



# LARA-R6 series

Single or multi-mode LTE Cat 1 modules

Data sheet



## Abstract

The LARA-R6 cellular module features uncompromised global connectivity in a very small form factor. With global, multi-regional and regional variants, customers have great flexibility and can simplify their logistics. The feature-rich LARA-R6 is secure by design and has a comprehensive certification scheme, versatile interfaces, and multi-band and multi-mode capabilities, all which make LARA-R6 ideal for use in any region and in wide range of applications.

# Document information

|                               |  |             |
|-------------------------------|--|-------------|
| <b>Title</b>                  | <b>LARA-R6 series</b>                  |             |
| <b>Subtitle</b>               | Single or multi-mode LTE Cat 1 modules |             |
| <b>Document type</b>          | Data sheet                             |             |
| <b>Document number</b>        | UBX-21004391                           |             |
| <b>Revision and date</b>      | R14                                    | 19-Jun-2024 |
| <b>Disclosure restriction</b> | C1-Public                              |             |

| <b>Product status</b>                | <b>Corresponding content status</b> |  |
|--------------------------------------|-------------------------------------|--|
| <b>Functional sample</b>             | Draft                               | For functional testing. Revised and supplementary data will be published later.        |
| <b>In development / Prototype</b>    | Objective specification             | Target values. Revised and supplementary data will be published later.                 |
| <b>Engineering sample</b>            | Advance information                 | Data based on early testing. Revised and supplementary data will be published later.   |
| <b>Initial production</b>            | Early production information        | Data from product verification. Revised and supplementary data may be published later. |
| <b>Mass production / End of life</b> | Production information              | Document contains the final product specification.                                     |

This document applies to the following products:

| Product name | Type number        | Firmware version                    | Notification reference | Product status  |
|--------------|--------------------|-------------------------------------|------------------------|-----------------|
| LARA-R6001   | LARA-R6001-00B-00  | Modem: 02.14<br>Application: A00.01 | UBX-22019779           | End of Life     |
|              | LARA-R6001-00B-01  | Modem: 02.14<br>Application: A00.01 | UBX-23004170           | Mass production |
|              | LARA-R6001-01B-00  | Modem: 04.22<br>Application: A00.01 | UBXDOC-686885345-2091  | Mass production |
| LARA-R6001D  | LARA-R6001D-00B-00 | Modem: 00.13<br>Application: A00.01 | UBX-22008409           | End of Life     |
|              | LARA-R6001D-00B-01 | Modem: 00.13<br>Application: A00.01 | UBX-23004170           | Mass production |
|              | LARA-R6001D-01B-00 | Modem: 04.22<br>Application: A00.01 | UBXDOC-686885345-2091  | Mass production |
| LARA-R6401   | LARA-R6401-00B-00  | Modem: 02.14<br>Application: A00.01 | UBX-22019779           | End of Life     |
|              | LARA-R6401-00B-01  | Modem: 02.14<br>Application: A00.01 | UBX-23004170           | Mass production |
|              | LARA-R6401-01B-00  | Modem: 04.22<br>Application: A00.01 | UBXDOC-686885345-2091  | Mass production |
| LARA-R6401D  | LARA-R6401D-00B-00 | Modem: 01.14<br>Application: A00.01 | UBX-22014149           | End of Life     |
|              | LARA-R6401D-00B-01 | Modem: 01.14<br>Application: A00.01 | UBX-23004170           | Mass production |
|              | LARA-R6401D-01B-00 | Modem: 04.22<br>Application: A00.01 | UBXDOC-686885345-2091  | Mass production |
| LARA-R6801   | LARA-R6801-00B-00  | Modem: 02.14<br>Application: A00.01 | UBX-22019779           | End of Life     |
|              | LARA-R6801-00B-01  | Modem: 02.14<br>Application: A00.01 | UBX-23004170           | Mass production |
|              | LARA-R6801-01B-00  | Modem: 04.22<br>Application: A00.01 | UBXDOC-686885345-2091  | Mass production |
| LARA-R6801D  | LARA-R6801D-01B-00 | Modem: 04.22<br>Application: A00.01 | UBXDOC-686885345-2091  | Mass production |

u-blox or third parties may hold intellectual property rights in the products, names, logos and designs included in this document. Copying, reproduction, modification or disclosure to third parties of this document or any part thereof is only permitted with the express written permission of u-blox.

The information contained herein is provided “as is” and u-blox assumes no liability for its use. No warranty, either express or implied, is given, including but not limited to, with respect to the accuracy, correctness, reliability and fitness for a particular purpose of the information. This document may be revised by u-blox at any time without notice. For the most recent documents, visit [www.u-blox.com](http://www.u-blox.com).

Copyright © u-blox AG.

# Contents

|  |           |
|--|-----------|
| <b>Document information</b>                            | <b>2</b>  |
| <b>Contents</b>  | <b>4</b>  |
| <b>1 Functional description</b>                        | <b>6</b>  |
| 1.1 Overview   | 6         |
| 1.2 Block diagram                                      | 8         |
| 1.3 Product description                                | 8         |
| 1.4 AT command support                                 | 10        |
| 1.5 Supported features                                 | 10        |
| <b>2 Interfaces</b>                                    | <b>13</b> |
| 2.1 Power management                                   | 13        |
| 2.1.1 Module supply input (VCC)                        | 13        |
| 2.1.2 Generic digital interfaces supply output (V_INT) | 13        |
| 2.2 Antenna interfaces                                 | 13        |
| 2.2.1 Antenna RF interfaces                            | 13        |
| 2.2.2 Antenna detection                                | 13        |
| 2.3 System functions                                   | 13        |
| 2.3.1 Module power-on                                  | 13        |
| 2.3.2 Module power-off                                 | 14        |
| 2.3.3 Module reset                                     | 15        |
| 2.4 SIM interface                                      | 15        |
| 2.4.1 SIM card / chip interface                        | 15        |
| 2.4.2 SIM card detection                               | 15        |
| 2.5 Serial communication                               | 15        |
| 2.5.1 UART interfaces                                  | 15        |
| 2.5.2 USB interface                                    | 16        |
| 2.5.3 I2C interface                                    | 17        |
| 2.6 Audio interface                                    | 17        |
| 2.7 Clock output                                       | 17        |
| 2.8 GPIO pins  | 17        |
| 2.9 Antenna dynamic tuner interface                    | 18        |
| 2.10 Reserved pins                                     | 19        |
| <b>3 Pin definition</b>                                | <b>20</b> |
| 3.1 Pin assignment                                     | 20        |
| <b>4 Electrical specifications</b>                     | <b>24</b> |
| 4.1 Absolute maximum rating                            | 24        |
| 4.1.1 Maximum ESD                                      | 24        |
| 4.2 Operating conditions                               | 25        |
| 4.2.1 Operating temperature range                      | 25        |
| 4.2.2 Thermal parameters                               | 25        |
| 4.2.3 Supply/power pins                                | 25        |

|          |  |           |
|----------|--|-----------|
| 4.2.4    | Current consumption.....                       | 26        |
| 4.2.5    | LTE RF characteristics .....                   | 27        |
| 4.2.6    | 3G RF characteristics .....                    | 29        |
| 4.2.7    | 2G RF characteristics .....                    | 30        |
| 4.2.8    | ANT_DET pin.....                               | 30        |
| 4.2.9    | PWR_ON pin.....                                | 30        |
| 4.2.10   | RESET_N pin .....                              | 31        |
| 4.2.11   | SIM pins .....                                 | 31        |
| 4.2.12   | USB pins .....                                 | 31        |
| 4.2.13   | I2C pins .....                                 | 32        |
| 4.2.14   | Generic Digital Interfaces pins .....          | 32        |
| 4.2.15   | Smart temperature supervisor .....             | 33        |
| 4.3      | Parameters for ATEX applications .....         | 34        |
| <b>5</b> | <b>Mechanical specifications .....</b>         | <b>35</b> |
| <b>6</b> | <b>Qualification and approvals.....</b>        | <b>36</b> |
| 6.1      | Reliability tests .....                        | 36        |
| 6.2      | Approvals .....                                | 36        |
| <b>7</b> | <b>Product handling &amp; soldering.....</b>   | <b>37</b> |
| 7.1      | Packaging .....                                | 37        |
| 7.1.1    | Reels .....                                    | 37        |
| 7.1.2    | Tapes.....                                     | 37        |
| 7.2      | Moisture sensitivity levels.....               | 38        |
| 7.3      | Reflow soldering .....                         | 38        |
| 7.4      | ESD precautions.....                           | 38        |
| <b>8</b> | <b>Labeling and ordering information .....</b> | <b>39</b> |
| 8.1      | Product labeling.....                          | 39        |
| 8.2      | Explanation of codes .....                     | 39        |
| 8.3      | Ordering information.....                      | 40        |
|          | <b>Appendix .....</b>                          | <b>41</b> |
| <b>A</b> | <b>Glossary .....</b>                          | <b>41</b> |
|          | <b>Related documentation .....</b>             | <b>43</b> |
|          | <b>Revision history .....</b>                  | <b>44</b> |
|          | <b>Contact.....</b>                            | <b>45</b> |

# 1 Functional description

## 1.1 Overview


The LARA-R6 series comprises multi-band and multi-mode modules supporting LTE Cat 1 FDD and LTE Cat 1 TDD radio access technology (RAT), with 3G UMTS/HSPA and 2G GSM/GPRS/EGPRS fallback, providing the ideal solution for global and multi-regional coverage in the small LARA LGA form-factor (26.0 x 24.0 mm, 100-pin), which is easy to integrate in compact designs.

The LARA-R6 series comprises six variants:

- LARA-R6001 (data and voice) and LARA-R6001D (data-only) modules are the smallest LTE Cat 1 multi-mode solutions with comprehensive support of RAT and bands for global connectivity, including 18 LTE FDD/TDD bands plus 3G/2G fallback in single SKU.
- LARA-R6401 (data and voice) and LARA-R6401D (data-only) modules offer an ideal LTE Cat 1 solution for North America, supporting all relevant LTE bands for use on AT&T, FirstNet, Verizon, or T-Mobile mobile networks in single SKU for the North American market
- LARA-R6801 (data and voice) and LARA-R6801D (data-only) modules are solutions designed for multi-regional deployments, supporting all relevant LTE bands plus 3G/2G fallback for use in EMEA, APAC, Japan and Latin America regions.

With the six variants of LARA-R6 series modules customers have great flexibility, can maximize reusing their development efforts, and can simplify logistics. Customers can take advantage of embedded IoT protocols (LwM2M, MQTT) and security features (TLS/DTLS, secure update/secure boot) to implement various applications, such as device management, remote device actions, and secure FOTA updates.

Versatile interfaces, features, multi-band and multi-mode capabilities make the LARA-R6 series modules ideally suitable for a wide range of applications, such as asset tracking, telematics, remote monitoring, alarm panels, video surveillance, connected health, point of sales terminals, and mobile cameras. Generally, the modules are suited to applications that require medium speed data, seamless connectivity, superior coverage, low latency, streaming services (data or voice), and to industrial applications focused on product life-cycle longevity.

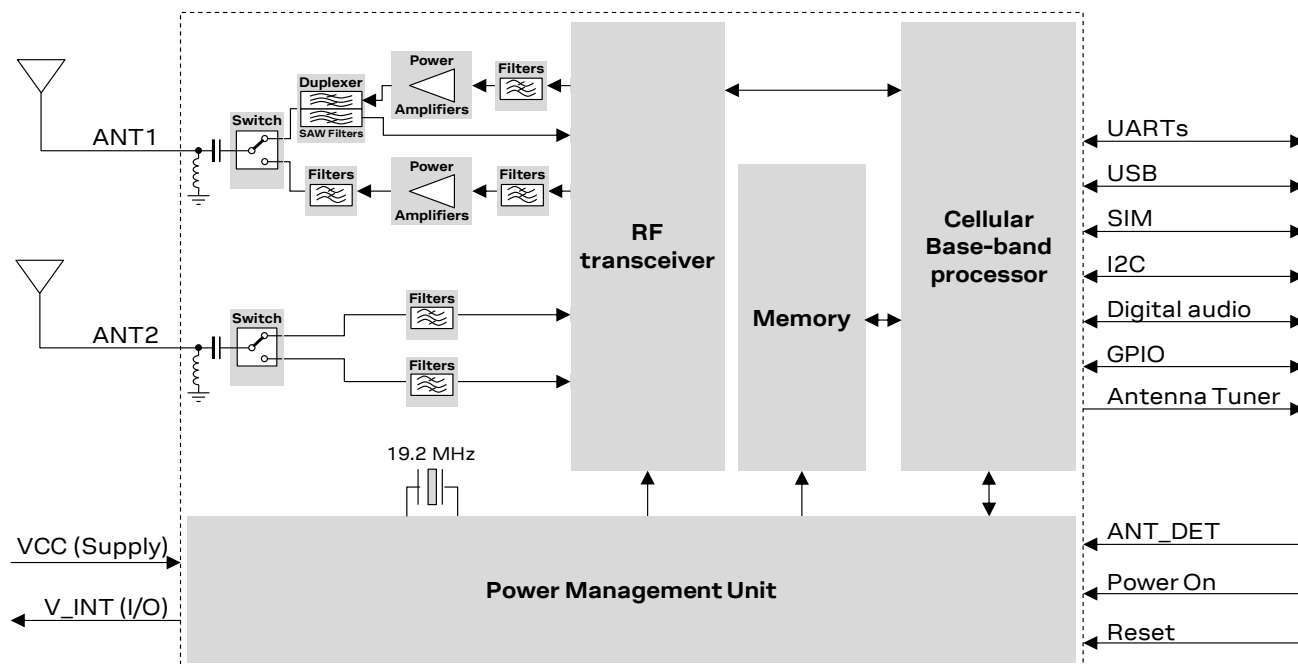
 The LARA-R6001D, LARA-R6401D and LARA-R6801D data-only modules have the same electrical characteristics, feature set, and functionalities of the LARA-R6001, LARA-R6401 and LARA-R6801 data and voice modules respectively, except for the support of voice / audio. Unless otherwise specified, “LARA-R6001” refers to both LARA-R6001 and LARA-R6001D modules, “LARA-R6401” refers to both LARA-R6401 and LARA-R6401D modules, and “LARA-R6801” refers to both LARA-R6801 and LARA-R6801D modules.

[Table 1](#) lists the main features of LARA-R6 series modules.



● = "00B", "01B" and future product versions      ■ = "01B" and future product versions

Table 1: LARA-R6 series main features summary

## 1.2 Block diagram



**Figure 1: LARA-R6 series block diagram**

-  The digital audio interface is not supported by LARA-R6001D, LARA-R6401D and LARA-R6801D data-only modules.
-  The antenna tuner interface is not supported by the LARA-R6001-00B, LARA-R6001D-00B and LARA-R6801-00B product versions. The corresponding pins are marked as reserved for future use (**RSVD**), they are intended to be left unconnected and they must not be driven by external devices.

### 1.3 Product description

LARA-R6 series modules include six variants providing flexibility to use the bands and the RAT available in specific region or with specific operators:

- LARA-R6001 / LARA-R6001D are the smallest LTE Cat 1 multi-mode modules for global coverage. Its single SKU for the world provides universal connectivity and simplifies logistics. This truly global module with comprehensive band support has 18 LTE bands plus 3G/2G fallback.
- LARA-R6401 / LARA-R6401D modules offer an ideal LTE Cat 1 solution for North America, supporting all relevant LTE bands. They are designed for use on AT&T, FirstNet, Verizon, or T-Mobile. Managing a single SKU for the North American market simplifies logistics and reduces related costs.
- LARA-R6801 / LARA-R6801D modules are a multi-regional variant specifically designed for use in EMEA, APAC, Japan and Latin America regions. They support all relevant LTE Cat 1 bands plus 3G/2G fallback.

Except for the LARA-R6001D, LARA-R6401D and LARA-R6801D data-only product versions, the LARA-R6 series modules provide Voice over LTE (VoLTE) and Circuit-switched fallback (CSFB) audio capability according to the supported RAT. The 911 and E911 services are not supported.



| Module                     | Region   | LTE FDD bands <sup>1</sup> | LTE TDD bands <sup>1</sup> | WCDMA bands  | GSM bands |
|----------------------------|--|----------------------------|----------------------------|--------------|-----------|
| LARA-R6001,<br>LARA-R6001D | Global   | 12 (700 MHz)               | 39 (1900 MHz)              | 5 (850 MHz)  | GSM 850   |
|                            |  | 28 (700 MHz)               | 40 (2300 MHz)              | 8 (900 MHz)  | E-GSM 900 |
|                            |  | 13 (700 MHz)               | 41 (2600 MHz)              | 2 (1900 MHz) | DCS 1800  |
|                            |  | 20 (800 MHz)               | 38 (2600 MHz)              | 1 (2100 MHz) | PCS 1900  |
|                            |  | 18 (850 MHz)               |                            |              |           |
|                            |  | 19 (850 MHz)               |                            |              |           |
|                            |  | 26 (850 MHz)               |                            |              |           |
|                            |  | 5 (850 MHz)                |                            |              |           |
|                            |  | 8 (900 MHz)                |                            |              |           |
|                            |  | 4 (1700 MHz)               |                            |              |           |
|                            |  | 3 (1800 MHz)               |                            |              |           |
|                            |  | 2 (1900 MHz)               |                            |              |           |
|                            |  | 1 (2100 MHz)               |                            |              |           |
|                            |  | 7 (2600 MHz)               |                            |              |           |
|                            |  |                            |                            |              |           |
| LARA-R6401,<br>LARA-R6401D | North America  | 71 (600 MHz)               |                            |              |           |
|                            |  | 12 (700 MHz)               |                            |              |           |
|                            |  | 13 (700 MHz)               |                            |              |           |
|                            |  | 14 (700 MHz)               |                            |              |           |
|                            |  | 5 (850 MHz)                |                            |              |           |
|                            |  | 4 (1700 MHz)               |                            |              |           |
|                            |  | 66 (1700 MHz)              |                            |              |           |
|                            |  | 2 (1900 MHz)               |                            |              |           |
| LARA-R6801,<br>LARA-R6801D | Europe, Middle East, Africa,<br>Asia-Pacific,<br>Japan,<br>Latin America | 28 (700 MHz)               |                            | 5 (850 MHz)  | GSM 850   |
|                            |  | 20 (800 MHz)               |                            | 8 (900 MHz)  | E-GSM 900 |
|                            |  | 18 (850 MHz)               |                            | 2 (1900 MHz) | DCS 1800  |
|                            |  | 19 (850 MHz)               |                            | 1 (2100 MHz) | PCS 1900  |
|                            |  | 26 (850 MHz)               |                            |              |           |
|                            |  | 5 (850 MHz)                |                            |              |           |
|                            |  | 8 (900 MHz)                |                            |              |           |
|                            |  | 4 (1700 MHz)               |                            |              |           |
|                            |  | 3 (1800 MHz)               |                            |              |           |
|                            |  | 2 (1900 MHz)               |                            |              |           |
|                            |  | 1 (2100 MHz)               |                            |              |           |
|                            |  | 7 (2600 MHz)               |                            |              |           |
|                            |  |                            |                            |              |           |

**Table 2: LARA-R6 series supported LTE, 3G and 2G bands summary**

| 4G LTE  | 3G UMTS/HSDPA/HSUPA   | 2G GSM/GPRS/EDGE  |
|---|---|---|
| 3GPP Release 10   | 3GPP Release 8  | 3GPP Release 9  |
| Long Term Evolution (LTE)   | High Speed Packet Access (HSPA)   | Enhanced Data rate GSM Evolution (EDGE)   |
| Evolved UTRA (E-UTRA)   | UMTS Terrestrial Radio Access (UTRA)  | GSM EGPRS Radio Access (GERA)   |
| Frequency/Time Division Duplex (FDD/TDD)                          | Frequency Division Duplex (FDD)   | Time Division Multiple Access (TDMA)  |
| DL Rx diversity   | DL Rx Diversity   | DL Advanced Rx Performance Phase 1  |
| LTE Power Class   | UMTS/HSDPA/HSUPA Power Class  | GSM/GPRS (GMSK) Power Class   |
| • Power Class 3 (23 dBm)  | • Class 3 (24 dBm)  | • Class 4 (33 dBm) for 850/900 band   |
|   |   | • Class 1 (30 dBm) for 1800/1900 band   |
|   |   | EDGE (8-PSK) Power Class  |
|   |   | • Class E2 (27 dBm) for 850/900 band  |
|   |   | • Class E2 (26 dBm) for 1800/1900 band  |
| Data rate   | Data rate   | Data rate   |
| • LTE category 1:<br>up to 10.3 Mbit/s DL,<br>up to 5.2 Mbit/s UL | • HSDPA category 8:<br>up to 7.2 Mbit/s DL<br>• HSUPA category 6:<br>up to 5.76 Mbit/s UL | • GPRS multi-slot class 33 <sup>2</sup> , CS1-CS4,<br>up to 107 kbit/s DL, 85.6 kbit/s UL<br>• EDGE multi-slot class 33 <sup>2</sup> , MCS1-MCS9,<br>up to 296 kbit/s DL, 236.8 kbit/s UL |

**Table 3: LARA-R6 series LTE, 3G and 2G characteristics summary**
<sup>1</sup> LARA-R6 modules support all E-UTRA channel bandwidths for each operating band according to 3GPP TS 36.521-1 [10]

<sup>2</sup> GPRS/EDGE multislot class 33 implies a maximum of 5 slots in DL (reception), 4 slots in UL (transmission) with 6 slots in total.

## 1.4 AT command support

The LARA-R6 series modules support AT commands according to 3GPP standards TS 27.007 [7], TS 27.005 [8] and the u-blox AT command extension.



For a complete list of supported AT commands, see the AT commands manual [1].

RIL (Radio Interface Layer) software for Android is available free of charge; see the Android RIL source code application note [3] for the supported software deliveries and more information.



## 1.5 Supported features

Table 4 lists some of the main features supported by LARA-R6 series modules. For more details, see the AT commands manual [1] and the application development guide [5].

| Feature                                      | Description  |
|--|--|
| Device security                              | Hardware-based security functions of the chipset are used to provide: <ul style="list-style-type: none"> <li>Secure boot: keep software authenticity and integrity</li> <li>Secure update: supervise the secure delivery of the correct FW to the module</li> <li>Secure production: secret keys are programmed into the module using encrypted protocols and within u-blox secured manufacturing environment</li> </ul> |
| u-blox Firmware update Over The Air (uFOTA)  | u-blox firmware module update over the air interface client/server solution using LwM2M.   |
| Firmware update Over AT commands (FOAT)      | Firmware module update over AT command interfaces.   |
| VoLTE and CSFB audio capability <sup>3</sup> | Voice over LTE (VoLTE) feature allows voice service over LTE bearer, via embedded IP Multimedia Subsystem (IMS).<br>Circuit-switched fallback (CSFB) feature allows voice service over circuit switched infrastructure (3G or 2G radio access technologies, which are not supported by LARA-R6401 modules).  |
| LTE / 3G Rx Diversity                        | Improved cellular link quality and reliability on all operating bands, by means of 2 receiving antenna.  |
| Network indication                           | GPIO configured to indicate the network status: registered home network, registered roaming, voice or data call enabled, or no service. The feature can be enabled by the +UGPIOC AT command.  |
| Antenna detection                            | The <b>ANT_DET</b> pin provides antenna presence detection capability, as optional features, evaluating the resistance from <b>ANT1</b> and <b>ANT2</b> pins to GND by means of an external antenna detection circuit implemented on the application board.  |
| Antenna dynamic tuning <sup>4</sup>          | Control of an external antenna matching IC via two GPIOs changing dynamically the high/low state in real time according to the cellular band used by the module.   |
| Jamming detection                            | Detects “artificial” interference that obscures the operator’s carriers entitled to give access to the radio service and reports the start and stop of such conditions to the application processor that can react accordingly.  |
| 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 serial interface.  |
| Embedded 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.   |
| Embedded HTTP, HTTPS                         | Hyper-Text Transfer Protocol as well as Secure Hyper-Text Transfer Protocol (SSL encryption) functionalities are supported via AT commands.  |
| CoAP (RFC 7252)                              | Embedded Constrained Application Protocol (CoAP) datagram-based client/server application protocol designed to easily translate from HTTP for simplified integration with the web.   |
| MQTT Anywhere and MQTT Flex                  | Integrated MQTT-SN client for MQTT Anywhere IoT Communication-as-a-Service support in combination with external Thingstream SIM, or for MQTT Flex IoT Communication-as-a-Service support in combination with any external SIM  |

<sup>3</sup> Not supported by LARA-R6001D, LARA-R6401D and LARA-R6801D data-only modules

<sup>4</sup> Not supported by LARA-R6001-00B, LARA-R6001D-00B and LARA-R6801-00B modules

| Feature                                      | Description  |
|--|--|
| 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  | 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) provides security for HTTP, FTP, MQTT, and TCP communications. Embedded Datagram Transport Layer Security (DTLS) provides security for LwM2M, and UDP communications.   |
| DNS  | Support for DNS functionality.   |
| IPv4/IPv6 dual-stack                         | Capability to move between IPv4 and dual stack network infrastructures. IPv4 and IPv6 addresses can be used.   |
| PPP  | IPv4/IPv6 packets relaying through the cellular protocol stack performed on a Point-to-Point Protocol (PPP) connection established with the external application via a serial interface. Transitions between Online command mode (OLCM) and PPP mode are supported.  |
| Multiple PDP contexts                        | Multiple PDP contexts can be activated, and multi secondary PDP contexts be associated to a primary PDP context.   |
| ODIS   | Open mobile alliance device management IMEI Sync (ODIS) is an AT&T functionality required at the cellular module level and used to identify the end device operating inside the network.   |
| BIP  | Bearer Independent Protocol (BIP) for Over-the-Air SIM provisioning. The data transfer to/from the SIM uses either an already active PDP context or a new PDP context established with the APN provided by the SIM card.   |
| External u-blox GNSS control via modem       | Access to u-blox positioning chips and modules is available through a dedicated I2C interface. This means that from any host processor, a single serial port can control the cellular module and the u-blox positioning chip or module. For more details, see the positioning application note <a href="#">[6]</a> .   |
| Embedded AssistNow software                  | Embedded AssistNow Online and AssistNow Offline clients are available to provide better GNSS performance and faster Time-to-First-Fix. An AT command can enable / disable the clients.   |
| CellLocate®                                  | <p>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</p> <p>A set of AT commands allows CellLocate® service configuration and position request.</p> <p> 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.</p>   |
| Hybrid positioning                           | <p>The current module position is provided by a u-blox positioning chip or module or the estimated position from CellLocate® depending on which method provides the best and fastest solution according to the user configuration.</p> <p>A set of AT commands allows Hybrid positioning service configuration and position request.</p>   |
| Smart Temperature Supervisor                 | <p>Constant monitoring of the module board temperature:</p> <ul style="list-style-type: none"> <li>Warning notification when the temperature approaches an upper or lower predefined threshold</li> <li>Shutdown notified and forced when the temperature value is outside the specified range (shutdown suspended in case of an emergency call in progress)</li> </ul> <p>The optional Smart Temperature Supervisor feature is by default disabled, and it can be enabled and configured through the +USTS AT command.</p> <p> The sensor measures the board temperature, which can differ from ambient temperature.</p> |
| 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.  |
| Low power idle mode                          | The power saving configuration is disabled by default, but it can be enabled and configured using the +UPSV AT command. When the power saving is enabled, the module automatically enters the low power idle mode whenever possible, reducing current consumption.   |
| Fast Dormancy                                | The Fast Dormancy feature, based on 3GPP specifications, allows reduction of current consumption and network utilization during periods of data inactivity.  |

| Feature                                   | Description   |
|---|---|
| 3GPP Power Saving Mode (PSM) <sup>5</sup> | The Power Saving Mode (PSM) feature, based on 3GPP specifications, allows further reduction of the module current consumption maximizing the amount of time a device can remain in the PSM ultra-low power deep-sleep mode during periods of data inactivity.   |
| LTE eDRX                                  | Extended idle mode Discontinuous Reception (eDRX) feature, based on 3GPP specifications, reduces the amount of signaling overhead decreasing the frequency of scheduled measurements and/or transmissions performed by the module in idle mode. This in turn leads to a reduction in the module power consumption while maintaining a perpetual connection with the base station. |
| LTE cDRX                                  | Both the Long DRX Cycle and the Short DRX cycle are supported for LTE Connected Discontinuous Reception, allowing reduction of current consumption and LTE network utilization during periods of data inactivity.   |
| Backup and restore                        | This feature allows the modules to autonomously restore the flash file system using the last backup stored on the module itself. For further details about the backup and restore feature, see the +UBKUPDATA AT command description in the AT commands manual <a href="#">[1]</a> , and the related section in the application development guide <a href="#">[5]</a> .           |

**Table 4: Some of the main features supported by LARA-R6 series modules**

<sup>5</sup> Not supported by the LARA-R6001-00B, LARA-R6001D-00B, LARA-R6401-00B, LARA-R6401D-00B and LARA-R6801-00B product versions

## 2 Interfaces

### 2.1 Power management

#### 2.1.1 Module supply input (VCC)

LARA-R6 series modules must be supplied through the three **VCC** pins by a DC power supply. Voltage must be stable, because during operation the current drawn from **VCC** can vary by some order of magnitude, especially due to the surging consumption profile of the GSM system (described in the system integration manual [2]). It is important that the system power supply circuit can support peak power.

LARA-R6 series modules provide separate supply inputs over the three **VCC** pins:

- **VCC** pins #52 and #53 represent the supply input for the internal RF power amplifiers, demanding most of the total current drawn by the module when RF transmission is enabled
- **VCC** pin #51 represents the supply input for the internal baseband Power Management Unit and the internal transceiver, demanding a minor part of the total current drawn by the module when RF transmission is enabled

#### 2.1.2 Generic digital interfaces supply output (V\_INT)

LARA-R6 series modules provide a 1.8 V supply rail output on the **V\_INT** pin, which is internally generated when the module is switched on, and outside PSM deep-sleep mode<sup>6</sup>. The same voltage domain is used internally to supply the generic digital interfaces of the modules (as UARTs, I2C, I2S, GPIOs). The **V\_INT** supply output can be used in place of external discrete regulator.



It is recommended to provide accessible test point directly connected to the **V\_INT** input pin.

### 2.2 Antenna interfaces

#### 2.2.1 Antenna RF interfaces

The modules have two RF pins with a characteristic impedance of 50  $\Omega$ . The primary antenna pin (**ANT1**) supports both Tx and Rx, providing the main antenna interface, while the secondary antenna pin (**ANT2**) supports Rx only for the LTE / 3G Rx diversity configuration.

#### 2.2.2 Antenna detection

The **ANT\_DET** pin is an Analog to Digital Converter (ADC) input with a current source provided by LARA-R6 series modules to sense the external antenna(s) presence (as an optional feature). It evaluates the resistance from **ANT1** and **ANT2** pins to GND by means of an external antenna detection circuit implemented on the application board. For more details, see the system integration manual [2] and the AT commands manual [1].

### 2.3 System functions

#### 2.3.1 Module power-on

When LARA-R6 series 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 14), and then 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 4.2.9, module switch on).

<sup>6</sup> Not supported by "00B" products version


When LARA-R6 series modules are in power-off mode (switched off, with a voltage at the **VCC** module supply input within the normal operating range reported in [Table 14](#)), they can be switched on by:

- 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 [4.2.9](#), module switch-on).

When LARA-R6 series modules are in the ultra-low power PSM deep-sleep mode<sup>7</sup>, with a valid voltage present at the **VCC** module supply input within the operating range reported in [Table 14](#), 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 [4.2.9](#), module wake-up from PSM 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 point directly connected to the **PWR\_ON** input pin.

### 2.3.2 Module power-off

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

- AT+CPWROFF command (see the AT commands manual [\[1\]](#)), or
- Forcing a low pulse at the **PWR\_ON** input pin, which is normally set high by an internal pull-up, for a valid time period (see section [4.2.9](#), module graceful switch-off). The **PWR\_ON** line is intended to be driven by open drain, open collector or contact switch.

A faster emergency power-off procedure of the modules, with storage of current parameter settings, but without a clean network detach, can be triggered by:

- AT+CFUN=10 command (see the AT commands manual [\[1\]](#)), or
- Forcing a rising edge at the GPIO input pin configured with the faster power-off function (see section [2.8](#), faster power-off)

The fastest memory-safe emergency power-off procedure of the LARA-R6 series modules<sup>7</sup>, inhibiting further operations in the non-volatile flash memory, without executing the storage of the current parameter settings, and without executing a clean network detach, can be triggered by:

- AT+CFUN=11 command (see the AT commands manual [\[1\]](#)), or
- Forcing a rising edge at the GPIO input pin configured with the memory-safe power-off function (see section [2.8](#), memory-safe power-off)

An abrupt shutdown occurs on LARA-R6 series modules, without storage of the current parameter settings and without a clean network detach, when:

- The **VCC** supply voltage is removed, dropping below the under-voltage shutdown threshold, or
- Forcing a low level at the **RESET\_N** input pin, which is normally set high by an internal pull-up, for a valid time period (see [4.2.10](#), module abrupt emergency switch-off). The **RESET\_N** line is intended to be driven by open drain, open collector or contact switch.

An over-temperature or an under-temperature graceful shutdown occurs on LARA-R6 series modules when the temperature measured within the cellular module reaches the dangerous area, if the optional Smart Temperature Supervisor feature is enabled and configured by the dedicated AT command. For more details, see [4.2.15](#), and see the AT commands manual [\[1\]](#), +USTS AT command.

<sup>7</sup> Not supported by "00B" products version

### 2.3.3 Module reset

LARA-R6 series modules can be reset (rebooted), with storage of the current parameter settings in the module's internal non-volatile memory and a clean network detach, by:

- AT+CFUN=16 command (see the AT commands manual [1] for description and other options), or
- Forcing a low level at the **RESET\_N** input pin, which is normally set high by an internal pull-up, for a valid time period (see 4.2.10, module reset / reboot). The **RESET\_N** line is intended to be driven by open drain, open collector or contact switch.

## 2.4 SIM interface

### 2.4.1 SIM card / chip interface

LARA-R6 series modules include an interface to connect an external SIM card / chip over the **VSIM**, **SIM\_IO**, **SIM\_CLK**, **SIM\_RST** pins: the high-speed SIM/ME interface is implemented as well as the automatic detection of the required SIM supporting voltage.

Both 1.8 V and 3.0 V SIM types are supported (1.8 V and 3.0 V ME). Activation and deactivation with automatic voltage switch from 1.8 V to 3.0 V is implemented, according to ISO-IEC 7816-3 specs.

### 2.4.2 SIM card detection

LARA-R6 series modules provide the SIM detection function over the **GPIO5** pin to sense the SIM card physical presence (as an optional feature) when the pin of the module is properly connected to the mechanical switch of the SIM card holder (see the system integration manual [2]).

## 2.5 Serial communication

### 2.5.1 UART interfaces

LARA-R6 series modules include a main primary Universal Asynchronous Receiver/Transmitter serial interface (UART) for communication with an application host processor, supporting AT commands, data communication, multiplexer protocol functionality including virtual channel for GNSS tunneling, and FW update by means of FOAT:

- 8-wire serial port with RS-232 functionality conforming to ITU-T V.24 recommendation [13], with CMOS compatible levels (0 V for low data bit / ON state, 1.8 V for high data bit / OFF state)
  - Data lines (**RXD** output, **TXD** input),
  - hardware flow control lines (**CTS** output, **RTS** input),
  - modem status and control lines (**DTR** input, **DSR** output, **DCD** output, **RI** output)<sup>8</sup>
- Hardware flow control (default factory-programmed setting), or none flow control are supported
- 115'200 bit/s (default factory-programmed setting), 230'400 bit/s, 460'800 bit/s, 921'600 bit/s, and 3'000'000 bit/s baud rates are supported
- The default factory-programmed frame format is 8N1 (8 data bits, no parity, 1 stop bit)

LARA-R6 series modules include a secondary auxiliary Universal Asynchronous Receiver/Transmitter serial interface (UART AUX) for communication with an application host processor, supporting AT commands, data communication, and FW update by means of FOAT:

- 4-wire serial port with RS-232 functionality conforming to ITU-T V.24 recommendation [13], with CMOS compatible signal levels (0 V for low data bit / ON state, 1.8 V for high data bit / OFF state)
  - Data lines (**DCD** as data output, **DTR** as data input)
  - HW flow control lines (**RI** as flow control output, **DSR** as flow control input)

---

<sup>8</sup> Alternatively, **DTR**, **DSR**, **DCD** and **RI** pins can be mutually exclusively configured as a secondary auxiliary UART interface



- Hardware flow control (default setting), or none flow control are supported
- 115'200 bit/s (default setting), 230'400 bit/s, 460'800 bit/s, 921'600 bit/s, and 3'000'000 bit/s baud rates are supported
- The default frame format is 8N1 (8 data bits, no parity, 1 stop bit)

The UART serial interfaces can be conveniently configured through dedicated AT commands: see the AT commands manual [1] (+IPR, +ICF, +IFC, &K, \Q, &S, &D, &C, +UPSV, +USIO, +UUARTCONF AT commands).

### 2.5.1.1 Multiplexer protocol

LARA-R6 series modules include multiplexer functionality as per 3GPP TS 27.010 [9] on the main primary UART physical interface only. The multiplexer functionality is a data link protocol which uses HDLC-like framing and operates between the module (DCE) and the application processor (DTE), allowing several simultaneous sessions over the physical link (main primary UART): the user can concurrently use AT interface on one MUX channel and data communication on another MUX channel.

The following virtual channels are available:


- Multiplexer control
- AT commands / data connection
- GNSS data tunneling

### 2.5.2 USB interface

LARA-R6 series modules include a USB High-Speed 2.0 compliant interface with a maximum 480 Mbit/s data rate according to the Universal Serial Bus specification revision 2.0 [14]. The module itself acts as a USB device and can be connected to any compatible USB host.

The USB interface is available for communication with a host application processor (AT commands, data communication, GNSS tunneling, FW update by means of the FOAT feature), for FW update by means of the u-blox EasyFlash tool and for diagnostics.

The **USB\_D+** / **USB\_D-** lines carry the USB data and signaling. The USB interface is automatically enabled by an external valid USB VBUS voltage applied on the **VUSB\_DET** input pin of the module.


 The USB interface of the LARA-R6 series modules is enabled only if an external voltage detectable as High logic level (see Table 27 for the electrical characteristics) is present at the **VUSB\_DET** input during the switch-on boot sequence of the module. This configuration can be changed by the +UUSBDET AT command on all LARA-R6 series modules versions except LARA-R6001D-00B.

The USB interface provides functions with various capabilities and purposes, such as:

- Virtual serial port over USB for AT commands and data communication
- Virtual serial port over USB for GNSS tunneling
- Virtual serial port over USB for Diagnostic log
- Ethernet-over-USB (not supported by “00B” products version)

The user can concurrently use AT command interface on one virtual serial port, and packet switched / circuit switched data communication on another virtual serial port over USB.

LARA-R6 series modules are compatible with the standard Linux/Android USB kernel drivers.

 It is highly recommended to provide access to the **VUSB\_DET**, **USB\_D+**, **USB\_D-** pins for FW update and for diagnostic purpose, by means of test points directly connected to the pins.




### 2.5.3 I2C interface

LARA-R6 series modules include an I2C-bus compatible interface (**SDA** and **SCL** pins) available to communicate with an external u-blox GNSS chips / modules, and with external compatible I2C devices as for example an audio codec: LARA-R6 series module acts as an I2C host which can communicate with I2C local devices in accordance with the I2C bus specifications [15].

For more details regarding I2C interface usage and the integration with a u-blox GNSS receiver, see the LARA-R6 series system integration manual [2], positioning implementation application note [6], and the I2C and GNSS AT commands description in the u-blox AT commands manual [1].

## 2.6 Audio interface


 LARA-R6001D, LARA-R6401D, LARA-R6801D data-only modules do not support of voice / audio.

LARA-R6 series modules support Voice over LTE (VoLTE) as well as Circuit-switched fallback (CSFB) from LTE to 3G or 2G radio bearer for providing audio services.

LARA-R6 series modules include a 4-wire I2S digital audio interface (**I2S\_TXD**, **I2S\_RXD**, **I2S\_CLK**, **I2S\_WA**) that can be configured by AT commands to transfer digital audio data to/from an external device as an audio codec.

For more details regarding I2S digital audio interface possible configurations, usage and guideline for the integration with an external digital audio device as an audio codec, see the LARA-R6 series system integration manual [2] and the audio sections in the AT commands manual [1].

## 2.7 Clock output

 LARA-R6001D, LARA-R6401D, LARA-R6801D modules do not support **GPIO6** clock output.

LARA-R6 series modules provide digital clock output functionality on the **GPIO6** pin. This is mainly designed to feed the clock input of an external audio codec, as the clock output is generated only when the audio is active. For more details, see the AT commands manual [1], +UMCLK AT command.

## 2.8 GPIO pins

LARA-R6 series modules include 9 pins (**GPIO1-GPIO5**, **I2S\_TXD**, **I2S\_RXD**, **I2S\_CLK**, **I2S\_WA**) that can be configured as General Purpose Input/Output or to provide custom functions as summarized in the Table 5 (for further details, see the GPIO section in the AT commands manual [1]).


| Function                       | Description   | Default GPIO | Configurable GPIOs   |
|--------------------------------|---|--------------|--|
| Network status indication      | Network status: registered home network, registered roaming, data transmission, no service      | --           | GPIO1, GPIO2, GPIO3, GPIO4, I2S_RXD <sup>9</sup> , I2S_TXD <sup>9</sup> , I2S_CLK <sup>9</sup> , I2S_WA <sup>9</sup> |
| GNSS supply enable             | Enable/disable the supply of u-blox GNSS receiver connected to the cellular module              | GPIO2        | GPIO1, GPIO2, GPIO3, GPIO4   |
| GNSS data ready                | Sense when u-blox GNSS receiver connected to the module is ready for sending data by the I2C    | GPIO3        | GPIO3  |
| SIM card detection             | External SIM card physical presence detection   | GPIO5        | GPIO5  |
| SIM card hot insertion/removal | Enable / disable SIM interface upon detection of external SIM card physical insertion / removal | --           | GPIO5  |
| RI                             | Main UART Ring Indicator output function  | --           | All  |
| DTR                            | Main UART DTR input line function   | --           | GPIO3, GPIO4   |

<sup>9</sup> Not supported by "00B" products version

| Function                                  | Description   | Default GPIO                      | Configurable GPIOs                |
|---|---|-----------------------------------|-----------------------------------|
| Last gasp                                 | Input to trigger last gasp notification by applying a rising or falling edge according to AT+ULGASP setting                   | --                                | GPIO3                             |
| Faster power-off                          | Input with internal pull-down to trigger a faster emergency shutdown (as AT+CFUN=10) by applying a rising edge                | --                                | GPIO3                             |
| Memory-safe power-off <sup>9</sup>        | Input with internal pull-down to trigger the fastest memory-safe emergency shutdown (as AT+CFUN=11) by applying a rising edge | --                                | GPIO3                             |
| I2S digital audio interface <sup>10</sup> | I2S digital audio interface   | I2S_RXD, I2S_TXD, I2S_CLK, I2S_WA | I2S_RXD, I2S_TXD, I2S_CLK, I2S_WA |
| General purpose input                     | Input to sense high or low digital level  | --                                | All                               |
| General purpose output                    | Output to set the high or the low digital level   | GPIO4                             | All                               |
| Pin disabled                              | Tri-state with an internal active pull-down enabled   | GPIO1                             | All                               |

**Table 5: GPIO custom functions configuration**

## 2.9 Antenna dynamic tuner interface

 The antenna dynamic tuner interface is not supported by LARA-R6001-00B, LARA-R6001D-00B and LARA-R6801-00B product versions.

LARA-R6 series modules include two 1.8 V digital output pins (**RFCTRL1** and **RFCTRL2**) that are configured to control in real time an external antenna tuning IC, as optional available feature, changing their output value dynamically according to the specific actual cellular band in use by the module. [Table 6](#), [Table 7](#) and [Table 8](#) illustrate the default factory-programmed configuration, which can be changed by dedicated AT command on the “01B” product versions.

| RFCTRL1 | RFCTRL2 | LTE frequency band in use                           | 2G/3G frequency band in use                          |
|---------|---------|---|--|
| 0       | 0       | B1, B2, B3, B4, B5, B7, B8, B19, B38, B39, B40, B41 | GSM 850, E-GSM 900, DCS 1800, PCS 1900, all 3G bands |
| 0       | 1       | B12, B13, B28                                       | N/A  |
| 1       | 0       | B18, B20, B26                                       | N/A  |
| 1       | 1       | N/A   | N/A  |

**Table 6: LARA-R6001 and LARA-R6001D antenna dynamic tuning truth table (default factory-programmed configuration)**

| RFCTRL1 | RFCTRL2 | LTE frequency band in use | 2G/3G frequency band in use |
|---------|---------|---------------------------|-----------------------------|
| 0       | 0       | B2, B4, B5, B66           | N/A                         |
| 0       | 1       | N/A                       | N/A                         |
| 1       | 0       | B12, B13, B14             | N/A                         |
| 1       | 1       | B71                       | N/A                         |

**Table 7: LARA-R6401 and LARA-R6401D antenna dynamic tuning truth table (default factory-programmed configuration)**

| RFCTRL1 | RFCTRL2 | LTE frequency band in use       | 2G/3G frequency band in use                          |
|---------|---------|---------------------------------|--|
| 0       | 0       | B1, B2, B3, B4, B5, B7, B8, B19 | GSM 850, E-GSM 900, DCS 1800, PCS 1900, all 3G bands |
| 0       | 1       | B28                             | N/A  |
| 1       | 0       | B18, B20, B26                   | N/A  |
| 1       | 1       | N/A                             | N/A  |

**Table 8: LARA-R6801 and LARA-R6801D antenna dynamic tuning truth table (default factory-programmed configuration)**

<sup>10</sup> Not supported by LARA-R6001D, LARA-R6401D, LARA-R6801D data-only modules: I2S pins are by default set as Pin disabled

## 2.10 Reserved pins

LARA-R6 series modules include pins reserved for future use, marked as **RSVD**, which can all be left unconnected on the application board, except connecting a test point to the **RSVD #33** pin.

## 3 Pin definition

### 3.1 Pin assignment

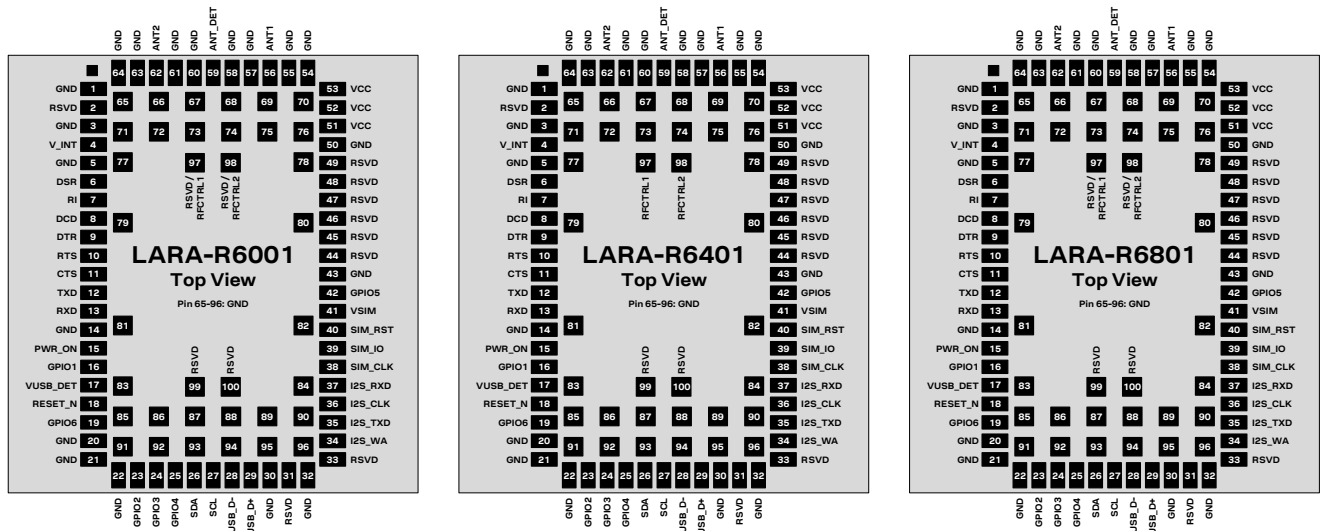


Figure 2: LARA-R6 series pin assignment (top view)

| No | Name  | Power domain | I/O   | Description                                     | Remarks  |
|----|-------|--------------|-------|---|--|
| 1  | GND   | -            | N/A   | Ground  | All the GND pins are intended to be connected to ground  |
| 2  | RSVD  | -            | N/A   | RESERVED pin                                    | Pin reserved for future use. Internally not connected.   |
| 3  | GND   | -            | N/A   | Ground  | All the GND pins are intended to be connected to ground  |
| 4  | V_INT | -            | O     | Generic Digital Interfaces supply output        | V_INT = 1.8 V (typical) generated by the module when it is switched-on, outside low power deep sleep mode.<br>See section 4.2.3 for detailed electrical specs.<br>Provide test point for diagnostic purposes.  |
| 5  | GND   | -            | N/A   | Ground  | All the GND pins are intended to be connected to ground  |
| 6  | 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).<br>See section 4.2.14 for detailed electrical specs.               |
| 7  | 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).<br>See section 4.2.14 for detailed electrical specs.  |
| 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).<br>See section 4.2.14 for detailed electrical specs.  |
| 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).<br>See section 4.2.14 for detailed electrical specs. |
| 10 | RTS   | GDI          | I     | UART ready to send                              | Circuit 105 in ITU-T V.24 (RTS flow control input, idle high, active low, with internal active pull-up enabled).<br>See section 4.2.14 for detailed electrical specs.  |

| No | Name     | Power domain | I/O | Description           | Remarks  |
|----|----------|--------------|-----|-----------------------|--|
| 11 | 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).<br>See section 4.2.14 for detailed electrical specs.   |
| 12 | 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).<br>See section 4.2.14 for detailed electrical specs.  |
| 13 | RXD      | GDI          | O   | UART data output      | Circuit 104 in ITU-T V.24 (RxD data output, push-pull, idle high, active low).<br>See section 4.2.14 for detailed electrical specs.  |
| 14 | GND      | -            | N/A | Ground                | All the GND pins are intended to be connected to ground  |
| 15 | PWR_ON   | POS          | I   | Power-on input        | Internal pull-up. Active low.<br>See section 4.2.9 for detailed electrical specs.<br>Provide test point for diagnostic purposes.   |
| 16 | GPIO1    | GDI          | I/O | GPIO                  | GPIO configurable as described in section 2.8.<br>Push-pull output type.<br>See section 4.2.14 for detailed electrical specs.  |
| 17 | VUSB_DET | VBUS         | I   | VBUS USB detect input | VBUS (5 V typical) USB supply generated by the host must be connected to this input pin during the switch-on boot sequence of the module to enable the USB interface.<br>See section 4.2.12 for detailed electrical specs.<br>Provide test point for diagnostic purposes.  |
| 18 | RESET_N  | ERS          | I   | External reset input  | Internal pull-up. Active low.<br>See section 4.2.10 for detailed electrical specs.   |
| 19 | GPIO6    | GDI          | O   | Clock output          | Configurable clock output as described in section 2.7.<br>Not supported by LARA-R6001D, LARA-R6401D and LARA-R6801D data-only modules.<br>Push-pull output type.<br>See section 4.2.14 / 4.2.14.1 for detailed electrical specs.   |
| 20 | GND      | -            | N/A | Ground                | All the GND pins are intended to be connected to ground  |
| 21 | GND      | -            | N/A | Ground                | All the GND pins are intended to be connected to ground  |
| 22 | GND      | -            | N/A | Ground                | All the GND pins are intended to be connected to ground  |
| 23 | GPIO2    | GDI          | I/O | GPIO                  | GPIO configurable as described in section 2.8.<br>Push-pull output type.<br>See section 4.2.14 for detailed electrical specs.  |
| 24 | GPIO3    | GDI          | I/O | GPIO                  | GPIO configurable as described in section 2.8.<br>Push-pull output type.<br>See section 4.2.14 for detailed electrical specs.  |
| 25 | GPIO4    | GDI          | I/O | GPIO                  | GPIO configurable as described in section 2.8.<br>Push-pull output type.<br>See section 4.2.14 for detailed electrical specs.  |
| 26 | SDA      | I2C          | I/O | I2C bus data line     | Open drain output type. Active low.<br>Internal 2.2 k $\Omega$ pull-up resistor to V_INT.<br>See section 4.2.13 for detailed electrical specs.   |
| 27 | SCL      | I2C          | O   | I2C bus clock line    | Open drain output type. Active low.<br>Internal 2.2 k $\Omega$ pull-up resistor to V_INT.<br>See section 4.2.13 for detailed electrical specs.   |
| 28 | USB_D-   | USB          | I/O | USB Data Line D-      | 90 $\Omega$ nominal differential characteristic impedance.<br>Pull-up, pull-down and series resistors as required by the USB 2.0 specifications [14] are part of the USB pin driver and need not be provided externally.<br>See section 4.2.12 for detailed electrical specs.<br>Provide test point for diagnostic purposes. |

| No | Name    | Power domain | I/O     | Description               | Remarks  |
|----|---------|--------------|---------|---------------------------|--|
| 29 | USB_D+  | USB          | I/O     | USB Data Line D+          | 90 $\Omega$ nominal differential characteristic impedance.<br>Pull-up, pull-down and series resistors as required by the USB 2.0 specifications [14] are part of the USB pin driver and need not be provided externally.<br>See section 4.2.12 for detailed electrical specs.<br>Provide test point for diagnostic purposes. |
| 30 | GND     | -            | N/A     | Ground                    | All the GND pins are intended to be connected to ground  |
| 31 | RSVD    | -            | N/A     | RESERVED pin              | Pin reserved for future use. Internally not connected.   |
| 32 | GND     | -            | N/A     | Ground                    | All the GND pins are intended to be connected to ground  |
| 33 | RSVD    | -            | N/A     | RESERVED pin              | Pin reserved with special function.<br>Provide test point for diagnostic purposes.   |
| 34 | I2S_WA  | GDI          | O / I/O | I2S word alignment / GPIO | Settable as I2S word alignment, or as GPIO (see 2.6, 2.8).<br>Push-pull output type.<br>I2S not supported by LARA-R6001D, LARA-R6401D and LARA-R6801D data-only modules.<br>See section 4.2.14 for detailed electrical specs.  |
| 35 | I2S_TXD | GDI          | O / I/O | I2S transmit data / GPIO  | Configurable as I2S data output, or as GPIO (see 2.6, 2.8).<br>Push-pull output type.<br>I2S not supported by LARA-R6001D, LARA-R6401D and LARA-R6801D data-only modules.<br>See section 4.2.14 for detailed electrical specs.   |
| 36 | I2S_CLK | GDI          | O / I/O | I2S clock / GPIO          | Configurable as I2S clock, or as GPIO (see 2.6, 2.8).<br>Push-pull output type.<br>I2S not supported by LARA-R6001D, LARA-R6401D and LARA-R6801D data-only modules.<br>See section 4.2.14 for detailed electrical specs.   |
| 37 | I2S_RXD | GDI          | I / I/O | I2S receive data / GPIO   | Configurable as I2S data input, or as GPIO (see 2.6, 2.8).<br>Push-pull output type.<br>I2S not supported by LARA-R6001D, LARA-R6401D and LARA-R6801D data-only modules.<br>See section 4.2.14 for detailed electrical specs.  |
| 38 | SIM_CLK | SIM          | O       | SIM clock                 | See section 4.2.10 for detailed electrical specs.  |
| 39 | SIM_IO  | SIM          | I/O     | SIM data                  | Internal 4.7 k $\Omega$ pull-up resistor to VSIM.<br>See section 4.2.10 for detailed electrical specs.   |
| 40 | SIM_RST | SIM          | O       | SIM reset                 | See section 4.2.10 for detailed electrical specs.  |
| 41 | VSIM    | -            | O       | SIM supply output         | VSIM = 1.80 V typical or 2.95 V typical generated by the module according to the external SIM card/chip type.<br>See section 4.2.3 for detailed electrical specs.  |
| 42 | GPIO5   | GDI          | I/O     | GPIO                      | Configurable for SIM card detection, or as GPIO (see 2.8).<br>Push-pull output type.<br>See section 4.2.14 for detailed electrical specs.  |
| 43 | GND     | -            | N/A     | Ground                    | All the GND pins are intended to be connected to ground  |
| 44 | RSVD    | -            | N/A     | RESERVED pin              | Pin reserved for future use.   |
| 45 | RSVD    | -            | N/A     | RESERVED pin              | Pin reserved for future use.   |
| 46 | RSVD    | -            | N/A     | RESERVED pin              | Pin reserved for future use.   |
| 47 | RSVD    | -            | N/A     | RESERVED pin              | Pin reserved for future use.   |
| 48 | RSVD    | -            | N/A     | RESERVED pin              | Pin reserved for future use.   |
| 49 | RSVD    | -            | N/A     | RESERVED pin              | Pin reserved for future use.   |
| 50 | GND     | -            | N/A     | Ground                    | All the GND pins are intended to be connected to ground  |
| 51 | VCC     | -            | I       | Module supply input       | Supply input for baseband Power Management Unit part.<br>All VCC pins must be connected to external supply.<br>See sections 4.2.3 and 4.2.4 for detailed specs.  |

| No    | Name    | Power domain | I/O | Description         | Remarks   |
|-------|---------|--------------|-----|---------------------|---|
| 52    | VCC     | -            | I   | Module supply input | Supply for RF Power Amplifiers part.<br>All VCC pins must be connected to external supply.<br>See sections 4.2.3 and 4.2.4 for detailed specs.  |
| 53    | VCC     | -            | I   | Module supply input | Supply for RF Power Amplifiers part.<br>All VCC pins must be connected to external supply.<br>See sections 4.2.3 and 4.2.4 for detailed specs.  |
| 54    | GND     | -            | N/A | Ground              | All the GND pins are intended to be connected to ground   |
| 55    | GND     | -            | N/A | Ground              | All the GND pins are intended to be connected to ground   |
| 56    | ANT1    | ANT          | I/O | Primary antenna     | 50 $\Omega$ nominal characteristic impedance.<br>Main Tx / Rx antenna interface.<br>See section 4.2.5, 4.2.6, 0 for details.  |
| 57    | GND     | GND          | N/A | Ground              | All the GND pins are intended to be connected to ground   |
| 58    | GND     | GND          | N/A | Ground              | All the GND pins are intended to be connected to ground   |
| 59    | ANT_DET | ADC          | I   | Antenna detection   | ADC input for antenna presence detection function.<br>See section 4.2.8 for detailed electrical specs.  |
| 60    | GND     | GND          | N/A | Ground              | All the GND pins are intended to be connected to ground   |
| 61    | GND     | GND          | N/A | Ground              | All the GND pins are intended to be connected to ground   |
| 62    | ANT2    | ANT          | I   | Secondary antenna   | 50 $\Omega$ nominal characteristic impedance.<br>Rx only for Down-Link Rx diversity.<br>See section 4.2.5, 4.2.6 for details.   |
| 63    | GND     | -            | N/A | Ground              | All the GND pins are intended to be connected to ground   |
| 64    | GND     | -            | N/A | Ground              | All the GND pins are intended to be connected to ground   |
| 65-96 | GND     | -            | N/A | Ground              | All the GND pins are intended to be connected to ground   |
| 97    | RFCTRL1 | GDI          | O   | RF control output   | 1.8 V push-pull output to dynamically control external RF antenna tuning IC, changing the high/low state in real time according to the cellular RF band in use by the module.<br>Not supported by LARA-R6001-00B, LARA-R6001D-00B and LARA-R6801-00B product versions.<br>See section 4.2.14 for detailed electrical specs. |
|       | RSVD    |              | N/A | RESERVED pin        | LARA-R6001-00B, LARA-R6001D-00B, LARA-R6801-00B product versions only.<br>Pin reserved for future use.  |
| 98    | RFCTRL2 | GDI          | O   | RF control output   | 1.8 V push-pull output to dynamically control external RF antenna tuning IC, changing the high/low state in real time according to the cellular RF band in use by the module.<br>Not supported by LARA-R6001-00B, LARA-R6001D-00B and LARA-R6801-00B product versions.<br>See section 4.2.14 for detailed electrical specs. |
|       | RSVD    | -            | N/A | RESERVED pin        | LARA-R6001-00B, LARA-R6001D-00B, LARA-R6801-00B product versions only.<br>Pin reserved for future use.  |
| 99    | RSVD    | -            | N/A | RESERVED pin        | Pin reserved for future use.  |
| 100   | RSVD    | -            | N/A | RESERVED pin        | Pin reserved for future use.  |




**Table 9: LARA-R6 series pin-out**


For more information about the pin-out, see the system integration manual [2].




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

-  Limit values given below are in accordance with the Absolute Maximum Rating System (IEC 134).

| Symbol   | Description                | Condition   | Min. | Max. | Unit |
|----------|----------------------------|---|------|------|------|
| VCC      | Module supply voltage      | Input DC voltage at VCC pin                         | -0.5 | 6.0  | V    |
| VUSB_DET | USB detection pin          | Input DC voltage at VUSB_DET pin                    | -0.3 | 5.5  | V    |
| USB      | USB D+/D- pins             | Input DC voltage at USB_D+ and USB_D- pins          | -0.3 | 3.6  | V    |
| GDI      | Generic digital interfaces | Input DC voltage at Generic digital interfaces pins | -0.3 | 2.1  | V    |
| I2C      | I2C interface              | Input DC voltage at I2C interface pins              | -0.3 | 2.1  | V    |
| SIM      | SIM interface              | Input DC voltage at SIM interface pins              | -0.3 | 3.6  | V    |
| ERS      | External reset signal      | Input DC voltage at RESET_N pin                     | -0.3 | 2.1  | V    |
| POS      | Power-on input             | Input DC voltage at PWR_ON pin                      | -0.3 | 2.1  | V    |
| Rho_ANT  | Antenna ruggedness         | Output RF load mismatch ruggedness at ANT pins      |      | 10:1 | VSWR |
| Tstg     | Storage Temperature        |   | -40  | +85  | °C   |


**Table 10: Absolute maximum ratings**

-  The product is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, 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 11: Maximum ESD ratings**

-  u-blox cellular modules are Electrostatic Sensitive Devices and require special precautions when handling. See section 7.4 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. | Typical | 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 12: Environmental conditions

### 4.2.2 Thermal parameters

| Symbol       | Parameter                           | Min. | Typ. | Max. | Unit | Remarks   |
|--------------|-------------------------------------|------|------|------|------|---|
| $\Psi_{M-A}$ | Module-to-Ambient thermal parameter | 10   |      |      | °C/W | Thermal characterization parameter $\Psi_{M-A} = (T_M - T_A) / P_H$ proportional to the delta between internal module temperature ( $T_M$ ) and ambient temperature ( $T_A$ ), due to heat power dissipation ( $P_H$ ), with the module mounted on a 79 x 62 x 1.41 mm 4-Layer PCB with a high coverage of copper, in still air conditions  |
| $\Psi_{M-C}$ | Module-to-Case thermal parameter    | 3    |      |      | °C/W | Thermal characterization parameter $\Psi_{M-C} = (T_M - T_C) / P_H$ proportional to the delta between internal module temperature ( $T_M$ ) and ambient temperature ( $T_C$ ), due to heat power dissipation ( $P_H$ ), with the module mounted on a 79 x 62 x 1.41 mm 4-Layer PCB with a high coverage of copper, with a robust aluminum heat-sink and with forced air ventilation, i.e. reducing to a value close to 0 °C/W the thermal resistance from the case of the module to the ambient |

Table 13: Thermal characterization parameters of the module

### 4.2.3 Supply/power pins

| Symbol | Parameter  | Min. | Typical | Max. | Unit |
|--------|--|------|---------|------|------|
| VCC    | Normal operating input voltage for VCC pins 51, 52, 53 <sup>11</sup> | 3.3  | 3.8     | 4.5  | V    |
|        | Extended operating input voltage for VCC pin 51 <sup>12</sup>        | 3.1  | 3.8     | 4.5  | V    |
|        | Extended operating input voltage for VCC pins 52, 53 <sup>13</sup>   | 2.8  | 3.8     | 4.5  | V    |

Table 14: Input characteristics of the module Supply/Power pins

| Symbol | Parameter   | Min. | Typical | Max. | Unit |
|--------|---|------|---------|------|------|
| VSIM   | SIM supply output voltage, with external 1.8 V SIM          |      | 1.80    |      | V    |
|        | SIM supply output voltage, with external 3.0 V SIM          |      | 2.95    |      | V    |
| V_INT  | Generic Digital Interfaces supply output voltage            |      | 1.80    |      | V    |
|        | Generic Digital Interfaces supply output current capability |      |         | 70   | mA   |

Table 15: Output characteristics of the Supply/Power pins

<sup>11</sup> Operating within 3GPP / ETSI specifications.

<sup>12</sup> The voltage has to be above the extended operating range minimum limit for the **VCC** pin 51 (supply input for the baseband Power Management Unit and the Transceiver) to switch-on the module and to avoid possible switch-off of the module.

<sup>13</sup> Operating with possible slight deviation in RF performance outside normal operating range. The Power Amplifier may not be fully functional when the voltage drops below the extended operating range minimum limit defined for the **VCC** pins 52 and 53 (supply input for the internal Power Amplifier).

#### 4.2.4 Current consumption

| Mode  | Condition   | Tx power | Min | Typ <sup>14</sup> | Max <sup>15</sup> | Unit |
|---|---|----------|-----|-------------------|-------------------|------|
| Power-off mode  | Averaged current value<br>Module switched off                         |          |     | 9                 |                   | μA   |
| PSM mode <sup>16</sup>  | Averaged current value<br>Module in deep-sleep Power Saving Mode      |          |     | 11                |                   | μA   |
| Cyclic Idle/Active-Mode<br>(Low power mode enabled by +UPSV,<br>Module registered with network) | Averaged current value,<br>Idle mode floor current, USB not connected |          |     | 0.9               |                   | mA   |
|   | Averaged current value,<br>Idle mode floor current, USB suspended     |          |     | 1.2               |                   | mA   |
|   | Averaged current value,<br>Cyclic eDRX = 655.36 s, USB not connected  |          |     | 1.1               |                   | mA   |
|   | Averaged current value,<br>Cyclic eDRX = 655.36 s, USB suspended      |          |     | 1.4               |                   | mA   |
|   | Averaged current value,<br>Cyclic eDRX = 20.48 s, USB not connected   |          |     | 1.6               |                   | mA   |
|   | Averaged current value,<br>Cyclic eDRX = 20.48 s, USB suspended       |          |     | 1.9               |                   | mA   |
|   | Averaged current value,<br>Cyclic DRX = 2.56 s, USB not connected     |          |     | 1.9               |                   | mA   |
|   | Averaged current value,<br>Cyclic DRX = 2.56 s, USB suspended         |          |     | 2.2               |                   | mA   |
|   |   |          |     |                   |                   |      |
| Active-Mode<br>(Low power mode disabled by +UPSV,<br>Module registered with network)            | Averaged current value,<br>Cyclic DRX = 2.56 s, USB not connected     |          |     | 10.6              |                   | mA   |
|   | Averaged current value,<br>Cyclic DRX = 2.56 s, USB in use            |          |     | 27.0              |                   | mA   |
| 2G Connected Mode<br>(Tx / Rx call enabled)   | Peak value at 1-slot GMSK Tx burst,<br>900 MHz band                   | Maximum  |     | 1.5               | 1.9               | A    |
|   | Averaged value along 1-slot GMSK call,<br>900 MHz band                | Minimum  |     | 50                |                   | mA   |
|   |   | Maximum  |     | 200               |                   | mA   |
|   | Averaged value along 1-slot GMSK call,<br>1800 MHz band               | Minimum  |     | 50                |                   | mA   |
|   |   | Maximum  |     | 150               |                   | mA   |
|   |   |          |     |                   |                   |      |
| 3G Connected Mode<br>(Tx / Rx enabled)  | Averaged value along 3G Tx/Rx   | Minimum  |     | 200               |                   | mA   |
|   |   | 0 dBm    |     | 220               |                   | mA   |
|   |   | 12 dBm   |     | 300               |                   | mA   |
|   |   | 18 dBm   |     | 440               |                   | mA   |
|   |   | Maximum  |     | 620               |                   | mA   |
|   |   |          |     |                   |                   |      |
| LTE Connected Mode<br>(Tx / Rx enabled)   | Averaged value along LTE-FDD Tx/Rx                                    | Minimum  |     | 250               |                   | mA   |
|   |   | 0 dBm    |     | 270               |                   | mA   |
|   |   | 12 dBm   |     | 320               |                   | mA   |
|   |   | 18 dBm   |     | 450               |                   | mA   |
|   |   | Maximum  |     | 650               |                   | mA   |
|   |   |          |     |                   |                   |      |

**Table 16: LARA-R6 series modules VCC current consumption**

<sup>14</sup> Typical values with a matched antenna

<sup>15</sup> Maximum values with a mismatched antenna

<sup>16</sup> Not supported by “00B” products version

## 4.2.5 LTE RF characteristics

The LTE bands supported by each LARA-R6 module are defined in [Table 3](#), while [Table 17](#) describes the transmitting and receiving frequencies for each LTE band according to 3GPP TS 36.521-1 [10].

| Parameter                                 |          | Min. | Max. | Unit | Remarks          |
|---|----------|------|------|------|------------------|
| Frequency range<br>FDD band 71 (600 MHz)  | Uplink   | 663  | 698  | MHz  | Module transmits |
|   | Downlink | 617  | 652  | MHz  | Module receives  |
| Frequency range<br>FDD Band 12 (700 MHz)  | Uplink   | 699  | 716  | MHz  | Module transmits |
|   | Downlink | 729  | 746  | MHz  | Module receives  |
| Frequency range<br>FDD Band 13 (700 MHz)  | Uplink   | 777  | 787  | MHz  | Module transmits |
|   | Downlink | 746  | 756  | MHz  | Module receives  |
| Frequency range<br>FDD Band 14 (700 MHz)  | Uplink   | 788  | 798  | MHz  | Module transmits |
|   | Downlink | 758  | 768  | MHz  | Module receives  |
| Frequency range<br>FDD Band 28 (700 MHz)  | Uplink   | 703  | 748  | MHz  | Module transmits |
|   | Downlink | 758  | 803  | MHz  | Module receives  |
| Frequency range<br>FDD Band 20 (800 MHz)  | Uplink   | 832  | 862  | MHz  | Module transmits |
|   | Downlink | 791  | 821  | MHz  | Module receives  |
| Frequency range<br>FDD band 26 (850 MHz)  | Uplink   | 814  | 849  | MHz  | Module transmits |
|   | Downlink | 859  | 894  | MHz  | Module receives  |
| Frequency range<br>FDD band 18 (850 MHz)  | Uplink   | 815  | 830  | MHz  | Module transmits |
|   | Downlink | 860  | 875  | MHz  | Module receives  |
| Frequency range<br>FDD Band 19 (850 MHz)  | Uplink   | 830  | 845  | MHz  | Module transmits |
|   | Downlink | 875  | 890  | MHz  | Module receives  |
| Frequency range<br>FDD Band 5 (850 MHz)   | Uplink   | 824  | 849  | MHz  | Module transmits |
|   | Downlink | 869  | 894  | MHz  | Module receives  |
| Frequency range<br>FDD Band 8 (900 MHz)   | Uplink   | 880  | 915  | MHz  | Module transmits |
|   | Downlink | 925  | 960  | MHz  | Module receives  |
| Frequency range<br>FDD Band 4 (1700 MHz)  | Uplink   | 1710 | 1755 | MHz  | Module transmits |
|   | Downlink | 2110 | 2155 | MHz  | Module receives  |
| Frequency range<br>FDD band 66 (1700 MHz) | Uplink   | 1710 | 1780 | MHz  | Module transmits |
|   | Downlink | 2110 | 2200 | MHz  | Module receives  |
| Frequency range<br>FDD Band 3 (1800 MHz)  | Uplink   | 1710 | 1785 | MHz  | Module transmits |
|   | Downlink | 1805 | 1880 | MHz  | Module receives  |
| Frequency range<br>FDD Band 2 (1900 MHz)  | Uplink   | 1850 | 1910 | MHz  | Module transmits |
|   | Downlink | 1930 | 1990 | MHz  | Module receives  |
| Frequency range<br>TDD Band 39 (1900 MHz) | Uplink   | 1880 | 1920 | MHz  | Module transmits |
|   | Downlink | 1880 | 1920 | MHz  | Module receives  |
| Frequency range<br>FDD Band 1 (2100 MHz)  | Uplink   | 1920 | 1980 | MHz  | Module transmits |
|   | Downlink | 2110 | 2170 | MHz  | Module receives  |
| Frequency range<br>TDD Band 40 (2300 MHz) | Uplink   | 2300 | 2400 | MHz  | Module transmits |
|   | Downlink | 2300 | 2400 | MHz  | Module receives  |
| Frequency range<br>TDD Band 38 (2600 MHz) | Uplink   | 2570 | 2620 | MHz  | Module transmits |
|   | Downlink | 2570 | 2620 | MHz  | Module receives  |
| Frequency range<br>TDD Band 41 (2600 MHz) | Uplink   | 2496 | 2690 | MHz  | Module transmits |
|   | Downlink | 2496 | 2690 | MHz  | Module receives  |
| Frequency range<br>FDD Band 7 (2600 MHz)  | Uplink   | 2500 | 2570 | MHz  | Module transmits |
|   | Downlink | 2620 | 2690 | MHz  | Module receives  |

**Table 17: LTE operating RF frequency bands**

LARA-R6 series modules include a UE Power Class 3 LTE transmitter (see [Table 3](#)), with output power and characteristics according to 3GPP TS 36.521-1 [\[10\]](#).

LARA-R6 series modules LTE receiver characteristics are compliant to 3GPP TS 36.521-1 [\[10\]](#), with LTE conducted receiver sensitivity performance described in [Table 18](#).

| Parameter  | Min. | Typical | Max. | Unit | Remarks                     |
|--|------|---------|------|------|-----------------------------|
| Receiver input sensitivity<br>Band 71 (600 MHz)  |      | -105    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -100    |      | dBm  | Channel bandwidth = 20 MHz  |
| Receiver input sensitivity<br>Band 12 (700 MHz)  |      | -110    |      | dBm  | Channel bandwidth = 1.4 MHz |
|  |      | -104    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -101    |      | dBm  | Channel bandwidth = 10 MHz  |
| Receiver input sensitivity<br>Band 13 (700 MHz)  |      | -105    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -102    |      | dBm  | Channel bandwidth = 10 MHz  |
| Receiver input sensitivity<br>Band 14 (700 MHz)  |      | -105    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -102    |      | dBm  | Channel bandwidth = 10 MHz  |
| Receiver input sensitivity<br>Band 28 (700 MHz)  |      | -107    |      | dBm  | Channel bandwidth = 3 MHz   |
|  |      | -105    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -99     |      | dBm  | Channel bandwidth = 20 MHz  |
| Receiver input sensitivity<br>Band 20 (800 MHz)  |      | -105    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -99     |      | dBm  | Channel bandwidth = 20 MHz  |
| Receiver input sensitivity<br>Band 26 (850 MHz)  |      | -110    |      | dBm  | Channel bandwidth = 1.4 MHz |
|  |      | -105    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -100    |      | dBm  | Channel bandwidth = 15 MHz  |
| Receiver input sensitivity<br>Band 18 (850 MHz)  |      | -105    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -101    |      | dBm  | Channel bandwidth = 15 MHz  |
| Receiver input sensitivity<br>Band 19 (850 MHz)  |      | -105    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -100    |      | dBm  | Channel bandwidth = 15 MHz  |
| Receiver input sensitivity<br>Band 5 (850 MHz)   |      | -110    |      | dBm  | Channel bandwidth = 1.4 MHz |
|  |      | -105    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -102    |      | dBm  | Channel bandwidth = 10 MHz  |
| Receiver input sensitivity<br>Band 8 (900 MHz)   |      | -110    |      | dBm  | Channel bandwidth = 1.4 MHz |
|  |      | -105    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -102    |      | dBm  | Channel bandwidth = 10 MHz  |
| Receiver input sensitivity<br>Band 4 (1700 MHz)  |      | -110    |      | dBm  | Channel bandwidth = 1.4 MHz |
|  |      | -104    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -99     |      | dBm  | Channel bandwidth = 20 MHz  |
| Receiver input sensitivity<br>Band 66 (1700 MHz) |      | -109    |      | dBm  | Channel bandwidth = 1.4 MHz |
|  |      | -104    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -99     |      | dBm  | Channel bandwidth = 20 MHz  |
| Receiver input sensitivity<br>Band 3 (1800 MHz)  |      | -107    |      | dBm  | Channel bandwidth = 1.4 MHz |
|  |      | -102    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -97     |      | dBm  | Channel bandwidth = 20 MHz  |
| Receiver input sensitivity<br>Band 2 (1900 MHz)  |      | -110    |      | dBm  | Channel bandwidth = 1.4 MHz |
|  |      | -104    |      | dBm  | Channel bandwidth = 5 MHz   |
|  |      | -99     |      | dBm  | Channel bandwidth = 20 MHz  |

| Parameter  | Min. | Typical | Max. | Unit | Remarks                    |
|--|------|---------|------|------|----------------------------|
| Receiver input sensitivity<br>Band 1 (2100 MHz)  |      | -104    |      | dBm  | Channel bandwidth = 5 MHz  |
|  |      | -99     |      | dBm  | Channel bandwidth = 20 MHz |
| Receiver input sensitivity<br>Band 7 (2600 MHz)  |      | -103    |      | dBm  | Channel bandwidth = 5 MHz  |
|  |      | -98     |      | dBm  | Channel bandwidth = 20 MHz |
| Receiver input sensitivity<br>Band 39 (1900 MHz) |      | -105    |      | dBm  | Channel bandwidth = 5 MHz  |
|  |      | -100    |      | dBm  | Channel bandwidth = 20 MHz |
| Receiver input sensitivity<br>Band 40 (2300 MHz) |      | -104    |      | dBm  | Channel bandwidth = 5 MHz  |
|  |      | -99     |      | dBm  | Channel bandwidth = 20 MHz |
| Receiver input sensitivity<br>Band 38 (2600 MHz) |      | -103    |      | dBm  | Channel bandwidth = 5 MHz  |
|  |      | -98     |      | dBm  | Channel bandwidth = 20 MHz |
| Receiver input sensitivity<br>Band 41 (2600 MHz) |      | -103    |      | dBm  | Channel bandwidth = 5 MHz  |
|  |      | -98     |      | dBm  | Channel bandwidth = 20 MHz |

Condition: 50  $\Omega$ , throughput > 95%, dual receiver, QPSK modulation, other settings as per clause 7.3 of 3GPP TS 36.521-1 [10]

**Table 18: LTE receiver sensitivity performance**

## 4.2.6 3G RF characteristics

The 3G bands supported by LARA-R6 series modules are defined in Table 3, while Table 19 describes the transmitting and receiving frequencies for each 3G band according to 3GPP TS 34.121-1 [11].

| Parameter                            |          | Min. | Max. | Unit | Remarks          |
|--------------------------------------|----------|------|------|------|------------------|
| Frequency range<br>Band 5 (850 MHz)  | Uplink   | 824  | 849  | MHz  | Module transmits |
|                                      | Downlink | 869  | 894  | MHz  | Module receives  |
| Frequency range<br>Band 8 (900 MHz)  | Uplink   | 880  | 915  | MHz  | Module transmits |
|                                      | Downlink | 925  | 960  | MHz  | Module receives  |
| Frequency range<br>Band 2 (1900 MHz) | Uplink   | 1850 | 1910 | MHz  | Module transmits |
|                                      | Downlink | 1930 | 1990 | MHz  | Module receives  |
| Frequency range<br>Band 1 (2100 MHz) | Uplink   | 1920 | 1980 | MHz  | Module transmits |
|                                      | Downlink | 2110 | 2170 | MHz  | Module receives  |

**Table 19: 3G operating RF frequency bands**

LARA-R6 series modules include a UE Power Class 3 3G transmitter (see Table 3), with output power and characteristics according to 3GPP TS 34.121-1 [11].

LARA-R6 series modules 3G receiver characteristics are compliant to 3GPP TS 34.121-1 [11], with 3G conducted receiver sensitivity performance described in Table 20.

| Parameter                                       | Min. | Typical | Max. | Unit | Remarks                                |
|---|------|---------|------|------|--|
| Receiver input sensitivity<br>Band 5 (850 MHz)  |      | -115    |      | dBm  | Downlink RF level for RMC @ BER < 0.1% |
| Receiver input sensitivity<br>Band 8 (900 MHz)  |      | -115    |      | dBm  | Downlink RF level for RMC @ BER < 0.1% |
| Receiver input sensitivity<br>Band 2 (2100 MHz) |      | -114    |      | dBm  | Downlink RF level for RMC @ BER < 0.1% |
| Receiver input sensitivity<br>Band 1 (2100 MHz) |      | -114    |      | dBm  | Downlink RF level for RMC @ BER < 0.1% |

Condition: 50  $\Omega$ , dual receiver, other settings as per clause 6.2 of 3GPP TS 34.121-1 [11]

**Table 20: 3G receiver sensitivity performance**

## 4.2.7 2G RF characteristics

The 2G bands supported by LARA-R6 series modules are defined in [Table 3](#), while [Table 21](#) describes Transmitting and Receiving frequencies for each 2G band according to 3GPP TS 51.010-1 [\[12\]](#).

| Parameter                    |          | Min  | Max  | Unit | Remarks          |
|------------------------------|----------|------|------|------|------------------|
| Frequency range<br>GSM 850   | Uplink   | 824  | 849  | MHz  | Module transmits |
|                              | Downlink | 869  | 894  | MHz  | Module receives  |
| Frequency range<br>E-GSM 900 | Uplink   | 880  | 915  | MHz  | Module transmits |
|                              | Downlink | 925  | 960  | MHz  | Module receives  |
| Frequency range<br>DCS 1800  | Uplink   | 1710 | 1785 | MHz  | Module transmits |
|                              | Downlink | 1805 | 1880 | MHz  | Module receives  |
| Frequency range<br>PCS 1900  | Uplink   | 1850 | 1910 | MHz  | Module transmits |
|                              | Downlink | 1930 | 1990 | MHz  | Module receives  |

**Table 21: 2G operating RF frequency bands**

LARA-R6 series modules include a GMSK Power Class 4 transmitter for 850 / 900 MHz bands, GMSK Power Class 1 transmitter for 1800 / 1900 MHz bands, 8-PSK Power Class E2 transmitter for all 2G bands (see [Table 3](#)), with output power and characteristics according to 3GPP TS 51.010-1 [\[12\]](#).

LARA-R6 series modules 2G receiver characteristics are compliant to 3GPP TS 51.010-1 [\[12\]](#), with conducted receiver sensitivity performance described in [Table 22](#).

| Parameter   | Min. | Typical | Max. | Unit | Remarks                                 |
|---|------|---------|------|------|---|
| Receiver input sensitivity<br>GSM 850 / E-GSM 900 |      | -110    |      | dBm  | Downlink RF level @ BER Class II < 2.4% |
| Receiver input sensitivity<br>DCS 1800 / PCS 1900 |      | -109    |      | dBm  | Downlink RF level @ BER Class II < 2.4% |

Condition: 50  $\Omega$ , other settings as per clause 14.2.1 of 3GPP TS 51.010-1 [\[12\]](#)

**Table 22: 2G receiver sensitivity performance**

## 4.2.8 ANT\_DET pin

| Parameter                           | Min. | Typ. | Max. | Unit    | Remarks                                     |
|-------------------------------------|------|------|------|---------|---|
| Output DC current pulse value       |      | 35   |      | $\mu$ A | Generated by means of the +UANTR AT command |
| Output DC current pulse time length |      | 1160 |      | $\mu$ s | Generated by means of the +UANTR AT command |

**Table 23: ANT\_DET pin characteristics**

## 4.2.9 PWR\_ON pin

| Parameter                                  | Min.  | Typical | Max. | Unit       | Remarks  |
|--|-------|---------|------|------------|--|
| Internal supply for<br>PWR_ON Input Signal |       | 1.8     |      | V          | The PWR_ON input is pulled up to an internal voltage rail minus a diode drop: the voltage value present at PWR_ON input pin is normally 0.8 V typical. |
| Low-level input                            | -0.30 |         | 0.35 | V          |  |
| Pull-up resistance                         | 150   | 200     | 250  | k $\Omega$ | Internal active pull-up  |
| Input leakage current                      | -0.20 |         | 0.20 | $\mu$ A    |  |
| PWR_ON low time                            | 0.15  |         | 3.20 | s          | Low time to trigger module switch on from power off mode, or wake-up from ultra-low power PSM deep-sleep mode  |
|  | 1.50  |         |      | s          | Low time to trigger module graceful switch off   |

**Table 24: PWR\_ON pin characteristics**

## 4.2.10 RESET\_N pin

| Parameter                                | Min.  | Typical | Max. | Unit | Remarks  |
|--|-------|---------|------|------|--|
| Internal supply for RESET_N Input Signal |       | 1.8     |      | V    |  |
| Low-level input                          | -0.30 |         | 0.63 | V    |  |
| Pull-up resistance                       |       | 37      |      | kΩ   | Internal active pull-up                                |
| Input leakage current                    | -0.20 |         | 0.20 | μA   |  |
| RESET_N low time                         | 0.05  | 6       |      | s    | Low time to trigger module reset (reboot)              |
|  | 10    |         |      | s    | Low time to trigger module abrupt emergency switch off |

**Table 25: RESET\_N pin characteristics**

## 4.2.11 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 26](#) are for information only.

| Parameter                           | Min.     | Typ. | Max.     | Unit | Remarks   |
|-------------------------------------|----------|------|----------|------|---|
| Low-level input                     | -0.30    |      | 0.2*VSIM | V    |   |
| High-level input                    | 0.7*VSIM |      | VSIM+0.3 | V    |   |
| Low-level output                    |          | 0    | 0.4      | V    | Max value at I <sub>OL</sub> = +2.0 mA          |
| High-level output                   | 0.8*VSIM | VSIM |          | V    | Max value at I <sub>OL</sub> = +2.0 mA          |
| Internal pull-up resistor on SIM_IO |          | 4.7  |          | kΩ   | Internal pull-up to VSIM supply                 |
| Input leakage current               | -2       |      | 2        | μA   | V <sub>IN</sub> = 0 V or V <sub>IN</sub> = VSIM |
| Clock frequency on SIM_CLK          |          | 4.8  |          | MHz  |   |

**Table 26: SIM pins characteristics**

## 4.2.12 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 [14] for detailed electrical characteristics. The values in [Table 27](#) 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  | 1.50 | 5.00    | 5.25 | V    | AT+UUSBDET=0 (factory-programmed setting) |
|   | 4.40 | 5.00    | 5.25 | V    | AT+UUSBDET=1                              |
| 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 27: USB pins characteristics**

### 4.2.13 I2C pins

I2C lines (**SCL** and **SDA**) are compliant with the I2C-bus standard mode specification. See the I2C-bus specification [15] for detailed electrical characteristics. The values in Table 28 related to I2C-bus standard mode specifications are for information only.

| Parameter                      | Min   | Typical | Max  | Unit | Remarks   |
|--------------------------------|-------|---------|------|------|---|
| Internal supply for GDI domain |       | 1.80    |      | V    | Digital I/O Interfaces supply (V_INT)           |
| Low-level input                | -0.30 | 0.00    | 0.63 | V    |   |
| High-level input               | 1.17  | 1.80    | 2.10 | V    |   |
| Low-level output               |       | 0.00    | 0.45 | V    | Max value at I <sub>OL</sub> = +2.0 mA          |
| Internal pull-up resistance    |       | 2.2     |      | kΩ   |   |
| Input/output leakage current   | -1    |         | 1    | μA   | V <sub>IN</sub> = 0 V or V <sub>IN</sub> = 1.8V |
| Clock frequency on SCL         |       | 100     |      | kHz  |   |

Table 28: I2C pins characteristics

### 4.2.14 Generic Digital Interfaces pins

| Parameter                          | Min   | Typical | Max  | Unit | Remarks   |
|------------------------------------|-------|---------|------|------|---|
| Internal supply for GDI domain     |       | 1.80    |      | V    | Digital I/O Interfaces supply (V_INT)           |
| Low-level input                    | -0.30 | 0.00    | 0.63 | V    |   |
| High-level input                   | 1.17  | 1.80    | 2.10 | V    |   |
| Low-level output                   |       | 0.00    | 0.45 | V    | Max value at I <sub>OL</sub> = +2.0 mA          |
| High-level output                  | 1.35  | 1.80    |      | V    | Min value at I <sub>OH</sub> = -2.0 mA          |
| Input leakage current              | -1    |         | 1    | μA   | V <sub>IN</sub> = 0 V or V <sub>IN</sub> = 1.8V |
| Internal pull-up /-down resistance | 55    |         | 390  | kΩ   |   |

Table 29: GDI pins characteristics

#### 4.2.14.1 AC characteristics of clock output pin (GPIO6)

| Parameter | Description                  | Min | Typical | Max | Unit | Remarks    |
|-----------|------------------------------|-----|---------|-----|------|------------|
| 1/T1      | GPIO6 clock output frequency |     | 12.288  |     | MHz  | AT+UMCLK=2 |

Table 30: AC characteristics of GPIO6 clock output pin



#### 4.2.14.2 AC characteristics of I2S pins

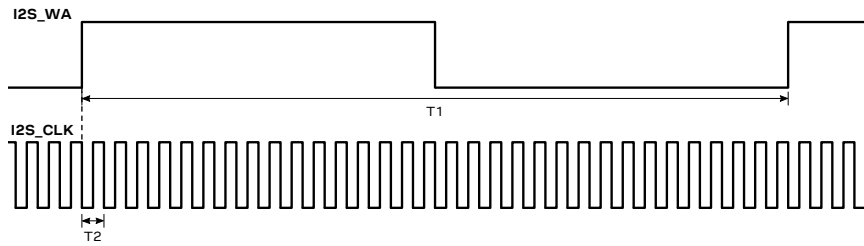


Figure 3: AC characteristics of digital audio interface (I2S) pins in Normal I2S mode (long synchronization signal), host role

| Parameter | Description                             | Min | Typical | Max | Unit | Remarks               |
|-----------|---|-----|---------|-----|------|-----------------------|
| 1/T1      | I2S_WA synchronization signal frequency | 16  |         |     | kHz  | <I2S_sample_rate> = 3 |
|           |   | 48  |         |     | kHz  | <I2S_sample_rate> = 8 |
| 1/T2      | I2S_CLK bit clock frequency             | 32  |         |     | 1/T1 | <I2S_mode> = 14       |

Table 31: AC characteristics of digital audio interface (I2S) pins in Normal I2S mode (long synchronization signal), host role

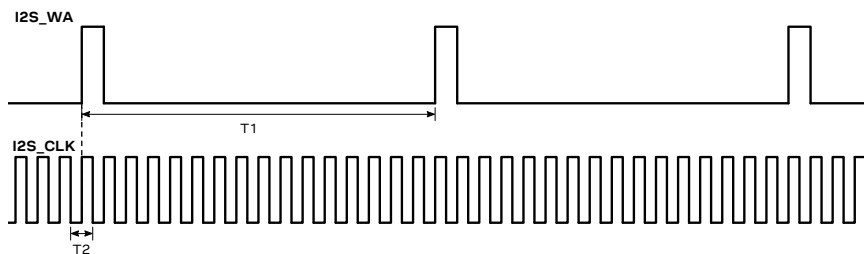


Figure 4: AC characteristics of digital audio interface (I2S) pins in PCM mode (short synchronization signal), host role

| Parameter | Description                             | Min | Typical | Max | Unit | Remarks               |
|-----------|---|-----|---------|-----|------|-----------------------|
| 1/T1      | I2S_WA synchronization signal frequency |     | 16      |     | kHz  | <I2S_sample_rate> = 3 |
|           |   |     | 48      |     | kHz  | <I2S_sample_rate> = 8 |
| 1/T2      | I2S_CLK bit clock frequency             |     | 16      |     | 1/T1 | <I2S_mode> = 30       |

Table 32: AC characteristics of digital audio interface (I2S) pins in PCM mode (short synchronization signal), host role

#### 4.2.15 Smart temperature supervisor

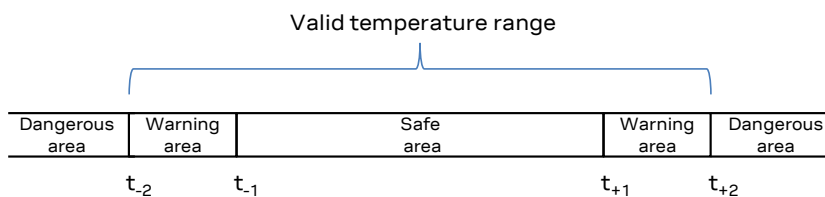


Figure 5: Temperature range and limits

| Symbol          | Parameter                 | Temperature |
|-----------------|---------------------------|-------------|
| t <sub>-2</sub> | Low temperature shutdown  | -40 °C      |
| t <sub>-1</sub> | Low temperature warning   | -30 °C      |
| t <sub>+1</sub> | High temperature warning  | +77 °C      |
| t <sub>+2</sub> | High temperature shutdown | +97 °C      |


Table 33: Thresholds definition for the “Smart temperature supervisor” feature on the LARA-R6 series modules


The sensor measures the temperature inside the shield, that can differ from ambient temperature

### 4.3 Parameters for ATEX applications

This section provides useful parameters and information to integrate LARA-R6 series modules in applications intended for use in areas with potentially explosive atmospheres (ATEX), describing:

- Total internal capacitance and inductance of LARA-R6 series modules (see [Table 34](#))
- Maximum RF output power at the antenna pin of LARA-R6 series modules (see [Table 35](#))

 Any specific applicable requirement for the implementation of the host apparatus integrating the modules, intended for use in potentially explosive atmospheres, must be fulfilled according to the exact applicable standards: check the detailed requisites on the pertinent normative for the application, as for example IEC 60079-0 [\[16\]](#), IEC 60079-11 [\[17\]](#), IEC 60079-26 [\[18\]](#) standards.

 The certification of the application device that integrates a LARA-R6 series 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 34](#) describes the maximum total internal capacitance and the maximum total internal inductance, considering internal parts tolerance, provided by LARA-R6 series modules.

| Module                     | Parameter | Description                        | Value | Unit |
|----------------------------|-----------|------------------------------------|-------|------|
| LARA-R6001,<br>LARA-R6001D | Ci        | Maximum total internal capacitance | 496   | μF   |
|                            | Li        | Maximum total internal inductance  | 9.8   | μH   |
| LARA-R6401,<br>LARA-R6401D | Ci        | Maximum total internal capacitance | 493   | μF   |
|                            | Li        | Maximum total internal inductance  | 9.7   | μH   |
| LARA-R6801,<br>LARA-R6801D | Ci        | Maximum total internal capacitance | 496   | μF   |
|                            | Li        | Maximum total internal inductance  | 9.7   | μH   |

**Table 34: LARA-R6 series maximum total internal capacitance and maximum total internal inductance**

[Table 35](#) describes the maximum RF output power transmitted by LARA-R6 series modules from the primary antenna (**ANT1**) pin as Power Class 4 Mobile Stations for GSM 850 / E-GSM 900 bands and/or as Power Class 3 User Equipment for the LTE / UMTS bands.

| Module                  | Parameter | Description                           | Value | Unit |
|-------------------------|-----------|---------------------------------------|-------|------|
| LARA-R6001, LARA-R6001D | ANT1 Pout | Maximum RF output power from ANT1 pin | 33    | dBm  |
| LARA-R6401, LARA-R6401D | ANT1 Pout | Maximum RF output power from ANT1 pin | 24    | dBm  |
| LARA-R6801, LARA-R6801D | ANT1 Pout | Maximum RF output power from ANT1 pin | 33    | dBm  |

**Table 35: LARA-R6 series antenna pin (ANT1) maximum RF output power**

## 5 Mechanical specifications

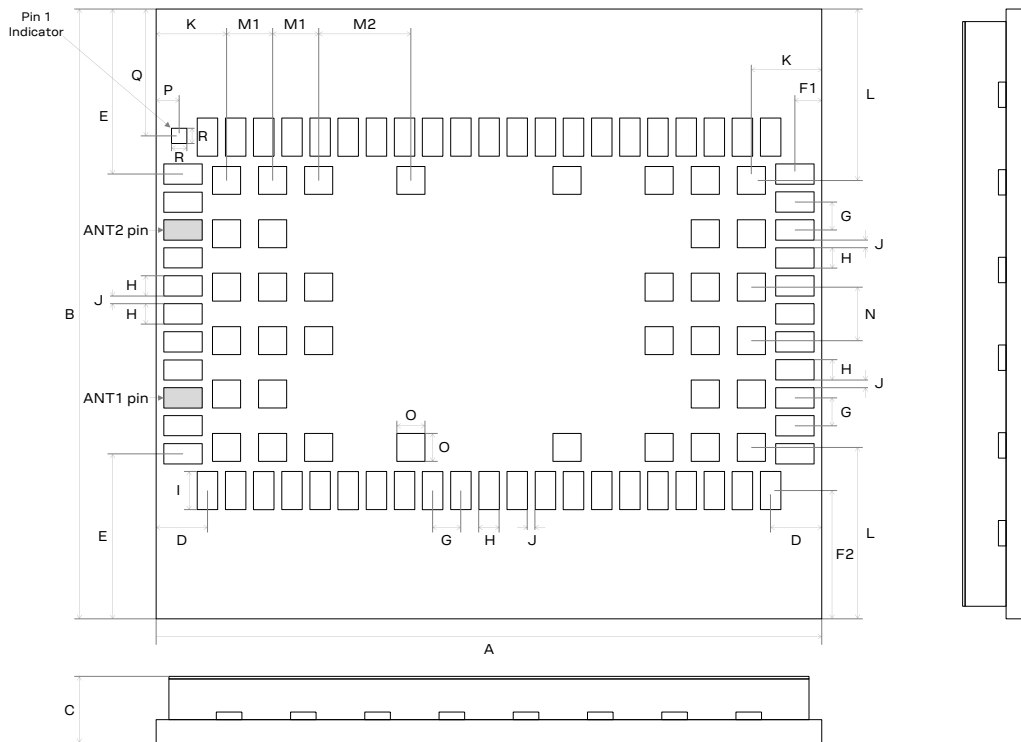


Figure 6: LARA-R6 series dimensions (bottom and side views)

| Parameter | Description                                   | Typical           | Tolerance                    |
|-----------|---|-------------------|------------------------------|
| A         | Module height [mm]                            | 26.0 (1023.6 mil) | +0.20/-0.20 (+7.9/-7.9 mil)  |
| B         | Module width [mm]                             | 24.0 (944.9 mil)  | +0.20/-0.20 (+7.9/-7.9 mil)  |
| C         | Module thickness [mm]                         | 2.6 (102.4 mil)   | +0.27/-0.17 (+10.6/-6.7 mil) |
| D         | Horizontal edge to lateral pin pitch [mm]     | 2.0 (78.7 mil)    | +0.20/-0.20 (+7.9/-7.9 mil)  |
| E         | Vertical edge to lateral pin pitch [mm]       | 6.5 (255.9 mil)   | +0.20/-0.20 (+7.9/-7.9 mil)  |
| F1        | Edge to lateral pin pitch [mm]                | 1.05 (41.3 mil)   | +0.20/-0.20 (+7.9/-7.9 mil)  |
| F2        | Edge to lateral pin pitch [mm]                | 5.05 (198.8 mil)  | +0.20/-0.20 (+7.9/-7.9 mil)  |
| G         | Lateral pin to pin pitch [mm]                 | 1.1 (43.3 mil)    | +0.05/-0.05 (+2.0/-2.0 mil)  |
| H         | Lateral pin height [mm]                       | 0.8 (31.5 mil)    | +0.05/-0.05 (+2.0/-2.0 mil)  |
| I         | Lateral pin width [mm]                        | 1.5 (59.1 mil)    | +0.05/-0.05 (+2.0/-2.0 mil)  |
| J         | Lateral pin to pin distance [mm]              | 0.3 (11.8 mil)    | +0.05/-0.05 (+2.0/-2.0 mil)  |
| K         | Horizontal edge to central pin pitch [mm]     | 2.75 (108.3 mil)  | +0.20/-0.20 (+7.9/-7.9 mil)  |
| L         | Vertical edge to central pin pitch [mm]       | 6.75 (265.7 mil)  | +0.20/-0.20 (+7.9/-7.9 mil)  |
| M1        | Central pin to pin horizontal pitch [mm]      | 1.8 (70.9 mil)    | +0.05/-0.05 (+2.0/-2.0 mil)  |
| M2        | Central pin to pin horizontal pitch [mm]      | 3.6 (141.7 mil)   | +0.05/-0.05 (+2.0/-2.0 mil)  |
| N         | Central pin to pin vertical pitch [mm]        | 2.1 (82.7 mil)    | +0.05/-0.05 (+2.0/-2.0 mil)  |
| O         | Central pin height and width [mm]             | 1.1 (43.3 mil)    | +0.05/-0.05 (+2.0/-2.0 mil)  |
| P         | Horizontal edge to pin 1 indicator pitch [mm] | 0.9 (35.4 mil)    | +0.20/-0.20 (+7.9/-7.9 mil)  |
| Q         | Vertical edge to pin 1 indicator pitch [mm]   | 5.0 (196.8 mil)   | +0.20/-0.20 (+7.9/-7.9 mil)  |
| R         | Pin 1 indicator height and width [mm]         | 0.6 (23.6 mil)    | +0.05/-0.05 (+2.0/-2.0 mil)  |
| Weight    | Module weight [g]                             | 4                 |                              |

Table 36: LARA-R6 series dimensions

Module width tolerance  $\pm 0.20$  mm may be exceeded close to the corners of the PCB due to the cutting process. In the worst case, the width could be  $+0.40$  mm more than the typical value.

For information regarding footprint and paste mask recommended for the application board integrating the cellular module, see the system integration manual [2].

## 6 Qualification and approvals

### 6.1 Reliability tests

Reliability tests for LARA-R6 series modules are executed according to u-blox qualification policy, based on AEC-Q104 standard.

### 6.2 Approvals

LARA-R6 series 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).


The LARA-R6 series modules are RoHS 3 compliant. No natural rubbers, hygroscopic materials, or materials containing asbestos are employed.

[Table 37](#) summarizes the main approvals for LARA-R6 series modules.

| Certification scheme      | LARA-R6001      | LARA-R6001D     | LARA-R6401      | LARA-R6401D     | LARA-R6801 | LARA-R6801D |
|---------------------------|-----------------|-----------------|-----------------|-----------------|------------|-------------|
| GCF conformance           | •               | •               | •               | •               | •          | ■           |
| PTCRB conformance         | •               | •               | •               | •               |            |             |
| CE (Europe)               | •               | •               |                 |                 | •          | ■           |
| FCC (United States)       | •               | •               | •               | •               |            |             |
| FCC ID                    | XPYUBX21BE01    | XPYUBX21BE01    | XPYUBX21BE02    | XPYUBX21BE02    |            |             |
| ISED (Canada)             | •               | •               | •               | •               |            |             |
| ISED certification number | 8595A-UBX21BE01 | 8595A-UBX21BE01 | 8595A-UBX21BE02 | 8595A-UBX21BE02 |            |             |
| NCC (Taiwan)              | •               | •               |                 |                 | •          | ■           |
| ACMA RCM (Australia)      | •               | •               |                 |                 | •          | ■           |
| GITEKI (Japan)            | •               | •               |                 |                 | •          | ■           |
| ANATEL (Brazil)           | ■               | •               |                 |                 |            |             |
| KC (South Korea)          |                 | •               |                 |                 |            |             |
| AT&T                      | ■               | •               | •               | •               |            |             |
| FirstNet                  |                 |                 | •               | •               |            |             |
| Verizon                   | ■               | ■               | •               | •               |            |             |
| T-Mobile US               |                 | ■               | ■               | ■               |            |             |
| Deutsche Telekom          |                 | ■               |                 |                 |            |             |
| Telefonica                |                 | ■               |                 |                 |            |             |
| Telstra                   |                 | ■               |                 |                 |            |             |
| NTT Docomo                |                 |                 |                 |                 |            | ■           |
| SoftBank Mobile           |                 |                 |                 |                 |            | ■           |
| KDDI                      |                 |                 |                 |                 |            | ■           |

• = Approval available with “00B” and “01B” product versions    ■ = Additional approval available with “01B” product versions

**Table 37: LARA-R6 series main certification approvals summary**

 The above listed certifications might not be available for all the different product type numbers. Please contact the nearest u-blox office or sales representative for the complete list of certification approvals available for the selected product ordering number.

## 7 Product handling & soldering

### 7.1 Packaging

LARA-R6 series 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 [4].

#### 7.1.1 Reels

LARA-R6 series modules are deliverable in quantities of 150 pieces on a reel. The modules are delivered using the reel type B2 described in the u-blox package information user guide [4].

Quantities of less than 150 pieces are also available. Contact u-blox for more information.

#### 7.1.2 Tapes

Figure 7 shows the position and the orientation of LARA-R6 series modules as they are delivered on the tape, while Figure 8 and Table 38 below specify the tape dimensions.

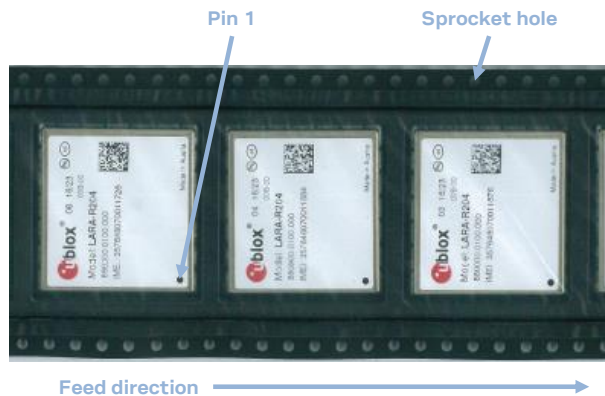


Figure 7: Orientation for LARA modules on tape

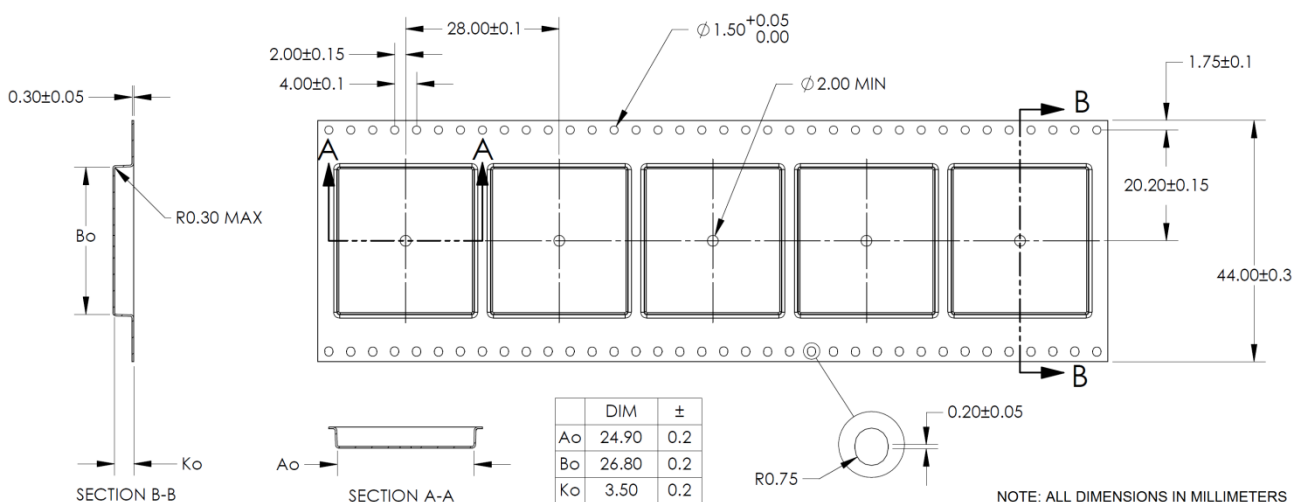






Figure 8: LARA-R6 series modules tape dimensions

| Parameter      | Typical value | Tolerance | Unit |
|----------------|---------------|-----------|------|
| A <sub>0</sub> | 24.9          | 0.2       | mm   |
| B <sub>0</sub> | 26.8          | 0.2       | mm   |
| K <sub>0</sub> | 3.5           | 0.2       | mm   |

**Table 38: LARA-R6 series modules tape dimensions**

-  10 sprocket hole pitch cumulative tolerance  $\pm 0.2$  mm.
-  Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.
-  A<sub>0</sub> and B<sub>0</sub> are measured on a plane at a distance “R” above the bottom of the pocket.

## 7.2 Moisture sensitivity levels


-  LARA-R6 series modules are Moisture Sensitive Devices (MSD) in accordance with the IPC/JEDEC specification.

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. LARA-R6 series 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 [4].


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

## 7.3 Reflow soldering

Reflow profiles are to be selected according to u-blox recommendations (see the system integration manual [2]).

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

## 7.4 ESD precautions

-  LARA-R6 series modules contain highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Handling LARA-R6 series modules without proper ESD protection may destroy or damage them permanently.

LARA-R6 series modules are Electrostatic Sensitive Devices (ESD) and require special ESD precautions typically applied to ESD sensitive components.

Table 11 details the maximum ESD ratings of the LARA-R6 series modules.

Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates the LARA-R6 series module.

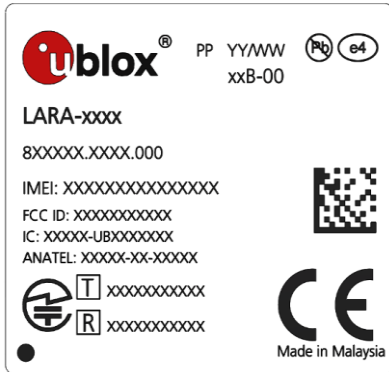
ESD precautions should be implemented on the application board where the module is mounted, as described in the system integration manual [2].

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

## 8 Labeling and ordering information

### 8.1 Product labeling

The label of LARA-R6 series modules include important product information as described in [Figure 9](#), as the label includes: u-blox logo, production lot, Pb-free marking, product type number, IMEI number, applicable regulatory certifications' info, and production country.



**Figure 9:** Illustrative example of LARA-R6 series 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 39](#) details these 3 different formats:

| Format        | Structure                  |
|---------------|----------------------------|
| Product name  | PPPP-TGVV(L)(HH)(F)        |
| Ordering code | PPPP-TGVV(L)(HH)(F)-MMQ    |
| Type number   | PPPP-TGVV(L)(HH)(F)-MMQ-XX |

**Table 39:** Product code formats

[Table 40](#) explains the parts of the product code.

| Code | Meaning  | Example |
|------|--|---------|
| PPPP | Form factor  | LARA    |
| TG   | Platform (technology and generation) <ul style="list-style-type: none"> <li>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 1 bis), L = LTE high data rate (Cat 3 and above)</li> <li>Generation: 1...9</li> </ul> | R6      |
| VV   | Variant function set based on the same platform: 00...99   | 40      |
| (L)  | LTE category (optionally indicated): 6,4,3,1,M ...   | 1       |
| (HH) | GNSS generation (indicated if supported): M8 = u-blox M8, M10 = u-blox M10, ...  | M8      |
| (F)  | Special features (optionally indicated): D = data only, S = secure cloud, ...  | D       |
| MM   | Major product version: 00...99   | 00      |
| Q    | Product grade: B = professional, A = automotive  | B       |
| XX   | Minor product version: 00...99   | 00      |

**Table 40:** Part identification code

## 8.3 Ordering information

| Ordering number | Product  |
|-----------------|--|
| LARA-R6001-00B  | Global LTE FDD / TDD Cat 1 module with 3G and 2G fallback. Data and Voice product version.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel                                   |
| LARA-R6001-01B  | Global LTE FDD / TDD Cat 1 module with 3G and 2G fallback. Data and Voice product version.<br>Maintenance release.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel           |
| LARA-R6001D-00B | Global LTE FDD / TDD Cat 1 module with 3G and 2G fallback. Data-only product version.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel  |
| LARA-R6001D-01B | Global LTE FDD / TDD Cat 1 module with 3G and 2G fallback. Data-only product version.<br>Maintenance release.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel                |
| LARA-R6401-00B  | LTE FDD Cat 1 module for North America. Data and Voice product version.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel  |
| LARA-R6401-01B  | LTE FDD Cat 1 module for North America. Data and Voice product version.<br>Maintenance release.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel                              |
| LARA-R6401D-00B | LTE FDD Cat 1 module for North America. Data-only product version.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel   |
| LARA-R6401D-01B | LTE FDD Cat 1 module for North America. Data-only product version.<br>Maintenance release.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel                                   |
| LARA-R6801-00B  | LTE FDD Cat 1 module with 3G and 2G fallback for multi-regional use. Data and Voice product version.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel                         |
| LARA-R6801-01B  | LTE FDD Cat 1 module with 3G and 2G fallback for multi-regional use. Data and Voice product version.<br>Maintenance release.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel |
| LARA-R6801D-01B | LTE FDD Cat 1 module with 3G and 2G fallback for multi-regional use. Data-only product version.<br>26.0 x 24.0 x 2.6 mm, 150 pcs/reel                              |

**Table 41: Product ordering codes**



# Appendix


## A Glossary

| Abbreviation | Definition   |
|--------------|--|
| 2G           | 2nd Generation Cellular Technology (GSM, GPRS, EGPRS)                              |
| 3G           | 3rd Generation Cellular Technology (UMTS, HSDPA, HSUPA)                            |
| 3GPP         | 3rd Generation Partnership Project   |
| 8-PSK        | 8 Phase-Shift Keying modulation  |
| ACMA         | Australian Communications and Media Authority                                      |
| ADC          | Analog to Digital Converter  |
| ANATEL       | Agência Nacional de Telecomunicações - National Telecommunications Agency (Brazil) |
| APAC         | Asia-Pacific   |
| AT           | AT Command Interpreter Software Subsystem, or attention                            |
| Cat          | Category   |
| CE           | European Conformity  |
| CSFB         | Circuit-Switched Fall-Back   |
| DL           | Down-link (Reception)  |
| DNS          | Domain Name System   |
| DTLS         | Datagram Transport Layer Security  |
| E2E          | End-to-End   |
| EAL5+        | Evaluation Assurance Level 5+  |
| eDRX         | Extended Discontinuous Reception   |
| EMEA         | Europe, the Middle East and Africa   |
| ERS          | External Reset Input Signal  |
| ESD          | Electrostatic Discharge  |
| FCC          | Federal Communications Commission (United States)                                  |
| FDD          | Frequency Division Duplexing   |
| 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 Interfaces (power domain)  |
| GITEKI       | Gijutsu kijun tekigō shōmei - technical standard conformity certification (Japan)  |
| GMSK         | Gaussian Minimum-Shift Keying modulation   |
| GND          | Ground   |
| GNSS         | Global Navigation Satellite System   |
| GPIO         | General Purpose Input Output   |
| HSDPA        | High Speed Downlink Packet Access  |
| HSUPA        | High Speed Uplink Packet Access  |
| HTTP         | HyperText Transfer Protocol  |
| I2C          | Inter-Integrated Circuit Interface   |
| I2S          | Inter-IC Sound Interface   |
| IEC          | International Electrotechnical Commission  |
| IMEI         | International Mobile Equipment Identity  |

| Abbreviation | Definition  |
|--------------|---|
| IMS          | IP Multimedia Subsystem   |
| IP           | Internet Protocol   |
| ISED         | Innovation, Science and Economic Development (Canada)             |
| KC           | Korea Certification   |
| KMS          | Key Management Service  |
| LGA          | Land Grid Array   |
| LPWA         | Low Power Wide Area   |
| LTE          | Long Term Evolution   |
| LWM2M        | Open Mobile Alliance Lightweight Machine-to-Machine protocol      |
| MNO          | Mobile Network Operator   |
| MQTT         | Message Queuing Telemetry Transport                               |
| MUX          | Multiplexer   |
| N/A          | Not Applicable  |
| NCC          | National Communications Commission (Taiwan)                       |
| PA           | Power Amplifier   |
| PCB          | Printed Circuit Board   |
| PD           | Pull-Down   |
| PDP          | Packet Data Protocol  |
| POS          | Power-On Input Signal   |
| PMU          | Power Management Unit   |
| PSM          | Power Saving Mode   |
| PTCRB        | PCS Type Certification Review Board                               |
| PU           | Pull-Up   |
| QPSK         | Quadrature Phase-Shift Keying modulation                          |
| RAT          | Radio Access Technology   |
| RCM          | Regulatory Compliance Mark  |
| REST API     | Representational State Transfer Application Programming Interface |
| RFC          | Request for Comments  |
| RMC          | Reference Measurement Channel                                     |
| RTC          | Real Time Clock   |
| Rx           | Receiver  |
| SIM          | Subscriber Identification Module                                  |
| TCP          | Transmission Control Protocol                                     |
| TDD          | Time Division Duplexing   |
| TEE          | Trusted Execution Environment                                     |
| TLS          | Transport Layer Security  |
| Tx           | Transmitter   |
| UART         | Universal Asynchronous Receiver/Transmitter serial interface      |
| UDP          | User Datagram Protocol  |
| uFOTA        | u-blox Firmware update Over The Air                               |
| UL           | Up-link (Transmission)  |
| UMTS         | Universal Mobile Telecommunications System                        |
| USB          | Universal Serial Bus  |
| VoLTE        | Voice over LTE  |

## Related documentation

- [1] u-blox AT commands manual, [UBX-21046719](#)
- [2] u-blox LARA-R6 series system integration manual, [UBX-21010011](#)
- [3] u-blox Android RIL source code application note, [UBX-13002041](#)
- [4] u-blox package information user guide, [UBX-14001652](#)
- [5] u-blox LARA-R6 series application development guide, [UBX-22001850](#)
- [6] u-blox Positioning implementation application note, [UBXDOC-686885345-1826](#)
- [7] 3GPP TS 27.007 - AT command set for User Equipment (UE)
- [8] 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)
- [9] 3GPP TS 27.010 - Terminal Equipment to User Equipment (TE-UE) multiplexer protocol
- [10] 3GPP TS 36.521-1 - Evolved Universal Terrestrial Radio Access; User Equipment conformance specification; radio transmission and reception; part 1: conformance testing
- [11] 3GPP TS 34.121-1 - User Equipment conformance specification; radio transmission and reception (FDD); part 1: conformance specification
- [12] 3GPP TS 51.010-1 - Mobile Station conformance specification; part 1: conformance specification
- [13] ITU-T recommendation V24, 02-2000. List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Connection Equipment (DCE)
- [14] Universal Serial Bus specification, revision 2.0, <https://www.usb.org/>
- [15] I2C-bus specification and user manual - UM10204 - NXP semiconductors, <https://www.nxp.com/docs/en/user-guide/UM10204.pdf>
- [16] IEC 60079-0 - Explosive atmospheres, part 0: equipment general requirements
- [17] IEC 60079-11 - Explosive atmospheres, part 11: equipment protection by intrinsic safety 'i'
- [18] 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](http://www.u-blox.com)).

# Revision history

| Revision | Date        | Name        | Comments   |
|----------|-------------|-------------|--|
| R01      | 29-Apr-2021 | sses        | Initial release  |
| R02      | 21-Dec-2021 | sses / psca | Added LARA-R6001D and LARA-R6401D data-only product variants.<br>Updated LARA-R6001 and LARA-R6401 product status.<br>Added current consumption and sensitivity values.<br>Revised supported features. Updated VUSB_DET characteristics.<br>Minor other editorial changes, corrections, and clarifications.  |
| R03      | 18-Jan-2022 | lpah        | Updated disclosure restriction to C1-Public  |
| R04      | 18-Feb-2022 | sses        | Updated LARA-R6001D and LARA-R6401D product status.<br>Added reboot feature for RESET_N input. Clarifications in USB description.<br>Added smart temperature supervisor details. Added features for GPIOs.<br>Added parameters for ATEX applications.<br>Minor other figures and clarifications added.   |
| R05      | 21-Feb-2022 | sses        | Corrected position of a pad in mechanical description. Corrected ESD ratings.  |
| R06      | 20-Apr-2022 | sses        | Updated LARA-R6001D product status.<br>Added antenna dynamic tuner description. Added thermal parameters.<br>Added clock output characteristics. Added AC characteristics of I2S pins.<br>Added reels and tapes description. Revised certification info.<br>Minor data and descriptions revised or added.  |
| R07      | 11-May-2022 | sses        | Updated LARA-R6001, LARA-R6401 and LARA-R6801 product status.<br>Minor data and descriptions added.  |
| R08      | 08-Jul-2022 | sses        | Updated LARA-R6401D product status.<br>Minor editorial changes and clarifications added.   |
| R09      | 18-Aug-2022 | sses        | Updated LARA-R6001, LARA-R6401 and LARA-R6801 product status.<br>Minor clarifications added.   |
| R10      | 09-Feb-2023 | sses        | Extended document applicability to type numbers LARA-R6001-00B-01, LARA-R6001-01B-00, LARA-R6001D-00B-01, LARA-R6001D-01B-00, LARA-R6401-00B-01, LARA-R6401-01B-00, LARA-R6401D-00B-01, LARA-R6401D-01B-00, LARA-R6801-00B-01, LARA-R6801-01B-00 and LARA-R6801D-01B-00.<br>Revised module dimension tolerance remark.<br>Minor other editorial changes and clarifications added.  |
| R11      | 06-Jul-2023 | sses        | Updated product status of type numbers LARA-R6001-00B-01, LARA-R6001D-00B-01, LARA-R6001D-01B-00, LARA-R6401-00B-01, LARA-R6401D-00B-01, LARA-R6801-00B-01, LARA-R6801-01B-00 and LARA-R6801D-01B-00.<br>Added description of some features available with "01B" product versions: fastest emergency shutdown (AT+CFUN=11), configurable antenna tuner, Ethernet over USB, PSM consumption, module status indication over GPIOs, network status indication over additional GPIOs, I2S sample rate 48 kHz.<br>Minor other clarifications. |
| R12      | 05-Oct-2023 | sses        | Updated product status of LARA-R6001-01B, LARA-R6001D-01B, LARA-R6401D-01B, LARA-R6801-01B and LARA-R6801D-01B.<br>Minor clarifications.   |
| R13      | 16-Feb-2024 | sses        | Updated product status of LARA-R6001-01B, LARA-R6001D-01B, LARA-R6401-01B, LARA-R6401D-01B, LARA-R6801-01B and LARA-R6801D-01B.<br>Clarified ultra-low power PSM deep-sleep mode scenarios.<br>Minor clarifications.   |
| R14      | 19-Jun-2024 | yatu        | Updated product status of LARA-R6001-01B, LARA-R6001D-01B, LARA-R6401-01B, LARA-R6401D-01B, LARA-R6801-01B and LARA-R6801D-01B.  |

# Contact

## u-blox AG

Address: Zürcherstrasse 68  
8800 Thalwil  
Switzerland

For further support and contact information, visit us at [www.u-blox.com/support](http://www.u-blox.com/support).

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[u-blox:](#)

[LARA-R6401-00B](#) [LARA-R6401D-00B](#) [LARA-R6801-00B](#) [LARA-R6801D-01B](#) [LARA-R6401-01B](#) [LARA-R6801-01B](#)  
[LARA-R6001-01B](#) [LARA-R6001D-01B](#) [LARA-R6401D-01B](#)