

**SATEL**

Mission-Critical Connectivity

**SATEL MCCU-20**  
**User Manual**  
**Version 2.4**

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Salo, FINLAND 2024

## RESTRICTIONS ON USE - MODELS WITH SATEL-TR49

The UHF part of **SATEL MCCU-20 radio transceivers equipped with SATEL-TR49 radio module** has been designed to operate on 410-475 MHz and 902-928 MHz frequency bands, the exact use of which differs from one region and/or country to another. The user of a radio modem must take care that the said device is not operated without the permission of the local authorities on frequencies other than those specifically reserved and intended for use without a specific permit.

**SATEL MCCU-20 radio transceivers equipped with SATEL-TR49 radio module** is allowed to be used in the following countries, either on license free channels, or on channels where the operation requires a license. More detailed information is available at the local frequency management authority.

Countries:

EU countries, BR, CA and US.

The frequency band in USA and Canada is 902 – 928 MHz.

In Brazil, the frequency band is limited to 915 – 928 MHz due to the local regulations.



**WARNING - RF Exposure!**

To satisfy FCC and IC RF exposure requirements for mobile transmitting devices, a separation distance of 55 cm or more should be maintained between antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter. FCC regulations allow up to 36 dBm equivalent isotropically radiated power (EIRP). Therefore, the sum of the transmitted power (in dBm), the cabling loss and the antenna gain cannot exceed 36 dBm.

This radio transmitter 2422A-SATELTA37 has been approved by FCC and Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Antenna type	Manufacturer	Antenna model	Maximum gain (dBi)
Omnidirectional	Oy CompleTech Ltd	CA915H-TNC_A	5

**Modification warning statement**

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s) and part 15 of the FCC Rules. Operation is subject to the following two conditions:

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

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

## PRODUCT CONFORMITY

Hereby, SATEL Oy declares that SATEL MCCU-20 radio modems is in compliance with the essential requirements (radio performance, electromagnetic compatibility and electrical safety) and other relevant provisions of Directive 2014/53/EU. Therefore the equipment is labelled with CE-marking.



Para maiores informações, consulte o site da ANATEL [www.anatel.gov.br](http://www.anatel.gov.br)

Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados.

Faixas de frequência brasileiras do SATEL MCCU-20.

### WWAN

Sistema de comunicação	Bandas suportadas
2G (GSM/GPRS/EDGE)	850/900/1800/1900 MHz
3G (WCDMA/HSDPA/HSUPA)	B1/B2/B5/B8
4G (LTE)	B1/B2/B3/B5/B7/B8/B28/B38/B39/B40

### UHF

Frequência (MHz)	Larguras de banda (kHz)	Modulações
406.10 – 413.05	12.5, 25.0	GMSK, 4FSK
423.05 – 430	12.5, 25.0	GMSK, 4FSK
451.00625 – 454	12.5, 25.0	GMSK, 4FSK
456.7875 – 460	12.5, 25.0	GMSK, 4FSK
461.00625 – 463.96785	12.5, 25.0	GMSK, 4FSK
468 – 470	12.5, 25.0	GMSK, 4FSK
915 – 928	230.4	2-GFSK

SATEL MCCU-20 (type SATEL-TA45) meets the requirements of the PTCRB Certification Program ([www.ptcrb.com](http://www.ptcrb.com)), awarded by CTIA Certification, Washington, DC.



## WARRANTY AND SAFETY INSTRUCTIONS

Read these safety instructions carefully before using the product:

- Warranty will be void, if the product is used in any way that is in contradiction with the instructions given in this manual, or if the radio modem housing has been opened or tampered with.
- The radio modem is only to be operated at frequencies allocated by local authorities, and without exceeding the given maximum allowed output power ratings. SATEL and its distributors are not responsible, if any products manufactured by it are used in unlawful ways.
- The devices mentioned in this manual are to be used only according to the instructions described in this manual. Faultless and safe operation of the devices can be guaranteed only if the transport, storage, operation, and handling of the devices is appropriate. This also applies to the maintenance of the products.
- To prevent damage both the radio modem and any terminal devices must always be switched OFF before connecting or disconnecting the serial connection cable. It should be ascertained that different devices used have the same ground potential. Before connecting any power cables, the output voltage of the power supply should be checked.
- Any radio link can be susceptible to external interference and signal degradation by its nature. Because of that, the effects of possible interference mechanisms and the sufficient back-up schemes must be considered in the system design of the critical applications.

**NOTE!**

When selecting a suitable location for the radio modem it must be ensured that no water can get into the radio modem under any conditions. Direct sunlight is also to be avoided. It is not recommendable to install the radio modem on a strongly vibrating surface. Suitable dampening and/or isolation materials should be used in cases where the installation surface will be subjected to vibration.



WARNING – Hot surfaces!



## DESCRIPTION OF THE PRODUCT

SATEL MCCU-20 is a dual-technology RTK transceiver for receiving the GNSS RTK correction data to a moving vehicle with UHF radio based RTK or NTRIP over LTE. The RTK correction data is forwarded over RS-232 serial communication to machine control system. MCCU-20 can operate either in LTE mode or UHF mode. LTE and UHF cannot be enabled at the same time.

In LTE NTRIP mode, SATEL MCCU-20 connects to NTRIP caster. Vehicle's real-time position may be relayed to NTRIP caster for most accurate RTK correction data.

When SATEL MCCU-20 is equipped with SATEL-TR49 radio module, it can operate in 410...475 MHz frequency band and 902...928 MHz license free ISM frequency band.

In the UHF mode, SATEL MCCU-20 provides a transparent data link with many SATEL serial radios and with many other manufacturers' radio modems.

SATEL MCCU-20 can be connected to various communication devices via RS-232 serial data interface. The Deutsch DT series connector provides the pins for data lines (TD, RD), ignition sense and power supply (+9...+30 VDC). Antennas are connected to female TNC connector (UHF antenna) or female SMA connectors (LTE antennas) with longer than 0.2 m antenna cables.

SATEL MCCU-20 transceivers are heavy-duty radio modems that meet the requirements of machine control, smart farming and marine applications. They are built to last dirt, vibration, sand, dust, water and lightning.

SATEL MCCU-20 transceivers have a profound electrical protection - both the power and data lines as well as the antenna interface are surge protected.

SATEL MCCU-20 transceivers are IP67/IP69K rated against ingress of dust and high temperature, high pressure water when all connectors are mated. See more detailed description on chapter "Technical Specifications".

Additionally, SATEL MCCU-20 transceivers, when used on UHF mode, provide RF filtering on GNSS frequencies to work seamlessly in GNSS positioning applications.

SATEL MCCU-20 consists internally of main board and LTE board. SATEL-TR49 radio module is attached to main board, which has CPU, power supplies and protection circuits for the combined data/power connector. Separate LTE board has RF related surge protection circuits, and additionally GNSS band reject filter on UHF RF line, to protect GNSS bands from possible emissions from UHF transmissions.

Depending on the build variant, the LTE board may have either "traditional" 3FF form factor SIM slot or soldered eSIM circuit, or both.

The LTE board has capability for GNSS reception, but that feature is not used in SATEL MCCU-20.

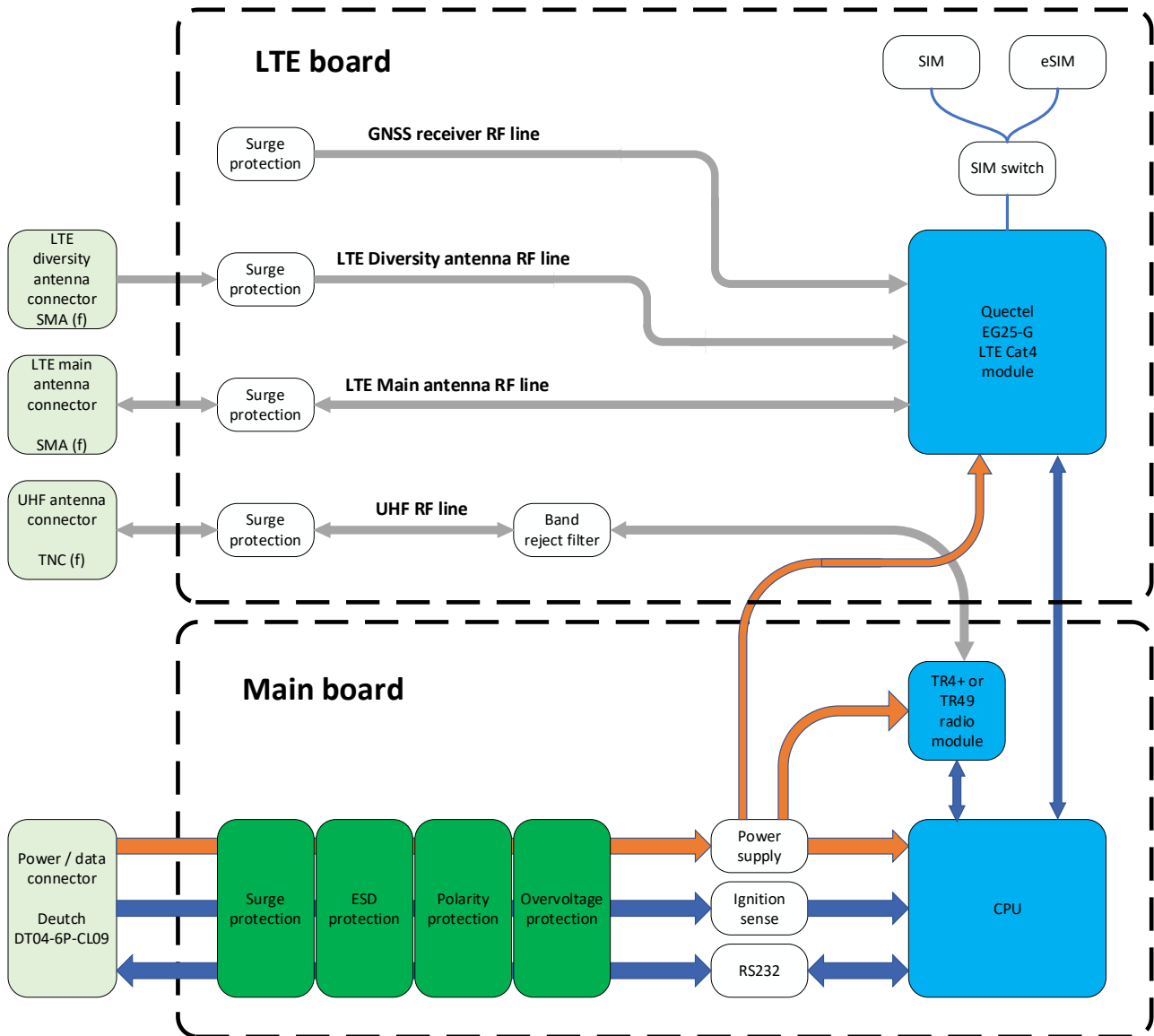


Figure 1: SATEL MCCU-20 block diagram.

# 1. SATEL MCCU-20 TECHNICAL SPECIFICATIONS

## 1.1 General technical specifications

DATA MODEM	
Electrical Interface	Combined data and power connector
Interface Connector	Deutsch DT04-6P-CL09 (Mating connector Deutsch DT06-6S)
Data speed of serial interface	4800 – 460800 bps
Serial interface parameters	8N1, 8N2, 8E1, 8E2, 8O1, 8O2, 7N2, 7E1, 7E2, 7O1, 7O2
GENERAL	
Operating voltage range	+9 ... +30 VDC (-15% / +20% *) **
Ignition sense voltage range	See “Operating voltage range”
Absolute MAX Voltage	+36 V (exceeding the value may damage the device)
Current consumption @ 12V	Typical: * ~200 mA @12 VDC @ NTRIP receive * ~78 mA @12 VDC @ RTK receive * 5-10 mA in Ignition sense off state Max: 2000 mA @12 VDC i.e. 24 W
Temperature Ranges	-20 °C ... +55 °C Type Approval conditions -30 °C ... +70 °C Functional** -40 °C ... +85 °C Storage***
Antenna Connectors	TNC female 50 Ohm, 2xSMA female 50 Ohm
Height above sea level	Max 3000 meters
Construction	Aluminium housing
Size L x W x T / Weight	173.9 mm x 94.8 mm x 46.4 mm / 520 g
Ingress protection	IP67 and IP69K with pure water when all connectors are mated.
COMPLIANT WITH THE INTERNATIONAL STANDARDS	
EMC-requirements	IEC 61000-4-2: 4 kV contact, 8 kV air discharge
Safety Standard	IEC 62368-1
Immunity	EN 301 489-1 v2.2.1: 20 V/m
Ingress	ISO 20653 and IEC 60529
UHF Radio	EN 300 113
Cellular Radio	EN 301 511, EN 301 908-1

\*Note: As a result of new revision of safety standard IEC600001, voltage range is marked to a label with tolerance limits.

\*\* Using the device beyond this region the functionality cannot be guaranteed.

\*\*\* Recommended storage is at dry, room temperature.

## **1.2 Technical specifications, when equipped with SATEL-TR49 module**

Please refer to SATEL-TR49 multimode transceiver module documentation for up-to-date information:

<https://www.satel.com/products/radio-modems/satel-tr49/>

SATEL-TR49 supports UHF band 410-475 MHz and operates on 12.5, 20 or 25 kHz radio channel. The maximum RF output power is 1 W, and it can be set to values 10, 20, 50, 100, 200, 500 or 1000 mW.

Please note, that with UHF radio, local regulations and/or granted radio license conditions regarding available frequencies, used output power and other related parameters must be obtained.

## **1.3 Technical specifications for cellular subsystem**

SATEL MCCU-20 is equipped with LTE Category 4 module, Quectel EG25-G, which supports following cellular bands:

- GSM: B2, B3, B5, B8
- WCDMA: B1, B2, B4, B5, B6, B8, B19
- LTE FDD: B1, B2, B3, B4, B5, B7, B8, B12, B13, B18, B19, B20, B26, B28
- LTE TDD: B38, B39, B40, B41

Maximum Output Power:

- GSM850: Class 4 (33 dBm  $\pm$ 2 dB), GSM850 8-PSK: Class E2 (27 dBm  $\pm$ 3 dB)
- EGSM900: Class 4 (33 dBm  $\pm$ 2 dB), EGSM900 8-PSK: Class E2 (27 dBm  $\pm$ 3 dB)
- DCS1800: Class 1 (30 dBm  $\pm$ 2 dB), DCS1800 8-PSK: Class E2 (26 dBm  $\pm$ 3 dB)
- PCS1900: Class 1 (33 dBm  $\pm$ 2 dB), PCS1900 8-PSK: Class E2 (26 dBm  $\pm$ 3 dB)
- WCDMA: Class 3 (27 dBm  $\pm$ 1/-3 dB)
- LTE-FDD: Class 3 (23 dBm  $\pm$ 2 dB)
- LTE-TDD: Class 3 (23 dBm  $\pm$ 2 dB)

Note, that all bands may not be available in all variants due to local regulations. For CE mark the following cellular bands are supported in European Union region:

- GSM: B3, B8
- WCDMA: B1, B8
- LTE FDD: B1, B3, B7, B8, B20, B28
- LTE TDD: B38, B40

Downlink MIMO i.e., RX diversity antenna is supported on LTE.

For complete information about cellular subsystem, please refer to LTE module manufacturer's pages: <https://www.quectel.com/product/lte-eg25-g>

## 2. CONFIGURATION WITH SL COMMANDS

The configuration of SATEL MCCU-20 can be modified via the serial interface by using specific SL commands (like AT commands in traditional wired modems) that are applicable especially in cases where radio modems are to be integrated seamlessly inside a system behind the integrator's own user interface. SL commands can be used to change e.g., the UHF frequency or addresses, or LTE modem parameters. It is also possible to interrogate the SATEL MCCU-20 to gain information concerning current settings that are in use. The terminal device is either a PC with suitable (terminal) program, or customer specific device using SATEL MCCU-20 services.

An SL command is a one continuous string of characters, which is separated from other data by pauses that are equal or greater than time defined by *Pause length* parameter in the set-up. No extra characters are allowed at the end of an SL command. SL command is properly recognised also in the case when the command string is terminated in <CR> (=ASCII character no. 13, Carriage Return, 0x0d) or <CR><LF> (<LF> = ASCII char. no. 10, Line Feed, 0x0a). If multiple SL commands are sent to the radio modem the next command can be given after receiving the response ("Ok" or "Error") of the proceeding command. In addition, it is recommended to implement a timeout to the terminal software for recovering the case when no response is received from the radio modem.

When the power of a radio modem is switched off the configuration settings of a radio modem always return to stored configuration values, thus resetting any settings changed using SL commands during power on, unless changed settings were stored as new configuration settings with specific SL commands.

The radio modem will acknowledge all commands by returning an **"OK"** (command carried out or accepted) or the requested value, or an **"ERROR"** (command not carried out or interpreted as erroneous) message.

Please contact SATEL to get the latest information of SL commands.

### 2.1 Command mode

Command mode purpose is separate device normal condition from configure condition. When command mode is active, device is looking for known commands from received data.

If the device is in LTE state, the LTE modem will continue operation, but no data will be relayed to client.

If the device is in UHF state, the UHF radio is disabled and therefore no data is transmitted or received by radio.

### 2.11 Entering to command mode - +++

Entering command mode is performed when device gets three (3) '+' characters in a row. Between characters needs to be a delay of pause length. In this way the device can decide that it is required to enter command mode after three correct characters. The first two (2) '+' – characters is transmitted by radio, because the device cannot know at this point whether the last character is correct. After successfully given command mode entering syntax, device responds "OK<CR><LF>". Below is a figure to entering command mode.

**+** <pause length> **+** <pause length> **+**

Delay between characters depends on what is the current serial baud rate. See specifications of three (3) character delays below in "Table 1: Delays with different bit speeds".

### 2.12 Return to data mode - ---

When command mode is active, it is possible to return to normal data mode by giving three (3) '-' –character in a row. Sequence is same as entering to command mode, so there is also needed the delay of pause length between sending the characters. After successfully given exit command mode syntax, device responds "OK<CR><LF>". Below is a description how to exit command mode.

**-** <pause length> **-** <pause length> **-**

Delay between characters depends on what is the current serial baud rate and pause length setting. See example of delays below in "Table 1: Delays with different bit speeds", when e.g., pause length setting is set to three.

**Table 1: Delays with different bit speeds.**

Bit speed bits per second	3-character delay in milliseconds
4800	6.25
9600	3.13
19200	1.57
38400	0.79
57600	0.53
115200	0.27
230400	0.14
460800	0.07

## **3. CONNECTORS AND LED INDICATORS**

### **3.1 Antenna connectors**

Device has three antenna connectors:

- TNC female type antenna connector with impedance of 50 Ohm for UHF. Maximum (and if possible, target) torque when connecting cable is 1.70Nm.
- 2x SMA female type antenna connector with impedance of 50 Ohm for LTE. Maximum (and if possible, target) torque when connecting cable is 1.13Nm.

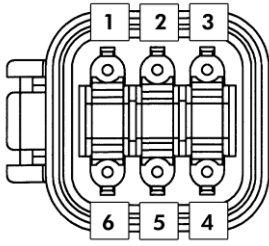
Antennas should always be connected when the power is on. Both LTE antennas need to be connected when using LTE to ensure proper cellular functionality and to ensure ingress protection. Removing the antenna while the transmitter is on may damage the power amplifier inside the transmitter. Antenna cable should be used, and minimum length of the cables is 0.2m.

IP67/IPX9K rating of the device requires that all the antenna connectors are mated. See details from the connector manufacturer's datasheet.

### **3.2 Combined Power/Data connector**

The combined power/data connector is type Deutsch DT04-6P-CL09. Pinout diagram of the connector is shown in Figure 2 and pinout table is shown in

Table 2.



**Figure 2: Deutsch DT pinout diagram.**



**Table 2: Deutsch DT pinout table.**

Pin	Signal	Type/Direction	Description
1	PWR	Power input	Operating voltage +9...+30 VDC
2	IGN	Input	Ignition sense Voltage range is same as operating voltage. Connect to power input line if this feature is not used.
3	-	-	not connected (reserved for future needs)
4	TD	RS-232 input	Transmit Data serial data from terminal equipment to modem
5	RD	RS-232 output	Receive Data serial data from modem to terminal equipment
6	GND	Ground	Signal and chassis ground

Notes:

- IP67/IP69K rating of the device requires the mating connector to be correctly assembled and connected into the device's Deutsch connector. Mating connector type is Deutsch DT06-6S. See details from the connector manufacturer's datasheet.
- GND (pin 6), the metal enclosure, grounding connector and the outer contact of the antenna connectors are galvanically connected.

### **3.2.1 Power supply**

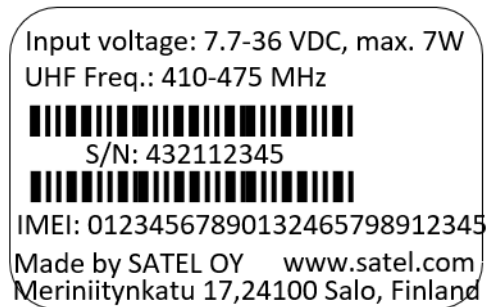
The radio modem will consume electric power when connected to a power supply. The amount of power the modem consumes depends on the operational mode it functions. Highest power consumption is while transmitter is active, and output RF-power level is set to maximum. Even higher power is drawn from the power supply in a moment when the modem is being connected to a power supply. This so-called inrush current can be several times higher than normal current consumption but will last only few tens of milliseconds. For proper operation it is crucial to assure that the power supply has output power rated to higher than the maximum power consumption of the device and that the power supply can handle short inrush currents properly.

As an increased safety feature, it is recommended to add a fuse between the power supply and the modem. This assures that both, the device and the power supply, is protected against over current situations. Recommended fuse size is 2 Amps.

SATEL MCCU-20 nominal voltage range is: +9.0 ...+30.0 VDC (-15% / +20%\*)

\*Note: As a result of new revision of safety standard IEC60001, voltage range is now marked with wider tolerance limits. Maximum and minimum operating voltages are +7.7 V and +36.0 VDC.

Operating voltage range of SATEL MCCU-20 is marked to a side of the housing as in Figure 3:



**Figure 3: Illustration of the operating voltage marked to the side of the device.**

### **3.2.2 Serial port**

Before connecting DTE (Data Terminal Equipment) to the radio modem, please make sure that the configuration matches the physical interface (electrical characteristics, timing, direction, and interpretation of signals).

Serial port bit speed can be selected between 4800 and 460800 bits per second. Recommended serial port speed is 115200 bit per second.

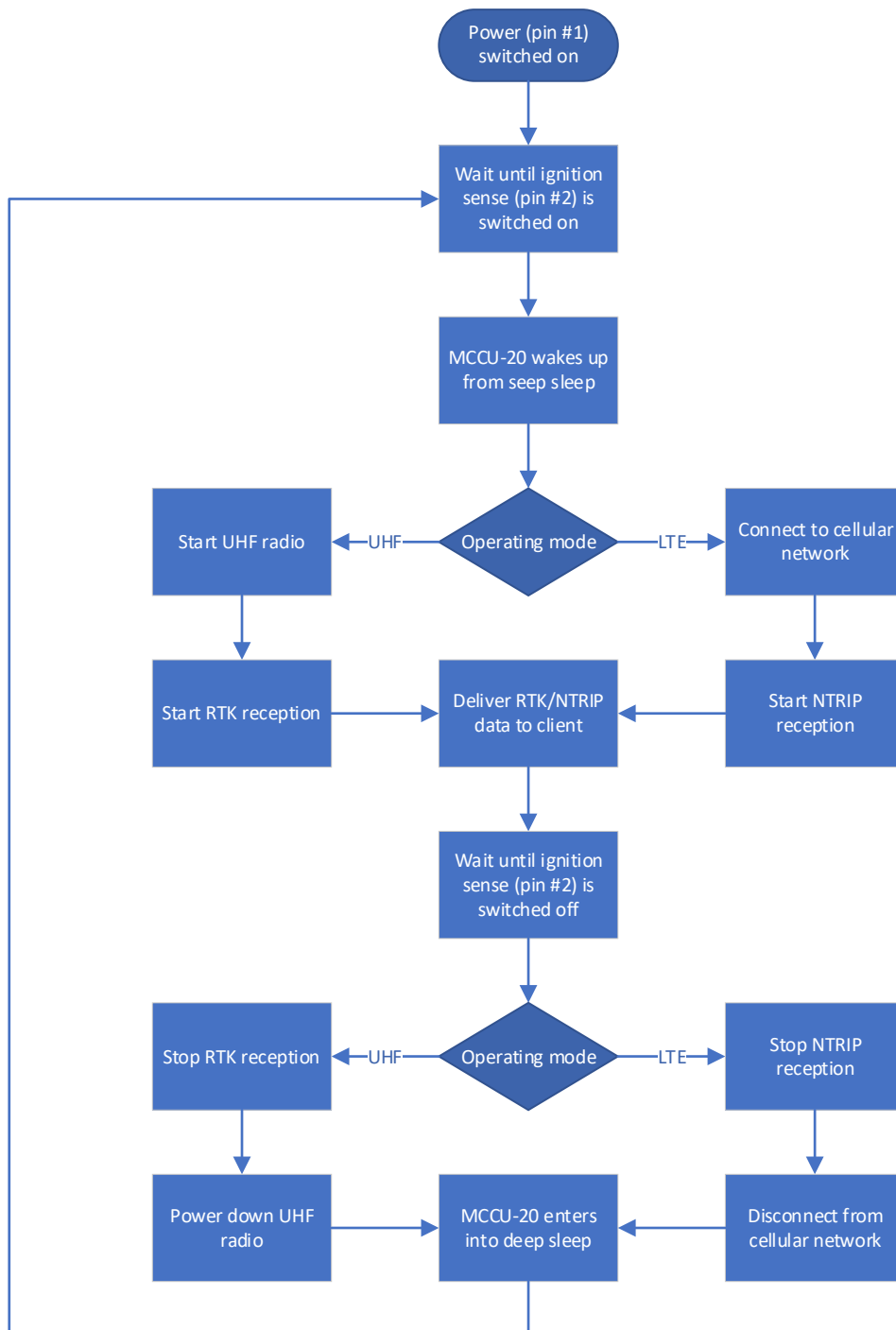
Please see chapter 4 for more information.

### **3.2.3 Ignition sense feature**

Whenever possible, SATEL MCCU-20 should be connected into vehicle's ignition sense line. This allows device's cellular modem to gracefully disconnect from cellular network. If operating power of SATEL MCCU-20 is just switched off, cellular connection to network just breaks, and this is seen as error behaviour on cellular network.

SATEL MCCU-20 senses the status of Deutsch connector pin #2 i.e. the ignition sense line. When the voltage in this line is the same as operating voltage, the device wakes from deep sleep mode, enters normal operating mode and starts radio operations. If the voltage in this line drops to zero, SATEL MCCU-20 disconnects from cellular network, stops all operations, and goes to power saving deep sleep mode.

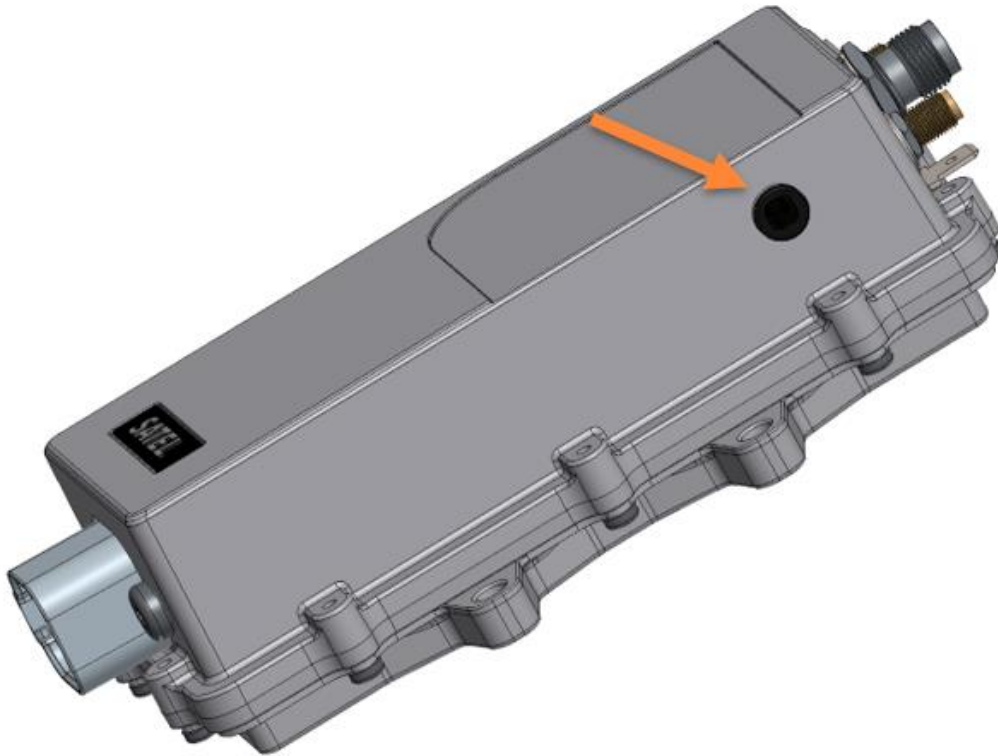
If the ignition sense feature can't be taken into use i.e., the vehicle does not have ignition sense line available, the Deutsch connector pin #2 must be connected to operating voltage.



**Figure 4: Ignition sense logic**

### **3.3 LED indicators**

There is one (1) RGB LED indicator on the side of the SATEL MCCU-20 (see Figure 5) which indicates the status of the serial port and the radio interface. Status indications are given with different colors, blinking and color sequences. Indications are explained in Table 3.



**Figure 5: RGB LED indicator on the side of the SATEL MCCU-20 device.**

**Table 3: RGB LED status indications.**

LED color	OFF	Slowly blinking (heartbeat), speed 2 sec	Fast blinking, speed 0.5 sec ON and 0.5 sec OFF	ON
Purple	-	Booting up	-	-
Blue	-	Establishing NTRIP caster connection	Establishing cellular network connection	Connection to both cellular network and NTRIP caster OK
Yellow	-	-	Establishing RTK connection	RTK Connection established and OK
Red	-	-	Bootloader's recovery flash mode	Device in error state, contact maintenance
Green	-	Command and programming mode activated.	-	-
Blue-Red Sequence	-	-	-	Connection to cellular modem failed, attempting recovery
Blue-Green Sequence	-	-	-	Cellular modem FOTA mode active
Rainbow sequence	-	-	-	Device in test mode

## 4. SERIAL PORT

The radio modem is referred to as DCE (Data Communication Equipment) whereas the device connected to it, typically a PLC or a PC, is referred to as DTE (Data Terminal Equipment).

In order to transfer data, the physical interface between DCE and DTE must be compatible and properly configured. This chapter describes shortly the basics of the physical interface options, the related settings and the operation of the serial interface.

Before connecting DTE (Data Terminal Equipment) to the radio modem, make sure that the configuration matches the physical interface (electrical characteristics, data speed, direction and interpretation of signals).

Serial port speed can be set between 4800 and 460800 bits per second. There are no hardware handshake lines.

### 4.1 Pause length

The modem recognises a pause on the serial line (a pause is defined as a time with no status changes on the RS-232 interface TD-line). The pause detection is used as criteria for:

End of radio transmission - When the transmit buffer is empty and a pause is detected, the modem stops the transmission and will then change the radio to the receive mode.

SL command recognition - For a SL command to be valid, a pause must be detected before the actual command character string.

User address recognition - In order for the start character to be detected, a pause must precede it in transmission.

Traditionally, in asynchronous data communication, pauses have been used to separate serial messages from each other. However, the use of non-real-time operating systems (frequently used on PC-type hardware) often adds random pauses, which may result in the user data splitting into two or more separate radio transmissions. This may cause problems especially in the systems including repeater stations.

In order to match the operation of the radio modem to the user data, the Pause length parameter can be adjusted on the programming menu. It may have any value between 3 and 255 characters. The default value is 3 characters.

Notes:

The absolute time of Pause length is depending on the serial port settings. For example, 1 character is ~1.04 ms at 9600 bps / 8N1 (10 bits).

The maximum absolute time is always 170 ms independent from the value of the Pause length given in the set-up.

An increase in the Pause length increases the round trip delay of the radio link correspondingly; this is due to the fact that the radio channel is occupied for the time of the Pause length after

each transmission (the time it takes to detect a pause). If this is not acceptable, the TX delay setting may also be useful in special cases.

## **4.2 Data buffering**

Whenever the radio modem is in Data Transfer Mode it monitors both the radio channel and the serial interface. When the terminal device starts data transmission the radio modem switches to transmission mode. At the beginning of each transmission a synchronisation signal is transmitted and this signal is detected by another radio modem, which then switches into receive mode. During the transmission of the synchronisation signal the radio modem buffers data into its memory. Transmission ends when a pause is detected in the data sent by the terminal device, and after all buffered data has been transmitted. When the serial interface speed is the same or slower than the speed of the radio interface, the internal transmit buffer memory cannot overflow. However, when the serial interface speed exceeds the speed of the radio interface, data will eventually fill transmit buffer memory. In this instance, it will take a moment after the terminal device has stopped transmission of data for the radio modem to empty the buffer and before the transmitter switches off. The maximum size of transmit buffer memory is one kilobyte (1 kB).

In the receive mode, the buffer works principally in the above described way thus evening out differences in data transfer speeds. If the terminal device transmits data to a radio modem in receive mode, the data will go into transmit buffer memory. Transmission will start immediately when the radio channel is available.

## **4.3 Serial port configuration for NTRIP mode**

When SATEL MCCU-20 is used on NTRIP mode, serial port must be configured to use 8 bit, as NTRIP data is 8 bit binary data. Suggested configuration for serial port is 8-N-1 (8 bits, No parity, 1 stop bit).

## 5. UHF AND CELLULAR RF INTERFACE

Please refer to SATEL-TR49 documentation for UHF interface information:

<https://www.satel.com/products/radio-modems/satel-tr49/>

SATEL MCCU-20 contains a Quectel EG25-G LTE Category 4 modem, which has global type approvals. Cellular modem has connectors for both main and diversity antennas, thus enabling RX MIMO for LTE.

### 5.1 SIM card

SATEL MCCU-20 is equipped with “traditional” 3FF form factor SIM card and eSIM card soldered into LTE board. The eSIM card allows operation in majority of cellular networks globally. In case local legislation does not allow prolonged roaming, “traditional” SIM card may be used. The SIM card is pre-installed in factory. In order to maintain SATEL MCCU-20’s IP67 and IP69K classification, end user is not allowed to open device, thus SIM card cannot be changed on the field.

SIM card PIN code must be pre-configured and programmed into device. It is not allowed change the PIN code for SIM card later. It is recommended to disable SIM cards PIN code lock.

### 5.2 Cellular PLMN scan

SATEL MCCU-20 supports cellular PLMN scan operation i.e., the operation where device searches for all available cellular operators. The execution may take several minutes.

To start the PLMN scan operation, respective SL command can be found below (Table 4). Result is given after the operation is finished.

### 5.3 Cellular RF interface configuration

Following items need to be configured for cellular interface to behave properly (Table 4). Please ask these from your cellular operator.

**Table 4: Cellular RF interface configuration.**

Item	SL command	Notes
Access Point Name (APN)	SL&L=I2007, S<X>	<X> = APN string, for example: SL&L=I2007, Sinternet
APN username	SL&L=I2008, S<X>	<X> = Information provided by operator.
APN password	SL&L=I2009, S<X>	<X> = Information provided by operator.
SIM selection	SL&L=I2010, P<X>	<X> = 0: plastic SIM, 1: eSIM, example: SL&L=I2010, P0 This selection is invalid if device has only one SIM option.

Item	SL command	Notes
Preferred operator	<p>SL&amp;L?I2015</p> <p>SL&amp;L=I2015,S&lt;index&gt;,&lt;format&gt;,&lt;oper&gt;,&lt;GMS&gt;,&lt;GSM_compact&gt;,&lt;UTRAN&gt;,&lt;E-UTRAN&gt;</p> <p>SL&amp;L=I2015,S1,2,"24405",1,0,1,1</p>	<p>Read list of preferred operators from SIM in use</p> <p><b>&lt;index&gt;</b> Integer type. The order number of the operator in the (U)SIM preferred operator list.</p> <p><b>&lt;format&gt;</b> Integer type. Format of &lt;oper&gt;</p> <p>0 Long format alphanumeric &lt;oper&gt;</p> <p>1 Short format alphanumeric &lt;oper&gt;</p> <p>2 Numeric &lt;oper&gt;</p> <p><b>&lt;oper&gt;</b> String type. &lt;format&gt; indicates the format is alphanumeric or numeric.</p> <p><b>&lt;GSM&gt;</b> Integer type. GSM access technology.</p> <p>0 Access technology is not selected</p> <p>1 Access technology is selected</p> <p><b>&lt;GSM_compact&gt;</b> Integer type. GSM compact access technology.</p> <p>0 Access technology is not selected</p> <p>1 Access technology is selected</p> <p><b>&lt;UTRAN&gt;</b> Integer type. GSM compact access technology.</p> <p>0 Access technology is not selected</p> <p>1 Access technology is selected</p> <p><b>&lt;E-UTRAN&gt;</b> Integer type. E-UTRAN access technology.</p> <p>0 Access technology is not selected</p> <p>1 Access technology is selected</p> <p>Exable of adding one Finnish operator to first index on the selected SIM.</p>
Selected operator	SL&L=I2006,S<X>	<X> = Information provided by operator.
Cellular PLMN scan	SL&L=I2016	



## 6. NTRIP CLIENT

### 6.1 NTRIP in brief

SATEL MCCU-20 has NTRIP client, which is compliant to NTRIP v2.0 (RTCM standard 10410.1).

The NTRIP client connects to pre-defined (per user settings) NTRIP caster through Internet, receives NTRIP encapsulated correction data and delivers it to customer device through local serial port connection. The data rate depends on used caster.

It is possible to get very accurately estimated correction data if device gives its own position to NTRIP caster. This feature is not available on all casters.

Correction data may be RTCM or proprietary format, as long as it is properly NTRIP encapsulated. The correction data payload is just passed through SATEL MCCU-20 without any modifications.

Please contact your NTRIP service provider for configuration details.

### 6.2 NTRIP configuration

Following items need to be configured for NTRIP client to operate properly (Table 5).

**Table 5: NTRIP configuration.**

Setting item	Related SL command	Explanation	Notes
NTRIP NMEA feed	SL&L=I1102, P<x>	Selection, whether customer device location is relayed to NTRIP server. 0 = disabled 1 = active	If this selection is activated, customer device must relay its position as NMEA feed to SATEL MCCU-20.
NTRIP mount point	SL&L=I1103, S<x>	The mount point in caster as string	
NTRIP caster IP address	SL&L=I1104, S<x>	Valid IPv4 address, for example 195.156.69.177	
NTRIP caster port	SL&L=I1105, P<x>	Caster port number, typically 2102	
NTRIP caster user name	SL&L=I1106, S<x>		Can be left empty.
NTRIP caster password	SL&L=I1107, S<x>		Can be left empty.

Setting item	Related SL command	Explanation	Notes
Connection watchdog destination	SL&L=I201, S<x>	Destination, which is pinged regularly to verify, that cellular IP connection is alive.	Own cellular operator DNS server is preferred choice.

## **7. SATEL CONNECT – GLOBAL CONNECTIVITY SOLUTION**

SATEL MCCU-20 contains a SATEL CONNECT - Global Connectivity solution. SATEL CONNECT offers global cellular connectivity.

### **7.1 Service**

SATEL MCCU-20 has integrated eSIM card and offers SATEL CONNECT – Global connectivity solution, which allows end user to test the solution with complimentary 50 MB preloaded data. In case end user is willing to continue using SATEL CONNECT – Global Connectivity solution, the activation shall be done through web-portal, where all the data packages and possible top-ups are available as prepaid data packages. SATEL CONNECT is very easy to be taken into use, end user fills in the the needed information and pays the service with credit card. SATEL CONNECT is powered by TATA Communications, which is world leading connectivity service provider. TATA Communications has global presence and roaming agreements available with excellent coverage. Location of the device and network available has big effect on service coverage and performance. On certain locations there are possibility that service coverage has limitations or performance restrictions which might affect longer latency or smaller data throughput.

### **7.2 Activation**

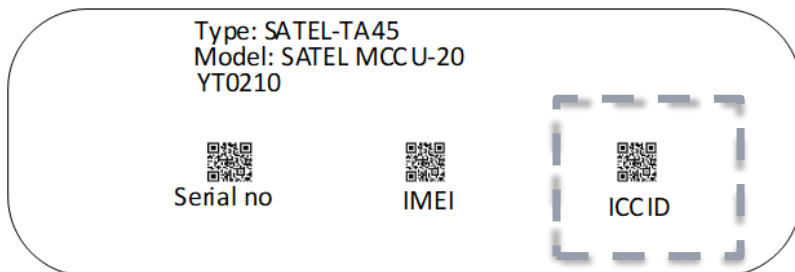
SATEL CONNECT – Global Connectivity solution is available as prepaid service package. Activation can be done by entering SATEL CONNECT web portal: [SATEL.HAPYSERVICES.COM](http://SATEL.HAPYSERVICES.COM) and only following steps are needed to activate the service:

1. Enter the web-portal
2. Fill in the details required
3. Select the needed data package
4. Pay with a credit card
5. Start using the service!

Service will send reminder to end user, if end user is running out of data or data package validity period is getting old. Service is maintained by Hapy Services.

## 7.2.1 **ICCID**

Each SATEL MCCU-20 device has integrated eSIM card with unique ICCID. To activate SATEL CONNECT – Global Connectivity solution, ICCID is mandatory information to be given. ICCID can be found from SATEL MCCU-20 carton box label as QR code (Figure 6), which can be read, copy and paste to SATEL CONNECT web portal for example by using cell phone.



**Figure 6. SATEL MCCU-20 carton box label, and ICCID on the right (circled).**

## 8. MECHANICAL DIMENSIONS

The device dimensions in millimetres are given in Figure 7.

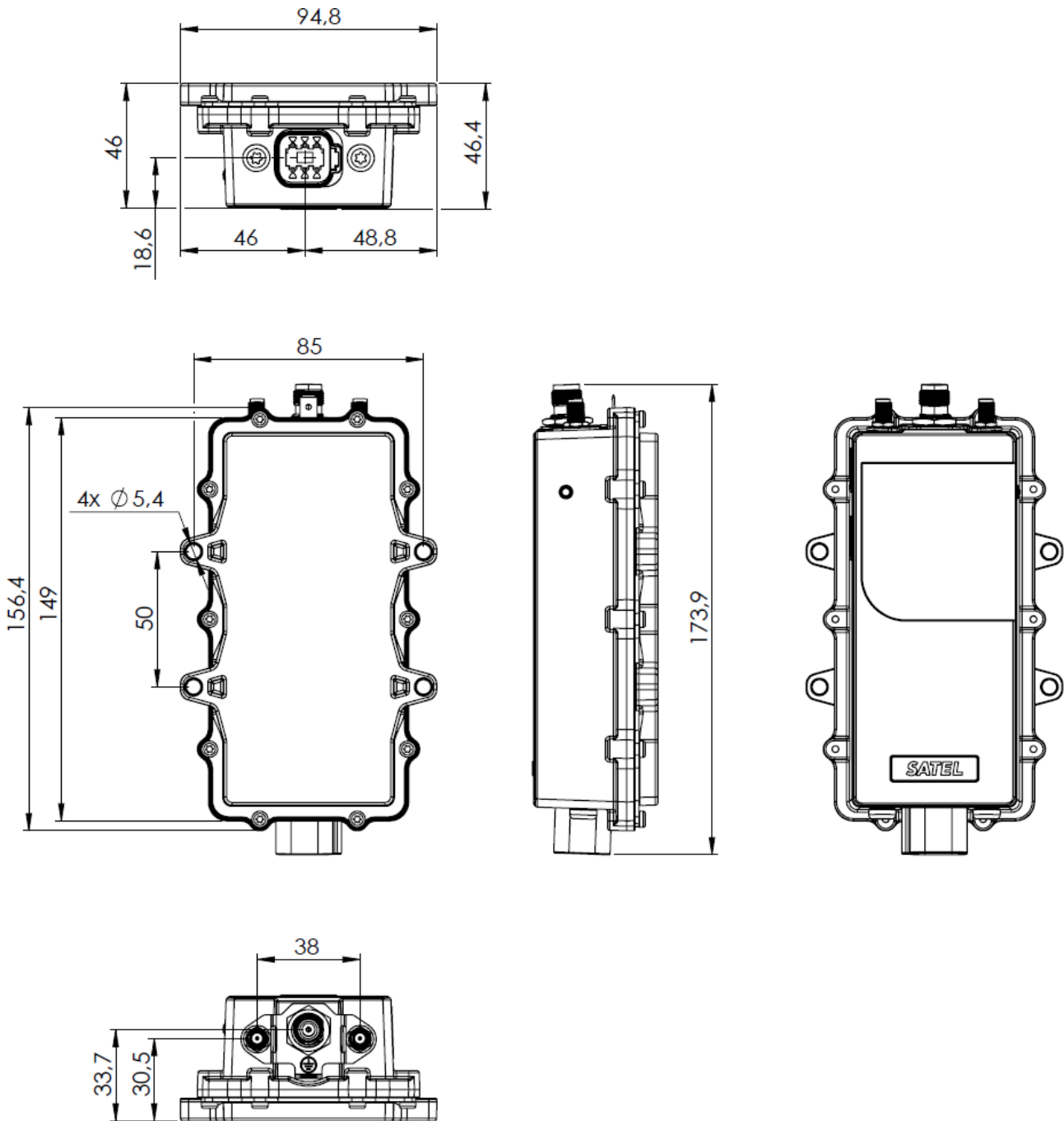


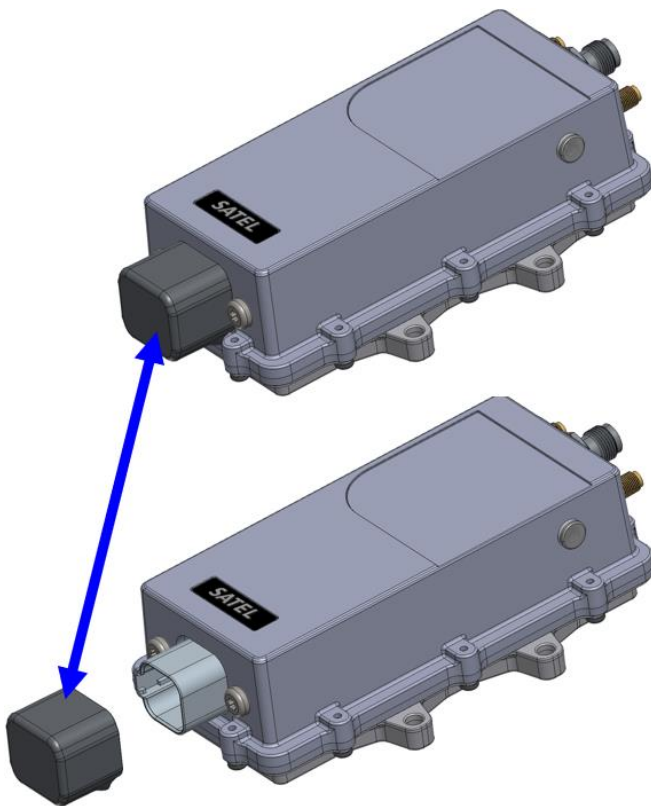
Figure 7: SATEL MCCU-20 mechanical dimensions.

## 9. INSTALLATION

SATEL MCCU-20 transceiver can be installed to any position from its 4 screw attachment points with maximum of M5 bolts/screws. Deutsch connector protective cover should be kept on the device until device has been fixed from the 4 attachment points.

**NOTE!**

In case Deutsch connector protective cover is damaged, SATEL MCCU-20 transceiver should be inspected by SATEL to ensure the condition of Deutsch connector.



**Figure 8. Deutsch connector's protective cover.**

SATEL MCCU-20 transceiver is waterproof fulfilling IP67 and IP69K specifications. Note that all antenna connectors must be installed properly, and Deutsch DT connector cable counterpart must have a gasket installed to properly seal the connection in order to reach the IP ratings.

In case connectors are left unplugged and SATEL MCCU-20 transceiver is exposed by water, dust or other respective harsh conditions, all unplugged connectors shall be plugged with specific connector plugs. Antenna connector plugs are not included in SATEL MCCU-20 package.

Avoid installations to vibrating surfaces, hot places, directly to sunlight or under water. Avoid abrasion and impacts. Protect cables and antennas placing them away from damaging elements. Keep antennas in open space and away from interference.

When connecting antennas, use good quality RF-cables and keep distances to its shortest to minimize signal losses.

The following points must be considered when installing and configuring a radio modem:

- All operating voltages of all the equipment concerned must always be switched OFF before connecting the serial interface cable.
- To ensure reliable operation the voltage output of the power supply must be stable enough and the current capability of the power supply must be sufficient.
- Antennas must be installed according to instructions.
- Serial interface settings between the radio modem and the terminal unit must correspond to each other.
- All radio modems in the same system must be configured using same radio related settings (radio frequency, channel spacing, etc).

Check the instructions of grounding the modem on chapter 9.3 Grounding.

**NOTE!**

It is not recommended to install the radio modem on a strongly vibrating surface. Suitable dampening and/or isolation materials should be used in cases where the installation surface will be subjected to vibration.

**NOTE!**

Do not expose the device to solvents or fuels/oils.

**NOTE!**

Opening of the housing of the device lead to warranty void.

## **9.1 Installation of the radio modem**

SATEL MCCU-20 has four (4) fixing screw positions on its housing (Figure 9), which are used to attach the device to a structure, using M5 sized bolts or screws. Maximum torque for the bolts or screws is 5Nm. It is recommended to use M5 washer together with bolt/screw.

The structure should be solid and even. There should be no curvature or bumps between MCCU-20 and the installation structure.

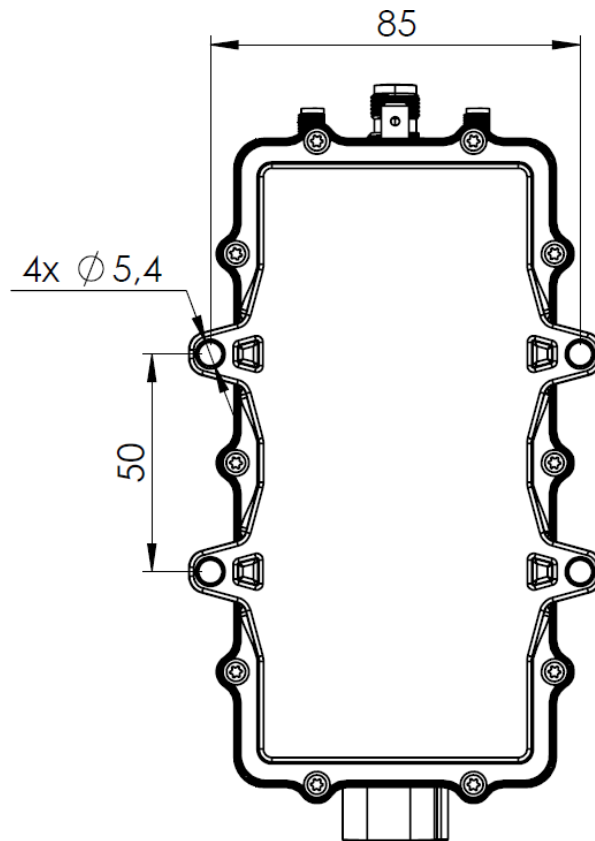


Figure 9: Mounting screw positions.

## 9.2 Installation requirements

Electronic devices are sensitive to external influences which should be taken into consideration while taking the device into operation. Proper place for assembling is necessary for good performance and long lifespan.

Even though SATEL MCCU-20 is built to withstand external vibrations, shocks, temperature fluctuations and high/low temperatures still those occurrences should be avoided as much as possible to maximize the durability and longevity of the product. High temperature decreases the lifespan of the components whereas vibration and shocks weaken the mechanical structure and can drastically affect the performance in use.

## 9.3 Grounding

SATEL MCCU-20 transceivers are equipped with grounding terminals, as shown in Figure 10. It is recommended to connect a ground wire from the grounding terminal to the earth ground and that all other interconnected devices share the same electrical ground potential.





**Figure 10: SATEL MCCU-20 grounding terminals.**

Besides the mains voltage safety, proper grounding is essential also for the error free operation of radio links and the protection against over-voltages and lightning. Although SATEL MCCU-20 incorporates a robust internal surge protection, the surge spikes and power transients caused by lightning, ESD or other electrical systems must be discharged to earth ground.

### **9.3.1 General installation guidelines for grounding**

Perform grounding of the system in accordance with local and national regulations. Check the grounding related information of other products in the system. Use short low impedance cables. Although DC resistance of a ground cable may be a fraction of an ohm, its impedance may be thousands of ohms on the radio frequency. Wide copper straps are the best.

The ground connection should be connected directly to the power supply, not the ground connection of the load, to isolate the radio from voltage drops across the ground return for the load.

Equipment of the radio system should be grounded in a star ground configuration. The center of the star should be usually connected directly to a good external earth ground scheme. The mast installations require special measures in the construction of ground electrodes and equipotential bonding – consult professional installation providers.

## 10. ACCESSORIES

SATEL provides a wide selection of accessories and solutions for its radio modems, for example:

- Antennas
- Serial data / Power cables and adapters
- RF-cables
- Filters and lightning protectors
- Power supplies

Please visit [www.satel.com](http://www.satel.com)

## 11. DEVICE SOFTWARE UPGRADE

SATEL MCCU-20 has various sub-modules, which contain different software. For example, the host system has its own software, LTE module has its own, and the UHF module has its own. All these can be upgraded using SATEL provided mechanism.

Please **do not upgrade device software for any sub-component unless you are specifically instructed** to perform that operation. If software upgrade is needed, you will receive detailed instructions, along with software upgrade packages.

Please contact SATEL technical support for more information.

## **12. PROPOSALS FOR MORE RELIABLE RADIO LINK**

In case where the environment is challenging the following methods can be used for improving the transmission reliability:

- Forward Error Correction, FEC, is recommended in challenging environment like urban areas.
- Directional antennas.
- Before building the radio link(s) it is highly recommended that the radio environment is measured to find out whether the radio environment is clean enough by using a spectrum analyzer or radio module's RSSI, Received Signal Strength Indication, value.
- Co-operation with the local authority to find out the optimum free radio channel.
- If the channel is disturbed an external band-pass filter can be used for improving the filtering.
- If at the adjacent channel is TDMA, Time Domain Multiple Access, it is recommended to use time slot for receiving which is not in synchronization with the TDMA radio transmission.
- In Europe it is not recommended to use channels which are located near by the TETRA or television frequencies.

## 13. APPENDIX

### 13.1 NTRIP State and Error descriptions

MCCU-20 NTRIP client an internal state and error status. State value describes in what state the client currently is: stopped, initializing connection, or downloading NTRIP stream. Error value describes which error(s) are currently pending, thus preventing the stream download.

#### 13.1.1 Combined state and error value

Combined state and error value is represented as a single numeric (hexadecimal) value, where four first digits (high-word) define the state and four last digits (low-word) define the error flags.

State values are:

0	Stopped	NTRIP fetch is either stopped with SL command or device is in SL command state.
1	Fetching Source Table	Client fetches the source table.
2	Initializing NTRIP Stream	Client is establishing the connection to NTRIP caster.
3	NTRIP Stream Running	Client has successfully connected to NTRIP and streaming to serial port.

Error flags are:

0x0	NONE (No error)
0x2	E_NO_NETWORK_CONNECTION - LTE modem has not yet connected to internet or has failed doing so.
0x4	E_NO_SOCKET_CONNECTION - Client has failed to connect to caster with configured IP address / port combination, or the connection is broken.
0x8	E_AUTHENTICATION_FAIL - Authentication to caster has not been successful.
0x10	E_REQUEST_NOT_FOUND - Caster has replied that mountpoint does not exist.
0x20	E_SERVICE_UNAVAILABLE - Caster has replied that service is unavailable.
0x40	E_NMEA_STRING_NOT_SET - It is configured, that client sends a NMEA location to caster, but client has not received any correct NMEA location from serial port.
0x80	E_CASTER_RESPONSE - Caster reply contains an unidentified error.
0x800	E_CASTER_REPLY_MISSING - Caster response is not received.
0x1000	E_INVALID_CONFIG - NTRIP configuration is invalid, for example caster address or port is not defined.
0x8000	E_UNKNOWN - Other error. For example, caster response is invalid and cannot be analysed in detail.

If info-tag is configured, the combined state and error value is ejected as an Info-message each time either state or error status changes. Value can be also queried from device in command state with SL command: `SL&L?I1101`.

### **13.1.2 Error messages**

In addition to numerical status described above, the device produces more descriptive, human readable error messages. They are emitted to serial port as an Error-message if error-tag is configured. Below are some examples how error and status messages are exported to serial port.

```
<Err>NMEA message not set</Err>  
<Inf>Ntrip status: 0x00020040</Inf>  
State 2 = Initializing NTRIP stream  
Error 0x40 = E_NMEA_STRING_NOT_SET
```

```
<Err>Invalid NTRIP Configuration</Err>  
<Inf>Ntrip status: 0x00021000</Inf>  
State 2 = Initializing NTRIP stream  
Error 0x1000 = E_INVALID_CONFIG
```

```
<Err>Network disconnected</Err>  
<Inf>Ntrip status: 0x00020002</Inf>  
State 2 = Initializing NTRIP stream  
Error 0x2 = E_NO_NETWORK_CONNECTION
```

## 14. VERSION HISTORY

Version history:

Version:	Date:	Remarks:
2.0	14.2.2024	First released version
2.1	22.2.2024	Updated LED indications
2.2	28.2.2024	Updated cap note + LED indications.
2.3	6.3.2024	Updated technical specs, LTE output power + notes regarding UHF and cellular
2.4	23.5.2024	Section 1.2 updated