LEXI-R520

Ultra-small LTE-M / NB-IoT module

Data sheet

Abstract

Technical data sheet describing the ultra-small LEXI-R520 multi-band LTE-M / NB-IoT modules, based on the latest u-blox UBX-R52 chipset, integrating cellular modem and A-GPS technology, delivering data connectivity alongside satellite positioning in the compact LEXI form factor.

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This document applies to the following products:

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LEXI-R520	LEXI-R520-02B-00	05.14.A00.01	UBXDOC-686885345-2121	Initial production

Contents

1 Functional description

1.1 Overview

LEXI-R520 is an LTE Cat M1 / LTE Cat NB2 module available in the ultra-small LEXI LGA form factor (16 x 16 mm, 133-pin), based on the latest u-blox UBX-R52 cellular chipset. It is optimized for extremely low power consumption in deep-sleep PSM / eDRX and it integrates the u-blox SpotNow Assisted-GPS receiver technology with separate GPS antenna interface.

The LEXI-R520 modules provide software-based multi-band configurability enabling international multi-regional coverage in LTE-M and NB-IoT radio access technologies, supporting a comprehensive set of 3GPP Rel. 14 features that are relevant for IoT applications.

LEXI-R520 modules offer data communications up to 1200 kbit/s over an extended operating temperature range of –40 °C to +85 °C, with low power consumption, and with coverage enhancement for deeper range into buildings and basements (and underground with NB2).

Measuring just 16 x 16 mm, LEXI-R520 modules are ideal for size-constrained devices like people and animal wearables, small asset trackers, portable healthcare systems and other small IoT applications.

With many interface options and an integrated IP stack, LEXI-R520 modules are the optimal choice for LPWA applications with low to medium data throughput rates, as well as devices that require long battery lifetimes, such as used in smart metering, smart lighting, telematics, asset tracking, remote monitoring, alarm panels, and connected healthcare.

Customers can future-proof their solutions by over-the-air firmware updates, thanks to the uFOTA client/server solution that utilizes LwM2M, a light and compact protocol ideal for IoT.

Table 1 lists the main features of LEXI-R520 modules.

Model	Region	RAT		Positioning			u-blox services					Interfaces						Features																Grade		
		LTE category	LTE FDD bands	Integrated u-blox SpotNow A-GPS receiver	Dedicated GPS antenna interface	External GNSS control via modem	MQTT Anywhere,	MQTT Flex	AssistNow	CellLocate®	CloudLocate	UARTs	USB (for diagnostics)	I2C	SIM	GPIOs	Digital audio (I2S)	u-blox open CPU (uCPU)	Secure boot, updates	Antenna dynamic tuning	Ultra-low power consumption in PSM	Embedded TCP/UDP stack	Embedded HTTP, FTP	Embedded TLS, DTLS	FW update via serial (FOAT)	u-blox FW update Over the Air (uFOTA)	LwM2M with dynamically loaded objects	Embedded MQTT, MQTT-SN	Embedded CoAP	Last gasp	Jamming detection	Antenna and SIM detection	Standard	Professional	Automotive
LEXI-R520	Global	M1 NB2	*	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	

* = LTE bands 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66, 71, 85

Table 1: LEXI-R520 main features summary

1.2 Block diagram

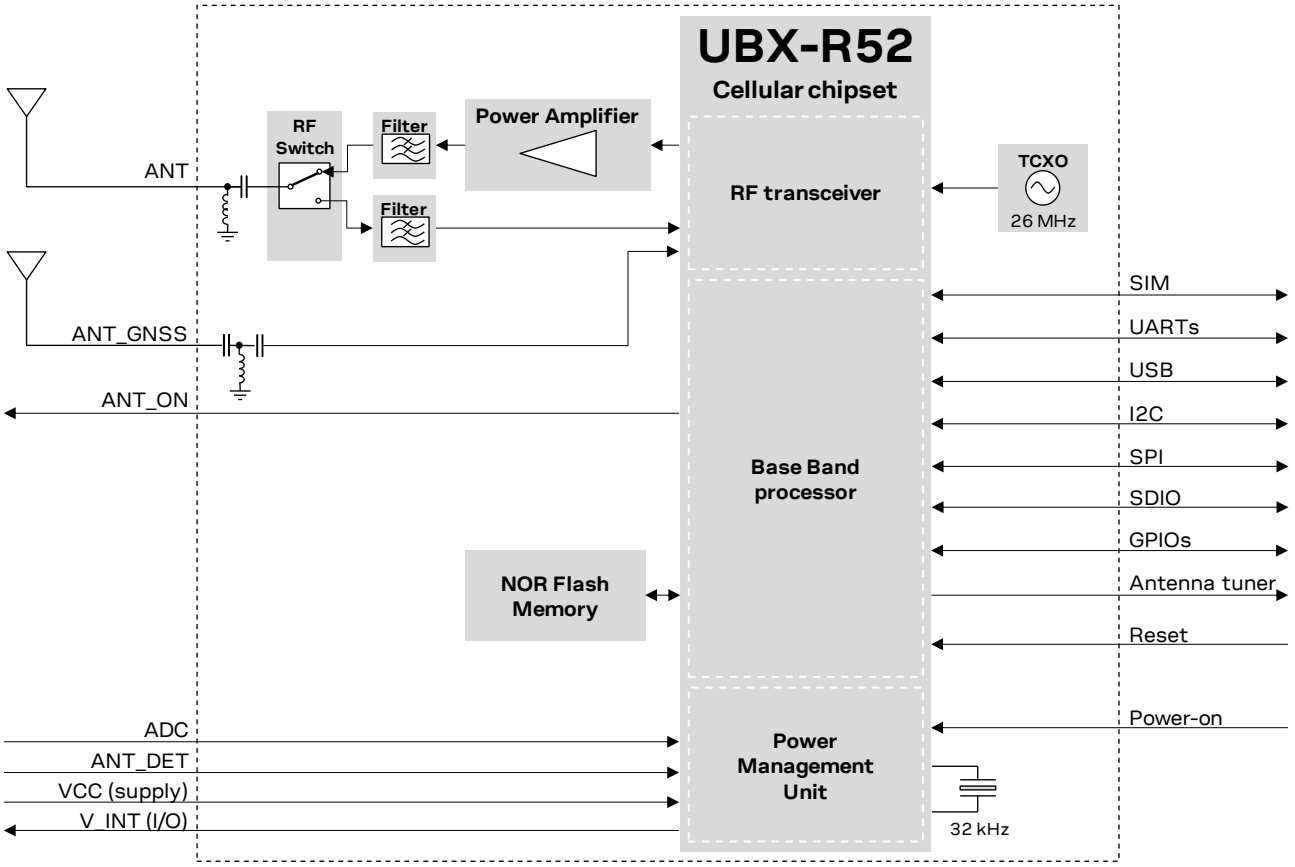


Figure 1: LEXI-R520 block diagram

The current product version of the LEXI-R520 module does not support the following interfaces, which should be left unconnected and should not be driven by external devices:

- SPI interface
- SDIO interface

1.3 Product description

The LEXI-R520 is an LTE Cat M1 / NB2 module for multi-region use, designed to achieve extremely low current consumption in deep-sleep power saving mode (PSM). It includes the integrated u-blox SpotNow A-GPS receiver functionality for global position acquisition.

Item	LEXI-R520
Cellular protocol stack	3GPP Rel. 13 LTE Cat M1 and NB1 3GPP Rel. 14 LTE Cat M1 additional core features: Coverage Enhancement Mode B, Uplink TBS of 2984b 3GPP Rel. 14 LTE Cat NB2 additional core features: Higher data rate (TBS of 2536b), Mobility enhancement (RRC connection re-establishment), E-Cell ID, 2 HARQ processes, Release Assistant, Random access on Non-Anchor Carrier
Cellular Radio Access Technology	LTE Cat M1 Half-Duplex LTE Cat NB2 Half-Duplex

Item	LEXI-R520
Cellular operating bands	LTE FDD band 1 (2100 MHz) LTE FDD band 2 (1900 MHz) LTE FDD band 3 (1800 MHz) LTE FDD band 4 (1700 MHz) LTE FDD band 5 (850 MHz) LTE FDD band 8 (900 MHz) LTE FDD band 12 (700 MHz) LTE FDD band 13 (750 MHz) LTE FDD band 18 (850 MHz) LTE FDD band 19 (850 MHz) LTE FDD band 20 (800 MHz) LTE FDD band 25 (1900 MHz) LTE FDD band 26 (850 MHz) LTE FDD band 28 (700 MHz) LTE FDD band 66 (1700 MHz) LTE FDD band 71 (600 MHz) LTE FDD band 85 (700 MHz)
Cellular power class	LTE power class 3 (23 dBm)
Cellular data rate	LTE category M1: • up to 1200 kbit/s UL • up to 588 kbit/s DL LTE category NB2: • up to 140 kbit/s UL • up to 125 kbit/s DL
Assisted-GPS receiver type	u-blox SpotNow engine GPS L1C/A

Table 2: LEXI-R520 cellular and GNSS main characteristics

1.4 AT command support

The LEXI-R520 module supports AT commands according to the 3GPP standards TS 27.007 [4], TS 27.005 [5], TS 27.010 [6], and the u-blox AT commands extension.

☞ For the complete list of AT commands and their description, see the AT commands manual [1].

1.5 Supported features

Table 3 lists some of the main features supported by LEXI-R520 modules.

Feature	Description
Open CPU (uCPU)	Capability to run customer application code directly on LEXI-R520 modules. The functionality is available upon request.
Device security	Hardware-based security functions of the chipset are used to provide: • Secure boot: guarantees software authenticity and integrity • Secure update: supervises the secure delivery of the correct FW to the module
MQTT Anywhere, MQTT Flex	With u-blox's communication services – MQTT Anywhere or MQTT Flex – data overhead, time spent on-the-air, and energy consumption can be reduced, thus enabling users to extend device life cycles, lower costs, and improve ROI.

Feature	Description
Integrated A-GPS receiver	Integrated u-blox SpotNow feature, a SW implementation of an Assisted GPS receiver (A-GPS) running on the u-blox UBX-R52 chipset. With the unique SpotNow feature, cellular and GPS use two dedicated antennas. Internally to the module, the radio resources are switched between the two inputs depending on the corresponding operating. SpotNow feature can be used when the cellular modem is offline or when it is registered to a cell. SpotNow feature relies on assistance data to be downloaded at least every couple of hours. Cellular and SpotNow may work together, with the GPS signals being tracked during the cellular eDRX paging cycle. This avoids any conflicts or possible interruptions of the cellular operations, bringing service continuity.
External GNSS control via modem	Access to external u-blox positioning chips and modules through I2C interface. This means that any host processor can control the LEXI-R520 module and the u-blox positioning chip or module through a single serial port.
Embedded AssistNow Software	Embedded AssistNow Online and AssistNow Offline clients are available.
CellLocate®	Enables the estimation of device position based on the parameters of the mobile network cells visible to the specific device based on the CellLocate® database.
Hybrid positioning	Provides the module's current position using the integrated A-GPS receiver or the estimated position from CellLocate®, depending on which positioning method provides the best and fastest solution according to the user configuration.
u-blox Smart Connection Manager (uSCM)	The u-blox Smart Connection Manager (uSCM) is an application running on the module that may be enabled to let the module automatically handle the connection with the network, setting up the link and reestablishing it if dropped according to some predefined and user-customizable profiles which set the module basic modes of operation. The uSCM feature massively reduces the complexity of the application code controlling the module, saving developers time, reducing time to market, and optimizing module behavior in typical operating modes.
Antenna dynamic tuning	Real-time control of an external antenna matching IC via two dedicated pins of the module according to the LTE band used by the module.
Embedded TCP and UDP stack	Embedded TCP/IP and UDP/IP stack including direct link mode for TCP and UDP sockets. Sockets can be set in Direct Link mode to establish a transparent end-to-end communication with an already connected TCP or UDP socket via the serial interface.
HTTP, HTTPS (v1.0 for +UHTTP, v1.1 for LwM2M client)	Hyper-Text Transfer Protocol as well as Secure Hyper-Text Transfer Protocol (SSL encryption) functionalities are supported via AT commands.
FTP, FTPS	File Transfer Protocol as well as Secure File Transfer Protocol (SSL encryption of FTP control channel) functionalities are supported by means of AT commands.
CoAP (RFC 7252 [11])	Embedded Constrained Application Protocol (CoAP) datagram-based client/server application protocol designed to easily translate from HTTP for simplified integration with the web.
MQTT (v3.1.1) and MQTT-SN (v1.2)	Embedded Message Queuing Telemetry Transport (MQTT) and MQTT for Sensor Networks (MQTT-SN) publish-subscribe messaging protocols designed for lightweight M2M communications over TCP (MQTT) or over UDP (MQTT-SN). These allow one-to-one, one-to-many and many-to-one communications over a TCP or UDP connection.
LwM2M (v1.0)	The LwM2M is a light and compact communication protocol designed for managing IoT machine-to-machine communication between a LwM2M server and a LwM2M client located in lightweight, low power or resource-constrained LwM2M devices, with object data model.
TLS (v1.0, v1.1, v1.2, v1.3) and DTLS (v1.2)	Transport Layer Security (TLS) version 1.3 provides security for HTTP, FTP, MQTT and TCP communications. Embedded Datagram Transport Layer Security (DTLS) version 1.2 provides security for CoAP, LwM2M, MQTT-SN and UDP communications.
Jamming detection	Detects "artificial" interference that obscures the operator's carrier entitled to give access to the radio service and automatically reports the start and stop of such conditions to the application processor that can react accordingly.
Smart temperature supervisor	Constant monitoring of the module board temperature: • Warning notification when the temperature approaches predefined thresholds (see 4.2.15) • Shutdown notified and forced when the temperature value is outside the specified range (shutdown suspended in case of an emergency call in progress) The feature can be enabled or disabled through the +USTS AT command.

Feature	Description
Last gasp	In case of power supply outage the cellular module can be configured through the +ULGASP AT command to send an alarm notification to a remote entity.
Network indication	GPIO configured to indicate the network status: registered home network, registered roaming, data call enabled, no service. The feature can be enabled through the +UGPIOC AT command.
Antenna detection	The **ANT_DET** pin provides antenna presence detection capability, evaluating the resistance from the **ANT** pin to GND by means of an external antenna detection circuit implemented on the application board. The feature can be enabled through the +UANTR AT command.
BIP	Bearer Independent Protocol for over-the-air SIM provisioning.
Dual stack IPv4/IPv6	Capability to move between Ipv4 and dual stack network infrastructures. IPv4 and IPv6 addresses can be used.
Firmware update Over AT commands (FOAT)	Firmware module update over AT command interface.
u-blox Firmware update Over The Air (uFOTA)	u-blox firmware module update over the LTE air interface client/server solution using LwM2M.
Power Saving Mode (PSM)	The Power Saving Mode (PSM) feature, defined in 3GPP Rel.13, allows further reduction of the module current consumption maximizing the amount of time a device can remain in PSM low power deep-sleep mode during periods of data inactivity.
eDRX	Extended mode DRX, based on 3GPP Rel.13, reduces the amount of signaling overhead decreasing the frequency of scheduled measurements and/or transmissions performed by the module in idle mode (for eDRX sleep time shorter than 70 s) or in deep-sleep mode (for eDRX sleep time longer than 70 s). This in turn leads to a reduction in the module power consumption while maintaining a perpetual connection with the base station.
Coverage Enhancement (mode A and mode B)	Coverage Enhancement modes introduced in 3GPP Rel.13 are used to improve the cell signal penetration.
LTE-M and NB-IoT 3GPP release 14 features	For LTE-M: Larger max UL TBS (2984 bits instead of 1000 bits), Enhanced PUCCH repetition in CE mode B (64 and 128 repetition factor) For NB-IoT: Cat-NB2 higher data rate (with 2536 bit TBS), Release assistance indication, RRC connection re-establishment for the control plane CIoT EPS optimization, 2 UL/DL HARQ processes, Non-anchor paging and RACH, E-CID positioning

Table 3: Main features supported by LEXI-R520 modules

☞ u-blox is extremely mindful of user privacy. When a position is sent to the CellLocate® server, u-blox is unable to track the SIM used or the specific device.

2 Interfaces

2.1 Power management

2.1.1 Module supply input (VCC)

LEXI-R520 modules must be supplied through the **VCC** pins by a proper external DC power supply providing a nominal voltage within the normal operating range (see Table 11). Voltage must be stable, because during operation the current drawn from **VCC** may vary significantly, based on the power consumption profile of the LTE Cat M1 and LTE Cat NB2 radio access technologies.

The three **VCC** pins of LEXI-R520 modules are internally connected to both the internal power amplifier and the internal power management unit, which integrates voltage regulators generating all the internal supply voltages needed by the module for its intended operations. This includes the supply voltage for the generic digital interfaces (**V_INT**) and for the SIM interface (**VSIM**).

It is important that the system power supply circuit is able to withstand the maximum pulse current during a transmit burst at maximum power level (see Table 13).

2.1.2 Generic digital interfaces supply output (V_INT)

LEXI-R520 modules provide a 1.8 V supply rail output on the **V_INT** pin, which is internally generated when the module is switched on, outside the ultra-low power deep-sleep mode. The same voltage domain is used internally to supply the generic digital interfaces of the module. The **V_INT** supply output can be used in place of an external discrete regulator.

☞ It is recommended to provide accessible test points directly connected to the **V_INT** pin.

2.2 Antenna interfaces

2.2.1 Cellular antenna RF interface (ANT)

The **ANT** pin is the cellular RF antenna I/O interface, designed with 50 Ω characteristic impedance.

2.2.2 Cellular antenna detection (ANT_DET)

The **ANT_DET** pin is an analog to digital converter (ADC) input with a current source provided by the LEXI-R520 modules to sense the presence of the external cellular antenna (as an optional feature), evaluating the DC resistance to GND by means of an externally implemented circuit.

2.2.3 GPS antenna RF interface (ANT_GNSS)

The **ANT_GNSS** pin represents the RF input for the u-blox SpotNow A-GPS receiver, designed with 50 Ω characteristic impedance and with an internal DC block, suitable for both active and/or passive external GPS antennas.

2.2.4 GPS antenna or LNA control (ANT_ON)

The **ANT_ON** digital output pin is available to provide optional control for switching on/off the power supply to an external active GPS antenna or an external separate LNA. This feature is provided to help minimize power consumption and it can be enabled by dedicated AT command (see section 2.7).

2.3 System functions

2.3.1 Module power-on

When the LEXI-R520 modules are not powered, they can be switched on as following:

- Applying a voltage at the **VCC** module supply input within the operating range (see Table 11)

When the LEXI-R520 modules are in power-off mode (i.e. switched off, but with a valid voltage present at the **VCC** module supply input within the operating range reported in Table 11), they can be switched on as follows:

- Forcing a low level at the **PWR_ON** input pin, which is normally set high by an internal pull-up, for a valid time period (see section 4.2.8, module switch on).

When the LEXI-R520 modules are in low power PSM / eDRX deep-sleep mode, with a valid voltage present at the **VCC** module supply input within the operating range reported in Table 11, they can be woken up as follows:

- Forcing a low level at the **PWR_ON** input pin, which is normally set high by an internal pull-up, for a valid time period (see section 4.2.8, module wake-up from PSM / eDRX deep-sleep).

The **PWR_ON** line is intended to be driven by open drain, open collector or contact switch.

☞ It is recommended to provide accessible test points directly connected to the **PWR_ON** input pin.

2.3.2 Module power-off

The proper graceful power-off procedure of the LEXI-R520 modules, with storage of the current parameter settings in module's non-volatile memory and a clean network detach, can be triggered by:

- AT+CPWROFF command
- Forcing a low pulse at the **PWR_ON** input pin, for a valid time period (see section 4.2.8, module normal graceful switch-off)

A faster power-off procedure of the LEXI-R520 modules, with storage of current parameter settings in the module's non-volatile memory, but without a clean network detach, can be triggered by:

- AT+CFUN=10 command
- Forcing a rising edge at the GPIO pin configured with faster power-off function (see section 2.7, faster switch-off)

An abrupt emergency hardware shutdown of the modules, without saving current parameter settings in the module's non-volatile memory and without clean network detach, can be executed by:

- Forcing a low pulse at the **PWR_ON** input pin, for a valid time period (see section 4.2.8, module emergency hardware shutdown)

An abrupt under-voltage shutdown occurs on the LEXI-R520 modules when the **VCC** supply is removed. If this event occurs, it is not possible to store the current parameter settings in the module's non-volatile memory or to perform a clean network detach.

An over-temperature or an under-temperature shutdown occurs on the LEXI-R520 modules when the temperature measured within the module reaches the dangerous area (see 4.2.15), if the optional smart temperature supervisor feature is enabled and configured by the dedicated AT command.

2.3.3 Module reset

LEXI-R520 modules can be reset (re-booted), saving current parameter settings in the module's non-volatile memory and performing a proper network detach, by:

- AT+CFUN=16 command. This causes a graceful software reset of the module.

An abrupt software reset of the module is executed by applying a low pulse at the **RESET_N** input pin, which is normally set high by an internal pull-up, for a valid time period (see section 4.2.9). The current parameter settings are not saved in the module's non-volatile memory and a proper network detach is not performed.

The **RESET_N** line is intended to be driven by open drain, open collector or contact switch.

☞ It is recommended to provide accessible test point directly connected to the **RESET_N** input pin.

2.4 SIM

2.4.1 SIM interface

LEXI-R520 modules provide an interface on the **VSIM**, **SIM_IO**, **SIM_CLK**, and **SIM_RST** pins to connect an external SIM card/chip. Both 1.8 V and 3.0 V SIM types are supported. Activation and deactivation with an automatic voltage switch from 1.8 V to 3.0 V is implemented according to the ISO-IEC 7816-3 specifications.

2.4.2 SIM detection

The **GPIO6** pin of LEXI-R520 modules is a 1.8 V digital input which can be configured as an external interrupt to detect the SIM card presence (as a feature which can be optionally used), as intended to be properly connected to the mechanical switch of an external SIM card holder.

2.5 Serial communication

The LEXI-R520 module provides the following serial communication interfaces:

- UART interfaces, available for communications with host application processor (2.5.1)
- USB 2.0 compliant interface, available for diagnostics only (2.5.2)
- SPI interface, available for diagnostic (2.5.3)
- SDIO interface, available for diagnostic (2.5.4)
- I2C bus compatible interface, available for communications with external I2C devices (2.5.5)

2.5.1 UART interfaces

LEXI-R520 modules include 1.8 V unbalanced asynchronous serial interfaces for communication with external application host processor(s). UART interfaces can be configured by dedicated AT command in the following variants:

- **Variant 0** (default configuration), consists of a single UART interface that supports AT commands, data communication, multiplexer protocol functionality, FW update by means of FOAT or by means of the u-blox EasyFlash tool, and provides the following lines:
  - Data lines (**RXD** as output, **TXD** as input),
  - Hardware flow control lines (**CTS** as output, **RTS** as input),
  - Modem status and control lines (**DTR** as input, **RI** as output)

- **Variant 1**, consists of a single UART interface that supports AT commands, data communication, multiplexer protocol functionality, FW update by means of FOAT or by means of the u-blox EasyFlash tool, and provides the following lines:
  - Data lines (**RXD** as output, **TXD** as input),
  - Hardware flow control lines (**CTS** as output, **RTS** as input),
  - Modem status and control lines (**DTR** as input, **DSR** as output, **DCD** as output, **RI** as output)
- **Variants 2, 3 and 4**, consists of two UART interfaces plus ring indication and DTR functions:
  - First primary UART interface supports AT commands, data communication, multiplexer protocol functionality, FW update by means of FOAT or by means of the u-blox EasyFlash tool, and provides the following lines:
    - Data lines (**RXD** as output, **TXD** as input),
    - Hardware flow control lines (**CTS** as output, **RTS** as input),
  - Second auxiliary UART interface supports AT commands (variant 2 only), data communication (variant 2 only), FW update by means of FOAT (variant 2 only), diagnostic trace logging (variant 3 only), and GNSS tunneling (variant 4 only), and provides the following lines:
    - Data lines (**DCD** as data output, **DTR** as data input),
    - Hardware flow control lines (**RI** as flow control output, **DSR** as flow control input),
  - Ring indication function over the GPIO pin configured with RI function (see section 2.7)

UART general features, valid for all variants, are:

- Serial port with RS-232 functionality conforming to the ITU-T V.24 recommendation [8], with CMOS compatible levels (0 V for low data bit or ON state, and 1.8 V for high data bit or OFF state)
- Hardware flow control (default value) or none flow control are supported
- UART power saving indication available on HW flow control output, if HW flow control is enabled: the line is driven to the OFF state when the module is not prepared to accept data by the UART
- One-shot autobauding is supported and it is enabled by default: automatic baud rate detection is performed only once, at module start up. After the detection, the module works at the fixed baud rate (the detected one) and the baud rate can only be changed via +IPR AT command
- The following baud rates are supported and can be auto detected: 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s, 230400 bit/s, 460800 bit/s, 921600 bit/s
- The following baud rates are supported but cannot be auto detected: 3000000 bit/s, 3250000 bit/s
- The default frame format is 8N1 (8 data bits, no parity, 1 stop bit)
- The following frame formats are supported: 8N1, 8N2, 8E1, 8O1, 7N1, 7E1, 7O1

The UART interfaces can be conveniently configured through AT commands.

☞ It is highly recommended to provide accessible test points directly connected to the **TXD** and **RXD** pins for FW upgrade purpose.

☞ Accessible test points directly connected to the **DCD** and **DTR** pins may be provided for diagnostic purpose, alternatively to the highly recommended accessible test points provided on the USB interface pins.

2.5.1.1 Multiplexer protocol

LEXI-R520 modules include multiplexer functionality as per 3GPP TS 27.010 [6] on the primary UART interface physical link. This is a data link protocol which uses HDLC-like framing and operates between the module (DCE) and the application processor (DTE), allowing a number of simultaneous sessions over the physical link (primary UART).

When USIO variant 0 or 1 is set, the following virtual channels are defined:

- Channel 0: control channel
- Channel 1 – 3: AT commands / data communication
- Channel 4: GNSS tunneling

When USIO variant 2 is set, AT commands and data communication are available on the second auxiliary UART, and the following virtual channels are defined on the primary UART:

- Channel 0: control channel
- Channel 1 – 2: AT commands / data communication
- Channel 3: GNSS tunneling

When USIO variant 3 is set, diagnostic trace log is available on the second auxiliary UART, and the following virtual channels are defined on the primary UART:

- Channel 0: control channel
- Channel 1 – 3: AT commands / data communication
- Channel 4: GNSS tunneling

When USIO variant 4 is set, GNSS tunneling is available on the second auxiliary UART, and the following virtual channels are defined on the primary UART:

- Channel 0: control channel
- Channel 1 – 3: AT commands / data communication

2.5.2 USB interface

LEXI-R520 modules include a high-speed USB 2.0 compliant interface with a maximum 480 Mbit/s data rate according to the USB 2.0 specification [9]. The module itself acts as a USB device and can be connected to any USB host equipped with compatible drivers.

The USB interface is available for diagnostic purpose only.

The **USB_D+** / **USB_D-** lines carry the USB data and signaling, while the **VUSB_DET** pin represents the input to enable the USB interface by applying an external valid USB VBUS voltage (5.0 V typical).

☞ It is highly recommended to provide accessible test points directly connected to the USB interface pins (**VUSB_DET**, **USB_D+**, **USB_D-**) for diagnostic purpose.

2.5.3 SPI interface

☞ The SPI interface is not supported by current LEXI-R520 product version, except for diagnostic.

LEXI-R520 modules include a 1.8V Serial Peripheral Interface over the **SDIO_D0**, **SDIO_D1**, **SDIO_D2** and **SDIO_D3** pins, with SPI_MOSI, SPI_MISO, SPI_CLK and SPI_CS alternative function respectively, with the module acting as SPI host.

2.5.4 SDIO interface

☞ The SDIO interface is not supported by current LEXI-R520 product version, except for diagnostic.

LEXI-R520 modules include a 1.8V 4-bit Secure Digital Input Output interface over the **SDIO_D0**, **SDIO_D1**, **SDIO_D2**, **SDIO_D3**, **SDIO_CLK** and **SDIO_CMD** pins, with the module acting a an SDIO host.

☞ Accessible test points directly connected to the **SDIO_D0**, **SDIO_D1**, **SDIO_D2** and **SDIO_D3** pins may be provided for diagnostic purpose, alternatively to the highly recommended accessible test points provided on the USB interface pins.

2.5.5 I2C interface

LEXI-R520 modules include a 1.8V I2C-bus compatible interface over the **SDA** and **SCL** pins, available to communicate with an external u-blox GNSS receiver and/or with compatible external I2C devices: the LEXI-R520 module acts as an I2C host that can communicate with I2C devices in accordance with the I2C bus specifications [10].

2.6 ADC

LEXI-R520 modules include an Analog-to-Digital Converter input pin, **ADC**, configurable via a dedicated AT command.

2.7 GPIO

LEXI-R520 modules include pins that can be configured as general-purpose input/output or to provide custom functions as summarized in Table 4.

Function	Description	Default GPIO	Configurable GPIOs
General purpose output	Output to set the high or the low digital level	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, ANT_ON
General purpose input	Input to sense high or low digital level	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, ANT_ON
Network status indication	Output indicating cellular network status: registered, data transmission, no service	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, ANT_ON
External GNSS supply enable	Output to enable/disable the supply of an external u-blox GNSS receiver connected to the LEXI-R520 module by I2C	-	GPIO2
External GNSS data ready	Input to sense when an external u-blox GNSS receiver connected to the LEXI-R520 module is ready for sending data over the I2C interface	-	GPIO3
SIM card detection	Input for SIM card physical presence detection, to optionally enable / disable SIM interface upon detection of external SIM card physical insertion / removal	-	GPIO6
Module status indication	Output indicating module status: power-off or deep-sleep mode versus idle, active or connected mode	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, ANT_ON
Module operating mode indication	Output indicating module operating mode: power-off, deep-sleep or idle mode versus active or connected mode	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, ANT_ON
Ring indicator	Output providing events indicator	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, ANT_ON
Last gasp	Input to trigger last gasp notification	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5
Faster switch-off	Input with internal pull-down to trigger a faster shutdown (as AT+CFUN=10) by applying a rising edge	-	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5
ANT_ON	Output to control the supply of an external active GPS antenna and/or LNA, synced with SpotNow activities	-	ANT_ON
Pin disabled	Tri-state with an internal active pull-down enabled	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, ANT_ON	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, ANT_ON

Table 4: GPIO custom functions configuration

2.8 Cellular antenna dynamic tuner interface

LEXI-R520 modules include two output pins (named **RFCTRL1** and **RFCTRL2**) that can optionally be used to control in real time an external antenna tuning IC, as the two pins change their output value dynamically according to the specific current LTE band in use by the module. Table 5 lists the default factory-programmed configuration that can be changed by dedicated AT command.

RFCTRL1	RFCTRL2	LTE frequency band in use
0	0	B71 (< 700 MHz)
0	1	B12, B13, B28, B85 (700..800 MHz)
1	0	B5, B8, B18, B19, B20, B26 (800..900 MHz)
1	1	B1, B2, B3, B4, B25, B66 (> 1000 MHz)

Table 5: LEXI-R520 modules antenna dynamic tuning truth table (default factory-programmed configuration)

2.9 Reserved pin (RSVD)

LEXI-R520 modules have a pin reserved for future use, marked as **RSVD**. This pin is to be left unconnected on the application board.

3 Pin definition

3.1 Pin assignment

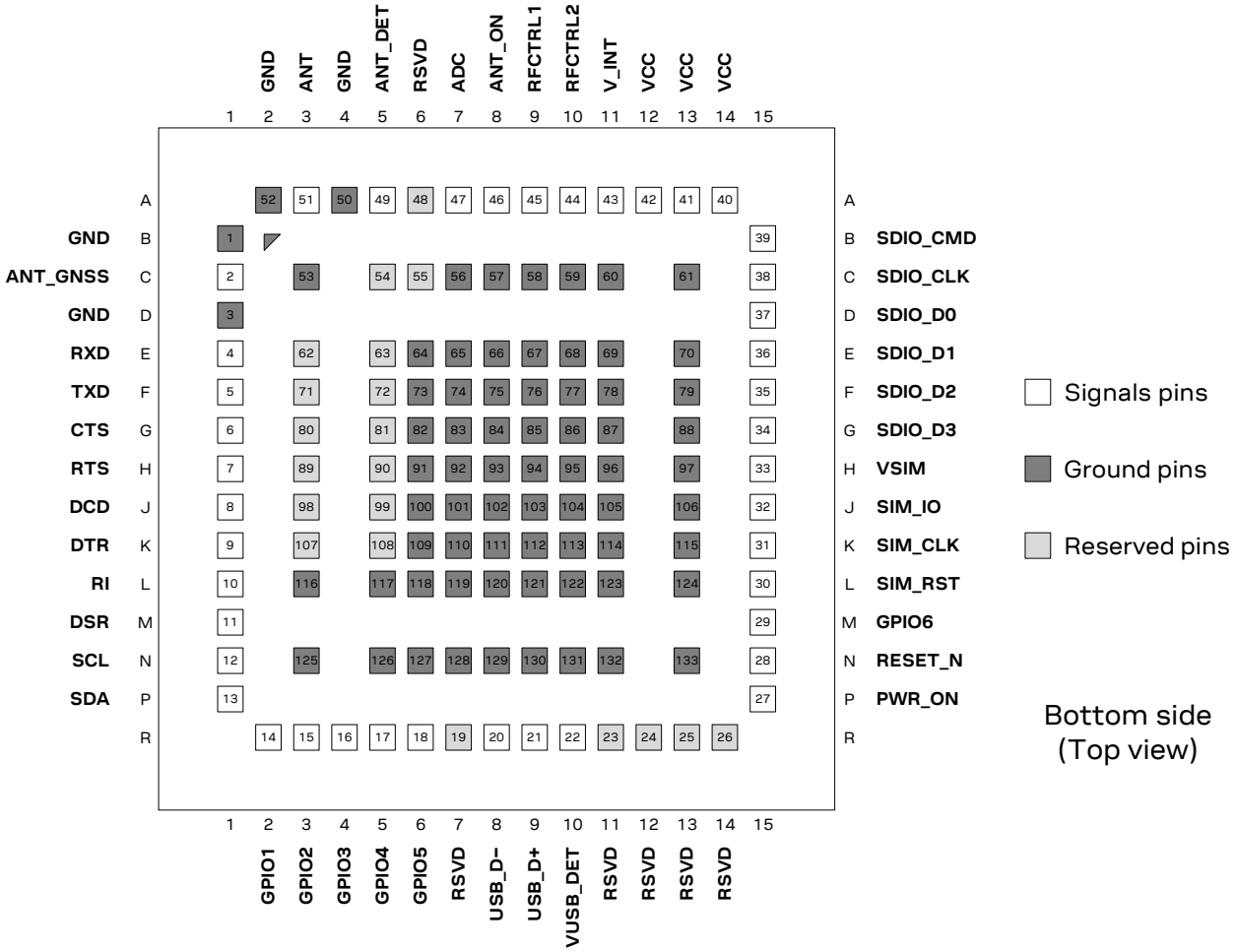


Figure 2: LEXI-R520 module pin assignment (top view)

ID	No	Name	Power domain	I/O	Description	Remarks
A2	52	GND	-	N/A	Ground	All the GND pins must be connected to ground.
A3	51	ANT	-	I/O	Cellular antenna	RF input/output for cellular Rx/Tx antenna. 50 Ω nominal impedance. See section 2.2.1 and 4.2.5 for details.
A4	50	GND	-	N/A	Ground	All the GND pins must be connected to ground.
A5	49	ANT_DET	ADC	I	Antenna detection	Antenna presence detection function. See section 2.2.2 for functional description. See section 4.2.7 for detailed electrical specs.
A6	48	RSVD	-	N/A	Reserved pin	Leave unconnected.
A7	47	ADC	ADC	I	ADC input	12-bit Analog to Digital Converter input. See section 2.6 for functional description. See section 4.2.14 for detailed electrical specs.
A8	46	ANT_ON	GDI	O	GPS Antenna / LNA supply control	Digital output to optionally control the supply of an external active GPS antenna or LNA. Push-pull output type. See section 2.2.4 for functional description. See section 4.2.12 for detailed electrical specs.

ID	No	Name	Power domain	I/O	Description	Remarks
A9	45	RFCTRL1	GDI	O	RF GPIO for cellular antenna tuning	Digital output to optionally control an antenna tuning IC. Push-pull output type. See section 2.8 for functional description. See section 4.2.12 for detailed electrical specs.
A10	44	RFCTRL2	GDI	O	RF GPIO for cellular antenna tuning	Digital output to optionally control an antenna tuning IC. Push-pull output type. See section 2.8 for functional description. See section 4.2.12 for detailed electrical specs.
A11	43	V_INT	-	O	Generic Digital Interfaces supply output	V_INT = 1.8 V (typical) supply generated by the module when is switched on, outside low power deep sleep mode. See section 2.1.2 for functional description. See section 4.2.3 for detailed electrical specs. Provide test point for diagnostic purposes.
A12	42	VCC	-	I	Module supply input	All VCC pins must be connected to external supply. See section 2.1.1 for functional description. See section 4.2.3 and 4.2.4 for detailed electrical specs.
A13	41	VCC	-	I	Module supply input	All VCC pins must be connected to external supply. See section 2.1.1 for functional description. See section 4.2.3 and 4.2.4 for detailed electrical specs.
A14	40	VCC	-	I	Module supply input	All VCC pins must be connected to external supply. See section 2.1.1 for functional description. See section 4.2.3 and 4.2.4 for detailed electrical specs.
B1	1	GND	-	N/A	Ground	All the GND pins must be connected to ground.
B15	39	SDIO_CMD	GDI	I/O	SDIO command	SDIO not supported by current product version. See section 2.5.4 for functional description. See section 4.2.12 for detailed electrical specs.
C1	2	ANT_GNSS	-	I	GPS antenna	RF input for GPS Rx antenna. 50 Ω nominal impedance. See section 2.2.2 and Table 2 for functional description.
C3	53	GND	-	N/A	Ground	All the GND pins must be connected to ground.
C5	54	RSVD	-	N/A	Reserved pin	Leave unconnected.
C6	55	RSVD	-	N/A	Reserved pin	Leave unconnected.
C7	56	GND	-	N/A	Ground	All the GND pins must be connected to ground.
C8	57	GND	-	N/A	Ground	All the GND pins must be connected to ground.
C9	58	GND	-	N/A	Ground	All the GND pins must be connected to ground.
C10	59	GND	-	N/A	Ground	All the GND pins must be connected to ground.
C11	60	GND	-	N/A	Ground	All the GND pins must be connected to ground.
C13	61	GND	-	N/A	Ground	All the GND pins must be connected to ground.
C15	38	SDIO_CLK	GDI	O	SDIO serial clock	SDIO not supported by current product version. See section 2.5.4 for functional description. See section 4.2.12 for detailed electrical specs.
D1	3	GND	-	N/A	Ground	All the GND pins must be connected to ground.
D15	37	SDIO_D0	GDI	I/O / O	SDIO serial data [0] / SPI_MOSI	SDIO not supported by current product version. Pin alternatively configurable as SPI_MOSI, for diagnostic. See section 2.5.4 for functional description. See section 4.2.12 for detailed electrical specs.
E1	4	RXD	GDI	O	UART data output	Circuit 104 in ITU-T V.24 (RxD data output, push-pull, idle high, active low). See section 2.5.1 for functional description. See section 4.2.12 for detailed electrical specs. Provide test point for FW upgrade purpose.

ID	No	Name	Power domain	I/O	Description	Remarks
E3	62	RSVD	-	N/A	Reserved pin	Leave unconnected.
E5	63	RSVD	-	N/A	Reserved pin	Leave unconnected.
E6	64	GND	-	N/A	Ground	All the GND pins must be connected to ground.
E7	65	GND	-	N/A	Ground	All the GND pins must be connected to ground.
E8	66	GND	-	N/A	Ground	All the GND pins must be connected to ground.
E9	67	GND	-	N/A	Ground	All the GND pins must be connected to ground.
E10	68	GND	-	N/A	Ground	All the GND pins must be connected to ground.
E11	69	GND	-	N/A	Ground	All the GND pins must be connected to ground.
E13	70	GND	-	N/A	Ground	All the GND pins must be connected to ground.
E15	36	SDIO_D1	GDI	I/O / I	SDIO serial data [1] / SPI_MISO	SDIO not supported by current product version. Pin alternatively configurable as SPI_MISO, for diagnostic. See section 2.5.4 for functional description. See section 4.2.12 for detailed electrical specs.
F1	5	TXD	GDI	I	UART data input	Circuit 103 in ITU-T V.24 (TxD data input, idle high, active low, with internal active pull-up enabled). See section 2.5.1 for functional description. See section 4.2.12 for detailed electrical specs. Provide test point for FW upgrade purpose.
F3	71	RSVD	-	N/A	Reserved pin	Leave unconnected.
F5	72	RSVD	-	N/A	Reserved pin	Leave unconnected.
F6	73	GND	-	N/A	Ground	All the GND pins must be connected to ground.
F7	74	GND	-	N/A	Ground	All the GND pins must be connected to ground.
F8	75	GND	-	N/A	Ground	All the GND pins must be connected to ground.
F9	76	GND	-	N/A	Ground	All the GND pins must be connected to ground.
F10	77	GND	-	N/A	Ground	All the GND pins must be connected to ground.
F11	78	GND	-	N/A	Ground	All the GND pins must be connected to ground.
F13	79	GND	-	N/A	Ground	All the GND pins must be connected to ground.
F15	35	SDIO_D2	GDI	I/O / O	SDIO serial data [2] / SPI_CLK	SDIO not supported by current product version. Pin is alternatively configurable as SPI_CLK, for diagnostic. See section 2.5.4 for functional description. See section 4.2.12 for detailed electrical specs.
G1	6	CTS	GDI	O	UART clear to send	Circuit 106 in ITU-T V.24 (CTS hardware flow control output, push-pull, idle high, active low). See section 2.5.1 for functional description. See section 4.2.12 for detailed electrical specs.
G3	80	RSVD	-	N/A	Reserved pin	Leave unconnected.
G5	81	RSVD	-	N/A	Reserved pin	Leave unconnected.
G6	82	GND	-	N/A	Ground	All the GND pins must be connected to ground.
G7	83	GND	-	N/A	Ground	All the GND pins must be connected to ground.
G8	84	GND	-	N/A	Ground	All the GND pins must be connected to ground.
G9	85	GND	-	N/A	Ground	All the GND pins must be connected to ground.
G10	86	GND	-	N/A	Ground	All the GND pins must be connected to ground.
G11	87	GND	-	N/A	Ground	All the GND pins must be connected to ground.
G13	88	GND	-	N/A	Ground	All the GND pins must be connected to ground.
G15	34	SDIO_D3	GDI	I/O / O	SDIO serial data [3] / SPI_CS	SDIO not supported by current product version. Pin alternatively configurable as SPI_CS, for diagnostic. See section 2.5.4 for functional description. See section 4.2.12 for detailed electrical specs.

ID	No	Name	Power domain	I/O	Description	Remarks
H1	7	RTS	GDI	I	UART request to send	Circuit 105 in ITU-T V.24 (RTS flow control input, idle high, active low, with internal active pull-up enabled). See section 2.5.1 for functional description. See section 4.2.12 for detailed electrical specs.
H3	89	RSVD	-	N/A	Reserved pin	Leave unconnected.
H5	90	RSVD	-	N/A	Reserved pin	Leave unconnected.
H6	91	GND	-	N/A	Ground	All the GND pins must be connected to ground.
H7	92	GND	-	N/A	Ground	All the GND pins must be connected to ground.
H8	93	GND	-	N/A	Ground	All the GND pins must be connected to ground.
H9	94	GND	-	N/A	Ground	All the GND pins must be connected to ground.
H10	95	GND	-	N/A	Ground	All the GND pins must be connected to ground.
H11	96	GND	-	N/A	Ground	All the GND pins must be connected to ground.
H13	97	GND	-	N/A	Ground	All the GND pins must be connected to ground.
H15	33	VSIM	-	O	SIM supply output	VSIM = 1.8 V (typical) or 3 V (typical) supply generated by the module according to the external SIM card type, when it is switched on, after the internal boot sequence, outside low power deep sleep mode. See section 2.4.1 for functional description. See section 4.2.10 for detailed electrical specs.
J1	8	DCD	GDI	O / O	UART data carrier detect / AUX UART data output	Circuit 109 in ITU-T V.24 (DCD output, push-pull, idle high, active low), alternatively settable as Second Auxiliary UART RXD (data output, push-pull, idle high, active low). See section 2.5.1 for functional description. See section 4.2.12 for detailed electrical specs.
J3	98	RSVD	-	N/A	Reserved pin	Leave unconnected.
J5	99	RSVD	-	N/A	Reserved pin	Leave unconnected.
J6	100	GND	-	N/A	Ground	All the GND pins must be connected to ground.
J7	101	GND	-	N/A	Ground	All the GND pins must be connected to ground.
J8	102	GND	-	N/A	Ground	All the GND pins must be connected to ground.
J9	103	GND	-	N/A	Ground	All the GND pins must be connected to ground.
J10	104	GND	-	N/A	Ground	All the GND pins must be connected to ground.
J11	105	GND	-	N/A	Ground	All the GND pins must be connected to ground.
J13	106	GND	-	N/A	Ground	All the GND pins must be connected to ground.
J15	32	SIM_IO	SIM	I/O	SIM data	Internal pull-up resistor to VSIM. See section 2.4.1 for functional description. See section 4.2.10 for detailed electrical specs.
K1	9	DTR	GDI	I / I	UART data terminal ready / AUX UART data input	Circuit 108/2 in ITU-T V. 24 (DTR input, idle high, active low, with internal active pull-up enabled), alternatively settable as second auxiliary UART TXD (data input, idle high, active low, with internal active pull-up enabled). See section 2.5.1 for functional description. See section 4.2.12 for detailed electrical specs.
K3	107	RSVD	-	N/A	Reserved pin	Leave unconnected.
K5	108	RSVD	-	N/A	Reserved pin	Leave unconnected.
K6	109	GND	-	N/A	Ground	All the GND pins must be connected to ground.
K7	110	GND	-	N/A	Ground	All the GND pins must be connected to ground.
K8	111	GND	-	N/A	Ground	All the GND pins must be connected to ground.
K9	112	GND	-	N/A	Ground	All the GND pins must be connected to ground.
K10	113	GND	-	N/A	Ground	All the GND pins must be connected to ground.
K11	114	GND	-	N/A	Ground	All the GND pins must be connected to ground.

ID	No	Name	Power domain	I/O	Description	Remarks
K13	115	GND	-	N/A	Ground	All the GND pins must be connected to ground.
K15	31	SIM_CLK	SIM	O	SIM clock	See section 2.4.1 for functional description. See section 4.2.10 for detailed electrical specs.
L1	10	RI	GDI	O / O	UART ring indicator / AUX UART clear to send	Circuit 125 in ITU-T V.24 (RI output, push-pull, idle high, active low), alternatively configurable as second auxiliary UART CTS (HW flow control output, push-pull, idle high, active low). See section 2.5.1 for functional description. See section 4.2.12 for detailed electrical specs.
L3	116	GND	-	N/A	Ground	All the GND pins must be connected to ground.
L5	117	GND	-	N/A	Ground	All the GND pins must be connected to ground.
L6	118	GND	-	N/A	Ground	All the GND pins must be connected to ground.
L7	119	GND	-	N/A	Ground	All the GND pins must be connected to ground.
L8	120	GND	-	N/A	Ground	All the GND pins must be connected to ground.
L9	121	GND	-	N/A	Ground	All the GND pins must be connected to ground.
L10	122	GND	-	N/A	Ground	All the GND pins must be connected to ground.
L11	123	GND	-	N/A	Ground	All the GND pins must be connected to ground.
L13	124	GND	-	N/A	Ground	All the GND pins must be connected to ground.
L15	30	SIM_RST	SIM	O	SIM reset	See section 2.4.1 for functional description. See section 4.2.10 for detailed electrical specs.
M1	11	DSR	GDI	O / I	UART data set ready / AUX UART request to send	Circuit 107 in ITU-T V.24 (DSR output, push-pull, idle high, active low), alternatively configurable as second auxiliary UART RTS (HW flow control input, idle high, active low, with internal active pull-up enabled). See section 2.5.1 for functional description. See section 4.2.12 for detailed electrical specs.
M15	29	GPIO6	GDI	I/O	Pin for SIM card detection	Configurable GPIO, alternatively configurable as input pin for SIM card detection. Push-pull output type. See sections 2.4.2 and 2.7 for functional description. See section 4.2.12 for detailed electrical specs.
N1	12	SCL	I2C	O	I2C bus clock line	Fixed open drain. Internal active pull-up. Idle high, active low. See section 2.5.5 for functional description. See section 4.2.11 for detailed electrical specs.
N3	125	GND	-	N/A	Ground	All the GND pins must be connected to ground.
N5	126	GND	-	N/A	Ground	All the GND pins must be connected to ground.
N6	127	GND	-	N/A	Ground	All the GND pins must be connected to ground.
N7	128	GND	-	N/A	Ground	All the GND pins must be connected to ground.
N8	129	GND	-	N/A	Ground	All the GND pins must be connected to ground.
N9	130	GND	-	N/A	Ground	All the GND pins must be connected to ground.
N10	131	GND	-	N/A	Ground	All the GND pins must be connected to ground.
N11	132	GND	-	N/A	Ground	All the GND pins must be connected to ground.
N13	133	GND	-	N/A	Ground	All the GND pins must be connected to ground.
N15	28	RESET_N	GDI	I	External reset input	Internal active pull-up. Active low. See section 2.3.3 for functional description. See section 4.2.9 for detailed electrical specs. Provide test point for diagnostic purposes.
P1	13	SDA	I2C	I/O	I2C bus data line	Fixed open drain. Internal active pull-up. Idle high, active low. See section 2.5.5 for functional description. See section 4.2.11 for detailed electrical specs.

ID	No	Name	Power domain	I/O	Description	Remarks
P15	27	PWR_ON	POS	I	Power-on / power-off input	Internal active pull-up. Active low. See section 2.3.1 and 2.3.2 for functional description. See section 4.2.8 for detailed electrical specs. Provide test point for diagnostic purposes.
R2	14	GPIO1	GDI	I/O	GPIO	Configurable GPIO. Push-pull output type. See section 2.7 for functional description. See section 4.2.12 for detailed electrical specs.
R3	15	GPIO2	GDI	I/O	GPIO	Configurable GPIO. Push-pull output type. See section 2.7 for functional description. See section 4.2.12 for detailed electrical specs.
R4	16	GPIO3	GDI	I/O	GPIO	Configurable GPIO. Push-pull output type. See section 2.7 for functional description. See section 4.2.12 for detailed electrical specs.
R5	17	GPIO4	GDI	I/O	GPIO	Configurable GPIO. Push-pull output type. See section 2.7 for functional description. See section 4.2.12 for detailed electrical specs.
R6	18	GPIO5	GDI	I/O	GPIO	Configurable GPIO. Push-pull output type. See section 2.7 for functional description. See section 4.2.12 for detailed electrical specs.
R7	19	RSVD	-	N/A	Reserved pin	Leave unconnected.
R8	20	USB_D-	USB	I/O	USB Data Line D-	90 Ω nominal differential impedance. Pull-up, pull-down and series resistors, as required by the USB 2.0 specifications [9], are part of the USB pin driver and shall not be provided externally. USB interface supported for diagnostic purpose only. See section 2.5.2 for functional description. See section 4.2.13 for detailed electrical specs. Provide test point for diagnostic purposes.
R9	21	USB_D+	USB	I/O	USB Data Line D+	90 Ω nominal differential impedance. Pull-up, pull-down and series resistors, as required by USB 2.0 specifications [9], are part of the USB pin driver and shall not be provided externally. USB interface supported for diagnostic purpose only. See section 2.5.2 for functional description. See section 4.2.13 for detailed electrical specs. Provide test point for diagnostic purposes.
R10	22	VUSB_DET	USB	I	USB detect input	Input for VBUS (5 V typical) USB supply sense. USB interface supported for diagnostic purpose only. See section 2.5.2 for functional description. See section 4.2.13 for detailed electrical specs. Provide test point for diagnostic purposes.
R11	23	RSVD	-	N/A	Reserved pin	Leave unconnected.
R12	24	RSVD	-	N/A	Reserved pin	Leave unconnected.
R13	25	RSVD	-	N/A	Reserved pin	Leave unconnected.
R14	26	RSVD	-	N/A	Reserved pin	Leave unconnected.

Table 6: LEXI-R520 pin-out

☞ See appendix A for an explanation of the abbreviations and terms used.

4 Electrical specifications

⚠ Stressing the device above one or more of the ratings listed in the Absolute Maximum Rating section may cause permanent damage. These are stress ratings only. Operating the module at these or at any conditions other than those specified in the Operating Conditions sections (section 4.2) of the specification should be avoided. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

☞ Electrical characteristics are defined according to the verification on a representative number of samples or according to the simulation.

☞ Where application information is given, it is advisory only and does not form part of the specification.

4.1 Absolute maximum rating

☞ Limiting values given below are in accordance with Absolute Maximum Rating System (IEC 134).

Symbol	Description	Condition	Min.	Max.	Unit
VCC	Module supply voltage	Input voltage at VCC pins	-0.3	4.6	V
		Input voltage ramp at VCC pins		130	mV/µs
VUSB_DET	USB detection pin	Input voltage at VUSB_DET pin	-0.3	5.5	V
		Input voltage ramp at VUSB_DET pin		650	mV/µs
USB	USB D+/D- pins	Input voltage at USB interface pins	-0.3	3.6	V
GDI	Generic digital interfaces	Input voltage at generic digital interfaces pins	-0.3	2.3	V
I2C	I2C interface	Input voltage at I2C interface pins	-0.3	2.3	V
SIM	SIM interface	Input voltage at SIM interface pins	-0.3	3.5	V
POS	Power-on input	Input voltage at PWR_ON pin	-0.3	1.65	V
ADC	Antenna detection input	Input DC voltage at ADC and ANT_DET pins	-0.3	1.65	V
P_RF	RF power	Input RF power at ANT and ANT_GNSS pins		3	dBm
Rho_ANT	Antenna ruggedness	Output RF load mismatch ruggedness at ANT pin		10:1	VSWR
Tstg	Storage temperature		-40	+85	°C

Table 7: Absolute maximum ratings

⚠ The product is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the voltage specifications given in the table above, must be limited to values within the specified boundaries by using appropriate protection devices.

4.1.1 Maximum ESD

Parameter	Min	Max	Unit	Remarks
ESD sensitivity for all pins		1000	V	Human Body Model according to JS-001-2017
		500	V	Charged Device Model according to JS-002-2018

Table 8: Maximum ESD ratings

⚠ u-blox cellular modules are electrostatic sensitive devices and require special precautions when handling. See section 7.3 for ESD handling instructions.

4.2 Operating conditions

☞ Unless otherwise indicated, all operating condition specifications are at an ambient temperature of +25 °C.

⚠ Operation beyond the operating conditions is not recommended and extended exposure beyond them may affect device reliability.

4.2.1 Operating temperature range

Parameter	Min.	Typ.	Max.	Unit	Remarks
Normal operating temperature	-20	+25	+65	°C	Operating within 3GPP / ETSI specifications
Extended operating temperature	-40		+85	°C	Operating with possible slight deviation in RF performance outside normal operating range

Table 9: Environmental conditions

4.2.2 Thermal parameters

Symbol	Parameter	Min.	Typ.	Max.	Unit	Remarks
Ψ_{M-A}	Module-to-Ambient thermal parameter		15		°C/W	Thermal characterization parameter $\Psi_{M-A} = (T_M - T_A) / P_H$ proportional to the difference between the internal temperature sensor of the module (T_M) and the ambient temperature (T_A), produced by the module heat power dissipation (P_H), with the module mounted on a board with roughly 9 x 8 cm size, with still air conditions
Ψ_{M-C}	Module-to-Case thermal parameter		7		°C/W	Thermal characterization parameter $\Psi_{M-C} = (T_M - T_C) / P_H$ proportional to the difference between the internal temperature sensor of the module (T_M) and the ambient temperature (T_C), produced by the module heat power dissipation (P_H), with the module mounted on a board with roughly 9 x 8 cm size, with forced air ventilation and with a robust aluminum heat-sink, reducing case-to-ambient thermal resistance as much as possible

Table 10: Thermal characterization parameters of the module

4.2.3 Supply/power pins

Symbol	Parameter	Min.	Typical	Max.	Unit
VCC	Module supply normal operating input voltage [1]	3.3	3.8	4.4	V
	Module supply extended operating input voltage [2]	3.0		4.5	V

Table 11: Input characteristics of the Supply/Power pins

Symbol	Parameter	Min.	Typical	Max.	Unit
VSIM	SIM supply output voltage with 1.8 V external SIM		1.8		V
	SIM supply output voltage with 3.0 V external SIM		3.0		V
V_INT	Generic Digital Interfaces supply output voltage		1.8		V
	Generic Digital Interfaces supply output current capability			70	mA

Table 12: Output characteristics of the Supply/Power pins

[1] Operating within 3GPP / ETSI specifications.
[2] Operating with possible slight deviation in RF performance outside normal operating range. The input voltage has to be above the extended operating range minimum limit to switch-on the module and to avoid possible switch-off of the module.

4.2.4 Current consumption

Mode	Condition	Tx power	Min	Typ[3]	Max	Unit
Power-off mode	Average current value (power-off mode)	--		0.5		µA
PSM deep-sleep mode	Average current value (PSM deep-sleep mode)	--		0.5		µA
Cyclic deep-sleep / active mode (+UPSV: 1)	Average current value (eDRX deep-sleep mode[4] rock bottom floor current)	--		0.5		µA
	Average current value (DRX = 2.56 s, PTW = 20.48 s, eDRX = 655.36 s, +UPSMVER: 8)	--		180		µA
Cyclic idle / active mode (+UPSV: 1)	Average current value (low power idle mode rock bottom floor current)	--		1.4		mA
	Average current value (DRX = 2.56 s, PTW = 20.48 s, eDRX = 655.36 s, +UPSMVER: 0)	--		1.4		mA
	Average current value (DRX = 2.56 s, no eDRX)	--		1.8		mA
	Average current value (DRX = 1.28 s, no eDRX)	--		2.2		mA
Idle mode (+UPSV: 1)	Average current value (airplane mode, +CFUN: 0)	--		1.4		mA
Active mode (+UPSV: 0)	Average current value (DRX = 1.28 s)	--		15		mA
LTE Cat M1 connected mode	Average current value (Tx / Rx data transfer)	Minimum (–50 dBm)		95		mA
		0 dBm		100		mA
		8 dBm		115		mA
		14 dBm		140		mA
		20 dBm		170		mA
		Maximum (23 dBm)		195		mA
	Maximum current value (during Tx only)	Maximum (23 dBm)		395		mA
LTE Cat NB2 connected mode	Average current value (Tx / Rx data transfer)	Minimum (–50 dBm)		85		mA
		0 dBm		90		mA
		8 dBm		100		mA
		14 dBm		110		mA
		20 dBm		125		mA
		Maximum (23 dBm)		135		mA
	Maximum current value (during Tx only)	Maximum (23 dBm)		395		mA

Table 13: VCC current consumption of the LEXI-R520 module

[3] Typical values with matched antenna, VCC = 3.8 V
[4] Supported for eDRX sleep time longer than 70 s

4.2.5 LTE RF characteristics

The LTE Cat M1 / NB2 bands supported by LEXI-R520 modules are defined in Table 2, while Table 14 describes the frequency ranges for each LTE band as per 3GPP TS 36.521-1 [7].

Parameter		Min.	Max.	Unit	Remarks
Frequency range FDD band 71 (600 MHz)	Uplink	663	698	MHz	Module transmits
	Downlink	617	652	MHz	Module receives
Frequency range FDD band 12 (700 MHz)	Uplink	699	716	MHz	Module transmits
	Downlink	729	746	MHz	Module receives
Frequency range FDD band 28 (700 MHz)	Uplink	703	748	MHz	Module transmits
	Downlink	758	803	MHz	Module receives
Frequency range FDD band 85 (700 MHz)	Uplink	698	716	MHz	Module transmits
	Downlink	728	746	MHz	Module receives
Frequency range FDD band 13 (750 MHz)	Uplink	777	787	MHz	Module transmits
	Downlink	746	756	MHz	Module receives
Frequency range FDD band 20 (800 MHz)	Uplink	832	862	MHz	Module transmits
	Downlink	791	821	MHz	Module receives
Frequency range FDD band 26 (850 MHz)	Uplink	814	849	MHz	Module transmits
	Downlink	859	894	MHz	Module receives
Frequency range FDD band 18 (850 MHz)	Uplink	815	830	MHz	Module transmits
	Downlink	860	875	MHz	Module receives
Frequency range FDD band 5 (850 MHz)	Uplink	824	849	MHz	Module transmits
	Downlink	869	894	MHz	Module receives
Frequency range FDD band 19 (850 MHz)	Uplink	830	845	MHz	Module transmits
	Downlink	875	890	MHz	Module receives
Frequency range FDD band 8 (900 MHz)	Uplink	880	915	MHz	Module transmits
	Downlink	925	960	MHz	Module receives
Frequency range FDD band 4 (1700 MHz)	Uplink	1710	1755	MHz	Module transmits
	Downlink	2110	2155	MHz	Module receives
Frequency range FDD band 66 (1700 MHz)	Uplink	1710	1780	MHz	Module transmits
	Downlink	2110	2200	MHz	Module receives
Frequency range FDD band 3 (1800 MHz)	Uplink	1710	1785	MHz	Module transmits
	Downlink	1805	1880	MHz	Module receives
Frequency range FDD band 2 (1900 MHz)	Uplink	1850	1910	MHz	Module transmits
	Downlink	1930	1990	MHz	Module receives
Frequency range FDD band 25 (1900 MHz)	Uplink	1850	1915	MHz	Module transmits
	Downlink	1930	1995	MHz	Module receives
Frequency range FDD band 1 (2100 MHz)	Uplink	1920	1980	MHz	Module transmits
	Downlink	2110	2170	MHz	Module receives

Table 14: LTE operating RF frequency bands

LEXI-R520 modules include a UE Power Class 3 LTE Cat M1 / NB2 transmitter (see Table 2) and an LTE receiver, with output power and characteristics according to 3GPP TS 36.521-1 [7].

The LEXI-R520 module's LTE receiver characteristics are compliant to 3GPP TS 36.521-1 [7], with LTE conducted receiver sensitivity performance described in Table 15 and Table 16.

Parameter	Min.	Typical	Max.	Unit	Remarks
Receiver input sensitivity Band 71 (600 MHz)		–108.0		dBm	Without repetitions
Receiver input sensitivity Band 12 / 28 / 85 (700 MHz)		–108.0		dBm	Without repetitions
Receiver input sensitivity Band 13 (750 MHz)		–108.0		dBm	Without repetitions
Receiver input sensitivity Band 20 (800 MHz)		–108.0		dBm	Without repetitions
Receiver input sensitivity Band 5 / 18 / 19 / 26 (850 MHz)		–107.0		dBm	Without repetitions
Receiver input sensitivity Band 8 (900 MHz)		–107.0		dBm	Without repetitions
Receiver input sensitivity Band 3 (1800 MHz)		–107.0		dBm	Without repetitions
Receiver input sensitivity Band 2 / 25 (1900 MHz)		–107.0		dBm	Without repetitions
Receiver input sensitivity Band 1 / 4 / 66 (2100 MHz)		–107.0		dBm	Without repetitions
Condition: 50 Ω source, throughput > 95%, QPSK modulation, other settings as per clause 7.3EA of 3GPP TS 36.521-1 [7]					

Table 15: LTE Cat M1 receiver sensitivity performance

Parameter	Min.	Typical	Max.	Unit	Remarks
Receiver input sensitivity Band 71 (600 MHz)		-116.0		dBm	Without repetitions
Receiver input sensitivity Band 12 / 28 / 85 (700 MHz)		-116.0		dBm	Without repetitions
Receiver input sensitivity Band 13 (750 MHz)		-116.0		dBm	Without repetitions
Receiver input sensitivity Band 20 (800 MHz)		-115.5		dBm	Without repetitions
Receiver input sensitivity Band 5 / 18 / 19 / 26 (850 MHz)		-115.5		dBm	Without repetitions
Receiver input sensitivity Band 8 (900 MHz)		-115.0		dBm	Without repetitions
Receiver input sensitivity Band 3 (1800 MHz)		-114.0		dBm	Without repetitions
Receiver input sensitivity Band 2 / 25 (1900 MHz)		-115.0		dBm	Without repetitions
Receiver input sensitivity Band 1 / 4 / 66 (2100 MHz)		-115.0		dBm	Without repetitions
Condition: 50 Ω source, throughput > 95%, QPSK modulation, other settings as per clause 7.3F of 3GPP TS 36.521-1 [7]					

Table 16: LTE Cat NB2 receiver sensitivity performance

4.2.6 SpotNow characteristics

Parameter	Specification
Receiver type	u-blox SpotNow A-GPS
GNSS signals	GPS L1C/A (1575.42 MHz)
Time-To-Fix (TTF)[5]	1 s
Sensitivity[6]	–148 dBm
Position accuracy[7]	5 m
Fix energy[5]	60 uWh

Table 17: SpotNow characteristics and performance

4.2.7 ANT_DET pin

Pin Name	Parameter	Min.	Typ.	Max.	Unit	Remarks
ANT_DET	Output DC current pulse value		30		µA	
	Output DC current pulse time length		2		ms	

Table 18: ANT_DET pin characteristics

4.2.8 PWR_ON pin

Parameter	Min.	Typical	Max.	Unit	Remarks
Low-level input	-0.3		0.2	V	
Pull-up resistance		100		kΩ	Integrated pull-up to internal rail (typ. 1.2 V)
Low-level input current		-15		µA	
PWR_ON low time	0.1		0.9	s	Low time to trigger module switch on from power-off mode
	0.1		0.9	s	Low time to trigger module wake-up from deep-sleep
	1.5			s	Low time to trigger module normal graceful switch off
	17			s	Low time to trigger module emergency hardware shutdown

Table 19: PWR_ON pin characteristics

4.2.9 RESET_N pin

Parameter	Min.	Typical	Max.	Unit	Remarks
Internal supply		1.8			Digital I/O Interfaces supply (V_INT)
Low-level input	-0.3		0.5	V	
Low-level input current	-18	-32	-56	µA	
RESET_N low time	100			ms	Low time to trigger module reset / reboot

Table 20: RESET_N pin characteristics

[5] Commanded starts; all satellites at -130 dBm; aiding available.
[6] Good external LNA; room temperature.
[7] CEP, 50%, static, –130 dBm, > 6 SVs.

4.2.10 SIM pins

The SIM pins are a dedicated interface to the external SIM card/chip. The electrical characteristics fulfill the regulatory specification requirements. The values in Table 21 are for information only.

Parameter	Min.	Typ.	Max.	Unit	Remarks
Internal supply domain for SIM interface		1.8		V	VSIM, with external 1.8 V SIM type
		3.0		V	VSIM, with external 3.0 V SIM type
Low-level input	-0.3		0.2*VSIM	V	
High-level input	0.6*VSIM		VSIM+0.3	V	
Low-level output		0.0		V	
High-level output		VSIM		V	
Internal pull-up resistor on SIM_IO		4.7		kΩ	Internal pull-up to VSIM supply
Clock frequency on SIM_CLK		3.13		MHz	

Table 21: SIM pins characteristics

4.2.11 I2C pins

I2C lines (**SCL** and **SDA**) are compliant to the I2C-bus standard mode specification. See the I2C-bus specification [10] for detailed electrical characteristics.

Parameter	Min	Typical	Max	Unit	Remarks
Internal supply for I2C domain		1.8		V	Digital I/O Interfaces supply (V_INT)
Low-level input	-0.3		0.5	V	
High-level input	1.3		2.1	V	
Low-level output		0.0		V	
Pull-up input current		-450		µA	

Table 22: I2C pins characteristics

4.2.12 Generic Digital Interfaces pins

Parameter	Min	Typical	Max	Unit	Remarks
Internal supply for GDI domain		1.8		V	Digital I/O Interfaces supply (V_INT)
Low-level input	-0.3		0.5	V	
High-level input	1.3		2.1	V	
Low-level output		0.0	0.4	V	
High-level output	1.4	1.8		V	
Input leakage current			1	µA	0 V < V_{IN} < 1.8 V
Output high driver strength	3.28	5.22	7.92	mA	V_{OUT} = 1.4
Output low driver strength	3.02	5.41	8.63	mA	V_{OUT} = 0.4
Pull-up input current	-18	-32	-56	µA	
Pull-down input current	15	30	56	µA	

Table 23: GDI pins characteristics

4.2.13 USB pins

USB data lines (**USB_D+** / **USB_D–**) are compliant with the USB 2.0 high-speed specification. See the Universal Serial Bus specification revision 2.0 [9] for detailed electrical characteristics. The values in Table 24 related to USB 2.0 high-speed physical layer specifications are for information only.

Parameter	Min.	Typical	Max.	Unit	Remarks
VUSB_DET pin, High-level input	4.40	5.00	5.25	V	
High-speed squelch detection threshold (input differential signal amplitude)	100		150	mV	
High speed disconnect detection threshold (input differential signal amplitude)	525		625	mV	
High-speed data signaling input common mode voltage range	–50		500	mV	
High-speed idle output level	–10		10	mV	
High-speed data signaling output high level	360		440	mV	
High-speed data signaling output low level	–10		10	mV	
Chirp J level (output differential voltage)	700		1100	mV	
Chirp K level (output differential voltage)	–900		–500	mV	

Table 24: USB pins characteristics

4.2.14 ADC pin

Parameter	Min.	Typical	Max.	Unit	Remarks
Resolution		12		Bits	
Input voltage range	0.25		1.15	V	
Input resistance	1			MΩ	With respect to GND

Table 25: Analog to Digital Converter input pin (ADC) characteristics

4.2.15 Smart temperature supervisor

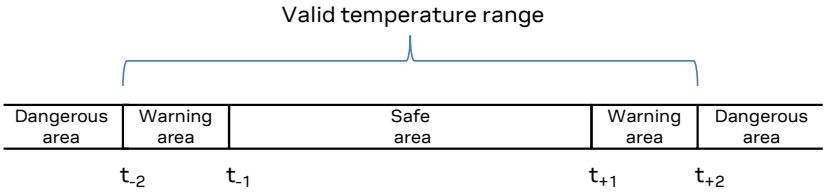


Figure 3: Temperature range and limits

Symbol	Parameter	Temperature
t_{-2}	Low temperature shutdown	–40 °C
t_{-1}	Low temperature warning	–30 °C
t_{+1}	High temperature warning	+77 °C
t_{+2}	High temperature shutdown	+97 °C

Table 26: Thresholds definition for the "Smart temperature supervisor" feature on the LEXI-R520 modules

☞ The sensor measures the board temperature inside the shield, which can differ from the ambient temperature.

4.3 Parameters for ATEX applications

This section provides useful parameters and information to integrate LEXI-R520 modules in applications intended for use in areas with potentially explosive atmospheres (ATEX), including:

- Total internal capacitance and inductance of the modules (see Table 27)
- Maximum RF output power at the antenna (**ANT**) pin of the modules (see Table 28)

☞ For any device integrating the LEXI-R520 modules and intended for use in potentially explosive atmospheres, check the detailed requisites on the pertinent normative for the application, as for example the IEC 60079-0 [12], IEC 60079-11 [13], and IEC 60079-26 [14] standards. The requirements must be fulfilled according to the exact applicable standards.

☞ The certification of the application device that integrates a LEXI-R520 module and the compliance of the application device with all the applicable certification schemes, directives and standards required for use in potentially explosive atmospheres are the sole responsibility of the application device manufacturer.

Table 27 describes the maximum total internal capacitance and the maximum total internal inductance, considering internal parts tolerance, of the LEXI-R520 modules.

Parameter	Description	Value	Unit
Ci	Maximum total internal capacitance	180	µF
Li	Maximum total internal inductance	2.79	µH

Table 27: LEXI-R520 maximum total internal capacitance and maximum total internal inductance

Table 28 describes the maximum RF output power transmitted by LEXI-R520 modules from the antenna (**ANT**) pin as Power Class 3 User Equipment for the LTE bands.

Parameter	Description	Value	Unit
ANT Pout	Maximum RF output power from ANT pin	25.00	dBm

Table 28: LEXI-R520 maximum RF output power

☞ LEXI-R520 modules do not contain internal blocks that increase the input voltage (such as step-up, duplicators, or boosters) except for the antenna (**ANT**) pin, for which the maximum RF output power shown in Table 28.

5 Mechanical specifications

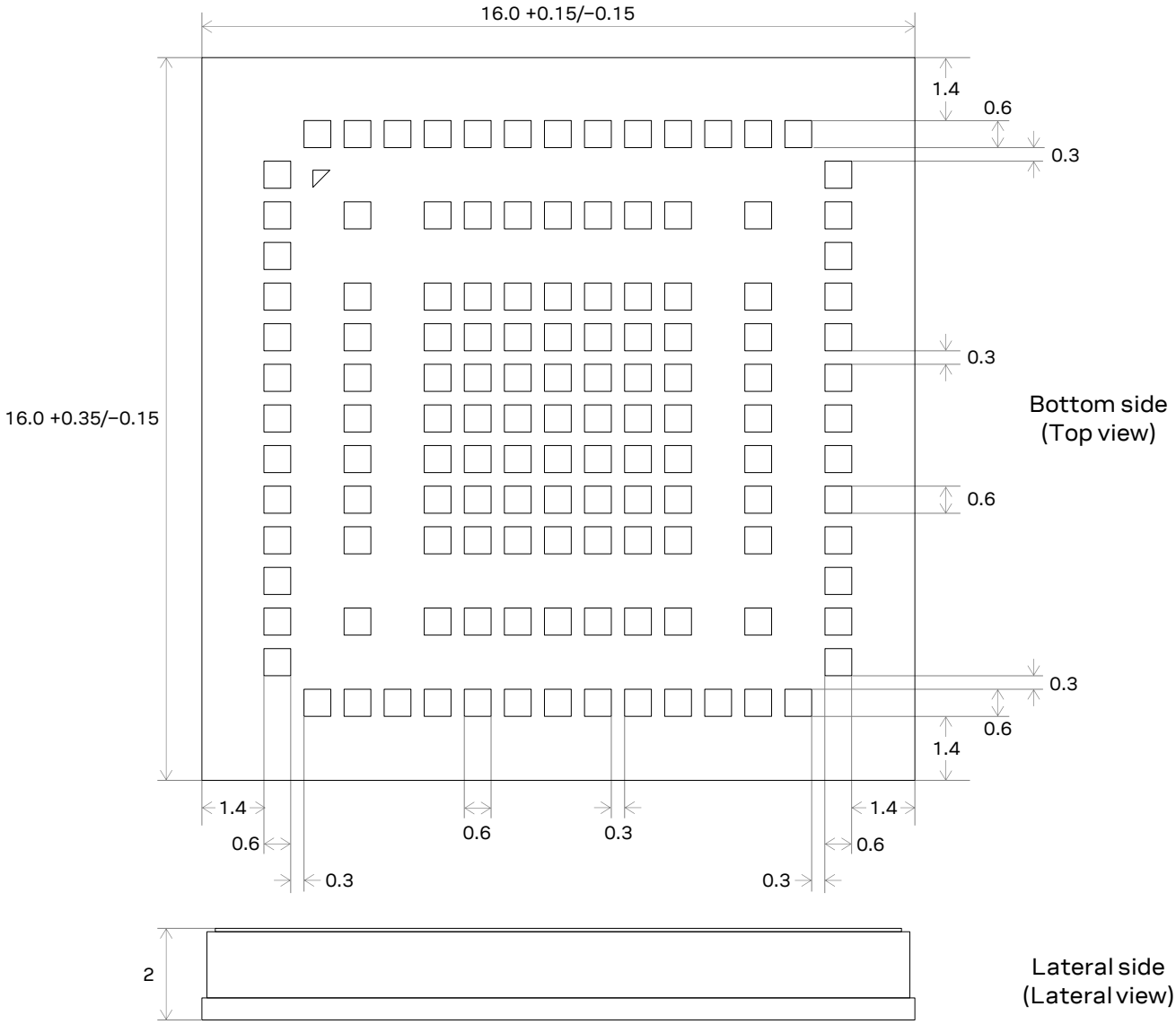


Figure 4: LEXI-R520 dimensions, typical values [mm]

Actual geometries of the pads may depend on related implementation of the solder resist mask openings and the underlying copper layer.

For information regarding Footprint and Paste Mask recommended for the application board integrating the cellular module, see the LEXI-R520 system integration manual [2] .

6 Qualification and approvals

6.1 Reliability tests

Reliability tests for LEXI-R520 modules are executed according to u-blox qualification policy, based on AEC-Q104 standard.

6.2 Approvals

LEXI-R520 modules comply with the Directive 2011/65/EU of the European Parliament and the Council on the Restriction of Use of certain Hazardous Substances in Electrical and Electronic Equipment (EU RoHS 2) and its amendment Directive (EU) 2015/863 (EU RoHS 3).

LEXI-R520 modules are RoHS 3 compliant.

No natural rubbers, hygroscopic materials, or materials containing asbestos are employed.

Table 29 summarizes the main approvals for LEXI-R520 modules.

Certification	LEXI-R520
CE Europe	•
FCC United Sates	•
FCC ID	XPYUBX23KM02
ISED Canada	•
ISED Certification Number	8595A-UBX23KM02
GITEKI Japan	•
[R] Certificate Number	003-240117
[T] Certificate Number	D240093003
NCC Taiwan	•
NCC Certificate Number	CCAF24Y00430T0
ACMA RCM Australia	•
PTCRB	•
GCF	•
AT&T with FirstNet	•
Verizon	•
T-Mobile USA	•
Telus	•
Telstra	•
Orange	•
Deutsche Telekom	•

Table 29: LEXI-R520 main certification approvals summary

☞ For guidelines and notices about compliance with certification approvals requirements integrating LEXI-R520 modules in the end-device, see the system integration manual [2].

7 Product handling & soldering

7.1 Packaging

LEXI-R520 modules are delivered as hermetically sealed, reeled tapes to enable efficient production, production lot set-up and tear-down. For more information about packaging, see the u-blox package information user guide [3].

7.1.1 Reels

LEXI-R520 modules are deliverable in quantities of 500 pieces on a reel. The modules are delivered using reel type A4 described in the u-blox package information user guide [3].

Quantities of less than 500 pieces are also available. Contact u-blox for more information.

7.1.2 Tapes

Figure 5 shows the position and the orientation of the modules on the tape. LEXI-R520 modules are delivered on the tape illustrated in Figure 6.

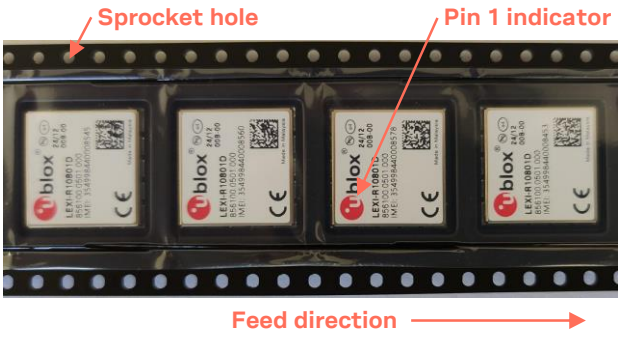
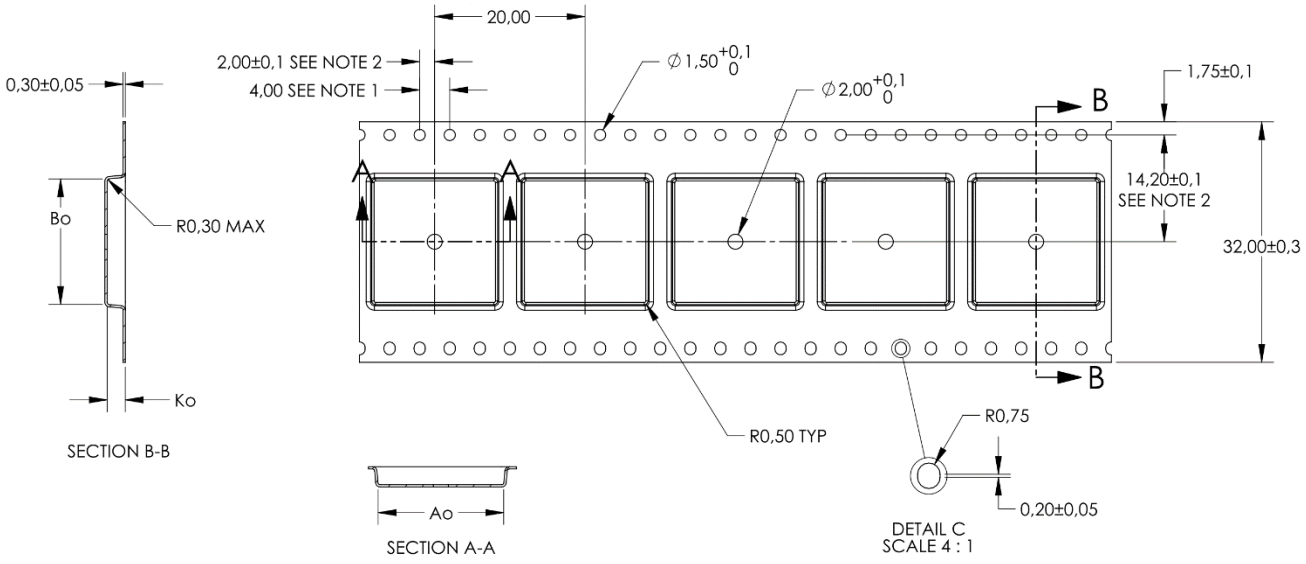


Figure 5: Orientation of modules on tape



	DIM	±
Ao	16,70	0.1
Bo	16,70	0.1
Ko	2,40	0.1

NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE.
3. Ao AND Bo ARE MEASURED ON A PLANE AT A DISTANCE "R" ABOVE THE BOTTOM OF THE POCKET.

Figure 6: LEXI-R520 modules tape

7.2 Moisture sensitivity levels

⚠ LEXI-R520 modules are moisture sensitive devices (MSD) in accordance to the IPC/JEDEC specification.

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. LEXI-R520 modules are rated at MSL level 4. For more information regarding moisture sensitivity levels, labeling, storage and drying, see the u-blox package information user guide [3].

☞ For the MSL standard, see IPC/JEDEC J-STD-020 (can be downloaded from www.jedec.org).

7.3 ESD precautions

⚠ LEXI-R520 modules contain highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Handling LEXI-R520 modules without proper ESD protection may destroy or damage them permanently.

⚠ Ensure ESD precautions are implemented during handling of the module.

Electrostatic discharge (ESD) is the sudden and momentary electric current that flows between two objects at different electrical potentials caused by direct contact or induced by an electrostatic field. The term is usually used in the electronics and other industries to describe momentary unwanted currents that may cause damage to electronic equipment.

Table 8 details the maximum ESD ratings of the LEXI-R520 modules.

Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates LEXI-R520 modules.

ESD precautions should be appropriately implemented on the application board where the module is mounted.

⚠ Failure to observe these precautions can result in severe damage to the device!

7.4 Reflow soldering

Reflow profiles are to be selected according to u-blox recommendations, as illustrated in details in the system integration manual [2].

⚠ Failure to observe these recommendations can result in severe damage to the device!

8 Labeling and ordering information

8.1 Product labeling

The labels of LEXI-R520 modules include important product information, as described in this section. Figure 7 provides an illustrative example of LEXI-R520 modules' label, which includes for example: the u-blox logo (acting also as pin 1 indicator), production date, Pb-free marking, product type number, IMEI number, certification info, and production country of the module.

Figure 7: Illustrative example of LEXI-R520 modules' label

8.2 Explanation of codes

Three different product code formats are used. The **Product name** is used in documentation such as this data sheet and identifies all the u-blox products, independent of packaging and quality grade. The **Ordering code** includes options and quality, while the **Type number** includes the hardware and firmware versions. Table 30 details these 3 different formats:

Format	Structure
Product name	PPPP-TGVV
Ordering code	PPPP-TGVV-MMQ
Type number	PPPP-TGVV-MMQ-XX

Table 30: Product code formats

Table 31 explains the parts of the product code.

Code	Meaning	Example
PPPP	Form factor	LEXI
TG	Platform (Technology and Generation) • Dominant technology: G = GSM, U = UMTS, C = CDMA, N = NB-IoT (LTE Cat NB1/NB2), R = LTE low data rate (Cat M1, Cat 1, Cat 1bis), L = LTE high data rate (Cat 3 and above) • Generation: 1…9	R5
VV	Variant function set based on the same platform: 00…99	20
MM	Major product version: 00…99	02
Q	Product grade: C = standard, B = professional, A = automotive	B
XX	Minor product version: 00…99	Default value: 00

Table 31: Part identification code

8.3 Ordering information

Ordering No.	Product
LEXI-R520-02B	LTE Cat M1 / NB2 module for global use. Designed with integrated u-blox SpotNow A-GPS receiver, with dedicated RF input for GPS antenna. 16.0 x 16.0 mm, 500 pieces/reel

Table 32: Product ordering codes

Appendix

A Glossary

Abbreviation	Definition
3GPP	3rd Generation Partnership Project
ACMA	Australian Communications and Media Authority
ADC	Analog to Digital Converter
A-GPS	Assisted Global Positioning System
Cat	Category
CE	Coverage Enhancement
CE	European Conformity
CEP	Circular Error Probable
CLK	Clock
CIoT	Cellular Internet of Things
CMOS	Complementary Metal-Oxide-Semiconductor
CoAP	Constrained Application Protocol
CTS	Clear To Send
DC	Direct Current
DCD	Data Carrier Detect
DL	Down Link (Reception)
DRX	Discontinuous Reception
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTLS	Datagram Transport Layer Security
DTR	Data Terminal Ready
E-CID	Enhanced Cell Identity
eDRX	Extended Discontinuous Reception
EPS	Evolved Packet System
ESD	Electrostatic Discharge
E-UTRA	Evolved Universal Terrestrial Radio Access
FCC	Federal Communications Commission United States
FDD	Frequency Division Duplex
FOAT	Firmware (update) Over AT commands
FOTA	Firmware (update) Over-The-Air
FTP	File Transfer Protocol
FW	Firmware
GCF	Global Certification Forum
GDI	Generic Digital Interface
GITEKI	Gijutsu kijun tekigō shōmei - Technical standard conformity certification (Japan)
GND	Ground
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input/Output
GPS	Global Positioning System
HARQ	Hybrid Automatic Repeat Request
HDLC	High-level Data Link Control

Abbreviation	Definition
HTTP	HyperText Transfer Protocol
HW	Hardware
ID	Identifier
IEC	International Electrotechnical Commission
I2C	Inter-Integrated Circuit
I2S	Inter-IC Sound
I/O	Input/Output
IMEI	International Mobile Equipment Identity
ISED	Innovation, Science and Economic Development Canada
ISO	International Organization for Standardization
ITU	International Telecommunications Union
LGA	Land Grid Array
LNA	Low Noise Amplifier
LPWA	Low Power Wide Area
LTE	Long-Term Evolution
LTE-M	Long-Term Evolution – enhanced Machine Type Communication
LwM2M	Lightweight Machine-to-Machine protocol
M2M	Machine to Machine
MQTT	Message Queuing Telemetry Transport
MQTT-SN	Message Queuing Telemetry Transport for Sensor Networks
MSD	Moisture Sensitive Device
MSL	Moisture Sensitivity Level
MUX	Multiplexer
N/A	Not Applicable
NB-IoT	Narrowband Internet of Things
NCC	National Communications Commission Taiwan
No	Number
PCB	Printed Circuit Board
PCN	Product Change Notification / Sample Delivery Note / Information Note
POS	Power On Signal
PPS	Pulse Per Second
PSM	Power Saving Mode
PTCRB	PCS Type Certification Review Board
PUCCH	Physical Uplink Control Channel
QPSK	Quadrature Phase Shift Keying modulation
RACH	Random Access Channel
RAT	Radio Access Technology
RCM	Regulatory Compliance Mark
RF	Radio Frequency
RI	Ring Indicator
RIL	Radio Interface Layer
RRC	Radio Resource Control
RTC	Real Time Clock
RTS	Request To Send
Rx	Reception
SCL	Serial Clock

Abbreviation	Definition
SDA	Serial Data
SDIO	Secure Digital Input Output
SIM	Subscriber Identity Module
SPI	Serial Peripheral Interface
SSL	Secure Socket Layer
TBS	Transport Block Size
TCP	Transmission Control Protocol
TLS	Transport Layer Security
TS	Technical Specification
Tx	Transmission
TXD	Transmit Data
UART	Universal Asynchronous Receiver/Transmitter
uCPU	u-blox open CPU solution
UDP	User Datagram Protocol
UE	User Equipment
uFOTA	u-blox Firmware (update) Over-The-Air
UKCA	United Kingdom Conformity Assessed
UL	Uplink (Transmission)
USB	Universal Serial Bus
uSCM	u-blox Smart Connection Manager
VSWR	Voltage Standing Wave Ratio

Related documentation

[1] u-blox SARA-R5 series / LEXI-R520 AT commands manual, UBX-19047455
[2] u-blox LEXI-R520 system integration manual, UBX-23008006
[3] u-blox package information user guide, UBX-14001652
[4] 3GPP TS 27.007 – AT command set for User Equipment (UE)
[5] 3GPP TS 27.005 – Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[6] 3GPP TS 27.010 – Terminal Equipment to User Equipment (TE-UE) multiplexer protocol
[7] 3GPP TS 36.521-1 – Evolved Universal Terrestrial Radio Access; User Equipment conformance specification; Radio transmission and reception; Part 1: Conformance Testing
[8] ITU-T Recommendation V24 – List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Connection Equipment (DCE)
[9] Universal Serial Bus Revision 2.0 specification, https://www.usb.org/
[10] I2C-bus specification and user manual – UM10204 – NXP semiconductors, https://www.nxp.com/docs/en/user-guide/UM10204.pdf
[11] RFC 7252 - Constrained Application Protocol (CoAP)
[12] IEC 60079-0 - Explosive atmospheres, part 0: equipment general requirements
[13] IEC 60079-11 - Explosive atmospheres, part 11: equipment protection by intrinsic safety 'i'
[14] IEC 60079-26 - Explosive atmospheres, part 26: equipment with EPL Ga

☞ For regular updates to u-blox documentation and to receive product change notifications, register on our homepage (www.u-blox.com).

Revision history

Revision	Date	Name	Comments
R01	30-Jun-2023	fvid / sses	Initial release
R02	20-Oct-2023	fvid / sses	Updated LEXI-R520-02B product status to prototype. Added absolute maximum rating for VCC and VUSB_DET voltage ramp. Improvement on PWR_ON pin specifications. Corrected approvals description. Minor other clarifications and corrections.
R03	14-Mar-2024	fvid	Updated LEXI-R520-02B product status to engineering sample. Updated current consumption. Updated PWR_ON pin specifications. Updated approvals section. Minor other clarifications and corrections.
R04	19-Sep-2024	fvid	Updated LEXI-R520-02B product status to initial production. Added eDRX deep-sleep time threshold. Added parameters for ATEX applications. Added thermal characterization parameters. Updated electrical specifications for PWR_ON, ANT_DET and ADC pins. Minor other clarifications and corrections.

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