Check for previously saved position survey result⁵;
2. Use incoming GPS TPV data to perform a short initial survey (~2 minutes);
3. Allow the LocataLite to perform TimeLoc and become active;
4. Continue using incoming TPV data to perform a full survey (~12 hours);
5. Continue using incoming TPV data to detect antenna movement (flag error condition if movement detected);

Defining LocataLite Response to Loss of GPS Position Data

The behavior of self-survey may be customized using several `config.txt` parameters. These parameters, listed below, define whether GPS position data is required during the various stages of self-survey and what the response of the LocataLite should be if GPS position data is not available.

`SelfSurvey_GPS_rqd_to_load_nv_posn`

YES	At boot any previous survey result stored in non-volatile memory must be validated by comparing it against a GPS position before it can be used.
NO	At boot any previous survey result stored in non-volatile memory can be used even if GPS position data is unavailable.

`SelfSurvey_GPS_rqd_during_full_survey`

YES	During the full survey the LocataLite will broadcast that it has bad health if the GPS is unavailable.
NO	During the full survey the LocataLite will continue to broadcast good health even if the GPS is unavailable.

`SelfSurvey_GPS_rqd_during_monitoring`

YES	During on-going position monitoring the LocataLite will broadcast that it has bad health if the GPS is unavailable.
NO	During on-going position monitoring the LocataLite will continue to broadcast good health if the GPS is unavailable

⁵ If a previously saved position survey result was detected the LocataLite will attempt to verify that the position using a small number of incoming TPV messages. If the LocataLite does not appear to have moved the saved position will be trusted and the LocataLite will skip step 2.

`SelfSurvey_movement_asserts_bad_health`

<code>YES</code>	If the LocataLite detects movement it will broadcast bad health
<code>NO</code>	If the LocataLite detects movement it will continue to broadcast good health

Recommended Configuration

The recommended configuration depends on the availability of GPS, how likely a movement event is and what sort of network monitoring is being performed.

If there is little risk of a LocataLite moving after the full survey has been performed then most of the above configuration options can be switched off. This will allow a single full survey result to be used irrespective of whether GPS is continuously available or not.

If there is an appreciable risk that the LocataLite may move during operation then ideally the ‘GPS_rqd’ options should be enabled.

GPS Self-Survey Installation Procedure

1. Mount all four antennas phase centers aligned vertically with each other and with the GPS antenna on top.
2. Measure vertical offsets between the phase center of the GPS antenna, and the phase centers of the Locata antennas using a tape measure
3. Enter these offsets into the LocataLite’s `config.txt` file.
4. Enable GPS survey in the `config.txt` file.
5. Configure GPS to output 115200 baud rate.
6. Connect GPS to the COM port designed ‘`IO_PORT_GPS`’ using a null modem cable.
7. Power up the LocataLite and GPS receiver.

CHAPTER 4 LOCATALITE OPERATION

LocataLites are self-regulating, and do not require any attention during operations once transmissions begin. Operation may continue for months without the LocataLites requiring attention. The areas where user action may be required are: starting and ceasing operations, accessing log files, configuration and software upgrades. These are all covered in the following sections.

4.1. Starting Operations

Before starting operations, ensure that a LocataLite's transmit and receive antennas are properly connected to their respective LocataLite outputs. Peripherals such as GPS receivers or MET stations should also be connected.

LocataLites within a network may be started in any order. Slave LocataLites (so configured in `config.txt`) will look for a Master or reference signal to acquire, then synchronizing to before beginning transmission. If the Slave sees no reference signal, it will continue the search for one, and remain in a non-radiating, non-synchronized state until it succeeds.

The availability of meteorological data does not affect transmissions from LocataLites to which they may be attached, only the data reported in the navigation message overlay regarding the meteorological data seen.

The availability of GPS data may affect transmissions from a LocataLite configured to perform a self-survey depending on the parameters defined in `config.txt`.

Once power has been applied, the LEDs on the front edge of the LocataLite case will show the status of the LocataLite as it progresses through its startup sequence (see section 2.4 on page 17 for details of the LED flashing scheme). In particular, once LED 3 switches ON solid the LocataLite is broadcasting with good health. The LBMP messages may also be queried to determine the health and status of the LocataLite.

There is no need for operator action once power has been applied unless `config.txt` parameters need to be changed. If this is the case the operator will need to apply power, wait for the LocataLite to boot, make the changes then restart or reboot the LocataLite.

4.1.1. Master Startup

You may start the Master at any time. Simply apply power to the LocataLite to do so. Once the Master is transmitting, any Slave LocataLites in the network that are powered on will be able to acquire, track and TimeLoc to the Master signals.

Masters that are configured to synchronize to GPS time will not transmit until they have good GPS timing data and have synchronized to the one-pulse-per-second timing pulses furnished by the GPS receiver. During the synchronization process the Master LocataLite will be broadcasting, however it will broadcast at low power and with bad health in its NAV data until the synchronization process completes. If GPS timing is lost after the LocataLite has achieved full synchronization, the LocataLite will continue operation however it will no longer report that it is synchronized to an external time source.

4.1.2. Slave Startup

Slave LocataLites may be started at any time however they will not broadcast until they have acquired a reference signal (typically the network Master).

The Slave LocataLite will remain in a TimeLoc search mode until it receives a Master or other TimeLoc'd Slave's signal. It will then proceed to acquire the signal and TimeLoc to it. Once the Slave begins the TimeLoc synchronization process, it will transmit a weaker signal adequate for its own receiver to detect, to use to pull in the synchronization. Once the Slave achieves synchronization, it will ramp up its transmit power to its operational level. The entire process from power on to signal transmission is handled automatically and ordinarily requires no operator intervention.

4.2. Ceasing Operations

You can use the presence or absence of Master LocataLite signal within the network to control the transmissions of all Slave LocataLites within the network. If you stop the Master's transmissions, the Slaves will all immediately cease transmission within seconds and revert to a search mode until the Master reactivates. Therefore you may stop all transmitted signals within the network at once by powering off the Master LocataLite for the network or sharply reducing its transmitted power. This provides a rapid network stop capability. Note that this stops all Slave transmissions, but does not power off the Slave LocataLites, which will continue to consume their nominal DC power until powered off by other means.

You may also deactivate any LocataLite simply by removing DC power from it at any time. For example, LocataLites may be connected to power through a timer, such as those used to control lights by time of day. When the timer removes power, operation will cease. When the timer again restores power, LocataLite operation will begin again, assuming its reference LocataLite is up and radiating.

If desired, you may include a remote means for controlling DC power to the LocataLites in Locata network deployments. An example would be using a wireline or wireless modem to control a power relay, configured to provide power to the LocataLite when activated by remote command. You can also use such a modem for accessing the LocataLite serial or Ethernet interfaces for additional device control and monitoring.

This will give you complete remote control of each LocataLite installation, greatly simplifying the operation, control, and monitoring of widely dispersed networks.

4.3. Accessing the LocataLite via FTP

The LocataLite runs an FTP server. With an Ethernet connection to the LocataLite users may use an FTP client to initiate an FTP session with the LocataLite. The IP address of the LocataLite must be known to start an FTP session. The LocataLite supports anonymous logins so no username or password is required.

The FTP interface provides several capabilities including:

1. upload new software
2. upload/download LocataLite application configuration file (*config.txt)
3. upload/download Ethernet configuration file (*ethernet_config.txt)
4. upload/download device name file (hostname.txt)
5. check software version information
6. download or delete log files
7. issue basic commands (reboot, upgrade software, restart)

Once an FTP connection has been established the user will have access to the FTP root directory. This directory resides in part of the LocataLite's non-volatile memory. The following table defines the FTP directory structure and available content.

Directory	File	Description
/		FTP root directory
	*config.txt	LocataLite application configuration file.
	*ethernet_config.txt	Ethernet configuration file
	hostname.txt	Hostname configuration file
	iode.bin	IODE counter
	*_upgrade.tar.gz	Software upgrade file (file is removed once used)
/logs		Logs sub-directory
	log#.lbf	Auto-incrementing numbered LBMP log files
	error_log.txt	Any system errors will be reported here
/version		Version information sub-directory
	software_name.txt	Contains the name of the last *_upgrade.tar.gz file

	<code>sw_version.txt</code>	Contains software version information
	<code>fpga_header.txt</code>	Contains FPGA version information

The LocataLite FTP server supports the usual commands: `put`, `get`, `delete`, `cd`, `ls`, `pwd` and `quit`.

FTP sessions do not persist over system reboots however they will persist across an application restart.

4.4. Issuing Commands via FTP

The LocataLite recognizes several specifically named files as command requests when they are put into the FTP root directory by a user. The files require no content and are recognized with the `.txt` extension or without any filename extension.

Available commands by filename and their effects include:

<code>cmd_restart.txt</code>	Restart the LocataLite application. This causes any <code>config.txt</code> changes to take effect
<code>cmd_upgrade.txt</code>	Initiate a software upgrade provided a suitable upgrade file is present. This will result in a system reboot which will also cause any other configuration file change to take effect.
<code>cmd_ethernet.txt</code>	Apply the current <code>ethernet_config.txt</code> changes without causing a reboot.
<code>cmd_reboot.txt</code>	Power cycle the LocataLite. This causes all configuration file changes to take effect. It also initiates a software upgrade if an upgrade file is present.

To issue one of these commands start an FTP session with the LocataLite and upload one of the named files. The LocataLite should respond within two seconds to the command. As part of responding to the command the LocataLite will delete the command file.

4.5. Configuring the LocataLite

The LocataLite's configuration files `config.txt`, `ethernet_config.txt` and `hostname.txt` reside in the FTP root directory. They can be copied onto or off the LocataLite using FTP. Any modifications to the files need to be made by copying the

files off the LocataLite onto a PC, editing them there, then copying them back onto the LocataLite.

Changes to configuration files require a trigger to take effect. All configuration changes may be triggered by a system power cycle or reboot. Alternatively use the appropriate FTP command file defined in section 4.4.

4.6. Accessing Log Files

The LocataLite may be configured to log data to internal memory during operation. This configuration is handled in the `config.txt` file. The LocataLite may log LBMP data, ASC data, event and error messages. At present the LocataLite may only log LBMP or ASC data if those protocols have been allocated to one of the serial ports. In a future release this restriction will be lifted.

LBMP data is logged to files using the naming convention `log#.lbf`. The hash mark represents an incrementing integer for successive log files.

ASC data is logged to files using the naming convention `log#.csv`. The hash mark represents an incrementing integer for successive log files.

System events are logged to files using the naming convention `event#.log`. The hash mark represents an incrementing integer for successive log files.

Errors are automatically logged to the file `error_log.txt`. This includes any issues found during a software upgrade.

All log files can be accessed via FTP to the LocataLite. The files are located in the `/logs` subdirectory. Log files can be downloaded or deleted as desired.

It is possible to fill the LocataLite's internal memory if file logging is enabled for too long. The internal memory is large enough to log continuously for up to several weeks depending on which messages are scheduled, at what rates, and how many LocataLites are present in the network. If the internal memory becomes full LED 1 will flash.

4.7. Upgrading the LocataLite Software

LocataLite software updates take the form of an upgrade file such as `'v8r0p0_loclite_upgrade.tar.gz'`, where the `'v8r0p0'` reflects the version number of the software.

Performing a software upgrade requires an Ethernet connection to the LocataLite. Use FTP to upload the file to the FTP root directory on the LocataLite. Once the file is uploaded, issue an upgrade command to the LocataLite. This command may be issued

using the FTP `cmd_upgrade` file or via the LBMP system command message. Alternatively power cycling the LocataLite will trigger the upgrade process.

The upgrade process can take up to 5 minutes to complete. Once the upgrade process has completed the LocataLite application will automatically restart. During some of the upgrade process the LocataLite will disable FTP and LBMP socket connections. The LEDs will indicate when an upgrade is in progress and when it has completed. For remote users the ability to create an LBMP socket connection will signify that the upgrade process has completed.

As a safety measure, if for any reason the LocataLite encounters an error or loses power while upgrading, it will revert to the version of software in use before the upgrade.

Users can check whether an upgrade has completed successfully by checking the version information as described in section 4.8.

4.8. Checking Version Information

The LocataLite stores its version information in a directory accessible via FTP. As defined in section 4.3 the `/version` directory contains three version files.

Users should check the contents of the `software_name.txt` file to see which version of software is running. This file contains the name of the last upgrade file used to program the LocataLite. This file will typically start with the version string which takes the form:

```
vXrYpZ  
  
Where:  
  o v - version  
  o r - release  
  o p - patch
```

The version string may also be obtained from the LBMP message 0x9002.

4.9. LBMP via TCP

The LocataLite operates two TCP based LBMP servers. With an Ethernet connection to the LocataLite a user may establish a socket based connection to either or both of these servers.

The first server listens on port 5012. When a client connects to this port the server automatically outputs any messages that have been scheduled using the 'LBMP_schedule_message' parameters in the `config.txt` file. This is the same behavior as a serial port that has been assigned the LBMP protocol.

The second server listens on port 5013. When a client connects to this port it will not output any message automatically. The server listens for queries or commands from the client and responds to them.

See the LBMP ICD (see reference 4) for further details of the LBMP protocol.

The LocataLite will accept up to 16 simultaneous connections on each port. The speed of the connection is limited by the overall speed of the Ethernet connection. An LBMP connection over Ethernet will typically be faster than one using a serial port.

LBMP socket sessions do not persist between application restarts or LocataLite reboots.

4.10. Serial Communication

The LocataLite has two serial communications ports; both accessible via a single 5-pin LEMO connector (see Figure 3). These ports are typically used to connect the LocataLite to peripherals such as GPS receivers and MET stations; however they may also be used to access measurement and network data, as well as query and set the Ethernet configuration.

The `config.txt` file specifies what protocols are active on each COM port as well as the data rate for each port. See section **Error! Reference source not found.** on page **Error! Bookmark not defined.** for more detail on setting up the serial ports.

Serial protocols include

NONE	No protocol selected for the port
MET	Used when the port is connected to a meteorological station.
GPS	Used when the port is connected to a GPS timing or survey receiver
LBMP	Used for LBMP query and response covering a range of measurement and network data
NMEA	Used for ASCII data output following standard NMEA conventions
ASC	Proprietary protocol used for voltage and temperature testing

Supported data rates include: 9,600, 19,200, 38,400, 56,400, 115,200, and 230,400 Baud. The higher rates are preferred when feasible.

The serial ports may be used to determine the Ethernet configuration (e.g. IP address) of the LocataLite. This process is described in section **Error! Reference source not found.** on page **Error! Bookmark not defined.**

4.11. Web Interface

The LocataLite operates a HTTP server which provides a set of simple web pages which display information derived from the LBMP messages defined in reference [4]. To access the web interface use a web browser and set the address to,

```
http://<locatalite_ip_address>
```

Once on this page click on a link to one of the LBMP messages to display data from a given message. The web server will generate a static page and populate it with current data from the selected message. Refreshing the page will trigger a or re-requesting of data that will then be updated on the page.

Supported web browsers include:

- Internet Explorer 9+
- Firefox 16+
- Chrome 24+

CHAPTER 5 TROUBLESHOOTING

For the most part, once the LocataLite and associated equipment are properly configured and interconnected, operating the LocataLite is simply a matter of turning it on and letting it initialize and begin operations. The following troubleshooting advice may however assist in solving issues should they arise.

5.1. General Troubleshooting

The following general advice may assist in troubleshooting operational and performance issues:

- Check the state of the device LEDs for general warnings or error conditions. The typical steady state operating condition for all LEDs is either solid OFF or solid ON, with the exception of LED 7 – Heartbeat which briefly occults every two seconds. Flashing sequences on the other LEDs typically indicate a warning, fault or non-steady state operating condition that may require attention. See Section 2.4 for details of LED pattern meanings.
- Ensure that all electrical connections to the device are present and secure. Ensure that the desired communications interfaces have been connected in accordance with descriptions provided in this manual and that antenna connections are present.
- Ensure the frequency plan configuration of the device matches the rest of the network.
- Ensure the desired LocataLite device type has been selected and that each LocataLite device is assigned a unique device identifier.

5.2. Device Configuration Troubleshooting

In the event that the `config.txt` file is missing or contains an error when the application is started the system will enter an error state where an error report is output via COM1 at 1Hz with LED 5 flashing to indicate that an error has been encountered. In this error state users will not be able to establish TCP based LBMP connections to the device. Users will be able to FTP into the device and check the `error_log.txt` file in the `/logs` directory to determine the source of the problem.

5.2.1. Communications Interface Troubleshooting

If the device is not responding to communications requests at all or accepting remote connections the following steps may be helpful:

- Confirm there are no issues with the physical connections to the device
- Check that the device configuration file has been configured as expected. Serial port baud rates, IP configuration, and automatic message output settings are all user accessible and may be different than expected.
- Check that the communications settings being used on the host platform match the device configuration. If the device is not responsive the settings may have changed and the Ethernet IP address or serial port baud rate may be incorrect.
- Try an alternate interface for communicating with the device. Communication is possible through either the Ethernet port (TCP/IP) or either serial port. When using a TCP connection it is possible to interact with the device through a HTTP connection, FTP session, or through the LBMP protocol via a TCP socket. See **Error! Reference source not found.** for details.
- It is possible to determine the current device configuration by observing information output at boot time on the serial ports. This ASCII boot message is always output at a fixed baud rate and includes the current communications interface configuration. See Section 3.5 for details.

5.3. Troubleshooting the Position Reference GPS Receiver

1. Check that the serial cable is plugged into the appropriate COM ports on the LocataLite and GPS receiver.
2. Check that the GPS receiver is outputting TPV messages.

If not, perhaps the GPS receiver was started or connected after the LocataLite had sent the TPV request message. Restarting the LocataLite after connecting the GPS receiver may solve this issue.

3. Check that the TPV messages are reporting an RTK solution (solution type 254).

If not, perhaps the GPS receiver is not getting differential correction data from its reference station. Consult the GPS manufacturer for more help on this issue.

5.4. Troubleshooting the Timing Reference GPS Receiver

5.4.1. uTevo GPS Receivers

In case of difficulties getting a uTevo GPS receiver time source working, check the following items:

1. Check that the serial and PPS cables are plugged into the appropriate ports on the LocataLite and uTevo.
2. Check the behavior of LEDs 3 and 4.

LED 3 indicates the status for GPS synchronization, as shown in Table 12, LED 3, health & tracking status on page 27. LED 4 will display the particular fault detected if there exists no other higher priority fault. LED 4 fault codes are shown in Table 13, LED 4, on page 27. Possible faults include:

External PPS Missing. Serial communication is operating between the uTevo and the LocataLite, the uTevo has GPS lock, but the LocataLite can't see the PPS. Most likely the cable connecting the GPS PPS to the LocataLite is incorrectly installed or faulty.

External PPS Bad. Serial communication is operating between the uTevo and the LocataLite, but the uTevo receiver has not locked to GPS time itself;

External Time Missing. The LocataLite cannot detect a serial connection between itself and the PPS timing source.

External Time Bad. Serial communication is operating between the uTevo and the LocataLite, the uTevo has GPS lock, but the LocataLite can't see the PPS. Most likely the cable connecting the GPS PPS to the LocataLite is incorrectly installed or faulty.

If the LocataLite LED behavior is difficult to distinguish it is possible to get the same information from the serial stream of \$GPLOC,ASC messages that output from COM1 on the LocataLite [115200 baud, 8 data bits, 1 parity bit, no flow control, null modem cable]. The second last field of the ASC message before the checksum indicates the GPS sync error state with the following possible values (matching the error states above):

State 0: no error

State 1: missing serial comms

State 2: bad PPS status

State 3: missing PPS

Connect a computer to the GPS receiver serial feed [115200 baud, 8 data bits, 1 parity bit, no flow control, null modem cable] and check the SSR report status (which is output automatically at 1Hz). The Appendix "Message Definitions" contains a definition of the SSR message.

In particular look at the last 6 fields of the SSR (underlined below). These are the holdover (1), time/frequency tolerances (4) and error conditions (1). When the uTevo has a good solution and an accurate PPS output they should read **0,1,1,1,1,0*** as shown. If they read differently then the uTevo is not fully locked to GPS and the LocataLite will not trust the PPS. This would constitute the "State 2" error cited above.

```
$PSGNR,SSR,20100721,093159,1,15.0,0,1,0,1,1,1,1,0*CS
```

If the uTevo is reporting that it does not have GPS lock (as described in point 3 above) it is possible to send queries to determine which signals are being tracked, which have downloaded ephemeris data, and whether a position/time solution is being computed. The following set of commands would be useful. The uTevo communication protocol (Reference 7) describes the commands and their responses.

```
$GPGPQ,GSV
```

```
$GPGPQ,GGA
```

```
$GPGPQ,GSA
```

```
$GPGPQ,UNC
```


\$GPGPQ,EPL

Power cycle the uTevo receiver.

5.4.2. TSC-4400 GPS Receivers

TBD

CHAPTER 6 MAINTENANCE

There are no user-serviceable parts inside the LocataLite. If you are unable to obtain satisfactory LocataLite operation after following the advice in this manual, contact your Locata representative for additional help. Be sure to have the serial number and if possible the software version number of your LocataLite available when enquiring.

6.1. Routine Maintenance

The LocataLite does not require any user maintenance.

CHAPTER 7 LOCATALITE SPECIFICATIONS

RF Power output	-55 to +20 dBm																					
Transmit Frequencies	2411.211, 2414.28, 2462.361, 2465.43, 2472.591 MHz																					
Receive Frequencies	2411.211, 2414.28, 2462.361, 2465.43, 2472.591 MHz																					
RF Modulation	BPSK using a pseudorandom binary sequence at 10.23 mcps/sec																					
Data overlay	50 bps modulo-2 added to pseudorandom binary sequence																					
Transmitter Duty cycle	10 percent, transmitting 100 microseconds per millisecond using 100 microsecond/slot slotted TDMA across the network, slot assignments are pseudo-randomly rearranged each millisecond																					
Interfaces	<table border="1"> <thead> <tr> <th>Type</th> <th>Required Connector</th> <th>Specification</th> </tr> </thead> <tbody> <tr> <td>COM</td> <td>LEMO FGG.0B.305</td> <td>2 ports, RS-232</td> </tr> <tr> <td>LAN</td> <td>LEMO FGG.0B.306</td> <td>Ethernet IEEE 802.3</td> </tr> <tr> <td>Aux1 and Aux 2</td> <td>LEMO FGG.0B.306</td> <td>Differential 5 volt</td> </tr> <tr> <td>USB:</td> <td>LEMO FGG.0B.304</td> <td>USB 2.0</td> </tr> <tr> <td>Power</td> <td>LEMO FGG.0B.302</td> <td>-</td> </tr> <tr> <td>RF</td> <td>SMA</td> <td>Tx1 and Tx2 Transmit signal output, Rx receive signal input</td> </tr> </tbody> </table>	Type	Required Connector	Specification	COM	LEMO FGG.0B.305	2 ports, RS-232	LAN	LEMO FGG.0B.306	Ethernet IEEE 802.3	Aux1 and Aux 2	LEMO FGG.0B.306	Differential 5 volt	USB:	LEMO FGG.0B.304	USB 2.0	Power	LEMO FGG.0B.302	-	RF	SMA	Tx1 and Tx2 Transmit signal output, Rx receive signal input
Type	Required Connector	Specification																				
COM	LEMO FGG.0B.305	2 ports, RS-232																				
LAN	LEMO FGG.0B.306	Ethernet IEEE 802.3																				
Aux1 and Aux 2	LEMO FGG.0B.306	Differential 5 volt																				
USB:	LEMO FGG.0B.304	USB 2.0																				
Power	LEMO FGG.0B.302	-																				
RF	SMA	Tx1 and Tx2 Transmit signal output, Rx receive signal input																				
Device setup files	config.txt ethernet_config.txt hostname.txt																					
config.txt	Most LocataLite settings See Section Error! Reference source not found. , “ Error! Reference source not found. ” on page Error! Bookmark not defined.																					
ethernet_config.txt	Ethernet settings, including , IP address, and netmask See Section 3.4.1 on page 32. Defaults to DHCP																					
hostname.txt	Specifies the host name for the LocataLite, Defaults to “locata_tx”																					
COM Interface	RS-232, ±5 volts Receiver input nominal impedance: 5 kilohms Transmitter nominal load impedance: 3-7 kilohms																					
COM speeds available	9,600, 19,200, 38,400, 56,400, 115,200, 230,400 baud																					
COM interface settings available	GPS, NMEA, LBMP, MET, NONE																					

NMEA setting: Sentences supported	Transmit: \$GPLOC,ETH, (See Appendix A) Receive: \$GPGSV, (See Appendix A) \$GPALM, (See Appendix A) \$GPLOC,ETH (See Appendix A) \$PLEIQ,TPV (See Appendix A)
GPS setting: Sentences supported	Transmit: \$PSGNC,CAR (See page 37), \$GPLOC,ETH (See Appendix A) Receive: \$GPGSV, (See Appendix A) \$PPSNC,SSR (See Appendix A) \$GPLOC,SVY (See Appendix A) \$PLEIQ,TPV (See Appendix A) \$TIMEA; \$GPLOC,ETH (See Appendix A)
MET setting: Sentences supported	Transmit: Poll command (to MET station) Receive: Response data (from MET station) \$GPLOC,ETH, (See Appendix A)
LBMP setting	Transmit and Receive: Locata Binary Messaging Protocol See Reference 4
DC Power outputs	Aux outputs: 5 volts, up to 0.8 amps
Power consumption	12-28 volts DC ⁶ , less than 40 watts
Dimensions	134mm wide x 241mm long x 28mm high
Weight	1.4kg

⁶ 29 volts absolute maximum. DC power sources that may sometimes exceed this value should be clamped to 28 volts.

CHAPTER 8 NOTES

8.1. Definitions

Word	Definition
LocataLite	A positioning signal transmitter used in Locata networks. It functions in a manner analogous to GPS satellites, but is normally deployed at selected ground sites around and within the area served by a Locata network
Rover	A Locata positioning signal receiver, which operates in a manner analogous to a high-precision GPS receiver. Rovers can solve for positions using both code and carrier phase information derived from the signals transmitted by the LocataLites. All Rover position solutions are single point solutions. The Rover does not use differential techniques to derive positions.
TimeLoc	A proprietary technique for synchronizing LocataLites within a Locata network to within a few nanoseconds or less. This enables the network to furnish precise positions without requiring atomic clocks at the LocataLites.

8.2. Acronyms and Abbreviations

Acronym	Meaning
ASCII	American Standard Code for Information Interchange
DOP	Dilution of precision
FPGA	Field programmable gate array
HDOP	Horizontal dilution of precision
LocataNet	Locata Network
LocLite	Shorter form of “LocataLite”
MET	Meteorological
NMEA	National Marine Electronics Association
PCB	Printed circuit board
PPS	Pulse per second
Rx	Receive
Sync	Synchronization (referring to time and frequency)
TCXO	Temperature compensated crystal oscillator
TimeLoc	Proprietary synchronization method used by LocataLites
Tx	Transmit
VDOP	Vertical dilution of precision

APPENDIX A MESSAGE DEFINITIONS

A.1 STANDARD MESSAGES

This section covers standard GPS messages adopted by the Locata System. These messages present position information in a standard and familiar format.

A.1.1 GPS GSV Message

The GSV message shows the satellites, or in this case, the Locatalites, in view based on their almanac data. It also shows the current ability to track this signal. One GSV sentence can provide data for up to 4 signals. The NMEA standard dictates a maximum of 3 GSV messages providing information on a maximum of 12 Signals.

GSV Format

```
$GPGSV,3,1,6,01,01,083,21,02,05,308,19,03,07,344,18,04,01,228,10*75
```

GSV Fields

Table 17, GSV message fields

Field	Symbol	Description (units)	Range / Options / Comments	
1		GSV	Satellites in view	
2	x	3	Number of sentences of this type in this cycle	
3	x	1	Sentence number in cycle	
4	x	6	Number of Locata Signals in view	
5+4*(n-1)	x	01	Locatalite Signal PRN number	For n=1-4; 4 satellites per sentence
6+4*(n-1)	x	01	Elevation, degrees	
7+4*(n-1)	x	083	Azimuth, degrees	
8+4*(n-1)	x	21	SNR, dB, null when not tracking	
21	x	*75	Checksum data. Always begins with *	

A.2 LOCATA PROPRIETARY MESSAGES

Since a Locata System differs in some important ways from a standard GPS system, it must also use a few proprietary messages to convey device and system status. This section describes the Locata proprietary messages LocataLites use at this time.

A.2.1 Locata ETH Message

This message allows querying or setting of the Ethernet configuration.

ETH Format

```
$GPLOC,ETH*22\r\n
```

```
$GPLOC,ETH,<mode>,<address>,<netmask>,<gateway>*CS\r\n
```

The LocataLite interprets the shorter format as a query request. It will respond with the full message containing the current Ethernet configuration.

The LocataLite interprets the longer format message as a command to set the Ethernet configuration. The LocataLite does not respond to the long message. You can verify that a command to set the Ethernet configuration has taken effect by sending a query message for the present configuration after making a change, which should reflect the updated configuration.

Note that as per the NMEA standard the checksum is optional. If the checksum is omitted the '*' should also be omitted.

ETH Fields

Table 18, ETH message fields

Field	Symbol	Description (units)	Range / Options / Comments
1	mode	DHCP or static	0 – static IP mode 1 – DHCP mode
2	address	IPv4 IP address	e.g. 192.168.1.111 (only relevant for static IP mode)
3	netmask	IPv4 netmask	e.g. 255.255.255.0 (only relevant for static IP mode)
4	gateway	IPv4 gateway address	e.g. 192.168.1.1 (only relevant for static IP mode)

A.2.2 Locata ENV Message

This message reports the internal temperature and supply voltage for the LocataLite.

ENV Format

```
$GPSLOC,ENV,<week>,<tow_s>,<t1>,<t2>,<t3>,<t4>,<t5>,<tmax>,<Vss>*C
S\r\n
```

ENV Fields

Table 19, ENV message fields

Field	Symbol	Description (units)	Range / Options / Comments
1	Week	Week number [week]	GPS week number
2	tow_s	Time of week [s]	Seconds into the week
3	t1	CPU temperature [°C]	Resolution to nearest °C
4	t2	CPU PCB temperature [°C]	Resolution to nearest °C
5	t3	FPGA temperature [°C]	Resolution to nearest °C
6	t4	FPGA PCB temperature [°C]	Resolution to nearest °C
7	t5	TCXO PCB temperature [°C]	Resolution to nearest °C
8	tmax	Max of t1 through t5 [°C]	Resolution to nearest °C
9	Vss	Supply voltage [V]	Resolution to mV

A.3 SIGNAV PROPRIETARY MESSAGES

A.3.1 SigNav uTevo SSR Message

This section describes the SigNav proprietary SSR message the uTevo GPS timing receiver sends over its serial interface to accompany the pulse-per-second timing supplied to the LocataLite.

SSR Format

```
$PSGNR,SSR,yyyymmdd,hhmmss,x,x.x,x,x,x,x,x,x,x,hh*CS\r\n
```

SSR Fields

Table 20, SSR fields

Field	Symbol	Description (units)	Range / Options
1	yyyymmdd d	Date: year, month, day	1980 – 2099, 01 – 12, 01 – 31
2	hhmmss	Time	Hours, minutes, seconds
3	x	Alignment	1 – UTC alignment 0 – GPS alignment
4	x.x	UTC Offset (seconds)	0 – 128 Will be 0 until UTC parameters are known.
5	x	Leap Second Pending	+1 – A positive leap scheduled 0 – No leap scheduled -1 – A negative leap scheduled
6	x	Position status	0 – Position unknown 1 – Position good to 300 m 2 – Self-survey complete
7	x	Holdover	0 – Receiver is fixing 1 – Receiver is in holdover
8	x	TS Inner Tolerance	0 – Not in inner tolerance 1 – In inner tolerance
9	x	TS Outer Tolerance	0 – Not in outer tolerance 1 – In outer tolerance
10	x	Frequency Inner Tolerance	0 – Not in inner tolerance 1 – In inner tolerance

Field	Symbol	Description (units)	Range / Options
11	x	Frequency Outer Tolerance	0 – Not in outer tolerance 1 – In outer tolerance
12	hh	Error conditions (bit flags)	Bit 0 – Hardware failure Bit 1 – TS alignment failure Bit 2 – Freq control failure Bit 3 – Antenna under current Bit 4 – Antenna over current Bits 5 - 7 – Reserved for future use

Notes

1. The SSR report outputs automatically by default.
2. The SSR report cannot be switched off in the uTevo.
3. The SSR output rate is 1Hz.
4. The SSR report output is expected to start 10ms-50ms after the PPS.
5. The uTevo NMEA protocol speed is 115,200 baud
6. The LocataLite software will also process the message if the date is combined to a single YYYYMMDD field (i.e. no comma separation)

A.4 LEICA PROPRIETARY MESSAGES

A.4.1 Leica TPV Message

The table below presents the TPV message fields. This is almost identical to the GPS TPV messages with the exception of the solution type. The solution type flags are unique to Locata.

TPV Format

```
$PLEIR,TPV,x.x,x,0,x,0,x,x,x,0,0,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x
.x,x.x,x.x,x,
x,x,*CS\r\n
```

TPV Fields

Table 21, TPV message fields

Field	Symbol	Description (units)	Range / Options / Comments
0		Headers	\$PLEIR,TPV,
1	x.x	UTC Time	hhmmss.ss
2	x	UTC Date	ddmmyy
3	0	Latency	milliseconds
4	X	Dynamics	0: Roving 1: Static
5	0	Confidence	Not used, fill with "0"
6	x	Solution Type	See Note 1
7	x	External Aiding	See Note 2
8	x	Failure Flag	See Note 3
9	0	Position Format	Always "0". Only support geodetic output at date See Note 4
10	0	Datum	Always "0". Geodetic

Field	Symbol	Description (units)	Range / Options / Comments
11	x.x	Latitude	DDMM.FFFFFFFF 2 fixed digits for degrees; 2 fixed digits for minutes; and 7 digits for decimal-fraction of minutes resulting in approximate resolution of 0.0000001 min * (1 deg/60 min) * 110,000 (m/deg @ equator = 0.000183 e.g. 2914.9456371 = 29°14.9456371'
12	x.x	Longitude	DDDMM.FFFFFFFF 3 fixed digits for degrees; 2 fixed digits for minutes; and 7 digits for decimal-fraction of minutes resulting in approximate resolution of 0.0000001 min * (1 deg/60 min) * 110,000 (m/deg @ equator = 0.000183 e.g. 2914.9456371 = 29°14.9456371'
13	x.x	Altitude	Variable length to the left of the decimal and 3 digits after the decimal xxxx.xxx
14	x.x	Latitude Quality (m)	xx.xx (from navigation solution)
15	x.x	Longitude Quality (m)	xx.xx (from navigation solution)
16	x.x	Altitude Quality (m)	xx.xx (from navigation solution)
17	x.x	Speed over the Ground (SOG) (knots)	Variable length to the left of the decimal and 3 digits after the decimal. xxxx.xxx 0.01 knot*(0.514 m/s per knot) = 0.000514 m/s resolution 0.02fill with zeros when not calculating SOG
18	xx.xx	Course over the Ground (COG) (degrees)	Variable length to the left of the decimal and 1 digit after the decimal xxxx.x Clockwise relative to true North 0-359.9° Fill with zeros when not calculating COG
19	x.x	HDOP	Variable length to the left of the decimal and 1 digit after the decimal. Dimensionless
20	x.x	TDOP	Variable length to the left of the decimal and 1 digit after the decimal. Dimensionless
21	x.x	VDOP	Variable length to the left of the decimal and 1 digit after the decimal. Dimensionless
22	x	Number of visible satellites	Integer Number of signals available from current position based on line of sight measurements with current antenna masks and no obstructions
23	x	Number of tracked LocxataLites	Integer Number of TX signals tracked with carrier (state 9)

Field	Symbol	Description (units)	Range / Options / Comments
24	x	Number of LocataLites in position solution	Integer Number of measurements used in the navigation solution
25		Checksum	

Notes

The following table presents the values permitted for describing the Solution Type.

Table 22, TPV message Solution Type field

Value	Meaning
10	Startup mode; Locata position not yet available
11	Locata Code Position
12	Locata Phase Position
13	Locata GPS Assisted Phase Position
14	Stale Locata Position
21	GPS Differential code position
22	GPS Differential phase position
23	GPS Non-differential position
253	GPS differential position based on prediction, not measurements
254	GPS differential phase position based on prediction, not measurements
255	GPS non-differential position based on prediction, not measurements

The following table presents the values permitted for describing External Aiding. Only options 1 and 2 are currently supported in the Locata navigation solution

Table 23, TPV message, External Aiding field

Value	Meaning
0	None
1	Height fixed – 2D navigation solution
2	Position fixed – time and height solution
3	Position and height fixed – Time solution

The following table presents the values permitted for describing the Failure Flag

Table 24, TPV message, Failure Flag field

Value	Meaning
0	Position OK
1	Position Bad

The following table presents the values permitted for describing the Position Format

Table 25, TPV message Position Format field

Value	Meaning
0	WGS Geodetic
1	Local Grid
2	WGS Cartesian
3	Local Cartesian
4	Local Geodetic
5	WGS Geodetic with Qxx elements
6	Local Grid with Qxx elements
7	WGS Cartesian with Qxx elements
8	Local Cartesian with Qxx elements
9	Local Geodetic with Qxx elements

A.4.2 Leica LVR Message

The Leica LVR message cites the antenna offsets from the Leica antenna phase center to the survey reference point.

LVR Format

```
$PLEIR,LVR,x.x,x,x.x,x.x,x.x,*CS\r\n
```

LVR Fields

Table 26, LVR message fields

Field	Symbol	Description (units)	Range / Options / Comments
0		Headers	\$PLEIR,LVR,
1	x.x	UTC Time	hhmmss.ss
2	x	UTC Date	ddmmyy
3	x.x	North Offset	Meters
4	x.x	East Offset	Meters
5	x.x	Down Offset	Meters
5		checksum	

APPENDIX B CONFIGURATION FILE

What follows is the contents of a standard LocataLite configuration file including documentation of all user configuration options.

```
#####
# Configuration File: loclite_release_config.txt [2014-05-14 at 02:44:40]
#####

#####
# LocataLite Device Type
#
# There is only one Master in a given network. The remaining LocataLites
# are Slaves. In general you should designate the LocataLite that is best
# placed to provide a timing reference for the network as the Master
# LocataLite. That is, the Master should be that LocataLite having the
# shortest paths, including using the fewest TimeLoc hops where necessary
# to all other LocataLites. This arrangement would provide the cleanest
# TimeLoc performance operationally. However, other reasons may prompt a
# different selection for Master, such as accessibility or elevation.
#
# Options: MASTER, MASTER_WITH_GPS_SYNC, SLAVE
#
Device_Type = MASTER;

#####
# LocataLite Device ID
#
# This is a numeric assignment to each LocataLite which determines the
# pseudorandom spreading code and TDMA timeslot used by each device.
#
# Device ID selection:
#
# - Each LocataLite device must be configured with a unique ID different from
# all other LocataLites in the same network.
#
# - Maximising usage of device IDs from within each decade series ensures
# overlap is avoided in small networks and kept to a minimum in larger
# networks.
#
# 10 or fewer devices - operators should choose device IDs within within
# the same decade. For example within the range 1-10
# or 11-20. This approach maximises network
# performance by ensuring that all active TDMA
# transmissions do not overlap.
#
# - Examples:
# 7 devices: 1,2,3,4,5,6,7
# 10 devices: 1,2,3,4,5,6,7,8,9,10
#
# More than 10 devices - operators should initially choose device IDs within
# the same decade (as above) and then repeat this
# process by only adding additional IDs from within
# another decade until this is full, etc.
#
```

```
# - Examples:
#
#           16 devices: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16
#           22 devices: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,
#                       17,18,19,20,21,22
#
# - It is convention to assign a loclite_device_id of 1 to the Master
#   LocataLite, although it is not necessary to do so.
#
# Notes:
#
# - Note that the TDMA transmission sequences have been carefully defined such
#   that the impact of transmission overlap possible in larger networks is
#   minimised. Key statistical properties of transmission sequence
#   combinations were optimised during this process to ensure performance is
#   consistent and reliable in these scenarios regardless of the specific
#   device ID combinations in play.
#
Loclite_Device_ID = 1;

#####
# Reference device for TimeLoc
#
# Relevant to SLAVE LocataLites only (not Master LocataLites)
#
# Defines the reference device ID used to acquire TimeLoc and synchronise with
# the network. Slave LocataLites will search for the LocataLite cited in this
# field when searching for a TimeLoc signal at boot.
#
# Typically a Slave LocataLite will have a direct line-of-sight path to the
# Master LocataLite and so operators should you should set this field to match
# the loclite_device_id of that Master LocataLite. When this direct line-of-
# sight path does not exist operators will need to set this field to match the
# loclite_device_id of another Slave LocataLite in the network which is
# TimeLoc'd directly from the Master LocataLite, or alternatively to another
# Slave LocataLite with the shortest path (fewest and shortest hops) to the
# Master LocataLite from itself.
#
Reference_Device_ID = 2;

#####
# Rx and Tx Antenna of this LocataLite
#
# Note that this parameters are ignored when self-survey is enabled.
#
# LocataLiteRx is the Receiver Antenna.
# LocataLiteTx1 uses the antenna connected to port Tx1 on the LocataLite.
# LocataLiteTx2 uses the antenna connected to port Tx2 on the LocataLite.
#
# LocataLiteRx/LocataLiteTx1/LocataLiteTx2:
#
#   Field           Description           Range
#   =====           =====           =====
#   Coords           Rx Antenna coordinates   [X,Y,Z] ECEF XYZ co-ordinates [m]
#   Attitude         Yaw, Pitch, Roll, Validity [0 - 359,-90-90,-90-90,YES/NO]
#   RxAntennaType    Possible types are:     [ 0-5 ]
```

```
#
# 0 - None
# 1 - AeroAntenna Patch (AT2400)
#
# Name of this site: [INSERT NAME HERE]
#
LocataLiteRx: Coords[ -4431684.7961, 2636076.3421, -3742707.4700 ] Attitude[
360, -90, -90, NO ] RxAntennaType[ 1 ];
LocataLiteTx1: Coords[ -4431684.7961, 2636076.3421, -3742707.4700 ] Attitude[
360, -90, -90, NO ] TxAntennaType[ 1 ];
LocataLiteTx2: Coords[ -4431683.5388, 2636075.3371, -3742706.1663 ] Attitude[
360, -90, -90, NO ] TxAntennaType[ 1 ];

#####
# LocataLite Self Survey
#####

# The following parameters apply to the LocataLite GPS self-survey feature.
#
# When this feature is enabled the LocataLiteRx/LocataLiteTx ECEF XYZ
# co-ordinate parameters are ignored.

#####
# Enable/disable self-survey
#
# Options: ON, OFF (default)
#
SelfSurvey_enabled = OFF;

#####
# Select the level of GPS dependency. This series of parameters changes the
# LocataLite behaviour when valid TPV data is unavailable during each stage
# of operation.
#
# Valid options are: YES (default) / NO
#
# Any combination may be selected to achieve the desired operation.
#
SelfSurvey_GPS_rqd_to_load_nv_posn:
#
# Defines whether GPS position data is required to validate a previous survey
# position loaded from non-volatile memory at boot.
#
# YES - non-volatile position must be validated before it can be used
# NO - non-volatile position will be used even if we can't validate it,
# position will ultimately be verified if GPS becomes available
#
SelfSurvey_GPS_rqd_during_full_survey:
#
# Defines whether the LocataLite reports bad health if GPS data is not
# available at any point during the full survey.
#
# YES - LocataLite will assert bad health during the full survey if GPS is
# not present or has bad quality
# NO - LocataLite can assert good health during the full survey even if
```

```
#           GPS is not present or has bad quality
#
# SelfSurvey_GPS_rqd_during_monitoring:
#
#   Defines whether the LocataLite reports bad health if GPS data is not
#   available at any point during on-going position monitoring.
#
#   YES - LocataLite will assert bad health during on-going monitoring if GPS
#         is not present or has bad quality
#   NO  - LocataLite can assert good health during on-going monitoring even
#         if GPS is not present or has bad quality
#
# SelfSurvey_movement_asserts_bad_health:
#
#   Set whether detecting movement is cause for setting the LocataLite health
#   as bad in the NAV data.
#
#   YES - LocataLite will assert bad health if movement is detected
#   NO  - LocataLite can assert good health even if movement is detected
#
SelfSurvey_GPS_rqd_to_load_nv_posn = YES;
SelfSurvey_GPS_rqd_during_full_survey = YES;
SelfSurvey_GPS_rqd_during_monitoring = YES;
SelfSurvey_movement_asserts_bad_health = YES;

#####
# Set the vertical offsets between the GPS antenna and the LocataLite
# antennas in metres.
#
# The GPS antenna should be above all LocataLite antennas and the offsets
# given as positive numbers. e.g. 0.015
#
# Defaults:
# Tx1 = 0.200
# Tx2 = 2.200
# Rx  = 0.350
#
# Units: [metres]
#
SelfSurvey_Tx1_offset = 0.200;
SelfSurvey_Tx2_offset = 2.200;
SelfSurvey_Rx_offset  = 0.350;
```

```
#####
# Comms Configuration
#####

#####
# Serial Port Assignment:
#
# Each of the two external serial ports (COMPORT_1, COMPORT_2) may be
# assigned one of the following values:
#
# IO_PORT_NONE      - no i/o assigned to this serial port
# IO_PORT_LBMP      - input and output are LBMP messages
# IO_PORT_ASC       - input user ascii commands, output is ASC measurement data
# IO_PORT_ASC_MET   - input is nmea from an external met unit, output is ASC
#                   measurement data and requests for met data
# IO_PORT_GPS       - input is nmea from an external gps unit, output is requests
#                   data from the gps unit
# IO_PORT_MET       - input is nmea from an external met unit, output is requests
#                   for met data
#
# IMPORTANT: It is not permissible to assign the same protocol to two ports.
#
COMPORT_1 = IO_PORT_ASC;
COMPORT_2 = IO_PORT_GPS;

#####
# Serial port baud rate:
#
# The supported rates are:
#
# 9600
# 19200
# 38400
# 57600
# 115200
# 230400
#
COMPORT_1_BAUD = 115200;
COMPORT_2_BAUD = 115200;

#####
# LBMP message scheduling
#
# LBMP message scheduling provides the ability for a user to define a set of
# desired messages to be output at various rates.
#
# The format of this element is:
#
#   LBMP_schedule_message = <msg_id>, <rate>
#
# Where:
#
#   <msg_id> : one of the set of LBMP message IDs (see the LBMP ICD for
#             a list of supported message IDs)
#
```

```
# <rate> : MEAS_RATE : output message at the measurement rate
#         NAV_RATE : output message at the nav solution rate
#         ON_UPDATE : output message whenever the underlying data changes
# <period_in_seconds> : a period in seconds (treated as a float)
#
# A maximum of 16 LBMP_schedule_message entries are allowed. Only one rate
# per message ID is accepted. If multiple requests for the same message ID
# are provided only the final request will apply.
#
# It is up to the user to schedule any desired messages, no LBMP messages
# are scheduled to output by default.
#
# These elements only apply when IO_PORT_LBMP is selected for at least one
# COM port.
#
LBMP_schedule_message = 1001, 1.0;
LBMP_schedule_message = 2001, 5;
LBMP_schedule_message = 6101, ON_UPDATE;
LBMP_schedule_message = 7001, ON_UPDATE;
LBMP_schedule_message = 8001, ON_UPDATE;
LBMP_schedule_message = 9001, ON_UPDATE;
LBMP_schedule_message = 9002, ON_UPDATE;
LBMP_schedule_message = 9003, ON_UPDATE;
LBMP_schedule_message = A001, 60;

#####
# Specify the initial time and date in the following format:
#
# Date = YYYY/MM/DD
# Time = HH:MM:SS
# GPS/UTC offset = [offset in seconds]
# - where UTC_time = GPS_time - offset)
#
Date = 2014/05/14;
Time = 02:44:40;
GPS_UTC_Offset = 16;

#####
# Operating_Region
#
# Set the region in which this LocataLite is operating for the purposes of
# spectrum management. This parameter will be used with the Frequency_Plan
# parameter to limit the maximum output power of the signals that are
# broadcast from the LocataLite.
#
# # | Location |
# ----|-----|
# 1 | US (FCC compliant, default) |
# ----|-----|
#
Operating_Region = 1;
```



```
#####
# Frequency_Plan
#
# Set the carrier frequencies to be used by the system. Default is plan '2'.
# This single parameter defines the frequencies for all four signals from the
# LocataLite. It is critical that this parameter be configured consistently
# by all LocataLites and Rovers across a LocataNet.
#
# # | Carrier 1 | Carrier 2 |
# ----|-----|-----|
# 1 | S02 | 2411.211 MHz | S62 | 2472.591 MHz |
# 2 | S02 | 2411.211 MHz | S52 | 2462.361 MHz |
# ----|-----|-----|
#
Frequency_Plan = 1;

#####
# LT_Board_Revision
#
# Specify which revision of transmitter hardware is present in this LocataLite.
# This information is used to determine the correct settings to achieve the
# requested output power. In future the LocataLite will be able to detect
# the hardware revisions itself and this parameter will be removed
#
# There are currently two supported boards:
#
# 1 - the original tx board
# 2 - the new tx board produced in 2012
#
# (Note that updated transmitter boards may be retrofitted to first generation
# systems)
#
LT_Board_Revision = 2;

#####
# LT_Tx_Power_dBm[]
#
# Set the transmit power for each of the four signals from this LocataLite.
# The powers are set in units of dBm with a special value 'max' which will
# use the maximum allowed power for the given operating region and frequency
# plan.
#
# Range : -49 to +20 dBm
# Step size : 1 dB
# Special cases : max
#
# Restrictions:
#
# (a) The max Tx power depends on the region in which the LocataLite is
# operating according to the 'Operating_Region' parameter and the
# frequency plan that has been selected. If a value higher than
# the maximum allowed power for that region and frequency is
# selected the LocataLite will limit the power to the maximum
# allowed value for that region and frequency.
#
# (b) Note that it is important to avoid setting too great a difference
```

```
#      between the transmit powers for two different transmit signals.
#      Doing so can introduce a persistent near/far effect where the stronger
#      signal causes interference on the weaker signal. The maximum transmit
#      power difference allowed between any two signals is therefore
#      restricted to 10dB.
#
# Channel map:
#
# 0 --> A
# 1 --> B
# 2 --> C
# 3 --> D
#
LT_Tx_Power_dBm[0] = max;
LT_Tx_Power_dBm[1] = max;
LT_Tx_Power_dBm[2] = max;
LT_Tx_Power_dBm[3] = max;

#####
# Network Longest Edge (m)
#
# This value defines the longest range between any two LocataLites in the
# Locata network.
#
# Note: this parameter is only used by a MASTER or MASTER_WITH_GPS_SYNC
#       LocataLite. SLAVE LocataLites will ignore the configuration file
#       value as it is transmit to them by their TimeLoc reference LocataLite.
#
Network_Longest_Edge = 2500.0;

#####
# Type of GPS Receiver to which Master will synchronise
# Note: Set to None if GPS synchronisation is not required
#
# Options:  uTevo, TSC4400, JPS, None
#
# Note: this parameter will be ignored for all LocataLite types other than
#       MASTER_WITH_GPS_SYNC
#
GPS_Receiver_Type = uTevo;

#####
# Met Station polling configuration.
# 0 - Do Nothing
# 1 - Poll the Met Station for data
# 2 - Configure the Met Station to output data we understand at boot (default)
#
met_station_polling = 1;
```

```
#####  
# Settings related to using the Leica TPV message for self-survey  
#  
# Used to determining if the message includes valid position or not  
# Pls refer to the Leica owi message specs  
  
# Latency in miliseconds (less than)  
Msg_Latency = 400;  
  
# Number of successful searches completed less than  
Num_Searched = 11;  
  
# Quality of latitude (less than) in metres  
lat_quality = 0.03;  
  
# Quality of longitude (less than) in metres  
lon_quality = 0.03;  
  
# Quality of height (less than) in metres  
height_quality = 0.05;  
  
# Speed over ground less than in knots  
Sog = 0.1;  
  
# HDOP less than  
HDOP = 4;  
  
# TDOP less than  
TDOP = 5;  
  
# VDOP less than  
VDOP = 6;  
  
# Number satellites in Pos Computation more than  
sats_used = 5;  
  
#####  
# Logging  
#####  
  
# Enable measurement logging. This allows messages generated in the given  
# protocol to be saved to internal flash memory.  
#  
# Valid options are:  
#  
# OFF : nothing is logged to file (default)  
# ON  : the application selects which port gets logged (LBMP preferred)  
# ASC : the ASC port output will be logged to file  
# LBMP : the LBMP port output will be logged to file  
#  
Measurement_Log = OFF;
```