SL500 Series
SIM
SirettaLINK
www.siretta-link.com

# SL500 Series

LTE Cat 1 / 3G (UMTS) / 2G (GSM)

LTE Cat M / LTE Cat NBIoT / 2G (GSM)

Modem Series for use with SirettaLINK Management Portal

## Hardware Manual

Rev 1.4

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# Introduction

This document is intended to provide guidance when adding a modem from the SL500 modem series to your system.

The SL500 is a series of LTE Cat 1 / 3G (UMTS) / 2G GSM and LTE Cat M / LTE Cat NB IoT / 2G (GSM) modems, an advanced range of high performance modems developed for easy integration into existing systems and to be used alongside SirettaLINK Management Portal.

This document discusses the modems states and modes of operation in addition to the electrical characteristics of the modems interfaces.

# About Siretta

Siretta is a wireless communications company located in Reading, United Kingdom manufacturing & supplying industrial IoT products since the early 2000s.

Siretta’s product portfolio is made up of:

» Antennas, plus their associated Cable Assemblies & Adapters,

» Cellular Network Analysers

» Industrial Modems

» Industrial Routers

» Associated Cloud management

Siretta supplies products directly and via a worldwide network of distributors, into numerous markets and applications across the globe.

Siretta’s distribution partners range from industrial IoT specialists through to global catalogue organisations.

Whether “off the shelf” or custom solutions are required, Siretta has a wide portfolio of products to fit many types of application.

Siretta’s extensive knowledge and experience in the wireless market allows support of a wide range of customer applications, focusing on frequencies between 150 MHz to 6 GHz. These encompass modems, routers and antennas for:

» Cellular technologies: GSM/GPRS/3G/UMTS/4G/LTE & 5G NR, plus LTE CAT 1, LTE CAT M & LTE CAT NBIoT

» Global positioning: GPS/GNSS

» WLAN/Wi-Fi

Whilst providing the above products for the industrial cellular market, Siretta also has a number of antennas to cover applications for:

» Bluetooth, Zigbee, ISM band, LoRa and Sigfox

With a heavy emphasis on design, Siretta has a team of dedicated Engineers and Product managers, who specialise in wireless applications.

Siretta continually makes significant investment in R&D endeavouring to provide customers with market leading, future-proofed, wireless solutions. Siretta works closely with many technology partners to stay at the forefront of industrial IOT.

# General Description

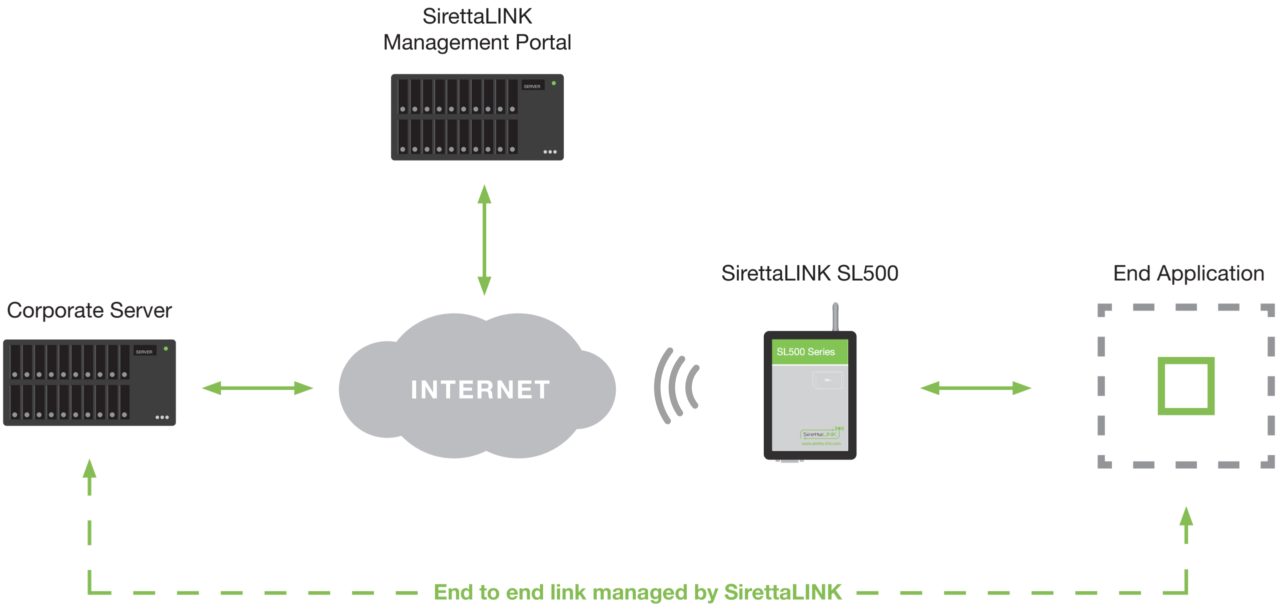
The Siretta SL500 modem series is used to create a data connection over a cellular network between a remote application and a server. Setup and management of the SL500 modem series is achieved by using a modern cloud-based management portal - SirettaLINK Management Portal - king deployment and remote management a simple task. This system works with any data enabled SIM card. A fixed IP address SIM is not required to use the SL500 modem.

The SirettaLINK Management Portal provides the user with an easy-to-use web-based interface, accessible on any device with a web browser. This enables:

- Configuration of server address, ports, time out settings etc for the server the SL500 modem is connected to, and the serial port connection to the attached hardware
- Overview of data usage and signal strength history, network used, location and many more operational parameters
- Auditing tools to allow the tracking of configuration changes made

Conceptually, this diagram below shows what SirettaLINK does:

Figure 1. Conceptual diagram of SirettaLINK


SirettaLINK
Management Portal
Corporate Server
INTERNET
SirettaLINK SL500
SL500 Series
End Application
End to end link managed by SirettaLINK

The SirettaLINK Management Portal is used to configure, monitor and control all SL500 modems deployed by a user – it is not designed as the server for end user application data.

The SL500 modem uses an embedded STM32F405 Arm® Cortex® M4 core processor to implement this functionality. This runs an application that connects the SL500 modem to the SirettaLINK Management Portal using an encrypted link, where it obtains all the configuration information required for ongoing use and posts operational data. This application performs the following tasks:

» Periodically pushes operational data of the SL500 modem to the SirettaLINK Management Portal

» Pulls configuration data from the SirettaLINK Management Portal

» Maintains the Internet connectivity of the SL500 modem, using minimum data techniques learnt by Siretta over the 20 years that they have been a vendor in the cellular market

## Features

» No AT Command knowledge needed or used

» Simple setup using GUI based tools

» Cloud based updates of the SL500 modem configuration and software

» Cloud based monitoring of deployed SL500 modems, allows you to track:

- Uptime history
- Signal strength history
- Data usage history
- Network assigned IP address
- Position
- Connection Technology
  2G (GSM) / 3G (UMTS) / LTE Cat 1 / LTE Cat M / LTE Cat NBIoT

» Cloud based network tariff recommendations based on historical usage

» Cloud based audit history of configuration changes

» Cloud based configuration profiles make cloning of settings for mass deployment or post deployment changes easy

» 3 General Purpose input pins whose state is tracked on the SirettaLINK Management Portal

» API for integration of the SirettaLINK Management Portal with third party applications

## SL500 Models

### SL500-LTEM (GL)

- Optimised for IoT networks
- Worldwide frequency band support
- LTE Cat M 1 / NB1 support
- 2G EGPRS fallback when LTE is unavailable
- Data rates up to 230.4 kbps:
    - 230.4 kbps upload, 230.4 kbps download (LTE Cat M1)*
    - 62.5 kbps upload, 21 kbps download (LTE Cat NB1)*
    - 230.4 kbps upload, 230.4 kbps download (EGPRS)*

(All models include an IPv4/IPv6 stack for network connectivity)

### SL500-LTE1 (EU)

- Optimised for LTE networks
- European frequency band support
- LTE Cat 1 support
- 2G and 3G fallback when LTE is unavailable
- Data rates up to 230.4 kbps (limited by RS232 interface):
    - 230.4 kbps upload, 230.4 kbps download (LTE Cat 1)*

(All models include an IPv4/IPv6 stack for network connectivity)

*All upload and download speeds are those supported by the SL500 modem. LTE Cat M1, EGPRS and LTE Cat 1 are limited by the speed of the RS232 interface of the SL500 modem. Actual speeds achieved will be dependent on the capabilities of the network cell connected to, any network congestion, and the radio link quality.

## Specifications

Table 1. Specifications of the SL500 series modems

| | SL500-LTEM (GL) | SL500-LTE1 (EU) |
|---|---|---|
| 2G frequency band:* | B2, B3, B5, B8 | B3, B8 |
| 3G frequency band:* | N/A | B1, B3, B8 |
| 4G frequency band:* | B1, B2, B3, B4, B5, B8, B12, B13, B18, B19, B20, B26, B28 | B1, B3, B7, B20, B28A |
| Dimensions: | 93 x 67 x 28 mm (exlcuding protruding antennas) | |
| Weight: | 92 g (excluding antenna, SIM card and packaging) | |
| Supply voltage: | 6 - 42 V | |
| Operating temperature: | -40 - +85 °C | |
| Storage temperature: | -40 - +85 °C | |
| Humidity range: | 20 to 85% RH non-condensing | |
| Antenna connector: | SMA Female | |

*See table overpage for full detail of frequency bands available.

## Frequency Bands

Table 2. GSM/2G, UMTS/3G, LTE/4G network support

| Band | Frequency | Support | SL500-LTEM (GL) | SL500-LTE1 (EU) |
|---|---|---|---|---|
| B1 | 2100 MHz | IMT | ✓ | ✓ |
| B2 | 1900 MHz | PCS | ✓ | × |
| B3 | 1800 MHz | DCS | ✓ | ✓ |
| B4 | 1700 MHz | AWS-1 | ✓ | × |
| B5 | 850 MHz | Cellular | ✓ | × |
| B7 | 2600 MHz | IMT-E | × | ✓ |
| B8 | 900 MHz | Extended GSM | ✓ | ✓ |
| B12 | 700 MHz | Lower SMH | ✓ | × |
| B13 | 700 MHz | Upper SMH | ✓ | × |
| B18 | 850 MHz | Lower 800 | ✓ | × |
| B19 | 850 MHz | Upper 800 | ✓ | × |
| B20 | 800 MHz | Digital Dividend | ✓ | ✓ |
| B26 | 850 MHz | Extended Cellular | ✓ | × |
| B28 | 700 MHz | APT | ✓ | × |
| B28A* | 700 MHz | APT | × | ✓ |

*B28A is a subset of B28 using the lower duplexer frequencies (Tx : 703-733 MHz / Rx : 758-788 MHz)

## Standard Hardware Interface

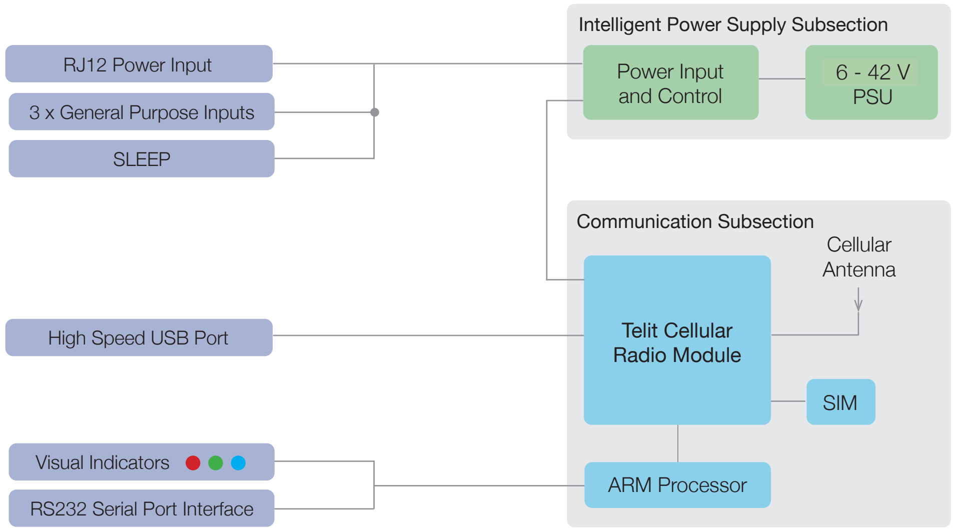
The SL500 modem series comes complete with the following interfaces:

- 1 x RS232 serial port interface for direct serial connection to module (9 wire interface)
- 1 x RJ12 power connection with 2 power lines (6 - 42 V) and 4 input interfaces
- 1 x SMA female cellular antenna connector
- 1 x SIM card reader (push-push)
- 3 x external LED status indicators (Red, Green, Blue)
- 1 x HS USB port
- Radio options:
  - SL500-LTE1 (EU): 4G (LTE Cat 1) / 3G (UMTS) / 2G (GSM)
  - SL500-LTEM (GL): 4G (LTE Cat M1) / 4G (LTE Cat NB1) / 2G (GSM)

## System Diagram

The SL500 series is a versatile range of modems offering multiple communication channels and interfaces to connect into other systems. The system diagram below gives a visual representation of the SL500 interfaces available to the user and shows the various subsections which make up the complete SL500 modem.

Figure 2. SL500 modem block diagram


Intelligent Power Supply Subsection
RJ12 Power Input
3 x General Purpose Inputs
SLEEP
Power Input and Control
6 - 42 V PSU
Communication Subsection
Cellular Antenna
High Speed USB Port
Telit Cellular Radio Module
SIM
Visual Indicators
RS232 Serial Port Interface
ARM Processor

Download Latest Edition

## Ordering Information

SL500 - XXXX (XX)

**Modem Identifier**

SL500 = Siretta Low Power Modem

**Product Module Version**

LTE1 (EU) = 4G (LTE Cat 1) / 3G (UMTS) / 2G (GSM)
LTEM (GL) = 4G (LTE Cat M) / 4G (LTE Cat NB IoT) / 2G (GSM)

## Part Numbers

### SL500 Series Modems

» SL500-LTEM (GL)
Siretta Code: 61157
Low Power Global Coverage 4G (LTE Cat M) / 4G (LTE Cat NB IoT) / 2G (GSM) Modem

» SL500-LTE1 (EU)
Siretta Code: 61158
Low Power European Coverage 4G (LTE Cat 1) / 3G (UMTS) / 2G (GSM) Modem

### SL500 Series Starter Kits

(Download datasheet here)

» SL500-LTEM (GL) Starter Kit
Siretta Code: 61163
SL500-LTEM (GL) CAT M Modem + Accessories

» SL500-LTE1 (EU) Starter Kit
Siretta Code: 61164
SL500-LTE1 (EU) CAT 1 Modem + Accessories

# Dimensions

All dimensions are shown in mm. These drawings are relevant for all SL500 series modems.

Figure 3. Side view showing LEDs and SIM card holder slot

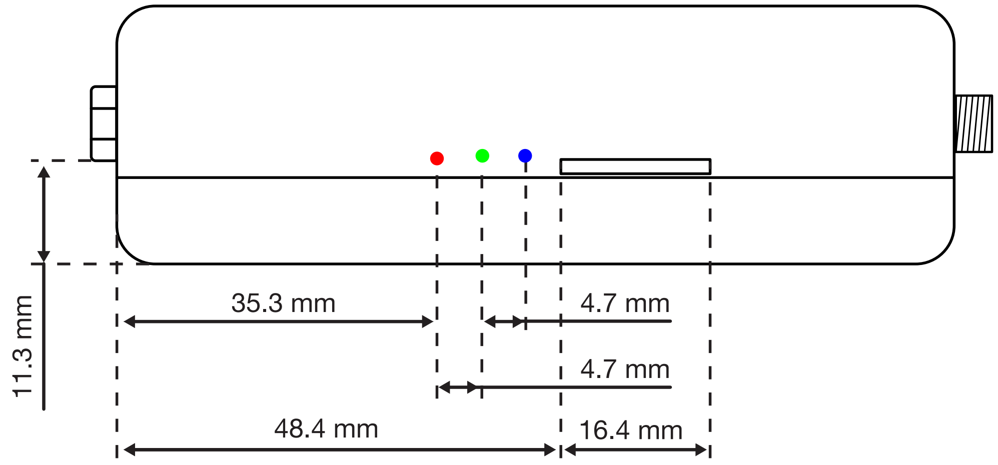

11.3 mm
35.3 mm
4.7 mm
4.7 mm
48.4 mm
16.4 mm

Figure 4. End view showing RS232 and USB connectors

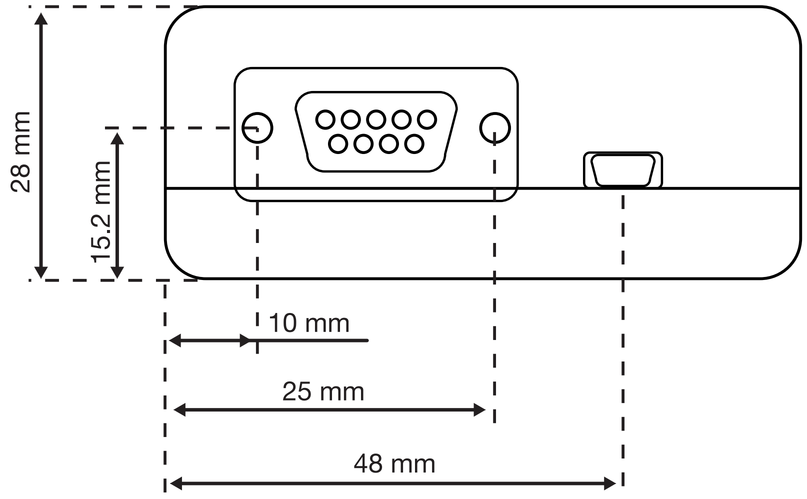

28 mm
15.2 mm
10 mm
25 mm
48 mm

Figure 5. End view showing power and antenna connectors

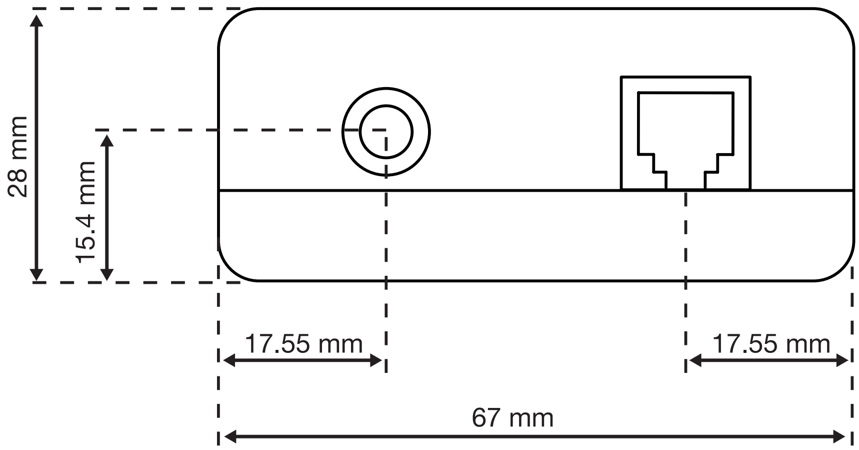
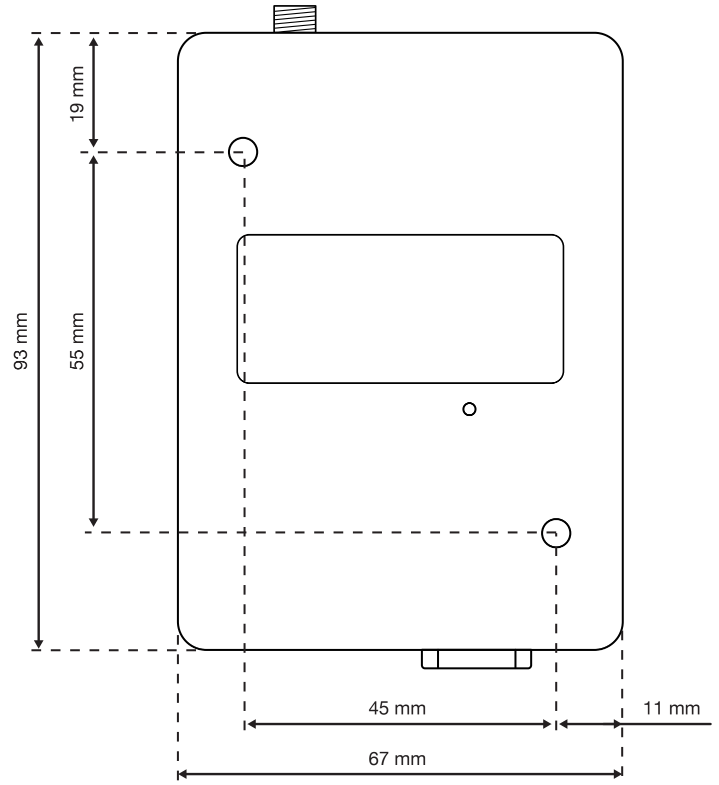

28 mm
15.4 mm
17.55 mm
17.55 mm
67 mm

Figure 6. Bottom view showing position of mounting holes and configuration switch aperture


19 mm
93 mm
55 mm
45 mm
11 mm
67 mm

Two mounting holes are shown. These are suitable for M3 pan/button/round head bolts, inserted through the top of the SL500 modem. Normally the entry to these holes is concealed by the product label. The flange retaining the head of the bolt is at a depth of 14mm.

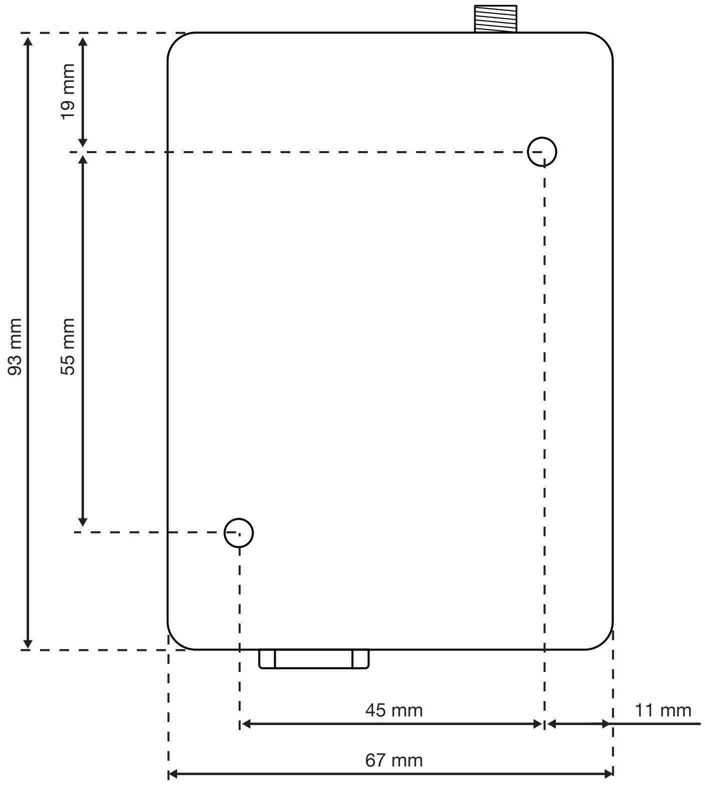


**Figure 7.** Top view showing positions of mounting holes

# SL500 Series Images

Figure 8. SL500 Modem - Front View

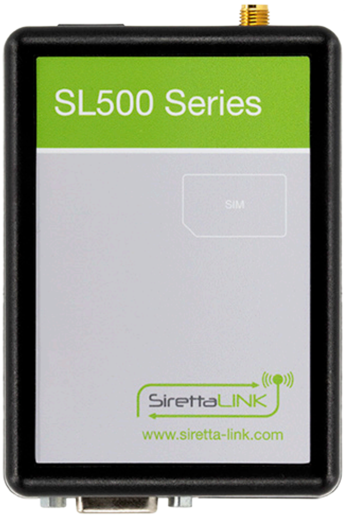

SL500 Series
SIM
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Figure 9. SL500 Modem - 3D View

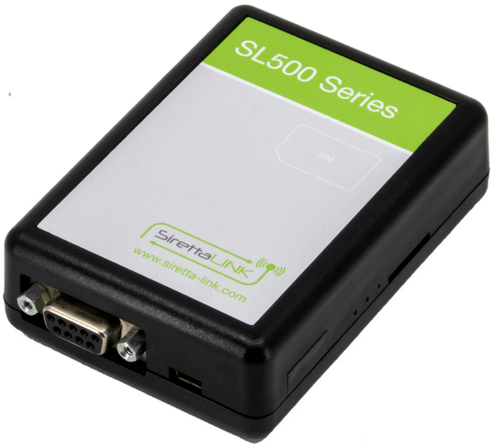

SL500 Series
SIM
SirettaLINK
www.siretta-link.com

Figure 10. SL500 Modem - RS232 and USB Ports

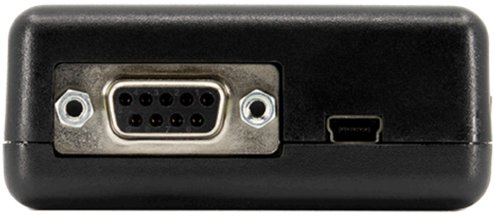
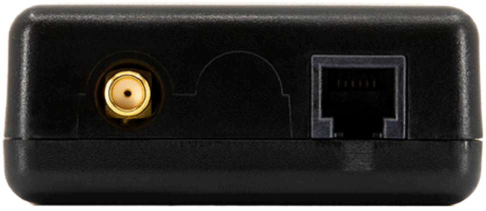


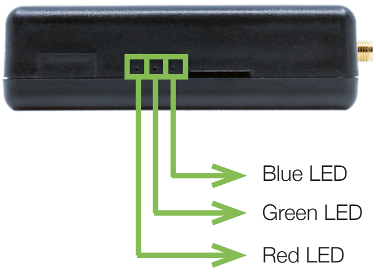
Figure 11. SL500 Modem - Antenna and Power Connector



# LED Indicators

To debug your modem connection status in the field, the SL500 modem uses a number of LED error codes to indicate its connection states. The Red, Green and Blue LED's all refer to different elements of the system which are described in more detail below. Monitor each LED colour flash code in isolation to work through the device status.

Figure 12. SL500 LED's



## Bootload Status (Alternating Green and Blue)

Bootloader mode allows you to update the SL500 modem software, cellular module firmware and configure SIM APN settings using the SirettaLINK Configuration Tool.

## Cellular Registration Status (Red LED)

The Red LED indicates the registration status of the cellular connection. If the SL500 modem is not registered to the cellular network, it is not possible for the modem to communicate to the SirettaLINK Management Portal or the configured end equipment.

Table 3. Red LED status

| Status | Flash Code | Description |
|---|---|---|
| Connecting | Solid On | Not registered to cellular network |
| Connecting | Flash (1Hz) | Registered to cellular network |
| Optimum | Flash (1Hz) | Connected to network |

## SirettaLINK Registration Status (Green LED)

The Green LED indicates the connection status of the SirettaLINK Management Portal. If the SL500 modem is able to sync correctly to the SirettaLINK Management Portal, the LED is solid on. The Green LED also indicates the SL500 modem power on sequence.

Table 4. Green LED status

| Status | Flash Code | Description |
|---|---|---|
| Connecting | Flash (4Hz) | Initialising modem |
| Connecting | Flash (3Hz) | Registering to network |
| Connecting | Flash (2Hz) | Obtaining IP address |
| Connecting | Flash (1Hz) | Connecting to server |
| Connecting | Solid On | Synchronised to SirettaLINK Managemental Portal |
| Optimum | Solid On | Connected and synchronised |

## Server Registration Status (Blue LED)

The Blue LED indicates the connection status of the client defined server. If the SL500 modem is able to connect to the client's defined server, the LED is solid on. The Blue LED also indicates connectivity error codes.

Table 5. Blue LED status

| Status | Flash Code | Description |
|---|---|---|
| Connecting | Flash (4Hz) | Initialising modem |
| Connecting | Flash (2Hz) | Online modem state |
| Connecting | Flash (1Hz) | Idle waiting state |
| Connecting | Solid On | Connected to client server |
| Error | Pulse (1 short - 1 long) | Connection failure |
| Error | Pulse (1 short - 2 long) | Local disconnect |
| Error | Pulse (1 short - 3 long) | Remote disconnect |
| Optimum | Solid On | Connected and communicating |

# Interfaces

## RS232 Serial Port Interface

This connector provides a serial RS232 data communication between the SL500 modem and the connected equipment. Unless in configuration mode, all traffic to and from the RS232 serial port is application data that will be carried over the cellular communication link created by the SL500. The SL500 modem is a DCE device (Data terminating). All pins in the 9-way D type connector are electrically connected inside the modem.

**Figure 13.** RS232 serial port connector

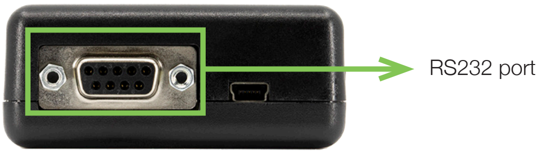


**Figure 14.** RS232 pin numbering

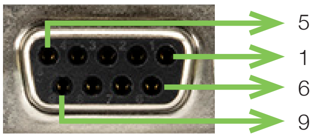


**Table 6.** Pin usage

| Pin | Name | Usage | Direction |
|---|---|---|---|
| 1 | DCD | Data Carrier Detect – DCE is receiving data from remote DCE | OUT |
| 2 | RXD | Received Data – data from DTE to DCE | OUT |
| 3 | TXD | Transmitted Data – data from DTE to DCE | IN |
| 4 | DTR | Data Terminal Ready – DTE is ready to operate | IN |
| 5 | GND | Ground | IN |
| 6 | DSR | Data Set Ready – DCE is ready to operate | OUT |
| 7 | RTS | Request to Send - hardware flow control, DTE requests to send | IN |
| 8 | CTS | Clear to Send - hardware flow control, DCE is ready to receive | OUT |
| 9 | RI | Ring Indicator - indicates the incoming calls | OUT |

## Supported RS232 Optional Parameters

### Baud Rates

- 2400
- 4800
- 9600
- 19200
- 38400
- 57600
- 115200
- 230400

### Data Bits

- 7
- 8

### Stop Bits

- 1
- 2

### Parity

- None
- Odd Even

### Flow Control

- None
- Hardware

9-Way RS232 connector compliant with TIA-232-F with all signals connected. Maximum data rate 230.4 kbps (with a load of 3k Ω, 1000 pF). All characteristics are over the operating temperature range of -40 to +85 °C unless stated otherwise.

Table 7. RS232 transmitter electrical characteristics

| Transmitter Parameter | Conditions | Min | Typ | Max |
|---|---|---|---|---|
| Output voltage swing | 3k Ω load to ground | ±5.0 V | ±5.4 V | |
| Output short circuit current | | | ±35 mA | ±60 mA |

Table 8. RS232 receiver electrical characteristics

| Transmitter Parameter | Conditions | Min | Typ | Max |
|---|---|---|---|---|
| Voltage range | | -25 V | | 25 V |
| Threshold low | | 0.6 V | 1.2 V | |
| Threshold high | | | 1.8 V | 2.4 V |
| Hysteresis | | | 0.3 V | |
| Resistance | +25 °C | 3k Ω | 5k Ω | 7k Ω |

## USB Serial Port Interface

This interface is provided only to allow the Embedded Telit radio module to be reprogrammed if necessary. It is not for (and cannot) power the SL500 modem, nor is it to be used to communicate with the SirettaLINK modem in normal operation.

Figure 15. USB Connector

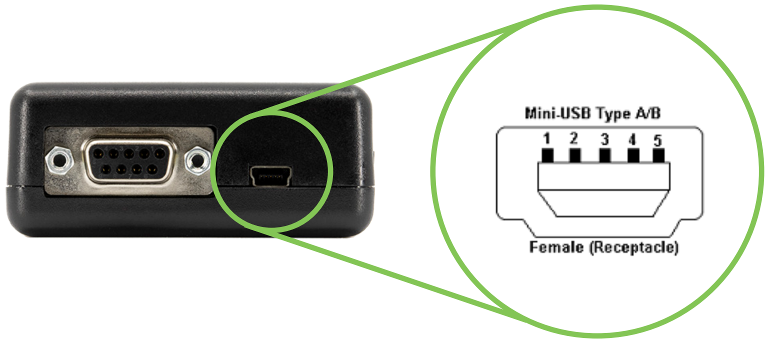


Table 9. Mini USB characteristics

| Parameter | Value |
|---|---|
| Connector | Mini-B |
| USB version | 2.0 high-speed (480 Mbps) interoperable with full speed (12 Mbps) |
| Power consumption | 5 mA maximum taken from VBUS |

This mini-USB type B connector has ESD protection to ±4 kV contact discharge and ±8 kV air discharge. Pins on this connector are shown in the table below.

Table 10. Mini USB Connectors

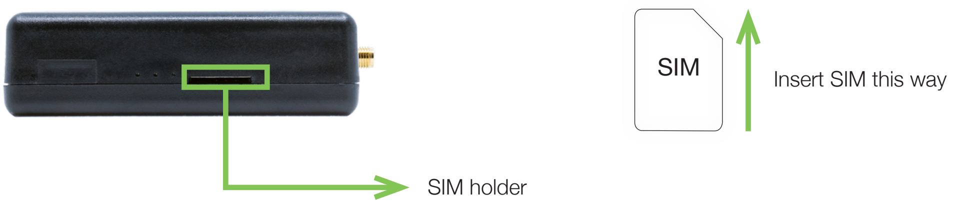
| Pin | Name | Direction | Description | Low Level | Nominal | High Level |
|---|---|---|---|---|---|---|
| 1 | VBUS | IN | USB Power VBUS | 4.75 V | 5 V | 5.25 V |
| 2 | D- | IN/OUT | Data Minus | 4.75 V | 5 V | 5.25 V |
| 3 | D+ | IN/OUT | Data Plus | 4.75 V | 5 V | 5.25 V |
| 4 | - | - | - | - | - | - |
| 5 | GND | IN / OUT | Signal Ground | - | 0 V | - |

# SIM Socket

The SirettaLINK modem will accept any data enabled SIM card. These may be Pay as You Go (PAYG) or Contract, fixed IP address or normal consumer SIM cards.

The SIM card holder is designed to accept a single mini-SIM (2FF) (measuring 25 mm x 15 mm). The SIM card voltages supported are 1.8 V and 3.3 V, meaning that the interface will be compatible with any SIM card manufactured after 1998.

**Figure 16.** SL500 SIM holder



## SIM Requirements

SIM services available for the SL500 series include:

- 2G GSM (850 MHz, 900 MHz, 1800 MHz, 1900 MHz)
- LTE Cat M / NB IoT (700 MHz, 800 MHz, 850 MHz, 900 MHz, 1700 MHz, 1800 MHz, 1900 MHz, 2100 MHz)
- 4G LTE (700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2600 MHz)
- SMS
- GPRS

**Table 11.** SIM card reader characteristics

| Parameter | Value |
|---|---|
| SIM card reader type | Push-Push type with card detection switch |
| SIM card voltage support | 1.8 V and 3 V |
| Durability | 10,000 cycles |
| Insertion force | 7N maximum |

# Configuration Switch

The status of the configuration switch is detected when power is applied. Pressing the switch after power has been applied has no effect. It will take a second or so between applying power and the switch being pressed is detected. Indication that the SL500 modem has detected the configuration switch press is by the blue and green LEDs flashing rapidly alternately. Press the switch using the supplied ‘Siretta Function Pin Tool’.

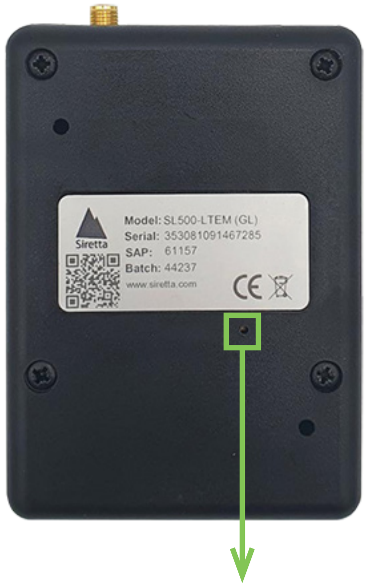
Continuing to press the configuration switch after the switch press has been detected will result in additional events occurring:

- 10 seconds: Network settings (APN etc) will be erased.
- 30 seconds: Account settings will be erased (in addition to the network settings). This is equivalent to a full factory reset.

Indication of settings erased at 10 and 30 seconds is by both green and blue LEDs blinking simultaneously twice.

30 seconds from power up, if the switch press was detected at power up, the SL500 modem will enter configuration mode. When the blue and green LEDs slowly alternate, this indicates that the SL500 modem is in configuration mode and can be used with the configuration tool can to connect to and setup the SL500 modem.

Figure 17. Configuration function boot switch



SL500 modem configuration function boot switch

Figure 18. Siretta Function Pin Tool

# Antenna Connector

The SL500 modem is designed for use with an antenna with a 50 Ohm SMA male antenna. The SL500 modem starter kit comes with an antenna suitable for many applications, but any suitable antenna may be used with the SL500 modem. Siretta also sells an extensive range of antennas suitable for most applications. Any antenna used should be capable of handling at least 2 W of output power.

When selecting an antenna, choose an antenna with a frequency band support that matches the frequencies supported by the SL500 modem and the chosen network operator. Note that different countries and different network operators support different frequency bands. If in any doubt, do a cellular site survey with one of Siretta's cellular network analysers to find which network operators are present and on which frequency bands they operate.

Figure 19. SL500 Antenna Connector

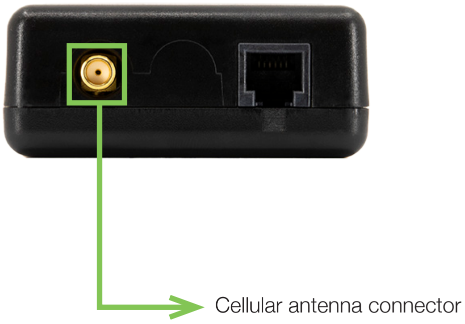


Table 12. SIM card reader characteristics

| Parameter | Value |
|---|---|
| Impedance | 50 Ω |
| Input power | > 24 dBm Average power (LTE Cat 1, M1 & NB1) |
| VSWR absolute max | ≤ 10:1 (limit to avoid permanent damage) |
| VSWR recommended | ≤ 2:1 (limit to fulfil all regulatory requirements) |
| Mating torque | 0.8 to 1.1 N-m |

## Cellular Antenna Connector

A female SMA antenna connector is provided to allow connection of a passive antenna. For optimum performance the antenna assembly connected to this modem is required to have the following characteristics:

- For 2G GSM operation specified operation in the following bands: 850/900/1800/1900 MHz
- For 4G LTE Cat 1, LTE Cat 4, LTE Cat M, LTE Cat NB IoT operation specified operation in the following bands: 700/800/850/900/1700/1800/1900/2100 MHz
- The characteristic impedance on any antenna or cable assembly attached to this modem should be 50 Ohms
- The antenna must be capable of handling a minimum of 2 W output power
- The VSWR should be less than 3:1 to avoid damage to the modem

### Antenna Placement

When in service the antenna should be placed away from electronic devices or other antennas in order to minimise interference. If the SL500 modem is used in a system with other radio devices such as WiFi then good practice is to keep a good separation between the antennas. Industry guidelines are to use at least ¼ wavelength between antennas and certainly not to place an antenna at an exact multiple of a wavelength from each other. However, this will also depend on the polarisation of the antennas and the antenna radiation patterns.

So, what does this mean for the the SL500 modems? Well, the wavelength of an 800 MHz antenna is 37.47 cm and that of a 2600 MHz antenna is 11.53 cm. But also consider the frequency of the other antenna and the cellular frequency used on the installation site. Also ensure that the antenna is not at an exact multiple of the wavelength. All things considered, Siretta suggest 50 cm separation for those who do not want to think about the problem.

### Antenna Connection Cable

If a cable is used to connect the modem to the antenna this cable must be a high quality low loss cable. The cable and any connectors used should have 50 ohms impedance.

# Power

## RJ12 Power Connector

This connector is primarily used for applying DC power to the SL500 modem. It also has some control signals that may be left disconnected if not used. The RJ12 connector used to apply power to the SirettaLINK modem is a polarised connector. As a consequence, no reverse voltage protection has been provided for the SirettaLINK modem. The power supply input V_IN does have ESD protection and is able to withstand a Human Body Model transient pulse of +/-2500 V per JEDEC JESD22-A114.

Figure 20. RJ12 power connector

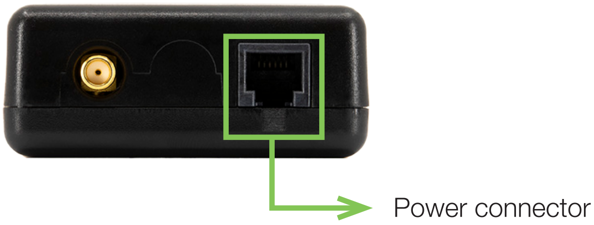


Figure 21. Pin numbering

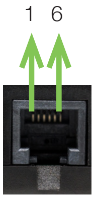


Table 13. Pin usage

| Pin | Name | Direction | Description |
|---|---|---|---|
| 1 | V_IN | Input | Input power (6 V to 42 V; 12 V @ 1A recommended) |
| 2 | SLEEP | Input | SL500 enters a sleep mode while in a high state |
| 3 | GPI3 | Input | General Purpose Input 3 |
| 4 | GPI2 | Input | General Purpose Input 2 |
| 5 | GPI1 | Input | General Purpose Input 1 |
| 6 | GND | Input | Ground |

### V_IN

When connecting and registering with the network, power consumption will be at a maximum and the changes in current can be rapid. This can cause problems for some power supplies which may not be able to respond quickly to the changes in current. For this reason, Siretta recommends using a 12V, 1A power supply so that any voltage drops due to poor regulation will not affect the SL500 modem operation.

### SLEEP

Pulling this pin high will put the SL500 modem into a sleep mode. This puts the SL500  modem into its lowest power mode. In this state the cellular radio will be powered off, and the unit will therefore not be able to communicate with the SirettaLINK Management Portal and the RS232 interface will not work. This pin has an internal 47K Ohm pull-down resistor. If unused, this pin should be left disconnected or connected to ground.

### GPI1, GPI2, GPI3

These pins are general purpose input pins whose logic level state is passed to the SirettaLINK Management Portal. They have internal 47K Ohm pull-down resistors. If unused, it is recommended to leave these pins disconnected for minimum power consumption.

## Power Supply Requirements

All characteristics are over the operating temperature range of -40 to +85 °C unless stated otherwise.

All signal input pins have an internal 47K Ohm pull down to ground, so it is acceptable to leave them disconnected if unused. This is their inactive state.

Table 14. Signal input pin parameters (GPI1, GPI2, GPI3)

| Name | Conditions | Min | Max |
|---|---|---|---|
| Maximum input voltage | | | 42 V |
| Input threshold low | | | 0.25 V |
| Input threshold high | | 1.75 V | |
| Input resistance | +25 °C | 23.5k Ω | 47k Ω |

## Current Consumption

All power consumption figures are with the SL500 modem powered from a 12 V power source, 25 °C ambient temperature, using the default profile. Current measurements are average values measured over a minute after the SL500 modem has registered onto the cellular network and established data connections to the SirettaLINK management Portal and application server.

Table 15. SL500 modem current consumption

| Modem State | SL500-LTEM (GL) | SL500-LTE1 (EU) |
|---|---|---|
| SLEEP | TBD | TBD |
| GSM network connection | 43 mA | 39 mA |
| UMTS network connection | NA | 46 mA |
| LTE Cat 1 network connection | NA | 46 mA |
| LTE Cat M1 network connection | TBD | NA |
| LTE Cat NB1 network connection | TBD | NA |

**NOTE:** These are average power measurements. Peak power occurs when the SL500 modem is transmitting to the cellular network and are more than an order of magnitude greater than the average values provided. It is highly recommended to use a power supply capable of supplying 1A to power the SL500 modem to prevent registration problems and the modem from randomly disconnecting from the cellular network.

**NOTE:** The achieved power consumption depends on many things including received signal strength, data rates and the operational mode (client, client maintain, or server).

# SMS Text Messages

Any text message received by the SL500 modem is relayed to the SirettaLINK Management Portal where it can be read. Additionally, when any text message is received, it is checked to see if the message is an SL500 modem command message. If the first word in that message is recognised as the modem's SMS password, then the message is interpreted as a command to the modem, otherwise it is a general-purpose text message that will get relayed to the SirettaLINK Management Portal.

The default SMS password is "connect", but this may be changed in the SirettaLINK Management Portal or by direct text message command to the modem. If changing the password in the portal, please leave sufficient time for the change to reach the modem before using the new password.

Every text message starting with the correct SMS password will elicit a text message in return from the SL500 modem.

## Supported SMS Commands

### Set the SMS password

<current smspassword> smspassword <new smspassword>

### Set the APN and DNS

<current smspassword> gprsapn <apn>[,<username>[,<password>[,<primary DNS>[,<secondary DNS>]]]]

*Comnds in square brackets are optional.*

### Reboot the device

<current smspassword> reboot

### Force a server ping

<current smspassword> ping

# Updating the SL500 Series Modem

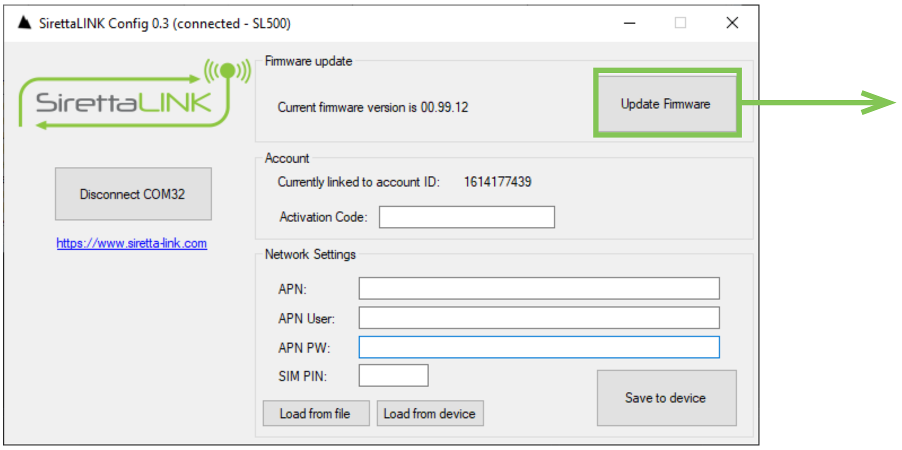
From time-to-time, Siretta may make software updates available for the SL500 modem. Additionally, Telit (the radio module manufacturer used in the SL500 modem) may make firmware updates available for the radio module.

## Updating the SL500 Modem Software

Software is usually updated on the SL500 modem over the air from the SirettaLINK Management Portal. However, the software in the modem can also be updated locally by putting the modem into configuration mode and using the configuration tool that was used to initially connect the modem to the SirettaLINK Management Portal. Please refer to the 'SirettaLINK - Start-up Guide'.

Once connected to the unit, the configuration tool window open.

Figure 22. Configuration tool



SirettaLINK Config 0.3 (connected - SL500)

Current firmware version is 00.99.12

Currently linked to account ID: 1614177439

SirettaLINK
Firmware update
Update Firmware
Account
Activation Code:
Disconnect COM32
https://www.siretta-link.com
Network Settings
APN:
APN User:
APN PW:
SIM PIN:
Load from file
Load from device
Save to device

Click to update firmware

Press the 'Update Firmware' button. This opens Windows Explorer for you to navigate to and select the software to be uploaded. This is supplied by Siretta and will have a file extension of *.lcu.

As soon as the file is selected, the firmware will immediately start updating.

After several minutes, the programming process will complete. On programming completion, the SL500 modem will reboot itself and connect to the network with no user intervention needed. All the LEDs will extinguish for a few seconds while the modem reboots.

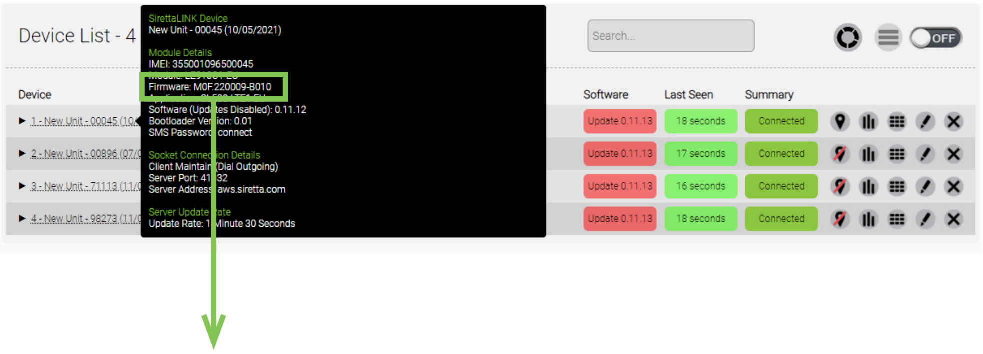
## Updating the Embedded Radio Module

The firmware in the radio module of the SL500 modem can be updated locally by putting the modem into configuration mode. In this mode the processor in the modem will be inactive and will not interact with the radio module which can then be accessed directly using a USB cable plugged into the USB socket of the modem.

Use the USB drivers found on the 'Industrial Modems' tab of the software library found at https://www.siretta.com/software-library/ to be able to correctly connect to the modem using the USB cable.

The firmware currently used in the SL500 modem can be found by going to the SirettaLINK Management Portal, selecting the 'Device' tab, and then hovering the mouse over the device name. A pop-up window will display information about the modem, as seen in the figure below, here you can check the firmware version.

**Figure 23.** Current firmware



Device List - 4

SirettaLINK Device
New Unit - 00045 (10/05/2021)

Module Details
IMEI: 355001096500045
Firmware: M0F.220009-B010
Software (Updates Disabled): 0.11.12
Bootloader Version: 0.01
SMS Password: connect

Socket Connection Details
Client Maintain (Dial Outgoing)
Server Port: 41 32
Server Address: aws.siretta.com

Server Update Rate
Update Rate: 1 Minute 30 Seconds

| Device | Software | Last Seen | Summary |
|---|---|---|---|
| ▶ 1 - New Unit - 00045 (10/ | Update 0.11.13 | 18 seconds | Connected |
| ▶ 2 - New Unit - 00896 (07/0 | Update 0.11.13 | 17 seconds | Connected |
| ▶ 3 - New Unit - 71113 (11/0 | Update 0.11.13 | 16 seconds | Connected |
| ▶ 4 - New Unit - 98273 (11/0 | Update 0.11.13 | 18 seconds | Connected |

Firmware version

Use appropriate Telit supplied firmware and firmware update procedures to program the radio via the USB cable. After programming is complete, power cycle the SL500 modem to take it out of configuration mode.

# Installation

## Considerations for Installations Incorporating the SL500 Modem

There are several conditions which need to be taken into consideration when designing your application as they might affect the SL500 modem and its functionality. These are:

Environmental conditions: The SL500 modem must be installed so that the environmental conditions stated such as temperature and humidity are satisfied. Additionally, the electrical specifications must not be exceeded.

Cellular signal strength: The antenna must be placed in a position that ensures sufficient cellular signal strength. To improve signal strength, the antenna should be moved to a more elevated position. Signal strength usually depends on how close the SL500 modem is to the cellular base station. You must ensure that the location at which you intend to use the SL500 modem is within the network coverage area. Degradation in signal strength can be the result of a disturbance from other sources, for example an electronic device in the immediate vicinity.

When the application is operational and connected to the SirettaLINK Management Portal, you can see the received signal strength on the 'Device' tab of the portal.

*Tip: Before installing the SL500 modem you can use an ordinary mobile phone to check the signal strength in the installation location. Siretta also sell cellular signal strength testers (https://www.siretta.com/products/cellular-network-analysers/) which provide a full breakdown of the cellular signals received at the survey location.**

When considering the location for the modem and antenna placement, you must consider received signal strength as well as cable length as long cable runs can attenuate the received signal strength.

Connections of components to SL500 modems: The system integrator is responsible for the final system solution. If external components are incorrectly designed or installed it may cause radiation limits to be exceeded. For instance, improper cable connections or incorrectly installed antennas can disturb the network and lead to modem malfunction.

*Please contact your Siretta representative for more information

**Network and subscription:** Before your application is used, you must ensure that your chosen network provides the necessary telecommunication services. Contact your service provider to obtain the necessary information.

Consider which network technologies are available in your region and the impact this will have on device connectivity. 2G/GSM, 3G/UMTS, LTE Cat 1/4, LTE Cat M and LTE Cat NBIoT all operate in different ways. As a result they all have different advantages and disadvantages and as such may be suited to different applications.

## Power Supply Installations

Use a high-quality power supply with short leads. This ensures that the voltages at the connector pins are within the specified range, especially during the maximum peak current of approximately 2A.

When the modem is powered from a battery or a high current supply, connect a fast 1.25A fuse in line with the positive supply. This protects the power cabling and modem from damage.

## Securing the Modem

Before securing the SL500 modem please take into account the amount of additional space required for the mating connectors and cables that will be used with the SL500 modem in the application.

- Where access is restricted, it may be easier to connect all the cables to the modem prior to placing it in the application.
- Securely attach the SL500 modem to a bulkhead using 2 x M3 (3 mm diameter) pan-head screws (refer to **page 13** for locations).
- Securely attach the SL500 modem using the optional Siretta Modem DIN Rail Adapter mounting bracket (Datasheet available here).

# Safety and Product Care

Please read the information in this section, before you begin your system integration.

## General Precautions

- The SL500 modem is a standalone item designed for indoor use only. For use outside it must be installed in a weatherproof enclosure.
- Do not exceed the environmental and electrical limits as specified.
- Avoid exposing the modem to lit cigarettes, naked flames or to extreme hot or cold temperatures.
- Never try to dismantle the modem. There are no components inside the modem that can be serviced by the user. If you try to dismantle the modem, you will invalidate the warranty.
- The SL500 modem must not be installed or located where the surface temperature of the enclosure may exceed 85 °C.
- All cables connected to the SL500 modem must be secured or clamped, immediately adjacent to the modem's connectors, to provide strain relief and to avoid transmitting excessive vibration to the modem in the installation.
- To protect power supply and to meet the fire safety requirements when the modem is powered from a battery or a high current supply, connect a fast 1.25A use in line with the positive supply.
- Do not connect any incompatible component or product to the SL500 modem.

## SIM Card Precautions

Before handling the SIM card in your application, ensure that you have discharged any static electricity. Use standard precautions to avoid electrostatic discharges.

- When designing a SL500 modem into your application, the accessibility of the SIM card should be considered so that it can be removed or changed.

## Antenna Precautions

If the antenna is to be mounted outside, always consider the risk of a lightning strike. Follow the instructions provided by the antenna manufacturer. In addition, please observe the following:

» Never connect more than one modem to a single antenna. The modem can be damaged by radio frequency energy from the transmitter of another modem.

» With all mobile station equipment, the antenna of the modem emits radio frequency energy. To avoid EMI (electromagnetic interference) you must decide if the application or equipment in the application's proximity needs further protection against radio emission and the disturbances that it might cause. Protection may be provided either by shielding the surrounding electronics or by moving the antenna away from the electronics and external signal cables.

» The modem and antenna may be damaged if either come into contact with ground potentials other than the ground potential used in your application. Beware, ground potentials can vary significantly between hardware platforms.

## Exposure to RF Energy

There has been some public concern about possible health effects of using cellular equipment in close proximity to a person or body. Although research on health effects from RF energy has focused for many years on the current RF technology, research has begun on new radio technologies, such as 5G. After existing research had been reviewed, and after compliance to all applicable safety standards has been tested, it has been concluded that the SL500 modem is fit for use.

If you are concerned about exposure to RF energy, there are several things you can do to minimize exposure. Obviously, limiting the duration of time near a device will reduce your exposure to RF energy. In addition, you can reduce RF exposure by using your modem efficiently by adhering to the following guidelines:

Electronic devices: Most electronic equipment, for example in hospitals and motor vehicles is shielded from RF energy. However, RF energy may affect some malfunctioning or improperly shielded electronic equipment.

Vehicle electronic equipment: Check your vehicle manufacturer's representative to determine if any on board electronic equipment is adequately shielded from external RF energy.

Aircraft: Turn your SL500 modem OFF before boarding any aircraft. To prevent possible interference with aircraft systems, Federal Aviation Administration (FAA) regulations require you to have permission from a crewmember to use your SL500 modem whilst the plane is on the ground. To prevent interference with cellular systems, local RF regulations prohibit using your SL500 modem whilst in the air.

Blasting areas: To avoid interfering with blasting operations, turn your SL500 modem OFF when in a “blasting area” or in areas posted: “turn off two-way radio“. Construction crew often use remote control RF devices to set off explosives.

Potentially explosive atmospheres: Turn your SL500 modem OFF before entering any area with a potentially explosive atmosphere. It is rare, but the SL500 modem or their accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injury or even death.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fuelling areas such as petrol stations, below deck on boats, fuel or chemical transfer or storage facilities and areas where the air contains chemicals or particles, such as grain, dust or metal powders. Do not transport or store flammable gas, liquid or explosives, in the compartment of your vehicle, which contains your SL500 modem or accessories. Before using your SL500 modem in a vehicle powered by liquefied petroleum gas (such as propane or butane) ensure that the vehicle complies with the relevant fire and safety regulations of the country in which the vehicle is to be used.

# Safety Recommendations

## PLEASE READ CAREFULLY

Be sure the use of this product is allowed in the country intended and the environment required. The use of this product may be dangerous and must be used with caution in the following areas:

- Where it can interfere with other electronic devices in environments such as hospitals, airports, aircrafts, etc
- Where there is risk of explosion such as gasoline stations, oil refineries, gas works etc

It is responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product, any mark of tampering will compromise the warranty.

We recommend following the instructions of this hardware user manual for the correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to conform to the security and fire prevention regulations.

The product must be handled with care, avoid any direct contact with the pins because electrostatic discharge may damage the product. The same precautions must be followed for the SIM card installation. Do not insert or remove the SIM when power is applied to the SL500 modem.

The system integrator is responsible for the complete functionality of the final product. Therefore, care must be taken with the external components used with the module, as well as any installation issue.

Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module must be equipped with a suitable antenna with characteristics which match the product requirements.

The antenna must be installed with care to avoid any interference with other electronic devices and must guarantee a minimum distance from the body (20 cm). In case this requirement cannot be satisfied, the system integrator must assess the final product against the SAR regulation EN 50360.

# Conformity Assessment

The SL500 modem conforms to the R&TTE Directive for use as a stand-alone product. If the SL500 modem is installed in compliance with the telecoms installation instructions then no further evaluation is required under Article 3.2 of the R&TTE Directive and no further involvement of an R&TTE Directive Notified Body is required for the final application.

The SL500 modem conforms to the following European Union Directives:

» R&TTE Directive 1999/5/EC (Radio Equipment & Telecommunications Terminal Equipment)

» LVD (Low Voltage Directive) 73/23/EEC and product safety

» Directive 89/336/EEC for conformity for EMC

To satisfy the essential requisite of the R&TTE 99/5/EC directive, the SL500 modem is compliant with the following standards:

» GSM (Radio Spectrum). Standard: EN 301 511 and 3GPP 51.010-1

» EMC (Electromagnetic Compatibility). Standards: EN 301 489-1 and EN 301 489-7

» Include stand-alone spurious emissions to Clause 8.2 of EN 301 489-1.

» LVD (Low Voltage Directive) Standards: EN 60 950

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# Definitions

| Term | Definition |
|---|---|
| 2G | 2nd Generation Mobile Telecommunications |
| 3G | 3rd Generation Mobile Telecommunications |
| 4G | 4th Generation Mobile Telecommunications |
| 5G | 5th Generation Mobile Telecommunications |
| API | Application Programming Interface |
| AT | Attention |
| Cat 1 | LTE Category 1 Network |
| Cat 4 | LTE Category 4 Network |
| Cat M | LTE Category M Network |
| Cat NB IoT | LTE Narrow Band Internet of Things Network |
| CSD | Circuit Switched Data |
| CTS | Clear To Send |
| DC | Direct Current |
| DCD | Data Carrier Detect |
| DSR | Data Set Ready |
| DTR | Data Terminal Ready |
| EGPRS | Enchanced Data rates for GSM Evolution |
| ESD | Electrostatic Discharge |
| GND | Ground |
| GSM | Global System for Mobile Communications |
| GUI | Graphical User Interface |
| IoT | Internet of Things |
| LED | Light Emitting Diode |
| LTE | Long Term Evolution |
| PCS | Personal Communication Services |
| RI | Ring Indicator |
| RS232 | Recommended Standard 232 |
| RTS | Request to Send |
| RX | Receive Signal |
| RXD | Receive Signal |
| SIM | Subscriber Identity Module |
| SMA | Sub Miniature Version A |
| SMS | Short Message Service |
| TXD | Transmit Signal |
| UMTS | Universal Mobile Telecommunications System (Same as 3G) |
| USB | Universal Serial Bus |

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