LISA-U2 series

3.75G HSPA+ cellular modules

Data sheet

Abstract

Technical data sheet describing the LISA-U2 series HSPA+ cellular modules. These modules are a complete and cost efficient 3.75G solution offering up to six-band high-speed HSPA+ and quad-band GSM/EGPRS voice and/or data transmission technology in a compact form factor.

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Functional sample	Draft	For functional testing. Revised and supplementary data will be published later.
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Mass production / End of life	Production information	Document contains the final product specification.

This document applies to the following products:

Name	Type number	Modem version	Application version	PCN reference	Product status
LISA-U200	LISA-U200-01S-00	22.40		UBX-TN-12040	Obsolete
	LISA-U200-01S-01	22.40	A01.00	UBX-14005764	End of life
	LISA-U200-01S-02	22.40	A01.02	UBX-17048820	End of life
	LISA-U200-01S-03	22.40	A01.03	UBX-18055867	Mass production
	LISA-U200-02S-01	22.90	A01.01	UBX-14005768	End of life
	LISA-U200-02S-02	22.90	A01.03	UBX-17048820	End of life
	LISA-U200-03S-00	23.41	A01.01	UBX-15020745	Obsolete
	LISA-U200-03S-01	23.41	A01.04	UBX-17048820	End of life
	LISA-U200-03S-02	23.41	A01.05	UBX-18055867	Mass production
	LISA-U200-04B-00	23.41	A01.11	UBX-19026176	Mass production
	LISA-U200-52S-01	22.86	A01.01	UBX-14005768	Obsolete
	LISA-U200-52S-02	22.86	A01.03	UBX-17048820	End of life
	LISA-U200-52S-03	22.86	A01.04	UBX-18055867	Mass production
	LISA-U200-62S-01	22.90	A01.01	UBX-14005768	Obsolete
	LISA-U200-62S-02	22.90	A01.02	UBX-16017712	End of life
	LISA-U200-62S-03	22.90	A01.03	UBX-17048820	End of life
	LISA-U200-62S-04	22.90	A01.04	UBX-18055867	Mass production
LISA-U200 FOTA	LISA-U200-83S-00	23.41	A01.01	UBX-15020745	End of life
LISA-U201	LISA-U201-03S-00	23.41	A01.01	UBX-15020745	End of life
	LISA-U201-03S-01	23.41	A01.04	UBX-17048820	Mass production
	LISA-U201-04B-00	23.41	A01.11	UBX-19026176	Mass production
LISA-U201 FOTA	LISA-U201-83S-00	23.41	A01.02	UBX-16006079	Obsolete
	LISA-U201-83S-01	23.41	A01.04	UBX-17048820	Mass production
LISA-U230	LISA-U230-01S-01	22.40	A01.00	UBX-TN-12040	Obsolete
	LISA-U230-01S-02	22.40	A01.02	UBX-17048820	End of life
	LISA-U230-01S-03	22.40	A01.03	UBX-18055867	Mass production
LISA-U260	LISA-U260-01S-02	22.61	A01.02	UBX-14042086	Obsolete
	LISA-U260-01S-03	22.61	A01.05	UBX-17048820	End of life
	LISA-U260-02S-02	22.90	A01.02	UBX-14042086	End of life
	LISA-U260-02S-03	22.90	A01.04	UBX-17048820	End of life
LISA-U270	LISA-U270-01S-02	22.61	A01.02	UBX-14042086	Obsolete
	LISA-U270-02S-02	22.90	A01.02	UBX-14042086	End of life
	LISA-U270-02S-03	22.90	A01.04	UBX-17048820	End of life
	LISA-U270-62S-04	22.93	A01.02	UBX-14042086	Obsolete
	LISA-U270-62S-05	22.93	A01.04	UBX-15029938	Obsolete
	LISA-U270-62S-06	22.93	A01.05	UBX-16009934	Obsolete
	LISA-U270-62S-07	22.93	A01.07	UBX-17048820	End of life
	LISA-U270-63S-00	22.93	A01.06	UBX-16010383	Obsolete
	LISA-U270-63S-01	22.93	A01.07	UBX-17048820	End of life
	LISA-U270-63S-02	22.93	A01.08	UBX-18055867	Mass production
	LISA-U270-68S-00	22.93	A01.03	UBX-15019240	Obsolete
	LISA-U270-68S-01	22.93	A01.07	UBX-17048820	End of life

Contents

1 Functional description

1.1 Overview

LISA-U2 modules are a 3.75G solution providing up to six-band HSPA+ and quad-band GSM/EDGE data transmission in a compact form factor. These modules feature low power consumption and HSUPA category 6, HSDPA up to category 14, GPRS/EDGE up to class 33 data transmission with voice capability. They also combine baseband, RF transceiver, power management unit, and power amplifier in a single, easy-to-integrate solution.

LISA-U2 modules are complete, fully qualified and certified solutions, which reduces cost and enables short time to market. They are ideally suited to M2M applications such as: mobile internet terminals and applications, car infotainment and telematics, Automatic Meter Reading (AMR), Remote Monitoring Automation and Control (RMAC), surveillance and security, road pricing, asset tracking, fleet management, anti-theft systems, and Point of Sales (PoS) terminals.

LISA-U2 modules support full access to u-blox GNSS receivers via the serial port. This means that WCDMA/GSM and GNSS modules can be controlled through a single serial port from any host processor. The compact LISA form factor and SMT pads allow fully automated assembly with standard pick & place and reflow soldering equipment for cost-efficient, high-volume production.

1.2 Product features

Model	UMTS		Bands		Interfaces					Audio		Features													Grade		
	HSUPA][Mbit/s]	HSDPA [Mbit/s]	UMTS / HSPA [MHz]	GPRS / EDGE quad-band	UART	SPI	USB 2.0	DDC (I2C)	GPIO	Analog audio	Digital audio	Network indication	Antenna supervisor	Jamming detection	Embedded TCP/UDP	Embedded HTTP, FTP	Embedded SSL / TLS	GNSS via modem	AssistNow Software	CellLocate®	FOTA	FW update via serial	eCall / ERA-GLONASS	Rx diversity	Standard	Professional	Automotive
LISA-U200	5.76	7.2	800/850/900 1700/1900/2100	•	1	1	1	1	14		2	•	•	•	•	•	•	•	•	•	•[1]	•	•[2]		•		
LISA-U200 FOTA	5.76	7.2	800/850/900 1700/1900/2100	•	1	1	1	1	14		2	•	•	•	•	•	•	•	•	•	•	•	•		•		
LISA-U201	5.76	7.2	800/850/900 1900/2100	•	1	1	1	1	14		2	•	•	•	•	•	•	•	•	•	•[3]	•	•		•		
LISA-U201 FOTA	5.76	7.2	800/850/900 1900/2100	•	1	1	1	1	14		2	•	•	•	•	•	•	•	•	•	•	•	•		•		
LISA-U230	5.76	21.1	800/850/900 1700/1900/2100	•	1	1	1	1	14		2	•	•	•	•	•	•	•	•	•		•		•	•		
LISA-U260	5.76	7.2	850/1900	•	1	1	1	1	14		2	•	•	•	•	•	•	•	•	•		•	•[2]		•		
LISA-U270	5.76	7.2	900/2100	•	1	1	1	1	14		2	•	•	•	•	•	•	•	•	•		•	•[2]		•		

LISA-U200-52S module product version is approved by the SKT Korean network operator
LISA-U200-62S module product version is approved by the DoCoMo Japanese network operator
LISA-U270-52S, -63S and -68S module product versions are approved and locked for the SoftBank Japanese network operator

Table 1: LISA-U2 series main features summary

[1] Not supported by the “01”, “02”, “03”, “52” and “62” product version
[2] Not supported by the “01” product version
[3] Not supported by the “03” product version

1.3 Block diagram

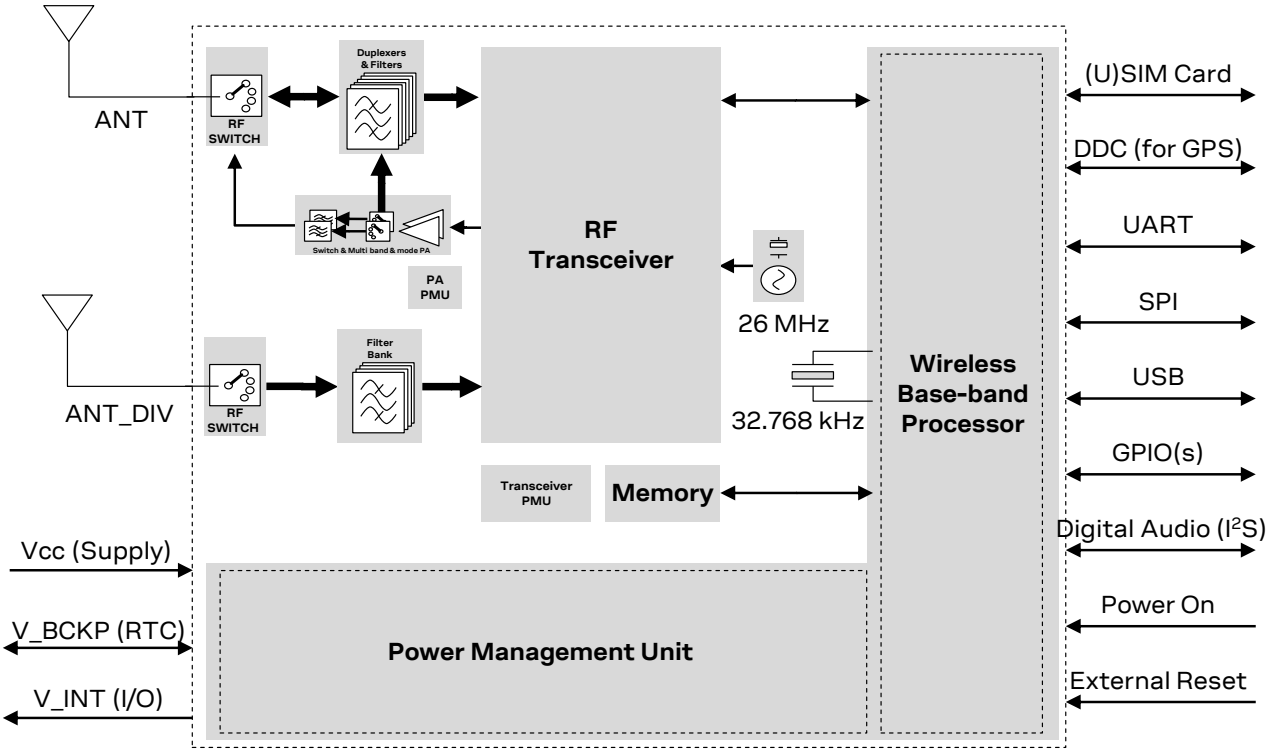

Figure 1: LISA-U2 series block diagram (for available options, see the product main features summary in Table 1)

1.4 Product description

3G UMTS/HSDPA/HSUPA Characteristics	2G GSM/GPRS/EDGE Characteristics
Class A User Equipment [4]	Class B Mobile Station [5]
UMTS Terrestrial Radio Access (UTRA) Frequency Division Duplex (FDD) 3GPP Release 7 Evolved High Speed Packet Access (HSPA+) Rx Diversity for LISA-U230	GSM EDGE Radio Access (GERA) 3GPP Release 7 Rx Diversity for LISA-U230
Six-band support for LISA-U200 and LISA-U230: • Band I (2100 MHz), Band II (1900 MHz), Band IV (1700 MHz), Band V (850 MHz), Band VI (800 MHz), Band VIII (900 MHz) Five-band support for LISA-U201: • Band I (2100 MHz), Band II (1900 MHz), Band V (850 MHz), Band VI (800 MHz), Band VIII (900 MHz) Dual-band support for LISA-U260: • Band II (1900 MHz), Band V (850 MHz) Dual-band support for LISA-U270: • Band I (2100 MHz), Band VIII (900 MHz)	Quad-band support • GSM 850 MHz, E-GSM 900 MHz, DCS 1800 MHz, PCS 1900 MHz
WCDMA/HSDPA/HSUPA Power Class • Power Class 3 (24 dBm) for WCDMA/HSDPA/HSUPA mode	GSM/GPRS Power Class • Power Class 4 (33 dBm) for GSM/E-GSM bands • Power Class 1 (30 dBm) for DCS/PCS bands EDGE Power Class • Power Class E2 (27 dBm) for GSM/E-GSM bands • Power Class E2 (26 dBm) for DCS/PCS bands
PS (Packet Switched) Data rate • HSUPA category 6, up to 5.76 Mbit/s UL • HSDPA category 8 up to 7.2 Mbit/s DL (except LISA-U230) • HSDPA category 14 up to 21.1 Mbit/s DL (only LISA-U230) • WCDMA PS data up to 384 kbit/s DL/UL	PS (Packet Switched) data rate [6] • GPRS multi-slot class 12 [7], coding scheme CS1-CS4, up to 85.6 kbit/s DL/UL • EDGE multi-slot class 12[7], coding scheme MCS1-MCS9, up to 236.8 kbit/s DL/UL
CS (Circuit Switched) Data rate • WCDMA CS data up to 64 kbit/s DL/UL	CS (Circuit Switched) data rate • GSM CS data up to 9.6 kbit/s DL/UL supported in transparent/non transparent mode

Table 2: LISA-U2 series UMTS/HSDPA/HSUPA and GSM/GPRS/EDGE characteristics

Operation modes I to III are supported on the GSM/GPRS network, with user-defined preferred service selectable from GSM to GPRS. Paging messages for GSM calls can be optionally monitored during GPRS data transfer in not-coordinating NOM II-III.

Direct Link mode is supported for TCP and UDP sockets.

[4] Devices can work simultaneously in Packet Switch and Circuit Switch modes: voice calls are possible while the data connection is active without any interruption in service.
[5] Device can be attached to both GPRS and GSM services (i.e. Packet Switch and Circuit Switch mode) using one service at a time. If for example during data transmission an incoming call occurs, the data connection is suspended to allow the voice communication. Once the voice call has terminated, the data service is resumed.
[6] GPRS/EDGE multi-slot class determines the number of timeslots available for upload and download and thus the speed at which data can be transmitted and received, with higher classes typically allowing faster data transfer rates.
[7] GPRS/EDGE multi-slot class 12 implies a maximum of 4 slots in DL (reception) and 4 slots in UL (transmission) with 5 slots in total.

Basic features	Supplementary services	Short Message Service (SMS)
Display of Called Number	Call Hold/Resume (CH)	SMS Classes 1, 2, 3
Indication of Call Progress Signals	Call Waiting (CW)	Mobile-Originating SMS (MO SMS)
Country/PLMN Indication	Multi-Party (MTPY)	Mobile-Terminating SMS (MT SMS)
International Access Function	Call Forwarding (CF)	SMS Cell Broadcast (SMS CB)
Service Indicator	Call Divert	Text and PDU mode supported
Dual Tone Multi Frequency (DTMF)	Explicit Call Transfer (ECT)	SMS during circuit-switched calls
Subscription Identity Management	Call Barring (CB)	SMS over PSD or CSD
Service Provider Indication	Advice of Charge Charging (AOCC)	SMS storage on SIM and memory module
Abbreviated Dialing	Calling Line Identification Presentation (CLIP)	
SIM Toolkit	Calling Line Identification Restriction (CLIR)	
SIM Access Profile	Connected Line Identification Presentation (COLP)	
	Connected Line Identification Restriction (COLR)	
	Unstructured Supplementary Services Data (USSD)	
	Network Identify and Time Zone (NITZ)	

Table 3: LISA-U2 series mobile station basic features, supplementary services and SMS services summary[8]

1.5 AT command support

LISA-U2 series modules support AT commands according to the 3GPP Technical Specifications TS 27.007 [1], 27.005 [2], 27.010 [3], and the u-blox AT commands extension.

☞ For the complete list of the supported AT commands and their syntax, see the u-blox AT commands manual [4].

RIL (Radio Interface Layer) software for Android is available for LISA-U2 series modules free of charge; see the Android RIL source code application note [5] for more information.

1.6 Supported features

Table 4 lists the main features supported by LISA-U2 modules. For more details, see the LISA-U2 series system integration manual [6] and the u-blox AT commands manual [4].

Feature	Description
Network Indication	GPIO configured to indicate the network status: registered home network, registered roaming, voice or data call enabled, no service. The feature can be enabled through the +UGPIOC AT command.
Antenna Detection	Antenna presence detection capability is provided, evaluating the resistance from the ANT pin to GND by means of an internal antenna detection circuit. The antenna detection feature can be enabled through the +UANTR AT command.
Jamming detection	Detects some “artificial” interference that obscures the operator’s carriers entitled to give access to the GSM/UMTS service and reports the start and stop of such conditions to the application processor (AP). The AP can react appropriately by e.g. switching off the radio transceiver to reduce power consumption and monitoring the environment at constant periods. The feature can be enabled and configured through the +UCD AT command.
Embedded TCP and UDP stack	Embedded TCP/IP and UDP/IP stack including direct link mode for TCP and UDP sockets. Sockets can be set in Direct Link mode to establish a transparent end-to-end communication with an already connected TCP or UDP socket via the serial interface.

[8] All these functionalities are supported via AT commands (for more details, see the u-blox AT commands manual [4]).

Feature	Description
FTP, FTPS	File Transfer Protocol as well as Secure File Transfer Protocol (SSL encryption of FTP control channel) functionalities are supported via AT commands.
HTTP, HTTPS	Hyper-Text Transfer Protocol as well as Secure Hypertext Transfer Protocol (SSL encryption) functionalities are supported via AT commands. HEAD, GET, POST, DELETE and PUT operations are available. Up to 4 client contexts can be used simultaneously.
Embedded TLS 1.2 [9]	With the support of X.509 certificates, it provides server and mutual authentication, data encryption, data signature and enables TCP/IP applications, such as HTTP and FTP to communicate over a secured and trusted connection. The feature can be configured and enabled by +USECMNG and +USECPRF AT commands.
IPv4/IPv6 dual-stack [9]	Capability to move between IPv4 and dual stack network infrastructures using external context. IPv4 and IPv6 addresses can be used.
GNSS via Modem	Full access to u-blox positioning chips and modules is available through a dedicated DDC (I2C) interface. This means that from any host processor, a single serial port can control the cellular module and the positioning chip or module. For more details, see the GNSS implementation application note [7].
Embedded AssistNow Software	Embedded AssistNow Online and AssistNow Offline clients to provide better GNSS performance and faster Time-to-First-Fix. An AT command can enable / disable the clients.
CellLocate®	Enables the estimation of device position based on the parameters of the mobile network cells visible to the specific device based on the CellLocate® database: • Normal scan: only the parameters of the visible home network cells are sent • Deep scan: the parameters of all surrounding cells of all mobile operators are sent CellLocate® is implemented using a set of AT commands that allow configuration and position request.
Hybrid Positioning	The module current position is provided using a u-blox positioning chip or module or the estimated position from CellLocate® depending on which positioning method provides the best and fastest solution according to the user configuration. Hybrid positioning is implemented through a set of AT commands that allow configuration and position request.
Control Plan Aiding / LCS [9]	Assisted GPS Location Services feature based on the Radio Resources Location Protocol (RRLP), according to 3GPP TS 44.031 [9] and Radio Resource Control (RRC), according to 3GPP TS 25.331 [18]. With the Assisted GPS feature, a location server provides the module with the GPS system information that otherwise needs to be downloaded from satellites. The feature allows faster position fixes, increases sensitivity and reduces module power consumption. The feature is invoked by the module through LCS Supplementary Services or by the Network during emergency calls.
Last gasp[10]	In case of power supply outage (i.e. main supply interruption, battery removal, battery voltage below a certain threshold) the cellular module can be configured to send an alarm notification to a remote entity. The feature can be enabled and configured through the +ULGASP AT command.
Firmware update Over AT commands (FOAT)	Firmware module upgrade over UART, USB and SPI interface using AT command. The firmware upgrade can be executed through the +UFWUPD AT command.
Firmware update Over The Air (FOTA) [11]	Firmware module update over the 3G/2G air interface. The feature can be enabled and configured through the +UFWINSTALL AT command.
Rx Diversity [12]	Improved link quality and reliability on all 2G and 3G operating bands except 2G DCS 1800.
Smart Temperature Supervisor	Constant monitoring of the module board temperature: • Warning notification when the temperature approaches an upper or lower predefined threshold • Shutdown notified and forced when the temperature value is outside the specified range (shutdown suspended in case of an emergency call in progress) The feature can be enabled or disabled through the +USTS AT command. ☞ The sensor measures the board temperature, which can differ from ambient temperature.

[9] Not supported by the "01", "x2", "63" and "68" product versions
[10] Not supported by "01","x2","x3", and "68" product versions
[11] Not supported by "01","02","03", "52", "62", "63" and "68" product versions
[12] Not supported by LISA-U200, LISA-U201, LISA-U260 and LISA-U270

Feature	Description
SIM Access Profile (SAP)	Allows access and use of a remote (U)SIM card instead of the local SIM card directly connected to the module (U)SIM interface. The module acts as an SAP client establishing a connection and performing data exchange to an SAP Server directly connected to the remote SIM. The modules provide a dedicated USB SAP channel and dedicated multiplexer SAP channel over UART and SPI for communication with the remote (U)SIM card. The feature can be configured and enabled by +USAPMODE and + USAPIND AT commands.
BIP [9]	Bearer Independent Protocol 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.
In-Band Modem [13]	In-Band modem solution for eCall and ERA-GLONASS emergency call applications over cellular networks implemented according to the 3GPP TS 26.267 specification [8]. When activated, the in-vehicle eCall / ERA-GLONASS system (IVS) creates an emergency call carrying both voice and data (including vehicle position data) directly to the nearest Public Safety Answering Point (PSAP) to determine whether rescue services should be dispatched to the known position.
DTMF decoder [13]	During a voice call, the Dual-Tone Multi-Frequency detector analyses the RX speech (coming from the remote party). The detected DTMF symbols can be output via the related URC. For more details, see the +UDTMFD AT command.
Power saving	The power saving configuration is disabled by default, but it can be configured using an AT command. When power saving is enabled, the module automatically enters the low power idle-mode whenever possible, reducing current consumption. During low power idle-mode, the module processor core runs with the RTC 32 kHz reference clock, which is generated by the internal 32 kHz oscillator The feature can be enabled through the +UPSV AT command.
Automatic selection of authentication type [9]	Automatic selection of authentication type during PDP context activation. The module will sequentially try different authentication protocols (none/CHAP/PAP) until the authentication succeeds. The feature can be enabled through the +UPSD and +UAUTHREQ AT commands.
Signal quality report for Packet Switched calls [9]	The quality of the GPRS UL and/or DL connection is returned by the AT+CSQ command.
eMLPP [9]	Multi-Level Precedence and Pre-emption Service (eMLPP) permits to handle the call priority. The maximum priority associated to a user is set in the SIM: within this threshold, the user can assign different priorities to the calls; this results in a differentiated treatment of the calls by the network in case of abnormal events such as handovers to congested cells. The feature can be enabled by +CAEMLPP, +CPPS, +CAAP AT commands.
Network Friendly Mode [9]	When the NFM is enabled, the module reacts to service request denials by using time-spaced, randomized or delayed retry schemes according to GSMA IoT Device Connection Efficiency Guidelines [19]. The feature can be enabled through the +UNFM, +UNFMCONF and +URPM AT commands.
Ethernet (CDC-ECM) over USB interface [9]	Ethernet (CDC-ECM) interface allowing networking from a HOST by means of the IP address received from the cellular network (bridge mode). The HOST configuration is performed via the DHCP protocol (a DHCP server is implemented). It operates as a non-exclusive alternative to PPP dial-up. The feature can be configured by +UUSBCONF and enabled by +UCEDATA AT commands.
Smart radio Coverage Manager (SCM) [10]	Smart radio coverage manager is a feature that aims to reduce the power consumption in those cellular scenarios where the radio coverage or the network conditions would cause an inefficient usage of power supply. The feature can be enabled and configured through the +UDCONF=57 AT command.

Table 4: LISA-U2 series main supported features

☞ 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.

[13] Not supported by “01” product version

2 Interfaces

2.1 Power management

2.1.1 Module supply (VCC)

Modules must be supplied through the **VCC** pin by a DC power supply. Voltages must be stable: 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 LISA-U2 series system integration manual [6]). It is important that the system power supply circuit is able to support the peak power.

2.1.2 RTC supply (V_BCKP)

V_BCKP is the Real Time Clock (RTC) supply. When the **VCC** voltage is within the valid operating range, the internal Power Management Unit (PMU) supplies the RTC and the same supply voltage is available on the **V_BCKP** pin. If the **VCC** voltage is under the minimum operating limit (e.g. during not powered mode), the **V_BCKP** pin can externally supply the RTC.

2.1.3 Digital I/O interfaces supply (V_INT)

LISA-U2 modules provide an internally generated supply rail output for digital interfaces (**V_INT**). This can be used in place of an external discrete regulator to supply pull-up resistors on the DDC interface. This optimizes the bill of materials for various applications, e.g. with u-blox GNSS receivers operating at 1.8 V.

2.2 RF antenna interface

The **ANT** pin has an impedance of 50 Ω and represents the main Tx/Rx antenna interface.

The **ANT_DIV** pin, provided only by LISA-U230 modules, has an impedance of 50 Ω and represents the Rx diversity antenna interface. The integrated diversity receiver provides improved link quality and reliability on all 2G and 3G operating bands except 2G DCS 1800.

2.3 System functions

2.3.1 Module power-on

LISA-U2 modules can be switched on in one of the following ways:

- Rising edge on the **VCC** pin to a valid voltage for module supply, i.e. applying module supply
- Low pulse on the **PWR_ON** pin, i.e. forcing the pin to a low level for a valid time period (see section 4.2.6), when the applied **VCC** voltage is within the valid operating range: **PWR_ON** pin requires an external pull-up resistor to set its value to normally logic high and may not be left floating
- Rising edge on the **RESET_N** pin, i.e. releasing the pin from the low level, normally high with internal pull-up, when the applied **VCC** voltage is within the valid operating range
- RTC alarm, i.e. pre-programmed scheduled time by AT+CALA command), when the applied **VCC** voltage is within the valid operating range

2.3.2 Module power-off

LISA-U2 modules can be switched off, with a complete storage of the current parameter settings and a network detach, in one of these ways:

- AT+CPWROFF command
- Low pulse on the **PWR_ON** pin for at least 1 s

An under-voltage shutdown occurs when the **VCC** supply drops below the extended operating range minimum limit, but in this case it is not possible to perform the storing of the current parameter settings in the module's non-volatile memory as well as the clean network detach.

An over-temperature or an under-temperature shutdown occurs 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 the LISA-U2 series system integration manual [6] and the u-blox AT commands manual [4], +USTS AT command.

2.3.3 Module reset

LISA-U2 modules can be properly reset (rebooted), with storage of current parameter settings and network detach, in this way:

- By the AT+CFUN command (see the u-blox AT commands manual [4]). This causes an "internal" or "software" reset of the baseband processor, excluding the integrated power management unit and the RTC internal block: the **V_INT** interfaces supply is enabled and each digital pin is set to its internal reset state (reported in Table 6), the **V_BCKP** supply and the RTC block are enabled. The current parameter settings are saved in the module's non-volatile memory and a clean network detach is performed.

An abrupt "external" or "hardware" reset occurs forcing a low level the **RESET_N** input pin, normally high with internal pull-up, for a valid time period (see section 4.2.7). This causes a reset of the entire module, including the integrated power management unit, except for the RTC internal block: the **V_INT** interfaces supply is switched off and all the digital pins are tri-stated, but the **V_BCKP** supply and the RTC block are enabled. The current parameter settings are not saved in the module's non-volatile memory and a clean network detach is not performed.

2.4 (U)SIM interface

A (U)SIM card interface is provided on the SMT pads of the LISA-U2 modules: the high-speed SIM/ME interface is implemented as well as automatic detection of the required SIM supporting voltage.

Both 1.8 V and 3 V SIM types are supported (1.8 V and 3 V ME). Activation and deactivation with automatic voltage switch from 1.8 V to 3 V is implemented, according to ISO-IEC 7816-3 specifications. The SIM driver supports the PPS (Protocol and Parameter Selection) procedure for baud-rate selection, according to the values offered by the SIM card.

2.5 Serial communication

LISA-U2 modules provide the following serial communication interfaces where AT command interface and Packet-Switched / Circuit-Switched Data communication are concurrently available:

- One asynchronous serial interface (UART)
- One Inter Processor Communication (IPC) interface: two handshake signals added to a SPI interface
- One high-speed USB 2.0 compliant interface

When used as AT command interface, all the serial communication interfaces listed above can be used for firmware upgrade using AT commands (for more details, see the u-blox AT commands manual [4] +UFWUPD), but only the following serial communication interfaces can be used for firmware upgrade using the u-blox Easy Flash tool:

- The UART interface, using the **RxD** and **TxD** lines only (the other UART lines are not needed)
- The USB interface, using all the provided lines (**VUSB_DET**, **USB_D+** and **USB_D-**)

2.5.1 Asynchronous serial interface (UART)

The UART interface is a 9-wire unbalanced asynchronous serial interface provided for all communications with LISA-U2 modules. The UART features are:

- Complete serial port with RS-232 functionality conforming to the ITU-T V.24 Recommendation [10], with CMOS compatible signal levels (0 V for low data bit or ON state and 1.8 V for high data bit or OFF state)
- Data lines (**RxD** as output, **TxD** as input), hardware flow control lines (**CTS** as output, **RTS** as input), modem status and control lines (**DTR** as input, **DSR** as output, **DCD** as output, **RI** as output) are provided
- Hardware flow control (default value), software flow control, or none flow control are supported
- Power saving indication available[14] on the hardware flow control output (**CTS** line): the line is driven to the OFF state when the module is not prepared to accept data by the UART interface
- 1,200, 2,400, 4,800, 9,600, 19,200, 38,400, 57,600, 115,200, 230,400, 460,800 and 921,600 bit/s baud rates are supported for the AT interface
- Autobauding is enabled by default
- Frame format can be:
  - 8N2 (8 data bits, no parity, 2 stop bits)
  - 8N1 (8 data bits, no parity, 1 stop bit)
  - 8E1 (8 data bits, even parity, 1 stop bit)
  - 8O1 (8 data bits, odd parity, 1 stop bit)
  - 7E1 (7 data bits, even parity, 1 stop bit)
  - 7O1 (7 data bits, odd parity, 1 stop bit)
- Default frame configuration is 8N1

The UART serial interface can be conveniently configured through AT commands. For more details, refer to the u-blox AT commands manual [4] (+IPR, +ICF, +IFC, &K, \Q, +UPSV AT command) and the LISA-U2 series system integration manual [6].

2.5.1.1 Autobauding feature

Only one-shot autobauding is supported. This means that the baud rate detection is performed once, at module start-up.

After detection, the module works at the fixed baud rate (the detected one) and the baud rate can only be changed via the appropriate AT command (for more details, see the u-blox AT commands manual [4], +IPR).

- The module detects the followings baud rates (bit/s): 1,200, 2,400, 4,800, 9,600, 19,200, 38,400, 57,600, 115,200, 230,400
- The only detectable frame configurations are: 7E1, 7O1, 8N1, 8E1, 8O1

2.5.2 Universal Serial Bus (USB)

LISA-U2 series modules include a high-speed USB 2.0 compliant interface with a maximum 480 Mbit/s data rate. The module itself acts as a USB device and can be connected to any USB host.

The USB is the suitable interface for transferring high speed data between LISA-U2 series and a host processor, available for AT commands, data communication, FW upgrade by means of the FOAT feature, FW upgrade by means of the u-blox EasyFlash tool and for diagnostic purposes.

The **USB_D+** / **USB_D-** lines carry the USB serial data and signaling. The USB interface is automatically enabled by an external valid USB VBUS supply voltage (5.0 V typical) applied on the **VUSB_DET** pin.

[14] If enabled

LISA-U2 series modules can provide the following functions over the USB interface:

- CDC-ACM for AT commands and data communication
- CDC-ACM for GNSS tunneling
- CDC-ACM for diagnostics
- CDC-ACM for SAP (SIM Access Profile)
- CDC-ECM for Ethernet-over-USB

☞ The CDC-ECM for Ethernet-over-USB function is not supported by the "01", "x2", "63" and "68" product versions.

The default configuration of the USB interface provides 7 USB CDC-ACM modem COM ports:

- USB1: AT and data
- USB2: AT and data
- USB3: AT and data
- USB4: GNSS tunneling
- USB5: Primary Log (diagnostic purposes)
- USB6: Secondary Log (diagnostic purposes)
- USB7: SAP (SIM Access Profile)

The user can concurrently use the AT command interface on one CDC and use Packet-Switched / Circuit-Switched Data communication on another CDC.

The USB interface can be configured by the AT+UUSBCONF command to provide a different set of functions, including 1 CDC-ECM for Ethernet-over-USB and 4 CDC-ACM modem COM ports enumerated as follows:

- USB1: AT and data
- USB2: GNSS tunneling
- USB3: Primary Log (diagnostic purposes)
- USB4: SAP (SIM Access Profile)

☞ The default profile of the USB interface cannot be changed on the "01", "x2", "63" and "68" product versions.

For more details regarding the USB configurations and capabilities, see the LISA-U2 series system integration manual [6] and the u-blox AT commands manual [4] (+UUSBCONF AT command).

USB drivers are available for the following operating system platforms:

- Windows XP
- Windows Vista
- Windows 7
- Windows 8
- Windows 8.1
- Windows 10
- Windows CE 5.0
- Windows Embedded CE 6.0
- Windows Embedded Compact 7
- Windows Embedded Automotive 7
- Windows Mobile 5
- Windows Mobile 6
- Windows Mobile 6.1
- Windows Mobile 6.5

LISA-U2 modules are compatible with the standard Linux/Android USB kernel drivers.

2.5.3 Serial Peripheral Interface (SPI)

The LISA-U2 modules provide a 5-wire Inter Processor Communication (IPC) interface that includes two handshake signals (**SPI_MRDY** and **SPI_SRDY**) added to a standard 3-wire SPI-compatible serial interface (**SPI_MOSI**, **SPI_MISO**, **SPI_SCLK**). The LISA-U2 modules run natively as an SPI slave.

The SPI / IPC interface can be used for high speed data transfer (UMTS/HSPA) between LISA-U2 modules and the host processor. The high speed communication (up to 26 Mbit/s) between the two processors is possible only if both sides follow the same Inter Processor Communication (IPC) specifications.

See the LISA-U2 series system integration manual [6] and the SPI interface application note [14] for a detailed description of the implementation of the SPI / IPC protocol.

2.5.4 Multiplexer protocol

The LISA-U2 module has a software layer with MUX functionality, 3GPP TS 27.010 Multiplexer Protocol [3], available either on the UART or on the SPI physical link.

- The multiplexer protocol is not supported by the USB interface.

This is a data link protocol (layer 2 of OSI model) which uses HDLC-like framing and operates between the module (DCE) and the application processor (DTE) and allows simultaneous sessions over the used physical link (UART or SPI): the user can concurrently use AT command interface on one MUX channel and Packet-Switched / Circuit-Switched Data communication on another MUX channel.

The multiplexer protocol can be used on one serial interface (UART or SPI) at a time. Each session consists of a stream of bytes transferring various kinds of data such as SMS, CBS, PSD, GNSS, AT commands in general.

LISA-U2 modules provide the following virtual channels:

- Channel 0: control channel
- Channel 1 – 5: AT commands / data connection
- Channel 6: GNSS tunneling
- Channel 7: SAP (SIM Access Profile)

For more details, see the Multiplexer implementation application note [11].

2.6 DDC (I2C) bus interface

LISA-U2 series modules include an I2C compatible DDC interface that is available to communicate with a u-blox GNSS receiver and at the same time with an external I2C device as an audio codec: the LISA-U2 module acts as an I2C master which can communicate with two I2C slaves in accordance with the I2C bus specifications [13].

2.7 Audio

LISA-U2 modules have two 4-wire I2S digital audio interfaces:

- First 4-wire I2S digital audio interface (**I2S_CLK**, **I2S_RXD**, **I2S_TXD** and **I2S_WA**)
- Second 4-wire I2S digital audio interface (**I2S1_CLK**, **I2S1_RXD**, **I2S1_TXD** and **I2S1_WA**)

These audio paths are selected by parameters <main_uplink> and <main_downlink> in the AT+USPM command (for more details, see the u-blox AT commands manual [4]).

LISA-U2 modules provide a digital clock output (**CODEC_CLK**) for an external audio codec.

For further details about the hardware integration of the audio interface in an application design, see the LISA-U2 series system integration manual [6].

For further details about the possible settings of the audio interface, as well as the allowed input/output audio path combinations and as the default values related to the uplink/downlink path, see the u-blox AT commands manual [4], +USPM AT command.

2.8 GPIO

LISA-U2 modules provide up to 14 GPIO pins (**GPIO1-GPIO14**) which can be configured for general purpose input/output, or to provide the custom functions listed in Table 5 using u-blox AT commands (for further details, see the LISA-U2 series system integration manual [6] and the u-blox AT commands manual [4], +UGPIOC, +UGPIOR, +UGPIOW, +UGPS, +UGPRF, +USPM, +UDCONF=50).

Function	Description	Module	Default GPIO	Configurable GPIOs
GSM Tx-burst indication	GSM transmit slot indication	All	--	GPIO1
GNSS supply enable	Enable/disable the supply of u-blox GNSS receiver connected to cellular module	All	GPIO2	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5
GNSS data ready	Sense when u-blox GNSS receiver connected to cellular module is ready for sending data by the DDC (I2C)	All	GPIO3	GPIO3
GNSS RTC sharing	RTC (Real Time Clock) synchronization signal to u-blox GNSS receiver connected to cellular module	All	GPIO4	GPIO4
SIM card detection	SIM card presence	All	GPIO5	GPIO5
SIM card hot insertion/removal	SIM card hot insertion/removal	All	--	GPIO5
Network status indication	Network status: registered 2G / 3G home network, registered 2G / 3G roaming, 2G / 3G data transmission, no service	All	--	GPIO1, GPIO2, GPIO3, GPIO4, GPIO5
Module status indication	Module status: power off mode, i.e. module switched off, versus idle, active or connected mode, i.e. module switched on	All	--	GPIO1, GPIO13
Module operating mode indication	Module operating mode: idle mode versus active or connected mode	All	--	GPIO5, GPIO14
I2S digital audio interface	Second I2S digital audio interface (**I2S1_RXD**, **I2S1_TXD**, **I2S1_CLK**, **I2S1_WA** respectively)	All	GPIO6, GPIO7, GPIO8, GPIO9	GPIO6, GPIO7, GPIO8, GPIO9
SPI serial interface	SPI / IPC serial interface (**SPI_SCLK**, **SPI_MOSI**, **SPI_MISO**, **SPI_SRDY** and **SPI_MRDY** respectively)	All	GPIO10, GPIO11, GPIO12, GPIO13 GPIO14	GPIO10, GPIO11, GPIO12, GPIO13 GPIO14
Last gasp[15]	Input to trigger the delivery of a last alarm notification to a remote entity	LISA-U200, LISA-U201	--	GPIO3
General purpose input	Input to sense high or low digital level	All	--	All
General purpose output	Output to set the high or the low digital level	All	--	All
Pad disabled	Tri-state with an internal active pull-down enabled	All	GPIO1	All

Table 5: GPIO custom functions configuration

[15] Not supported by "01", "02", "03", "52", "62", "83" product versions

3 Pin definition

3.1 Pin assignment

Figure 2: LISA-U2 series pin assignment

No	Module	Name	Power domain	I/O	Description	Remarks
1	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
2	All	V_BCKP	-	I/O	Real Time Clock supply input/output	V_BCKP = 1.8 V (typical) generated by the module to supply the Real Time Clock when VCC supply voltage is within valid operating range. A backup battery can be connected to this pin to supply the Real Time Clock when VCC supply voltage is not within valid operating range. See section 4.2.3 for detailed electrical specs.
3	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
4	All	V_INT	-	O	Digital I/O Interfaces supply output	V_INT = 1.8V (typical) generated by the module when it is switched on and the RESET_N (external reset input pin) is not forced to the low level. See section 4.2.3 for detailed electrical specs.
5	All	RSVD	-	N/A	RESERVED pin	This pin has special function: it must be connected to GND to allow module to work properly.

No	Module	Name	Power domain	I/O	Description	Remarks
6	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
7	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
8	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
9	All	DSR	GDI	O	UART data set ready	Circuit 107 (DSR) in ITU-T V.24. Output driver class D. PU/PD class a. Value at internal reset: T/PU. See section 4.2.9 for detailed electrical specs.
10	All	RI	GDI	O	UART ring indicator	Circuit 125 (RI) in ITU-T V.24. Output driver class C_0. PU/PD class c. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
11	All	DCD	GDI	O	UART data carrier detect	Circuit 109 (DCD) in ITU-T V.24. Output driver class C_0. PU/PD class c. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
12	All	DTR	GDI	I	UART data terminal ready	Circuit 108/2 (DTR) in ITU-T V. 24. Internal active pull-up to V_INT enabled. PU/PD class c. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
13	All	RTS	GDI	I	UART ready to send	Circuit 105 (RTS) in ITU-T V.24. Internal active pull-up to V_INT enabled. PU/PD class a. Value at internal reset: T/PU. See section 4.2.9 for detailed electrical specs.
14	All	CTS	GDI	O	UART clear to send	Circuit 106 (CTS) in ITU-T V.24. Output driver class A. PU/PD class a. Value at internal reset: T/PU. See section 4.2.9 for detailed electrical specs.
15	All	TXD	GDI	I	UART transmitted data	Circuit 103 (TxD) in ITU-T V.24. Internal active pull-up to V_INT enabled. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
16	All	RXD	GDI	O	UART received data	Circuit 104 (RxD) in ITU-T V.24. Output driver class A. PU/PD class a. Value at internal reset: T/PU. See section 4.2.9 for detailed electrical specs.
17	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
18	All	VUSB_DET	USB	I	USB detect input	Input for VBUS (5 V typical) USB supply sense. See section 4.2.10 for detailed electrical specs.
19	All	PWR_ON	POS	I	Power-on input	The PWR_ON pin has high input impedance: do not leave it floating in noisy environment (an external pull-up resistor is required) See section 4.2.6 for detailed electrical specs.
20	All	GPIO1	GDI	I/O	GPIO	Output driver class A. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
21	All	GPIO2	GDI	I/O	GPIO	Output driver class E. PU/PD class b. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
22	All	RESET_N	ERS	I	External reset input	Internal 10 kΩ pull-up resistor to V_BCKP. See section 4.2.7 for detailed electrical specs.
23	All	GPIO3	GDI	I/O	GPIO	Output driver class A. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.

No	Module	Name	Power domain	I/O	Description	Remarks
24	All	GPIO4	GDI	I/O	GPIO	Output driver class A. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
25	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
26	All	USB_D-	USB	I/O	USB Data Line D-	90 Ω nominal differential impedance Pull-up or pull-down resistors and external series resistors as required by the USB 2.0 high-speed specification [12] are part of the USB pin driver and need not be provided externally. Value at internal reset: T. See section 4.2.10 for detailed electrical specs.
27	All	USB_D+	USB	I/O	USB Data Line D+	90 Ω nominal differential impedance Pull-up or pull-down resistors and external series resistors as required by the USB 2.0 high-speed specification [12] are part of the USB pin driver and need not be provided externally. Value at internal reset: T. See section 4.2.10 for detailed electrical specs.
28	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
29	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
30	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
31	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
32	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
33	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
34	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
35	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
36	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
37	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
38	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
39	All	I2S1_RXD / GPIO6	GDI	I / I/O	2nd I2S receive data / GPIO	Can be configured as receive data input of the second digital audio interface (with internal active pull-down to GND enabled), or as GPIO. Output driver class E. PU/PD class b. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
40	All	I2S1_TXD / GPIO7	GDI	O / I/O	2nd I2S transmit data / GPIO	Can be configured as transmit data output of the second digital audio interface, or as GPIO. Output driver class E. PU/PD class b. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
41	All	I2S_WA	GDI	I/O	1st I2S word alignment	Input with internal active pull-down to GND enabled in slave mode, Output in master mode. Output driver class C. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
42	All	I2S_TXD	GDI	O	1st I2S transmit data	Output driver class C. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
43	All	I2S_CLK	GDI	I/O	1st I2S clock	Input with internal active pull-down to GND enabled in slave mode, Output in master mode. Output driver class C. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.

No	Module	Name	Power domain	I/O	Description	Remarks
44	All	I2S_RXD	GDI	I	1st I2S receive data	Internal active pull-down to GND enabled. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
45	All	SCL	DDC	O	I2C bus clock line	Fixed open drain. No internal pull-up. Value at internal reset: T. See section 4.2.11 for detailed electrical specs.
46	All	SDA	DDC	I/O	I2C bus data line	Fixed open drain. No internal pull-up. Value at internal reset: T. See section 4.2.11 for detailed electrical specs.
47	All	SIM_CLK	SIM	O	SIM clock	Value at internal reset: L. See section 4.2.8 for detailed electrical specs.
48	All	SIM_IO	SIM	I/O	SIM data	Internal 4.7 kΩ pull-up resistor to VSIM. Value at internal reset: L/PD. See section 4.2.8 for detailed electrical specs.
49	All	SIM_RST	SIM	O	SIM reset	Value at internal reset: L. See section 4.2.8 for detailed electrical specs.
50	All	VSIM	-	O	SIM supply output	VSIM = 1.80 V typical or 2.90 V typical generated by the module according to the SIM card type. See section 4.2.3 for detailed electrical specs.
51	All	GPIO5	GDI	I/O	GPIO	Output driver class A. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
52	All	CODEC_CLK	GDI	O	Clock output	Output driver class B. PU/PD class b. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
53	All	I2S1_CLK / GPIO8	GDI	I/O / I/O	2nd I2S clock / GPIO	Can be configured as clock (Input with internal active pull-down to GND enabled in slave mode, Output in master mode) of the second digital audio interface, or as GPIO. Output driver class E. PU/PD class b. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
54	All	I2S1_WA / GPIO9	GDI	I/O / I/O	2nd I2S word alignment / GPIO	Can be configured as word alignment (Input with internal active pull-down to GND enabled in slave mode, Output in master mode) of the second digital audio interface, or as GPIO. Output driver class E. PU/PD class b. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
55	All	SPI_SCLK / GPIO10	GDI	I / I/O	SPI Serial Clock Input / GPIO	Can be set as SPI Serial Clock Input, or as GPIO When configured as SPI Serial Clock: • Idle low (CPOL=0) • Internal active pull-down to GND enabled. Output driver class A. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
56	All	SPI_MOSI / GPIO11	GDI	I / I/O	SPI Data Line Input / GPIO	Can be set as SPI Data Line Input, or as GPIO When configured as SPI Data Line Input: • Shift data on rising clock edge (CPHA=1) • Latch data on falling clock edge (CPHA=1) • Idle high. • Internal active pull-up to V_INT enabled. Output driver class A. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.

No	Module	Name	Power domain	I/O	Description	Remarks
57	All	SPI_MISO / GPIO12	GDI	O / I/O	SPI Data Line Output / GPIO	Can be set as SPI Data Line Output, or as GPIO When configured as SPI Data Line Output: • Shift data on rising clock edge (CPHA=1) • Latch data on falling clock edge (CPHA=1) • Idle high Output driver class A. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
58	All	SPI_SRDY / GPIO13	GDI	O / I/O	SPI Slave Ready Output / GPIO	Can be set as SPI Slave Ready Output, or as GPIO When configured as SPI Slave Ready Output: • Idle low Output driver class A. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
59	All	SPI_MRDY / GPIO14	GDI	I / I/O	SPI Master Ready Input / GPIO	Can be set as SPI Master Ready Input, or as GPIO When configured as SPI Master Ready Input: • Idle low • Internal active pull-down to GND enabled Output driver class A. PU/PD class a. Value at internal reset: T/PD. See section 4.2.9 for detailed electrical specs.
60	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
61	All	VCC	-	I	Module supply input	All VCC pins must be connected to external supply
62	All	VCC	-	I	Module supply input	All VCC pins must be connected to external supply
63	All	VCC	-	I	Module supply input	All VCC pins must be connected to external supply
64	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
65	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
66	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
67	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
68	All	ANT	-	I/O	RF input/output for main Tx/Rx antenna	50 Ω nominal impedance
69	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
70	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
71	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
72	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
73	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
74	All except LISA-U230	RSVD	-	N/A	RESERVED pin	Leave unconnected.
	LISA-U230	ANT_DIV	-	I	RF input for Rx diversity antenna	50 Ω nominal impedance
75	All	GND	-	N/A	Ground	All GND pins must be connected to ground.
76	All	GND	-	N/A	Ground	All GND pins must be connected to ground.

Table 6: LISA-U2 series module pin-out

☞ For more information about pinouts, see the LISA-U2 series system integration manual [6].

☞ For an explanation of the abbreviations and terms used, see Appendix A.

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.

☞ Operating conditions ranges define those limits within which the functionality of the device is guaranteed.

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

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

4.1 Absolute maximum rating

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

Symbol	Description	Condition	Min.	Max.	Unit
VCC	Module supply voltage	Input DC voltage at VCC pin	-0.30	5.50	V
VUSB_DET	USB detection pin	Input DC voltage at VUSB_DET	-0.30	5.35	V
USB	USB D+/D- pins	Input DC voltage at USB_D+ and USB_D-	-1.00	5.35	V
V_BCKP	RTC supply voltage	Input DC voltage at V_BCKP pin	-0.15	2.00	V
GDI	Generic digital interfaces	Input DC voltage at Generic digital interfaces pins	-0.30	3.60	V
DDC	DDC interface	Input DC voltage at DDC interface pins	-0.30	3.60	V
SIM	SIM interface	Input DC voltage at SIM interface pin	-0.30	3.60	V
ERS	External reset signal	Input DC voltage at External reset signal pin	-0.15	2.10	V
POS	Power-on input	Input DC voltage at Power-on signal pin	-0.30	5.50	V
V_ANT	Antenna voltage	Input DC voltage at ANT pin	-0.15	3.00	V
P_ANT	Antenna power	Input in-band RF power at ANT pin		-8	dBm
Rho_ANT	Antenna ruggedness	Output RF load mismatch ruggedness at ANT pin		10:1	VSWR
Tstg	Storage temperature		-40	+90	°C

Table 7: 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	Module	Min.	Typ.	Max.	Unit	Remarks
ESD sensitivity for all pins except ANT and ANT_DIV pins	All			1000	V	Human Body Model as per JESD22-A114F
ESD sensitivity for ANT pin	All			1000	V	Human Body Model as per JESD22-A114F
ESD sensitivity for ANT_DIV pin	LISA-U230			1000	V	Human Body Model as per JESD22-A114F
ESD immunity for ANT pin	All			1000	V	Contact Discharge as per IEC 61000-4-2
				1000	V	Air Discharge as per IEC 61000-4-2
ESD immunity for ANT_DIV pin	LISA-U230			4000	V	Contact Discharge as per IEC 61000-4-2
				8000	V	Air Discharge as per IEC 61000-4-2

Table 8: Maximum ESD ratings

⚠ LISA-U2 modules are Electrostatic Sensitive Devices (ESD) and require special precautions when handling.

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

Symbol	Parameter	Min.	Typ.	Max.	Units	Remarks
Topr	Operating temperature range	-40		+85	°C	
		-20		+65	°C	Normal operating temperature range See section 4.2.1.1
		-40		-20	°C	Extended operating temperature range 1 See section 4.2.1.2
		+65		+85	°C	Extended operating temperature range 2 See section 4.2.1.3

Table 9: Environmental conditions

4.2.1.1 Normal operating temperature range

The cellular module is fully functional and meets the 3GPP specification across the specified temperature range.

4.2.1.2 Extended operating temperature range 1

The cellular module is fully functional across the specified temperature range. Occasional deviations from the 3GPP specification may occur.

4.2.1.3 Extended operating temperature range 2

The cellular module is functional across the specified temperature range. Occasional deviations from the 3GPP specification may occur. Thermal protection including automatic shutdown is implemented for protection against overheating. Thermal protection is disabled for emergency calls. For more details, see the u-blox AT commands manual [4], +USTS AT command).

4.2.2 Module thermal parameters

Symbol	Parameter	Min.	Typ.	Max.	Units	Remarks
Ψ_{M-A}	Module-to-Ambient thermal parameter	7		12	°C/W	Thermal characterization parameter $\Psi_{M-A} = (T_M - T_A) / P_H$ proportional to the temperature difference between the internal temperature sensor of the module (T_M) and the ambient temperature (T_A), produced by the module heat power dissipation (P_H), with the module mounted on a 90 mm x 70 mm x 1.46 mm 4-layer PCB with a high coverage of copper, in still air conditions
Ψ_{M-C}	Module-to-Case thermal parameter	1.5		3.5	°C/W	Thermal characterization parameter $\Psi_{M-C} = -T_M - T_C) / P_H$ proportional to the temperature difference between the internal temperature sensor of the module (T_M) and the ambient temperature (T_C), produced by the module heat power dissipation (P_H), with the module mounted on a 90 mm x 70 mm x 1.46 mm 4-layer PCB with a high coverage of copper, with a robust aluminum heat sink on the back of the application PCB, with forced air ventilation

Table 10: Module thermal parameters

4.2.3 Supply/Power pins

Symbol	Parameter	Min.	Typ.	Max.	Unit
VCC	Module supply normal operating input voltage [16]	3.30	3.80	4.40	V
	Module supply extended operating input voltage [17]	3.10		4.50	V
V_BCKP	RTC supply input voltage	1.00	1.80	1.90	V
I_BCKP	RTC supply average current consumption, at V_BCKP = 1.8 V		2.00		µA

Table 11: Input characteristics of the supply/power pins

Symbol	Parameter	Min.	Typ.	Max.	Unit
VSIM	SIM supply output voltage	1.76	1.80	1.83	V
		2.84	2.90	2.94	V
V_BCKP	RTC supply output voltage	1.71	1.80	1.89	V
I_BCKP	RTC supply output current capability			3	mA
V_INT	Digital I/O Interfaces supply output voltage	1.73	1.80	1.87	V
V_INT_RIPPLE	Digital I/O Interfaces supply output peak-to-peak voltage ripple during active or connected mode			15	mV
	Digital I/O Interfaces supply output peak-to-peak voltage ripple during low power idle mode with power saving enabled by AT+UPSV command			70	mV
I_INT	Digital I/O Interfaces supply output current capability			70	mA

Table 12: Output characteristics of the supply/power pins

[16] Input voltage at **VCC** must be above the normal operating range minimum limit to switch on the module.
[17] Occasional deviations from the 3GPP specifications may occur. Ensure that input voltage at **VCC** never drops below the extended operating range minimum limit during module operation: the wireless module may switch off when the **VCC** voltage value drops below the extended operating range minimum limit.

4.2.4 Current consumption

Table 13 details the LISA-U2 modules average current consumption through the **VCC** pins in the listed conditions[18].

Mode	Condition	Band	Min	Typ	Max	Unit
Power Off Mode	Averaged current, module switched off			55	60	µA
Idle-Mode (Power Saving enabled by AT+UPSV, module in low power idle-mode, equivalent to +CFUN=0 or +COPS=2)	Averaged current over a 100-ms period, USB interface disconnected			0.6		mA
	Averaged current over a 100-ms period, USB interface connected and suspended			1.0		mA
2G Cyclic Idle/Active-Mode (Power Saving enabled by AT+UPSV, Module registered with network)	Averaged current over a 10-minute period, DRX = 9[19], AT+UPSV=2 or 3, USB disconnected	All		0.9	1.0	mA
	Averaged current over a 10-minute period, DRX = 5[20], AT+UPSV=1, USB disconnected	All		1.3	1.5	mA
	Averaged current over a 10-minute period, DRX = 5, AT+UPSV=1, USB suspended[20]	All		1.7	2.0	mA
2G Active-Mode (Power Saving disabled by AT+UPSV=0, Module registered with network)	Averaged current over a 10-minute period, DRX = 5, USB disconnected	All		13.0		mA
	Averaged current over a 10-minute period, DRX = 5, USB connected and not suspended	All		36.8		mA
GSM Connected Mode (Tx / Rx call enabled)	Peak current[21] during a 1-slot Tx burst Maximum Tx power	GSM 850, EGSM 900		1.8	2.5	A
	Averaged current over a 10-second period, 1 Tx + 1 Rx slot, Maximum Tx power	GSM 850, EGSM 900		230	260	mA
	Averaged current over a 10-second period, 1 Tx + 1 Rx slot, Maximum Tx power	DCS 1800, PCS 1900		170	220	mA
GPRS Connected Mode (Tx / Rx call enabled)	Averaged current over a 10-second period, 4 Tx + 1 Rx slots, Maximum Tx power[22]	GSM 850, EGSM 900		550	600	mA
	Averaged current over a 10-second period, 4 Tx + 1 Rx slots, Maximum Tx power[22]	DCS 1800, PCS 1900		400	450	mA
EDGE Connected Mode (Tx / Rx call enabled)	Averaged current over a 10-second period, 4 Tx + 1 Rx slots, Maximum Tx power[22]	GSM 850, EGSM 900		460	510	mA
	Averaged current over a 10-second period, 4 Tx + 1 Rx slots, Maximum Tx power[22]	DCS 1800, PCS 1900		450	500	mA
3G Cyclic Idle/Active-Mode (Power Saving enabled by AT+UPSV, Module registered with network)	Averaged current over a 10-minute period, DRX = 9[23], AT+UPSV=2 or 3, USB disconnected	All		1.0	1.2	mA
	Averaged current over a 10-minute period, DRX = 7[24], AT+UPSV=1, USB disconnected	All		1.4	1.5	mA
	Averaged current over a 10-minute period, DRX = 7[24], AT+UPSV=1, USB suspended	All		1.8	2.0	mA
3G Active-Mode (Power Saving disabled by AT+UPSV=0, Module registered with network)	Averaged current over a 10-minute period, DRX = 7, USB disconnected[24]	All		12.5		mA
	Averaged current over a 10-minute period, DRX = 7, USB connected and not suspended[24]	All		35.4		mA

[18] It is assumed that no significant load is connected to any digital and analog pin except for antenna.
[19] Module is registered with the network, with a paging period of 2.12 s (2G network DRX setting = 9), with no neighbour cell.
[20] Module is registered with the network, with a paging period of 1.18 s (2G network DRX setting = 5), with 16 neighbour cells.
[21] It is recommended to use this figure to dimension maximum current capability of power supply.
[22] Condition for GPRS and EDGE multi-slot output power: Multi-Slot Power Reduction profile 2 (+UDCONF=40 AT command default value).
[23] Module is registered with the network, with a paging period of 5.12 s (3G network DRX setting = 9).
[24] Module is registered with the network, with a paging period of 1.28 s (3G network DRX setting = 7).

Mode	Condition	Band	Min	Typ	Max	Unit
UMTS Connected Mode (Tx / Rx call enabled)	Averaged current over a 10-second period, 12.2 kbit/s UL, 12.2 kbit/s DL Tx power = -50 dBm	Band I		115		mA
		Band II		115		mA
		Band IV		110		mA
		Band V, VI		118		mA
		Band VIII		117		mA
	Averaged current over a 10-second period, 12.2 kbit/s UL, 12.2 kbit/s DL Tx power = 0 dBm	Band I		125		mA
		Band II		121		mA
		Band IV		120		mA
		Band V, VI		119		mA
		Band VIII		120		mA
	Averaged current over a 10-second period, 12.2 kbit/s UL, 12.2 kbit/s DL Tx power = 12 dBm	Band I		180		mA
		Band II		178		mA
		Band IV		165		mA
		Band V, VI		167		mA
		Band VIII		168		mA
	Averaged current over a 10-second period, 12.2 kbit/s UL, 12.2 kbit/s DL Tx power = 18 dBm	Band I		255		mA
		Band II		267		mA
		Band IV		242		mA
		Band V, VI		220		mA
		Band VIII		234		mA
	Averaged current over a 10-second period, 12.2 kbit/s UL, 12.2 kbit/s DL Maximum Tx power	Band I		475	600	mA
		Band II		510	640	mA
		Band IV		450	600	mA
		Band V, VI		385	490	mA
		Band VIII		425	490	mA
HSDPA Connected Mode (Tx / Rx call enabled)	Averaged current over a 10-second period, Maximum DL data rate (HSDPA) Maximum Tx power	Band I		590	650	mA
		Band II		590	690	mA
		Band IV		580	650	mA
		Band V, VI		460	550	mA
		Band VIII		490	550	mA
HSUPA or HSPA Connected Mode (Tx / Rx call enabled)	Averaged current over a 10-second period, Maximum UL data rate (HSUPA) or Maximum both UL/DL data rate (HSPA) Maximum Tx power	Band I		540	620	mA
		Band II		540	660	mA
		Band IV		530	650	mA
		Band V, VI		395	500	mA
		Band VIII		425	500	mA

Table 13: VCC current consumption

4.2.5 RF characteristics

The 3G and 2G bands supported by each LISA-U2 series module are defined in Table 2, while the following Table 14 lists the Tx and Rx frequencies for each band, according to 3GPP TS 34.121-1 [15] and 3GPP TS 51.010-1 [16].

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

Parameter		Min.	Max.	Unit	Remarks
Frequency range UMTS 800 (band VI)	Uplink	830	840	MHz	Module transmit
	Downlink	875	885	MHz	Module receive
Frequency range UMTS 850 (band V)	Uplink	824	849	MHz	Module transmit
	Downlink	869	894	MHz	Module receive
Frequency range UMTS 900 (band VIII)	Uplink	880	915	MHz	Module transmit
	Downlink	925	960	MHz	Module receive
Frequency range UMTS 1700 (band IV)	Uplink	1710	1755	MHz	Module transmit
	Downlink	2110	2155	MHz	Module receive
Frequency range UMTS 1900 (band II)	Uplink	1850	1910	MHz	Module transmit
	Downlink	1930	1990	MHz	Module receive
Frequency range UMTS 2100 (band I)	Uplink	1920	1980	MHz	Module transmit
	Downlink	2110	2170	MHz	Module receive

Table 14: Operating RF frequency bands

LISA-U2 series modules include a UE Power Class 3 3G transmitter, an EDGE Power Class E2 transmitter, a GMSK Power Class 4 transmitter for GSM/E-GSM bands and a GMSK Power Class 1 transmitter for DCS/PCS bands (see Table 2). Output power and characteristics are compliant with 3GPP TS 34.121-1 [15], 3GPP TS 51.010-1 [16].
LISA-U2 series modules 3G and 2G receiver characteristics are compliant with 3GPP TS 34.121-1 [15] and 3GPP TS 51.010-1 [16], with conducted receiver sensitivity performance specified in Table 15.

Parameter	Min.	Typ.	Max.	Unit	Remarks
Receiver input sensitivity GSM 850 / E-GSM 900	-102.0	-110.0		dBm	Downlink RF level @ BER Class II < 2.4%
Receiver input sensitivity DCS 1800 / PCS 1900	-102.0	-109.0		dBm	Downlink RF level @ BER Class II < 2.4%
Receiver input sensitivity UMTS 800 (band VI)	-106.7	-111.0		dBm	Downlink RF level for RMC @ BER < 0.1%
Receiver input sensitivity UMTS 850 (band V)	-104.7	-112.0		dBm	Downlink RF level for RMC @ BER < 0.1%
Receiver input sensitivity UMTS 900 (band VIII)	-103.7	-111.0		dBm	Downlink RF level for RMC @ BER < 0.1%
Receiver input sensitivity UMTS 1700 (band IV)	-106.7	-111.0		dBm	Downlink RF level for RMC @ BER < 0.1%
Receiver input sensitivity UMTS 1900 (band II)	-104.7	-111.0		dBm	Downlink RF level for RMC @ BER < 0.1%
Receiver input sensitivity UMTS 2100 (band I)	-106.7	-111.0		dBm	Downlink RF level for RMC @ BER < 0.1%
Condition: 50 Ω source					

Table 15: Receiver sensitivity performance

4.2.6 PWR_ON pin

Pin name	Parameter	Min.	Typ.	Max.	Unit	Remarks
PWR_ON	Internal supply for power-on input signal	1.71	1.80	1.89	V	RTC supply (V_BCKP)
	L-level input	-0.30		0.65	V	High input impedance (no internal pull-up)
	H-level input	1.50		4.40	V	High input impedance (no internal pull-up)
	L-level input current		-6		µA	
	PWR_ON low time to switch on the module	50		80	µs	
	PWR_ON low time to switch off the module	1000			ms	

Table 16: PWR_ON pin characteristics (POS domain)

4.2.7 RESET_N pin

Pin name	Parameter	Min.	Typ.	Max.	Unit	Remarks
RESET_N	Internal supply for External Reset Input Signal	1.71	1.80	1.89	V	RTC supply (V_BCKP)
	L-level input	-0.30		0.51	V	
	H-level input	1.32		2.01	V	
	L-level input current		-180		µA	
	Pull-up resistance		10		kΩ	Internal pull-up to RTC supply (V_BCKP)

Table 17: RESET_N pin characteristics (ERS domain)

The **RESET_N** input line has to be driven as described in Figure 3 to perform an abrupt "external" or "hardware" reset (reboot) of the LISA-U200, LISA-U230, LISA-U260 and LISA-U270 modules:

- **RESET_N** line has to be set to the LOW level for 50 ms (minimum)

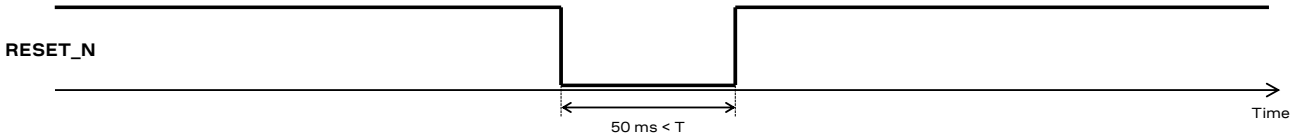

Figure 3: RESET_N waveform timings to perform an abrupt reset of LISA-U200, LISA-U230, LISA-U260, LISA-U270 modules

The **RESET_N** input line has to be driven as described in Figure 4 to perform an abrupt "external" or "hardware" reset (reboot) of the LISA-U201 modules:

- First, **RESET_N** line has to be set to the LOW level for 100 µs (minimum) to 200 µs (maximum)
- Then, **RESET_N** line has to be released to the HIGH level for 2 ms (minimum) to 4 ms (maximum)
- Then, **RESET_N** line has to be set to the LOW level for 500 ms (minimum)

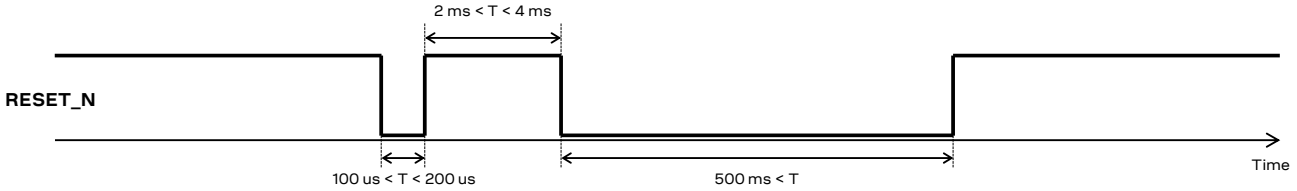

Figure 4: RESET_N line waveform timings to perform an abrupt reset of LISA-U201 modules

4.2.8 (U)SIM pins

The SIM pins are a dedicated interface to the (U)SIM chip card/IC. The electrical characteristics fulfill the regulatory specification requirements. The values in Table 18 are for information only.

Parameter	Min.	Typ.	Max.	Unit	Remarks
Low-level input	0.00		0.35	V	VSIM = 1.80 V
	0.00		0.57	V	VSIM = 2.90 V
High-level input	1.29		3.30	V	VSIM = 1.80 V
	2.07		3.30	V	VSIM = 2.90 V
Low-level output		0.00	0.35	V	VSIM = 1.80 V, Max value at I_{OL} = +1.0 mA
		0.00	0.35	V	VSIM = 2.90 V, Max value at I_{OL} = +1.0 mA
High-level output	1.26	1.80		V	VSIM = 1.80 V, Min value at I_{OH} = -1.0 mA
	2.03	2.90		V	VSIM = 2.90 V, Min value at I_{OH} = -1.0 mA
Input/Output leakage current			0.7	µA	0.2V < V_{IN} < 3.3V
Internal pull-up resistor on SIM_IO to VSIM		4.7		kΩ	
Clock frequency on SIM_CLK		3.25		MHz	

Table 18: (U)SIM pin characteristics (SIM domain)

4.2.9 Generic Digital Interface pins

Parameter	Min.	Typ.	Max.	Unit	Remarks
Internal supply for GDI domain	1.73	1.80	1.87	V	Digital I/O Interfaces supply (V_INT)
Input characteristic: L-level input	-0.20		0.35	V	
Input characteristic: H-level input	1.31		1.93	V	
Output characteristics: L-level output		0.00	0.20	V	Max value at I_{OL} = +0.1 mA for driver class A
		0.00	0.35	V	Max value at I_{OL} = +6.0 mA for driver class A
		0.00	0.20	V	Max value at I_{OL} = +0.1 mA for driver class B
		0.00	0.35	V	Max value at I_{OL} = +4.0 mA for driver class B
		0.00	0.20	V	Max value at I_{OL} = +0.1 mA for driver class C
		0.00	0.35	V	Max value at I_{OL} = +2.0 mA for driver class C
		0.00	0.45	V	Max value at I_{OL} = +2.0 mA for driver class C_0
		0.00	0.20	V	Max value at I_{OL} = +0.1mA for driver class D
		0.00	0.35	V	Max value at I_{OL} = +1.0 mA for driver class D
		0.00	0.20	V	Max value at I_{OL} = +0.1 mA for driver class E
Output characteristics: H-level output	1.45	1.80		V	Min value at I_{OH} = -6.0 mA for driver class A
	1.60	1.80		V	Min value at I_{OH} = -0.1 mA for driver class A
	1.45	1.80		V	Min value at I_{OH} = -4.0 mA for driver class B
	1.60	1.80		V	Min value at I_{OH} = -0.1 mA for driver class B
	1.45	1.80		V	Min value at I_{OH} = -2.0 mA for driver class C
	1.60	1.80		V	Min value at I_{OH} = -0.1 mA for driver class C
	1.35	1.80		V	Min value at I_{OH} = -2.0 mA for driver class C_0
	1.45	1.80		V	Min value at I_{OH} = -1.0 mA for driver class D
	1.60	1.80		V	Min value at I_{OH} = -0.1 mA for driver class D
	1.60	1.80		V	Min value at I_{OH} = -0.1 mA for driver class E
Input/Output leakage current			0.7	µA	0.2 V < V_{IN} < 1.93 V
Pull-up input current			-240	µA	PU Class a
			-150	µA	PU Class b
			-125	µA	PU Class c
Pull-down input current			+200	µA	PD Class a
			+150	µA	PD Class b
			+45	µA	PD Class c

Table 19: Generic Digital Interfaces pin characteristics (GDI domain)

4.2.9.1 AC characteristics of the digital audio interfaces pins

The 4-wire I2S digital audio interfaces can be configured in 4 different modes:

- Normal I2S mode – Master mode
- Normal I2S mode – Slave mode
- PCM mode – Master mode
- PCM mode – Slave mode

The AC characteristics of the 4 different modes of the I2S digital audio interfaces are detailed below.

Normal I2S mode – Master mode

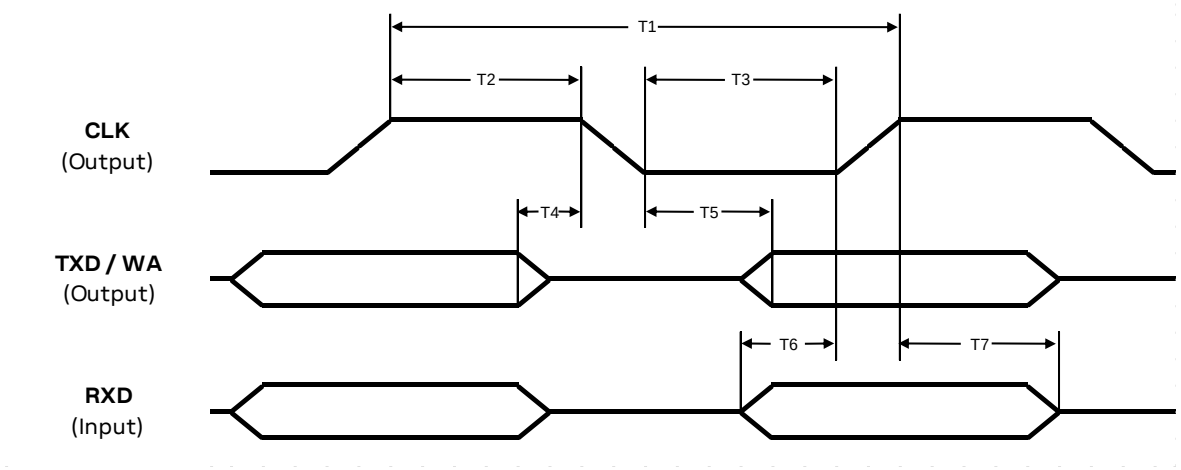

Figure 5: AC characteristics of digital audio interface in Normal I2S mode (<I2S_mode> = 2,4,6,8,10,12), Master mode enabled

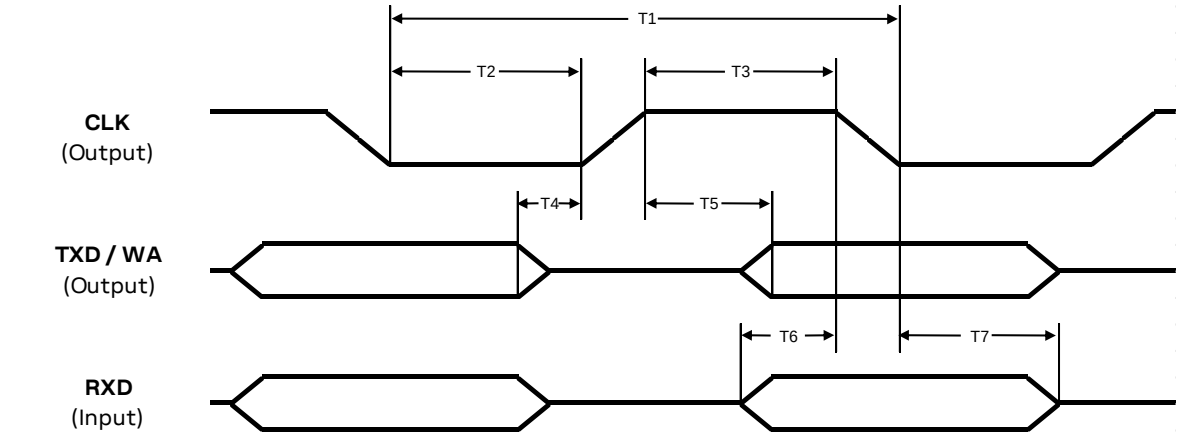

Figure 6: AC characteristics of digital audio interface in Normal I2S mode (<I2S_mode> = 3,5,7,9,11,13), Master mode enabled

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
T1	I2S clock period	3.902	3.906		µs	<I2S_sample_rate>=0
		2.830	2.834		µs	<I2S_sample_rate>=1
		2.600	2.604		µs	<I2S_sample_rate>=2
		1.949	1.953		µs	<I2S_sample_rate>=3
		1.413	1.417		µs	<I2S_sample_rate>=4
		1.298	1.302		µs	<I2S_sample_rate>=5
		0.973	0.977		µs	<I2S_sample_rate>=6
		0.705	0.709		µs	<I2S_sample_rate>=7
		0.647	0.651		µs	<I2S_sample_rate>=8
1/T1	I2S clock frequency		256.0	256.3	kHz	<I2S_sample_rate>=0
			352.8	353.3	kHz	<I2S_sample_rate>=1
			384.0	384.6	kHz	<I2S_sample_rate>=2
			512.0	513.1	kHz	<I2S_sample_rate>=3
			705.6	707.6	kHz	<I2S_sample_rate>=4
			768.0	770.4	kHz	<I2S_sample_rate>=5
			1024	1028	kHz	<I2S_sample_rate>=6
			1411	1419	kHz	<I2S_sample_rate>=7
			1536	1545	kHz	<I2S_sample_rate>=8

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
T2	I2S clock high time	1.933	1.953		µs	<I2S_sample_rate>=0
		1.397	1.417		µs	<I2S_sample_rate>=1
		1.282	1.302		µs	<I2S_sample_rate>=2
		0.957	0.977		µs	<I2S_sample_rate>=3
		0.689	0.709		µs	<I2S_sample_rate>=4
		0.631	0.651		µs	<I2S_sample_rate>=5
		0.468	0.488		µs	<I2S_sample_rate>=6
		0.334	0.354		µs	<I2S_sample_rate>=7
		0.306	0.326		µs	<I2S_sample_rate>=8
T3	I2S clock low time	1.933	1.953		µs	<I2S_sample_rate>=0
		1.397	1.417		µs	<I2S_sample_rate>=1
		1.282	1.302		µs	<I2S_sample_rate>=2
		0.957	0.977		µs	<I2S_sample_rate>=3
		0.689	0.709		µs	<I2S_sample_rate>=4
		0.631	0.651		µs	<I2S_sample_rate>=5
		0.468	0.488		µs	<I2S_sample_rate>=6
		0.334	0.354		µs	<I2S_sample_rate>=7
		0.306	0.326		µs	<I2S_sample_rate>=8
	I2S word alignment period		125.0		µs	<I2S_sample_rate>=0
			90.70		µs	<I2S_sample_rate>=1
			83.33		µs	<I2S_sample_rate>=2
			62.50		µs	<I2S_sample_rate>=3
			45.35		µs	<I2S_sample_rate>=4
			41.67		µs	<I2S_sample_rate>=5
			31.25		µs	<I2S_sample_rate>=6
			22.68		µs	<I2S_sample_rate>=7
			20.83		µs	<I2S_sample_rate>=8
	I2S word alignment frequency		8.000		kHz	<I2S_sample_rate>=0
			11.03		kHz	<I2S_sample_rate>=1
			12.00		kHz	<I2S_sample_rate>=2
			16.00		kHz	<I2S_sample_rate>=3
			22.05		kHz	<I2S_sample_rate>=4
			24.00		kHz	<I2S_sample_rate>=5
			32.00		kHz	<I2S_sample_rate>=6
			44.10		kHz	<I2S_sample_rate>=7
			48.00		kHz	<I2S_sample_rate>=8
T4	I2S TXD invalid before I2S CLK high end (before shifting edge of I2S CLK)			24	ns	<I2S_mode> = 2,4,6,8,10,12
	I2S TXD invalid before I2S CLK low end (before shifting edge of I2S CLK)			24	ns	<I2S_mode> = 3,5,7,9,11,13
T5	I2S TXD valid after I2S CLK low begin (after shifting edge of I2S CLK)			32	ns	<I2S_mode> = 2,4,6,8,10,12
	I2S TXD valid after I2S CLK high begin (after shifting edge of I2S CLK)			32	ns	<I2S_mode> = 3,5,7,9,11,13
T6	I2S RXD setup time before I2S CLK low end (before latching edge of I2S CLK)	60			ns	<I2S_mode> = 2,4,6,8,10,12
	I2S RXD setup time before I2S CLK high end (before latching edge of I2S CLK)	60			ns	<I2S_mode> = 3,5,7,9,11,13
T7	I2S RXD hold time after I2S CLK high begin (after latching edge of I2S CLK)	10			ns	<I2S_mode> = 2,4,6,8,10,12
	I2S RXD hold time after I2S CLK low begin (after latching edge of I2S CLK)	10			ns	<I2S_mode> = 3,5,7,9,11,13

Table 20: AC characteristics of digital audio interface in Normal I2S mode and Master mode enabled

Normal I2S mode – Slave mode

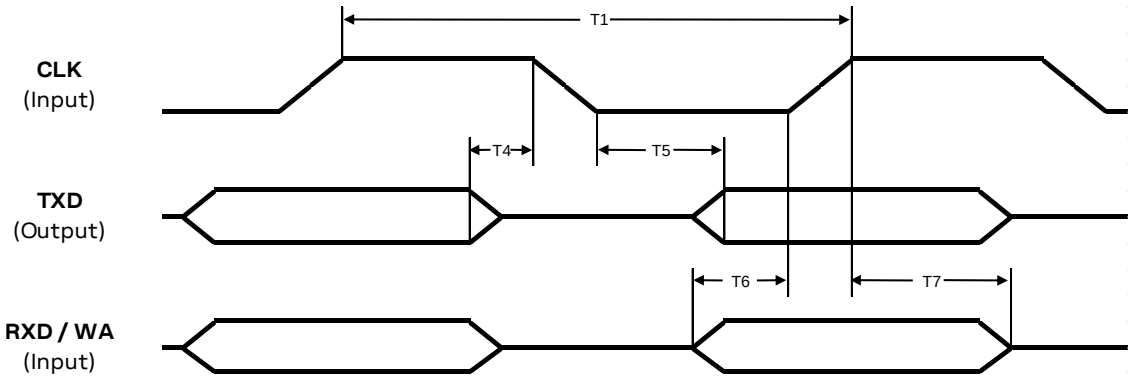

Figure 7: AC characteristics of digital audio interface in Normal I2S mode (<I2S_mode> = 2,4,6,8,10,12), Slave mode enabled

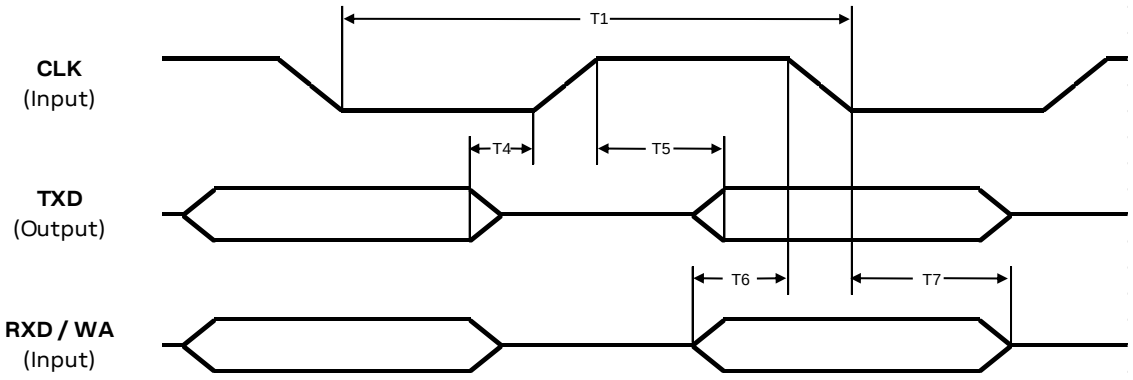

Figure 8: AC characteristics of digital audio interface in Normal I2S mode (<I2S_mode> = 3,5,7,9,11,13), Slave mode enabled

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
T1	I2S clock period	3.906			µs	<I2S_sample_rate>=0
		2.834			µs	<I2S_sample_rate>=1
		2.604			µs	<I2S_sample_rate>=2
		1.953			µs	<I2S_sample_rate>=3
		1.417			µs	<I2S_sample_rate>=4
		1.302			µs	<I2S_sample_rate>=5
		0.977			µs	<I2S_sample_rate>=6
		0.709			µs	<I2S_sample_rate>=7
		0.651			µs	<I2S_sample_rate>=8
1/T1	I2S clock frequency			256.0	kHz	<I2S_sample_rate>=0
				352.8	kHz	<I2S_sample_rate>=1
				384.0	kHz	<I2S_sample_rate>=2
				512.0	kHz	<I2S_sample_rate>=3
				705.6	kHz	<I2S_sample_rate>=4
				768.0	kHz	<I2S_sample_rate>=5
				1024	kHz	<I2S_sample_rate>=6
				1411	kHz	<I2S_sample_rate>=7
				1536	kHz	<I2S_sample_rate>=8

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
	I2S word alignment period	125.0			µs	<I2S_sample_rate>=0
		90.70			µs	<I2S_sample_rate>=1
		83.33			µs	<I2S_sample_rate>=2
		62.50			µs	<I2S_sample_rate>=3
		45.35			µs	<I2S_sample_rate>=4
		41.67			µs	<I2S_sample_rate>=5
		31.25			µs	<I2S_sample_rate>=6
		22.68			µs	<I2S_sample_rate>=7
		20.83			µs	<I2S_sample_rate>=8
	I2S word alignment frequency			8.000	kHz	<I2S_sample_rate>=0
				11.03	kHz	<I2S_sample_rate>=1
				12.00	kHz	<I2S_sample_rate>=2
				16.00	kHz	<I2S_sample_rate>=3
				22.05	kHz	<I2S_sample_rate>=4
				24.00	kHz	<I2S_sample_rate>=5
				32.00	kHz	<I2S_sample_rate>=6
				44.10	kHz	<I2S_sample_rate>=7
				48.00	kHz	<I2S_sample_rate>=8
T4	I2S TXD invalid before I2S CLK falling edge (before shifting edge of I2S CLK)			24	ns	<I2S_mode> = 2,4,6,8,10,12
	I2S TXD invalid before I2S CLK rising edge (before shifting edge of I2S CLK)			24	ns	<I2S_mode> = 3,5,7,9,11,13
T5	I2S TXD valid after I2S CLK falling edge (after shifting edge of I2S CLK)			32	ns	<I2S_mode> = 2,4,6,8,10,12
	I2S TXD valid after I2S CLK rising edge (after shifting edge of I2S CLK)			32	ns	<I2S_mode> = 3,5,7,9,11,13
T6	I2S RXD setup time before I2S CLK rising edge (before latching edge of I2S CLK)	60			ns	<I2S_mode> = 2,4,6,8,10,12
	I2S RXD setup time before I2S CLK falling edge (before latching edge of I2S CLK)	60			ns	<I2S_mode> = 3,5,7,9,11,13
T7	I2S RXD hold time after I2S CLK rising edge (after latching edge of I2S CLK)	10			ns	<I2S_mode> = 2,4,6,8,10,12
	I2S RXD hold time after I2S CLK falling edge (after latching edge of I2S CLK)	10			ns	<I2S_mode> = 3,5,7,9,11,13

Table 21: AC characteristics of digital audio interface in Normal I2S mode and Slave mode enabled

PCM mode – Master mode

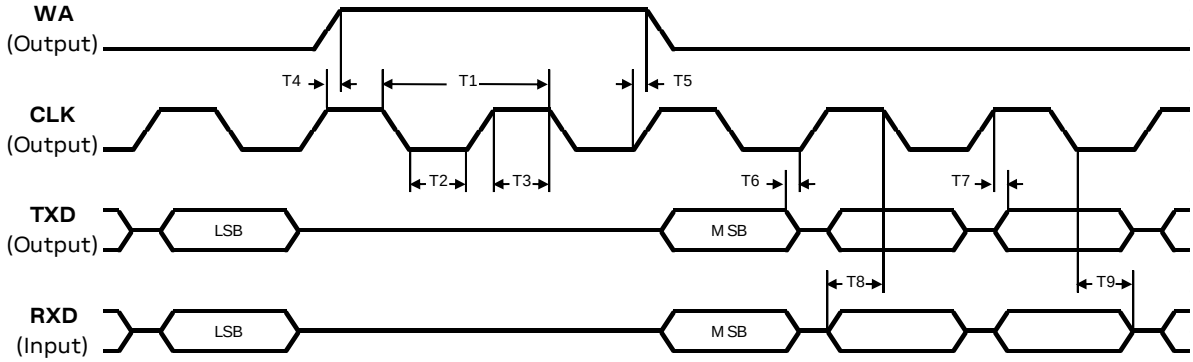

Figure 9: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 0) and Master mode enabled

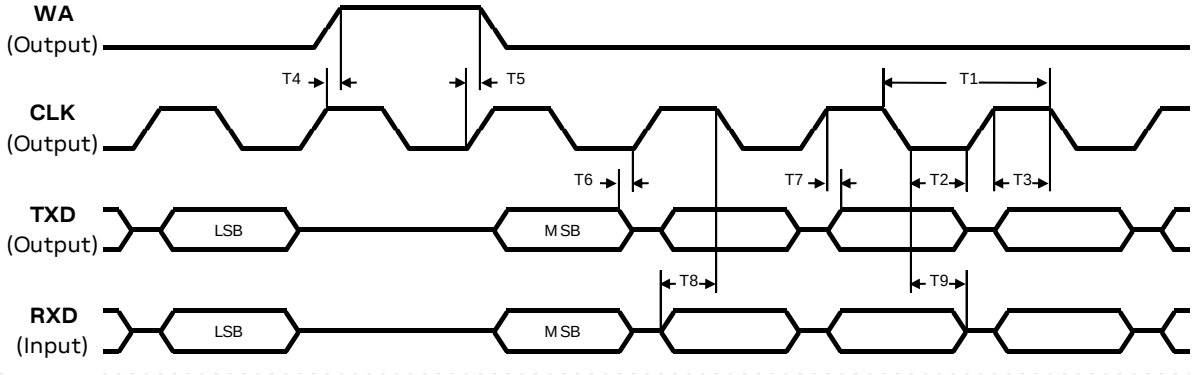

Figure 10: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 1) and Master mode enabled

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
T1	I2S clock period	6.940	6.944		µs	<I2S_mode>=0, <I2S_sample_rate>=0
		7.349	7.353		µs	<I2S_mode>=1, <I2S_sample_rate>=0
		5.035	5.039		µs	<I2S_mode>=0, <I2S_sample_rate>=1
		5.331	5.335		µs	<I2S_mode>=1, <I2S_sample_rate>=1
		4.626	4.630		µs	<I2S_mode>=0, <I2S_sample_rate>=2
		4.898	4.902		µs	<I2S_mode>=1, <I2S_sample_rate>=2
		3.468	3.472		µs	<I2S_mode>=0, <I2S_sample_rate>=3
		3.672	3.676		µs	<I2S_mode>=1, <I2S_sample_rate>=3
		2.516	2.520		µs	<I2S_mode>=0, <I2S_sample_rate>=4
		2.664	2.668		µs	<I2S_mode>=1, <I2S_sample_rate>=4
		2.311	2.315		µs	<I2S_mode>=0, <I2S_sample_rate>=5
		2.447	2.451		µs	<I2S_mode>=1, <I2S_sample_rate>=5
		1.732	1.736		µs	<I2S_mode>=0, <I2S_sample_rate>=6
		1.834	1.838		µs	<I2S_mode>=1, <I2S_sample_rate>=6
		1.256	1.260		µs	<I2S_mode>=0, <I2S_sample_rate>=7
		1.330	1.334		µs	<I2S_mode>=1, <I2S_sample_rate>=7
		1.153	1.157		µs	<I2S_mode>=0, <I2S_sample_rate>=8
		1.221	1.225		µs	<I2S_mode>=1, <I2S_sample_rate>=8

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
1/T1	I2S clock frequency		144.0	144.1	kHz	<I2S_mode>=0, <I2S_sample_rate>=0
			136.0	136.1	kHz	<I2S_mode>=1, <I2S_sample_rate>=0
			198.5	198.6	kHz	<I2S_mode>=0, <I2S_sample_rate>=1
			187.4	187.6	kHz	<I2S_mode>=1, <I2S_sample_rate>=1
			216.0	216.2	kHz	<I2S_mode>=0, <I2S_sample_rate>=2
			204.0	204.2	kHz	<I2S_mode>=1, <I2S_sample_rate>=2
			288.0	288.3	kHz	<I2S_mode>=0, <I2S_sample_rate>=3
			272.0	272.3	kHz	<I2S_mode>=1, <I2S_sample_rate>=3
			396.9	397.5	kHz	<I2S_mode>=0, <I2S_sample_rate>=4
			374.9	375.4	kHz	<I2S_mode>=1, <I2S_sample_rate>=4
			432.0	432.7	kHz	<I2S_mode>=0, <I2S_sample_rate>=5
			408.0	408.7	kHz	<I2S_mode>=1, <I2S_sample_rate>=5
			576.0	577.3	kHz	<I2S_mode>=0, <I2S_sample_rate>=6
			544.0	545.2	kHz	<I2S_mode>=1, <I2S_sample_rate>=6
			793.8	796.3	kHz	<I2S_mode>=0, <I2S_sample_rate>=7
			749.7	752.0	kHz	<I2S_mode>=1, <I2S_sample_rate>=7
			864.0	867.0	kHz	<I2S_mode>=0, <I2S_sample_rate>=8
			816.0	818.7	kHz	<I2S_mode>=1, <I2S_sample_rate>=8
T2	I2S clock low time	3.452	3.472		µs	<I2S_mode>=0, <I2S_sample_rate>=0
		3.656	3.676		µs	<I2S_mode>=1, <I2S_sample_rate>=0
		2.500	2.520		µs	<I2S_mode>=0, <I2S_sample_rate>=1
		2.648	2.668		µs	<I2S_mode>=1, <I2S_sample_rate>=1
		2.295	2.315		µs	<I2S_mode>=0, <I2S_sample_rate>=2
		2.431	2.451		µs	<I2S_mode>=1, <I2S_sample_rate>=2
		1.716	1.736		µs	<I2S_mode>=0, <I2S_sample_rate>=3
		1.818	1.838		µs	<I2S_mode>=1, <I2S_sample_rate>=3
		1.240	1.260		µs	<I2S_mode>=0, <I2S_sample_rate>=4
		1.314	1.334		µs	<I2S_mode>=1, <I2S_sample_rate>=4
		1.137	1.157		µs	<I2S_mode>=0, <I2S_sample_rate>=5
		1.205	1.225		µs	<I2S_mode>=1, <I2S_sample_rate>=5
		0.848	0.868		µs	<I2S_mode>=0, <I2S_sample_rate>=6
		0.899	0.919		µs	<I2S_mode>=1, <I2S_sample_rate>=6
		0.610	0.630		µs	<I2S_mode>=0, <I2S_sample_rate>=7
		0.647	0.667		µs	<I2S_mode>=1, <I2S_sample_rate>=7
		0.559	0.579		µs	<I2S_mode>=0, <I2S_sample_rate>=8
		0.593	0.613		µs	<I2S_mode>=1, <I2S_sample_rate>=8
T3	I2S clock high time	3.452	3.472		µs	<I2S_mode>=0, <I2S_sample_rate>=0
		3.656	3.676		µs	<I2S_mode>=1, <I2S_sample_rate>=0
		2.500	2.520		µs	<I2S_mode>=0, <I2S_sample_rate>=1
		2.648	2.668		µs	<I2S_mode>=1, <I2S_sample_rate>=1
		2.295	2.315		µs	<I2S_mode>=0, <I2S_sample_rate>=2
		2.431	2.451		µs	<I2S_mode>=1, <I2S_sample_rate>=2
		1.716	1.736		µs	<I2S_mode>=0, <I2S_sample_rate>=3
		1.818	1.838		µs	<I2S_mode>=1, <I2S_sample_rate>=3
		1.240	1.260		µs	<I2S_mode>=0, <I2S_sample_rate>=4
		1.314	1.334		µs	<I2S_mode>=1, <I2S_sample_rate>=4
		1.137	1.157		µs	<I2S_mode>=0, <I2S_sample_rate>=5
		1.205	1.225		µs	<I2S_mode>=1, <I2S_sample_rate>=5
		0.848	0.868		µs	<I2S_mode>=0, <I2S_sample_rate>=6
		0.899	0.919		µs	<I2S_mode>=1, <I2S_sample_rate>=6
		0.610	0.630		µs	<I2S_mode>=0, <I2S_sample_rate>=7
		0.647	0.667		µs	<I2S_mode>=1, <I2S_sample_rate>=7

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
		0.559	0.579		µs	<I2S_mode>=0, <I2S_sample_rate>=8
		0.593	0.613		µs	<I2S_mode>=1, <I2S_sample_rate>=8
	I2S word alignment period		125.0		µs	<I2S_sample_rate>=0
			90.70		µs	<I2S_sample_rate>=1
			83.33		µs	<I2S_sample_rate>=2
			62.50		µs	<I2S_sample_rate>=3
			45.35		µs	<I2S_sample_rate>=4
			41.67		µs	<I2S_sample_rate>=5
			31.25		µs	<I2S_sample_rate>=6
			22.68		µs	<I2S_sample_rate>=7
			20.83		µs	<I2S_sample_rate>=8
	I2S word alignment frequency		8.000		kHz	<I2S_sample_rate>=0
			11.03		kHz	<I2S_sample_rate>=1
			12.00		kHz	<I2S_sample_rate>=2
			16.00		kHz	<I2S_sample_rate>=3
			22.05		kHz	<I2S_sample_rate>=4
			24.00		kHz	<I2S_sample_rate>=5
			32.00		kHz	<I2S_sample_rate>=6
			44.10		kHz	<I2S_sample_rate>=7
			48.00		kHz	<I2S_sample_rate>=8
T4	I2S CLK high begin to I2S WA high begin	-24		32	ns	<I2S_mode> = 0
T5	I2S CLK low end to I2S WA high end	-24		32	ns	<I2S_mode> = 0
T6	I2S TXD invalid before I2S CLK low end			24	ns	<I2S_mode> = 0
T7	I2S TXD valid after I2S CLK high begin			22	ns	<I2S_mode> = 0
T8	I2S RXD setup time before I2S CLK high end	60			ns	<I2S_mode> = 0
T9	I2S RXD hold time after I2S CLK low begin	12			ns	<I2S_mode> = 0

Table 22: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 0,1) and Master mode enabled

PCM mode – Slave mode

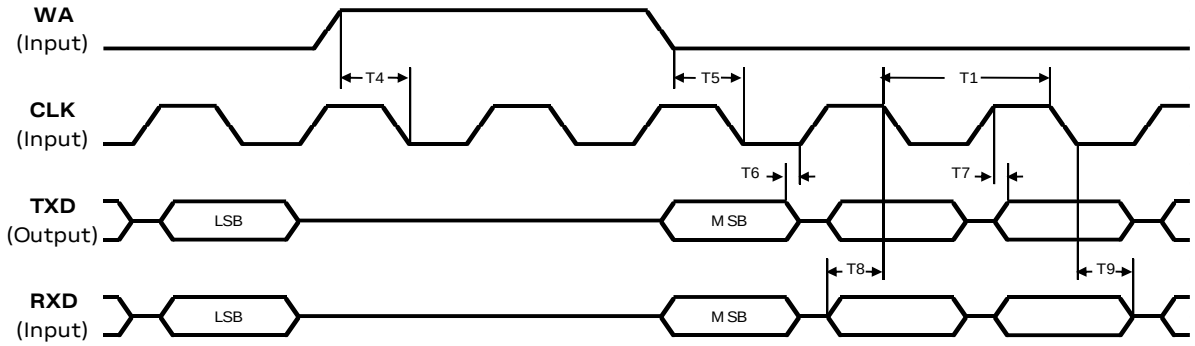

Figure 11: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 0) and Slave mode enabled

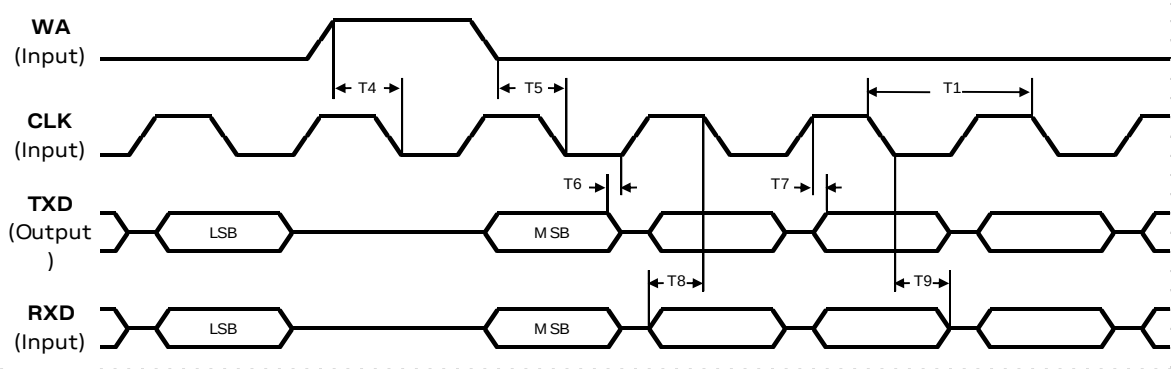

Figure 12: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 1) and Slave mode enabled

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
T1	I2S clock period	6.944			µs	<I2S_mode>=0, <I2S_sample_rate>=0
		7.353			µs	<I2S_mode>=1, <I2S_sample_rate>=0
		5.039			µs	<I2S_mode>=0, <I2S_sample_rate>=1
		5.335			µs	<I2S_mode>=1, <I2S_sample_rate>=1
		4.630			µs	<I2S_mode>=0, <I2S_sample_rate>=2
		4.902			µs	<I2S_mode>=1, <I2S_sample_rate>=2
		3.472			µs	<I2S_mode>=0, <I2S_sample_rate>=3
		3.676			µs	<I2S_mode>=1, <I2S_sample_rate>=3
		2.520			µs	<I2S_mode>=0, <I2S_sample_rate>=4
		2.668			µs	<I2S_mode>=1, <I2S_sample_rate>=4
		2.315			µs	<I2S_mode>=0, <I2S_sample_rate>=5
		2.451			µs	<I2S_mode>=1, <I2S_sample_rate>=5
		1.736			µs	<I2S_mode>=0, <I2S_sample_rate>=6
		1.838			µs	<I2S_mode>=1, <I2S_sample_rate>=6
		1.260			µs	<I2S_mode>=0, <I2S_sample_rate>=7
		1.334			µs	<I2S_mode>=1, <I2S_sample_rate>=7
		1.157			µs	<I2S_mode>=0, <I2S_sample_rate>=8
		1.225			µs	<I2S_mode>=1, <I2S_sample_rate>=8

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
1/T1	I2S clock frequency	144.0			kHz	<I2S_mode>=0, <I2S_sample_rate>=0
		136.0			kHz	<I2S_mode>=1, <I2S_sample_rate>=0
		198.5			kHz	<I2S_mode>=0, <I2S_sample_rate>=1
		187.4			kHz	<I2S_mode>=1, <I2S_sample_rate>=1
		216.0			kHz	<I2S_mode>=0, <I2S_sample_rate>=2
		204.0			kHz	<I2S_mode>=1, <I2S_sample_rate>=2
		288.0			kHz	<I2S_mode>=0, <I2S_sample_rate>=3
		272.0			kHz	<I2S_mode>=1, <I2S_sample_rate>=3
		396.9			kHz	<I2S_mode>=0, <I2S_sample_rate>=4
		374.9			kHz	<I2S_mode>=1, <I2S_sample_rate>=4
		432.0			kHz	<I2S_mode>=0, <I2S_sample_rate>=5
		408.0			kHz	<I2S_mode>=1, <I2S_sample_rate>=5
		576.0			kHz	<I2S_mode>=0, <I2S_sample_rate>=6
		544.0			kHz	<I2S_mode>=1, <I2S_sample_rate>=6
		793.8			kHz	<I2S_mode>=0, <I2S_sample_rate>=7
		749.7			kHz	<I2S_mode>=1, <I2S_sample_rate>=7
		864.0			kHz	<I2S_mode>=0, <I2S_sample_rate>=8
		816.0			kHz	<I2S_mode>=1, <I2S_sample_rate>=8
	I2S word alignment period		125.0		µs	<I2S_sample_rate>=0
			90.70		µs	<I2S_sample_rate>=1
			83.33		µs	<I2S_sample_rate>=2
			62.50		µs	<I2S_sample_rate>=3
			45.35		µs	<I2S_sample_rate>=4
			41.67		µs	<I2S_sample_rate>=5
			31.25		µs	<I2S_sample_rate>=6
			22.68		µs	<I2S_sample_rate>=7
			20.83		µs	<I2S_sample_rate>=8
	I2S word alignment frequency		8.000		kHz	<I2S_sample_rate>=0
			11.03		kHz	<I2S_sample_rate>=1
			12.00		kHz	<I2S_sample_rate>=2
			16.00		kHz	<I2S_sample_rate>=3
			22.05		kHz	<I2S_sample_rate>=4
			24.00		kHz	<I2S_sample_rate>=5
			32.00		kHz	<I2S_sample_rate>=6
			44.10		kHz	<I2S_sample_rate>=7
			48.00		kHz	<I2S_sample_rate>=8
T4	WA high begin before CLK low begin (latching edge of CLK)	36			ns	<I2S_mode> = 0
T5	WA low begin before CLK low begin (latching edge of CLK)	36			ns	<I2S_mode> = 0
T6	TXD invalid before CLK rising edge (shifting edge of CLK)			12	ns	<I2S_mode> = 0
T7	TXD valid after CLK rising edge (shifting edge of CLK)			79	ns	<I2S_mode> = 0
T8	RXD setup time before CLK fall edge (latching edge of CLK)	22			ns	<I2S_mode> = 0
T9	RXD hold time after CLK falling edge (latching edge of CLK)	24			ns	<I2S_mode> = 0

Table 23: AC characteristics of digital audio interface in PCM mode (<I2S_mode> = 0,1) and Slave mode enabled

4.2.9.2 AC characteristics of the Digital Clock Output pin

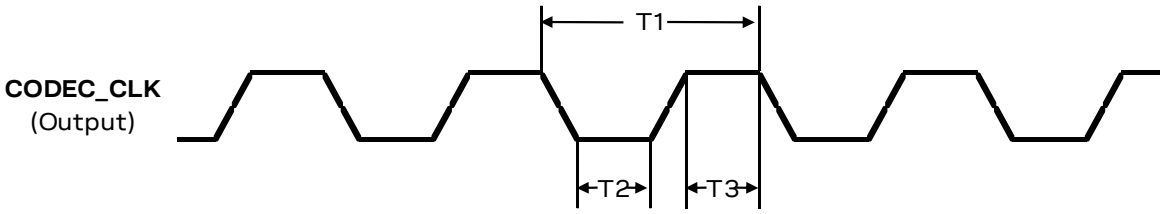

Figure 13: AC characteristics of CODEC_CLK digital clock output

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
T1	CODEC_CLK clock period		38		ns	CODEC_CLK output set to 26 MHz
			77		ns	CODEC_CLK output set to 13 MHz
1/T1	CODEC_CLK clock frequency		26		MHz	CODEC_CLK output set to 26 MHz
			13		MHz	CODEC_CLK output set to 13 MHz
T2	CODEC_CLK clock low time	10			ns	CODEC_CLK output set to 26 MHz
		26			ns	CODEC_CLK output set to 13 MHz
T3	CODEC_CLK clock high time	10			ns	CODEC_CLK output set to 26 MHz
		26			ns	CODEC_CLK output set to 13 MHz

Table 24: AC characteristics of CODEC_CLK digital clock output

4.2.9.3 AC characteristics of the SPI / IPC pins

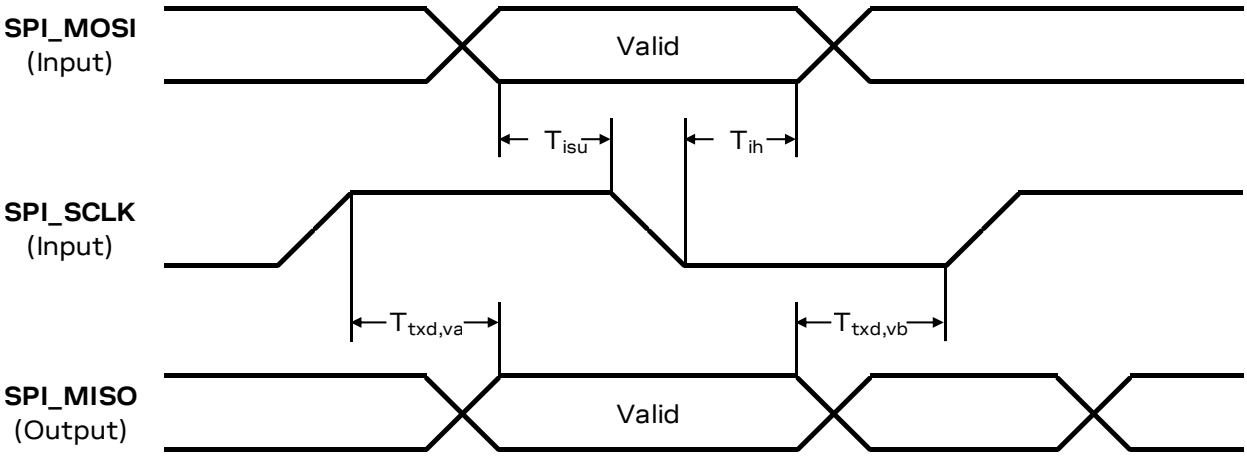

Figure 14: SPI_MOSI, SPI_MISO, SPI_SCLK timings

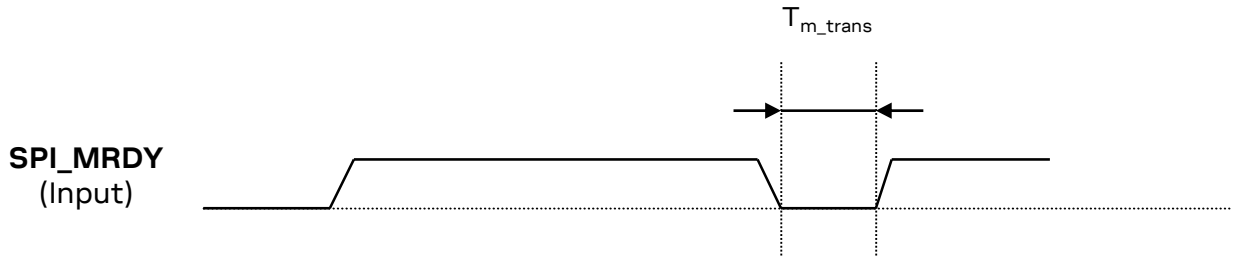

Figure 15: SPI_MRDY transition

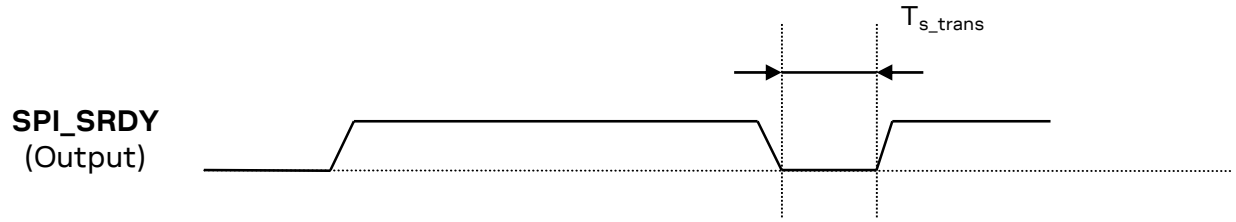

Figure 16: SPI_SRDY transition

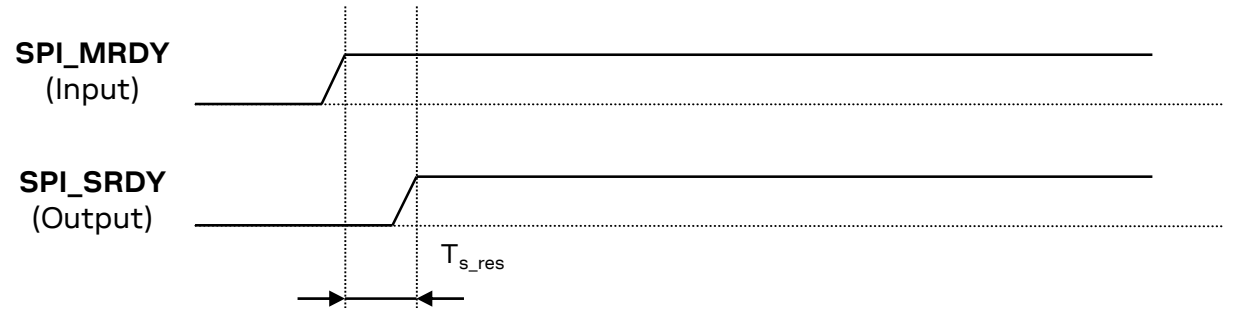

Figure 17: SPI_SRDY response

Parameter	Description	Min.	Typ.	Max.	Unit	Remarks
	SPI_SCLK frequency	0.26		26.0	MHz	
	SPI_SCLK period	38.5		3846.2	ns	
T_{isu}	Receive data setup time	5			ns	
T_{ih}	Receive data hold time	5			ns	
$T_{txd,va}$	Transmit data valid after clock rising edge			13	ns	
$T_{txd,vb}$	Transmit data valid before clock rising edge			0	ns	
T_{m_trans}	Time between two master data transfers	80			ns	Power saving disabled by AT+UPSV
		62			µs	Power saving enabled by AT+UPSV
T_{s_trans}	Time between two slave data transfers	80			ns	
T_{s_res}	SPI_SRDY active after SPI_MRDY active			200	µs	Power saving disabled by AT+UPSV
				10	ms	Power saving enabled by AT+UPSV

Table 25: AC characteristics of SPI interface

4.2.10 USB pins

USB data lines (**USB_D+** and **USB_D-**) are compliant to the USB 2.0 high-speed specification. See the Universal Serial Bus Revision 2.0 specification [12] for the detailed electrical characteristics.

Parameter	Min.	Typ.	Max.	Unit	Remarks
USB detection voltage on pin VUSB_DET	4.40	5.00	5.25	V	
Current sink at VUSB_DET		30		µA	
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 26: USB pin characteristics

4.2.11 DDC (I2C) pins

DDC (I2C) lines (**SCL** and **SDA**) are compliant to the I2C-bus standard mode specification. See the I2C-bus specification [13] for the detailed electrical characteristics.

Parameter	Min.	Typ.	Max.	Unit	Remarks
Internal supply for DDC domain	1.73	1.80	1.87	V	Digital I/O Interfaces supply (V_INT)
L-level input	-0.20		0.35	V	
H-level input	1.31		1.93	V	
L-level output		0.00	0.35	V	Max value at I_{OL} = +1.0 mA
Input/Output leakage current			0.7	µA	0.2 V < V_{IN} < 1.93 V
Clock frequency on SCL		100		kHz	

Table 27: DDC (I2C) pin characteristics (DDC domain)

4.3 Parameters for ATEX applications

This section provides useful parameters and information to integrate LISA-U2 series modules in applications intended for use in areas with potentially explosive atmospheres (ATEX), describing:

- Total internal capacitance and inductance of LISA-U2 series modules (see Table 28)
- Maximum RF output power at the RF output pin of LISA-U2 series modules (see Table 29)

☞ Any specific applicable requirement for the implementation of the apparatus integrating LISA-U2 series 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 the IEC 60079-0 [20], IEC 60079-11 [21], IEC 60079-26 [22] standards.

☞ The certification of the application device that integrates a LISA-U2 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 11 describes the maximum total internal capacitance and the maximum total internal inductance, considering internal parts tolerance, provided by LISA-U2 series modules.

Module	Parameter	Description	Value	Unit
LISA-U200	Ci	Maximum total internal capacitance	174.4	µF
	Li	Maximum total internal inductance	26.3	µH
LISA-U230, LISA-U260, LISA-U270	Ci	Maximum total internal capacitance	167.4	µF
	Li	Maximum total internal inductance	26.3	µH
LISA-U201	Ci	Maximum total internal capacitance	175.8	µF
	Li	Maximum total internal inductance	9.4	µH

Table 28: LISA-U2 series maximum total internal capacitance and maximum total internal inductance

Table 29 describes the maximum RF output power transmitted by LISA-U2 series modules from the RF antenna pin (**ANT**) as Power Class 4 Mobile Stations for GSM 850 / E-GSM 900 bands.

Module	Parameter	Description	Value	Unit
LISA-U2 series	ANT Pout	Maximum RF output power from ANT pin	35.0	dBm

Table 29: LISA-U2 series antenna pin (ANT) maximum RF output power

☞ LISA-U2 series modules do not contain internal blocks that increase the input voltage (e.g. like step-up, duplicators, boosters, etc.) except for the RF antenna pin (**ANT**), for which the maximum RF output power is illustrated in Table 29.

5 Mechanical specifications

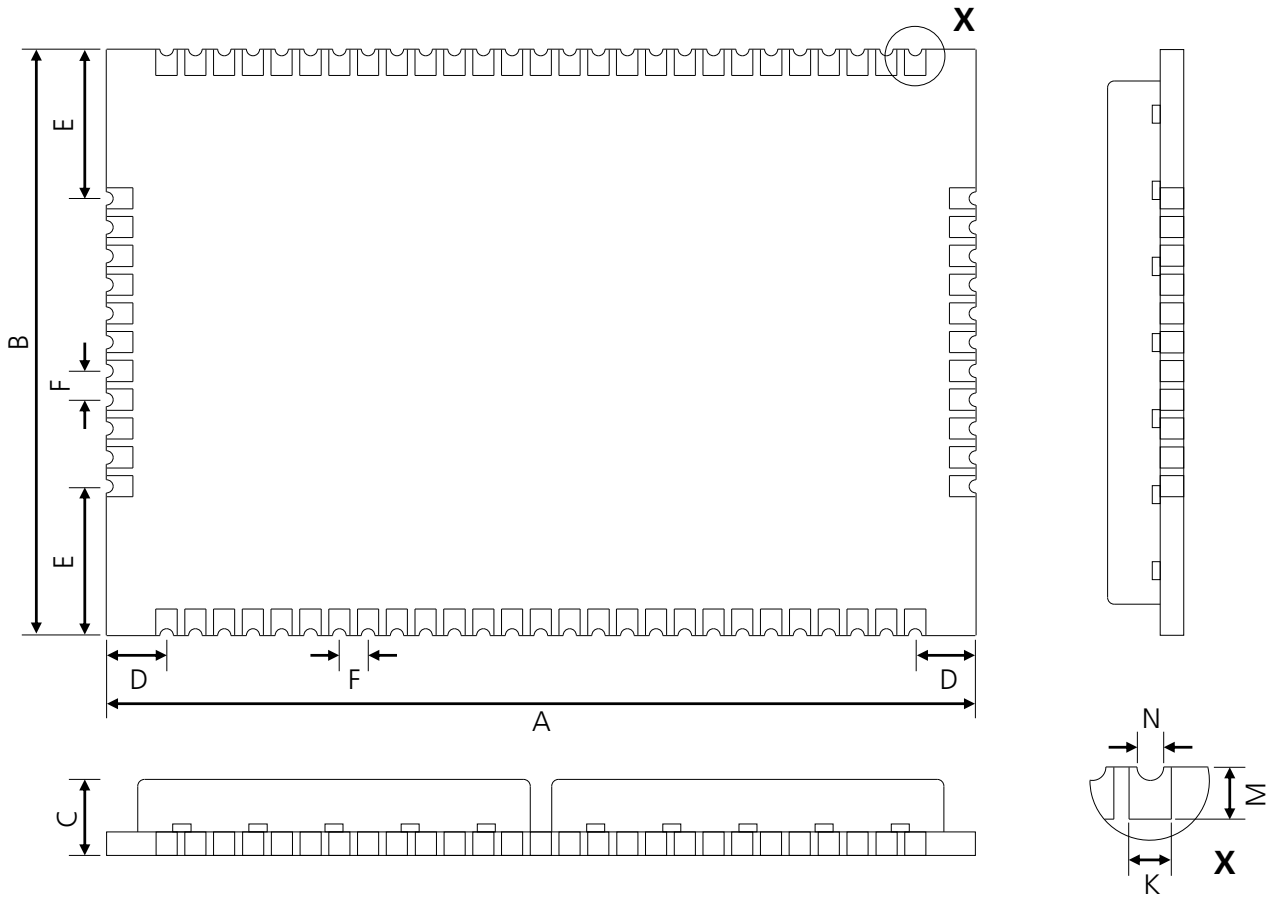

Figure 18: Dimensions (LISA-U2 series bottom and side views)

Parameter	Description	Typical		Tolerance	
A	Module Height [mm]	33.2	(1307.1 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
B	Module Width [mm]	22.4	(881.9 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
C	Module Total Thickness [mm]	2.6	(102.4 mil)	+0.27/-0.17	(+10.6/-6.7 mil)
D	Horizontal Edge to Pin Pitch [mm]	2.3	(90.6 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
E	Vertical Edge to Pin Pitch [mm]	5.7	(224.4 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
F	Pin to Pin Pitch [mm]	1.1	(43.3 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
K	Pad width [mm]	0.8	(31.5 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
M	Pad height [mm]	1.0	(39.4 mil)	+0.10/-0.10	(+3.9/-3.9 mil)
N	Pad half-moon diameter [mm]	0.5	(19.7 mil)	+0.10/-0.10	(+3.9/-3.9 mil)
Weight	Module Weight [g]	< 5			

Note: the values in mil have been calculated from the corresponding values in mm.

Table 30: Dimensions

☞ Module height tolerance +/–0.20 mm may be exceeded close to the corners of the PCB due to the cutting process: in the worst case, the height could be +0.40 mm longer than the typical value.

☞ For information regarding the Footprint and Paste Mask recommended for the application board, see the LISA-U2 series system integration manual [6].

6 Reliability tests and approvals

6.1 Reliability tests

Tests for product family qualifications are according to ISO 16750 “Road vehicles - Environmental conditions and testing for electrical and electronic equipment”, and appropriate standards.

6.2 Approvals

LISA-U2 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).

LISA-U2 series modules are RoHS 3 compliant.

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

Table 31 lists the LISA-U2 series main regulatory and mobile network operators’ approvals.

Directive / Standard / Regulatory	LISA-U200	LISA-U201	LISA-U230	LISA-U260	LISA-U270
CE (European Conformity)	•	•	•	•	•
FCC (US approval)	•	•	•	•	
FCC identification number	XPYLISAU200	XPYLISAU201	XPYLISAU230	XPYLISAU200	
ISED (Canadian approval) [25]	•	•	•	•	
IC certification number	8595A-LISAU200N	8595A-LISAU201	8595A-LISAU230N	8595A-LISAU200N	
RCM (Australian compliance)	•	•	•		
Giteki (Japanese approval)	•				•
NCC (Taiwanese approval)	•				•
KCC (Korean Certification)	•				•
ANATEL (Brazilian approval)	•	•			
ICASA (South African approval)	•				•
CCC (Chinese Certification)	•	•	•		•
NTC (Thailand approval)	•	•			
AT&T (Network Operator)	•	•	•	•	
NTT DoCoMo (Network Operator)	•				
SoftBank (Network Operator)					•
SKT (Network Operator)	•				
Telstra (Network Operator)	•				
Telecom NZ (Network Operator)	•				
Vodafone (Network Operator)	•		•		•
Vivo (Network Operator)	•				
Orange (Network Operator)	•				•
Bell Mobility (Network Operator)	•				
Rogers (Network Operator)	•		•	•	

Table 31: LISA-U2 series main regulatory and mobile network operators’ approvals

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

[25] Formerly known as IC (Industry Canada)

7 Product handling & soldering

7.1 Packaging

LISA-U2 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 [17].

Figure 19: Reeled LISA-U2 modules

7.1.1 Reels

LISA-U2 modules are deliverable in quantities of 150 pieces on a reel. LISA-U2 modules are delivered using reel type B as described in the u-blox package information user guide [17].

Parameter	Specification
Reel type	B
Delivery quantity	150

Table 32: Reel information for LISA-U2 modules

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

7.1.2 Tapes

Figure 20 shows the position and orientation of LISA-U2 modules as they are delivered on tape. The dimensions of the tapes are specified in Figure 21.

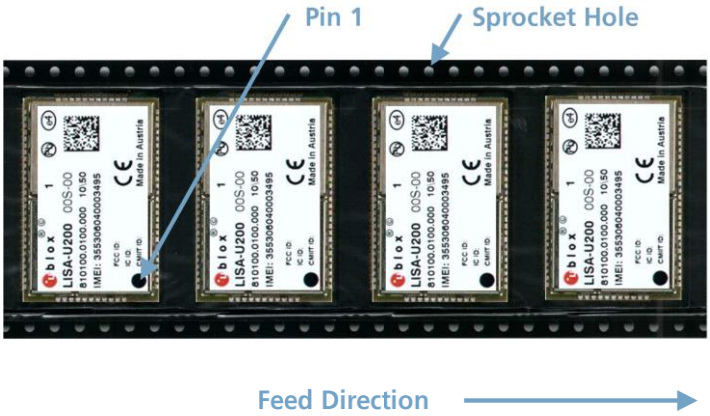

Figure 20: Orientation for the LISA-U2 modules on tape

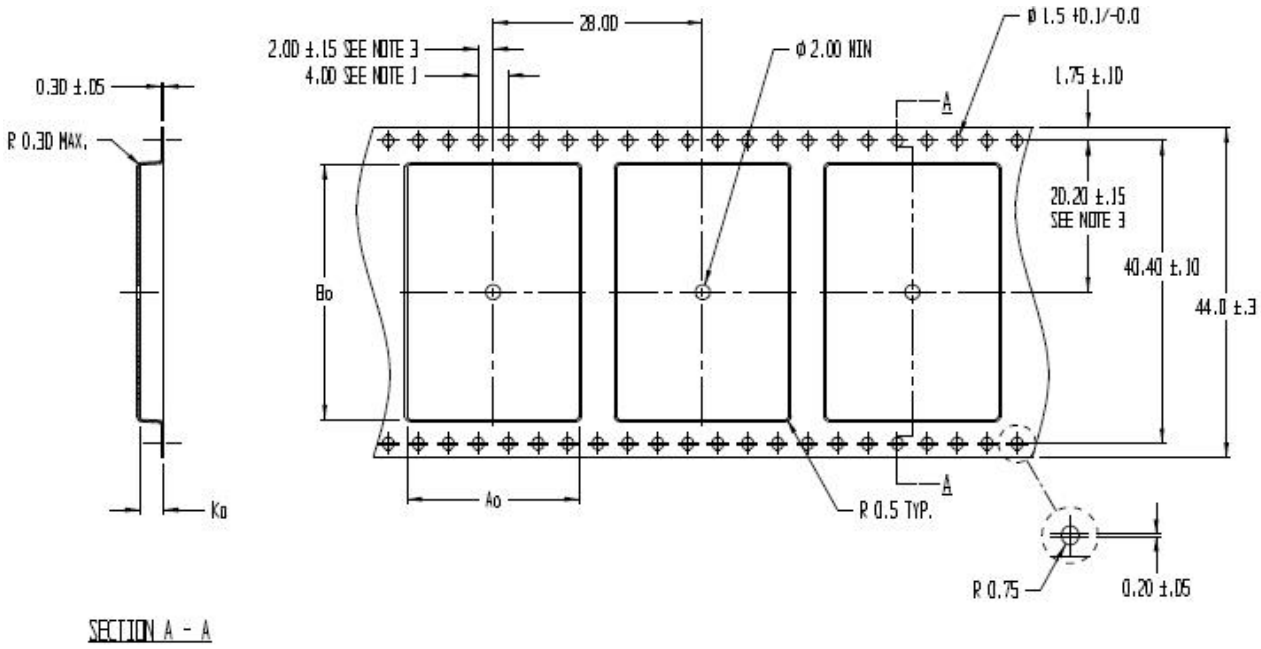

Figure 21: LISA-U2 series tape dimensions (mm)

Parameter	Value
A_0	23.0
B_0	34.0
K_0	3.2

Table 33: LISA-U2 series tape dimensions (mm)

- Note 1: 10 sprocket hole pitch cumulative tolerance ± 0.2.
- Note 2: the camber is compliant with EIA 481.
- Note 3: the pocket position relative to sprocket hole is measured as true position of pocket, not pocket hole.
- Note 4: A_0 and B_0 are calculated on a plane at a distance "R" above the bottom of the pocket.

7.2 Moisture Sensitivity Levels

⚠ LISA-U2 modules are Moisture Sensitive Devices (MSD) in accordance to the IPC/JEDEC specification.

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. LISA-U2 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 [17].

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

7.3 Reflow soldering

Reflow profiles are to be selected according to u-blox recommendations (see the LISA-U2 series system integration manual [6]).

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

7.4 ESD precautions

⚠ LISA-U2 modules contain highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Handling LISA-U2 modules without adequate ESD protection may destroy or damage them permanently.

LISA-U2 modules are Electrostatic Sensitive Devices (ESD) and require special ESD precautions typically applied to ESD sensitive components.

Table 8 details the maximum ESD ratings of the LISA-U2 module.

Adequate ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates the LISA-U2 module.

ESD precautions should be implemented on the application board where the module is mounted, as described in the LISA-U2 series system integration manual [6].

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

8 Default settings

Interface	AT Settings	Comments
UART interface	Enabled	Multiplexing mode can be enabled by AT+CMUX command providing following channels: • Channel 0: control channel • Channel 1 – 5: AT commands / data connection • Channel 6: GNSS tunneling • Channel 7: SAP (SIM Access Profile)
	AT+IPR=0	Autobauding enabled
	AT+ICF=3,1	Frame format: 8 bits, no parity, 1 stop bit Where AT+IPR=0 is the default value, the +ICF value in the profile is not applied (+IPR=0 overrules the +ICF setting) and the automatic frame detection is active.
	AT&K3	HW flow control enabled
	AT&S1	DSR line set ON in data mode and set OFF in command mode
	AT&D1	Upon an ON-to-OFF transition of DTR, the DCE enters online command state and issues an OK result code
	AT&C1	Circuit 109 changes in accordance with the Carrier detect status; ON if the Carrier is detected, OFF otherwise
USB interface	Enabled	7 CDCs are available, configured as described in the following list: • USB1: AT commands / data connection • USB2: AT commands / data connection • USB3: AT commands / data connection • USB4: GNSS tunneling • USB5: Primary Log (debug purpose) • USB6: Secondary Log (debug purpose) • USB7: SAP (SIM Access Profile)
	AT&K3	HW flow control enabled
	AT&S1	DSR line set ON in data mode and set OFF in command mode
	AT&D1	Upon an ON-to-OFF transition of DTR, the DCE enters online command state and issues an OK result code
	AT&C1	Circuit 109 changes in accordance with the Carrier detect status; ON if the Carrier is detected, OFF otherwise
SPI interface	Enabled	Multiplexing mode can be enabled by AT+CMUX command providing following channels: • Channel 0: control channel • Channel 1 – 5: AT commands / data connection • Channel 6: GNSS tunneling • Channel 7: SAP (SIM Access Profile)
	AT&K3	HW flow control enabled
	AT&S1	DSR line set ON in data mode and set OFF in command mode
	AT&D1	Upon an ON-to-OFF transition of DTR, the DCE enters online command state and issues an OK result code
	AT&C1	Circuit 109 changes in accordance with the Carrier detect status; ON if the Carrier is detected, OFF otherwise
Power Saving	AT+UPSV=0	Disabled
Network registration	AT+COPS=0	Self network registration

Table 34: Default settings

See the u-blox AT commands manual [4] and the LISA-U2 series system integration manual [6] for information about further settings.

9 Labeling and ordering information

9.1 Product labeling

The labels of LISA-U2 series modules include important product information as described in this section. Figure 22 illustrates a label of the LISA-U2 series modules, and includes: u-blox logo, production lot, Pb-free marking, product type number, IMEI number, applicable certification numbers and markings, and production country.

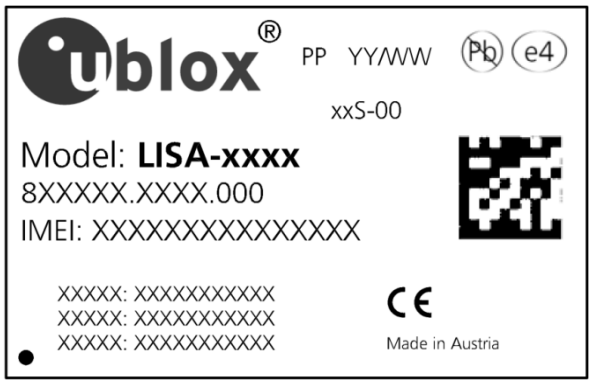

Figure 22: LISA-U2 module label

For information about the approval codes and for all the certificates of compliancy of LISA-U2 series modules, see our website www.u-blox.com.

9.2 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 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 35 details these 3 different formats:

Format	Structure
Product Name	LISA-TGVV
Ordering Code	LISA-TGVV-TTQ
Type Number	LISA-TGVV-TTQ-XX

Table 35: Product code formats

Table 36 explains the parts of the product code.

Code	Meaning	Example
PPP(P)	Form factor (3 or 4 digit, typically 4 for cellular products)	LISA
TG	Platform (Technology and Generation) • Dominant technology: G:GSM; U: HSUPA; C:CDMA 1xRTT; N: NB-IoT; R: LTE low data rate (Cat 1 and below); L: LTE high data rate (Cat.3 and above) • Generation: 1…9	U2
VV	Variant function set based on the same platform [00…99]	00
TT	Major product version [00…99]	00
Q	Quality grade/production site • S = professional • B = professional • A = automotive	S
XX	Minor product version (not relevant for certification)	Default value is 00

Table 36: Part identification code

9.3 Ordering information

Ordering No.	Product
LISA-U200-01S	HSPA 800/850/900/1700/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U200-02S	HSPA 800/850/900/1700/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U200-03S	HSPA 800/850/900/1700/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U200-04B	HSPA 800/850/900/1700/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U200-52S	HSPA 800/850/900/1700/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, approved by SKT Korean network operator, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U200-62S	HSPA 800/850/900/1700/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, approved by NTT DoCoMo Japanese network operator, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U200-83S	HSPA 800/850/900/1700/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, FOTA available, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U201-03S	HSPA 800/850/900/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U201-04B	HSPA 800/850/900/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U201-83S	HSPA 800/850/900/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, FOTA available, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U230-01S	HSPA 800/850/900/1700/1900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 14, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U260-01S	HSPA 850/1900 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U260-02S	HSPA 850/1900 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U270-01S	HSPA 900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U270-02S	HSPA 900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U270-62S	HSPA 900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, approved and locked for SoftBank Japanese network operator, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U270-63S	HSPA 900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, approved and locked for SoftBank Japanese network operator, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel
LISA-U270-68S	HSPA 900/2100 MHz, quad-band GPRS/EDGE, voice and data, HSDPA category 8, approved and locked for SoftBank Japanese network operator, 33.2 x 22.4 x 2.6 mm, 150 pcs/reel

Table 37: Product ordering codes

Appendix

A Glossary

Abbreviation	Definition
BER	Bit Error Rate
DCE	Data Communication Equipment
DDC	Display Data Channel (I2C compatible) Interface
DL	Down-link (Reception)
Driver Class	Output Driver Class: see Table 19 for definition
DRX	Discontinuous Reception
DTE	Data Terminal Equipment
EDGE	Enhanced Data rates for GSM Evolution
ERS	External Reset Input Signal
FOTA	Firmware upgrade Over The Air
GDI	Generic Digital Interfaces (power domain)
GND	Ground
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communication
H	High
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
I2C	Inter-Integrated Circuit Interface
I2S	Inter-IC Sound Interface
L	Low
LCC	Leadless Chip Carrier
N/A	Not Applicable (used in the I/O field of pinout)
OD	Open Drain
PCN / IN	Product Change Notification / Information Note
PD	Pull-Down
POS	Power-On Input (power domain)
PU	Pull-Up
PU/PD Class	Pull Class: see Table 19 for definition
RMC	Reference Measurement Channel
SIM	SIM Interface (power domain)
SPI	Serial Peripheral Interface
T	Tristate (Output of the pin set to tri-state, i.e. high impedance state)
T/PD	Tristate with internal active Pull-Down enabled
T/PU	Tristate with internal active Pull-Up enabled
UART	Universal Asynchronous Receiver-Transmitter serial interface
UL	Up-link (Transmission)
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus (power domain)

Table 38: Explanation of the abbreviations and terms used

Related documents

[1] 3GPP TS 27.007 - AT command set for User Equipment (UE)
[2] 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)
[3] 3GPP TS 27.010 - Terminal Equipment to User Equipment (TE-UE) multiplexer protocol
[4] u-blox AT commands manual, doc. no. UBX-13002752
[5] u-blox Android RIL source code application note, doc. no. UBX-13002041
[6] u-blox LISA-U2 series system integration manual, doc. no. UBX-13001118
[7] u-blox GNSS implementation application note, doc. no. UBX-13001849
[8] 3GPP TS 26.267 - eCall Data Transfer; In-band modem solution; General description
[9] 3GPP TS 44.031 - Location Services (LCS); Mobile Station (MS) - Serving Mobile Location Centre (SMLC) Radio Resource LCS Protocol (RRLP)
[10] ITU-T Recommendation V24, 02-2000. List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Connection Equipment (DCE)
[11] u-blox mux implementation application note for cellular modules, doc. no. UBX-13001887
[12] Universal Serial Bus Revision 2.0 specification, https://www.usb.org/
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[15] 3GPP TS 34.121-1 - User Equipment conformance specification; Radio transmission and reception (FDD); Part 1: Conformance specification
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[17] u-blox package information user guide, doc. no. UBX-14001652
[18] 3GPP TS 25.331 - Radio Resource Control (RRC); Protocol specification
[19] GSMA IoT Device Connection Efficiency Guidelines
[20] IEC 60079-0 - Explosive atmospheres, Part 0: Equipment general requirements
[21] IEC 60079-11 - Explosive atmospheres, Part 11: Equipment protection by intrinsic safety 'i'
[22] IEC 60079-26 - Explosive atmospheres, Part 26: Equipment with EPL Ga

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Revision history

Revision	Date	Name	Status / Comments
-	25-Jul-2011	lpah	Initial release (draft)
1	12-Oct-2011	sses	First release for LISA-U200-00S, LISA-U200-01x, LISA-U230-01x
2	22-Nov-2011	sses	Updated status to Advance Information Added Antenna Supervisor support by LISA-U200-00S; Added module switch-on by RESET_N support; Updated LISA-U2x0-01x features in GPIO section; Updated ESD maximum rating table
3	02-Feb-2012	sses	Updated status to Preliminary Updated current consumption table; Updated features support in module power off and GPIO sections
A	15-May-2012	sses / lpah	Updated status to Objective Specification Updated PWR_ON low time to switch-on the module; Removed Audio over USB support; Added UART autobauding feature support
A1	20-Jul-2012	sses / lpah	Updated status to Preliminary Updated LISA-U2x0-01x GPRS/EDGE multi-slot class support; Updated list of available USB drivers; Updated module dimensions tolerances
A2	28-Sep-2012	lpah	Updated status to Advance Information First release for LISA-U260-01S, LISA-U270-01S
A3	26-Nov-2012	lpah	Updated status to Preliminary status (Last revision with old doc number, 3G.G3-HW-11004)
B	11-Jul-2013	lpah	Updated status to Advance Information First release for LISA-U200-02S, LISA-U200-61S, LISA-U200-62S, LISA-U260-02S, LISA-U270-02S, LISA-U270-62S
B1	20-Aug-2013	lpah	Updated status to Preliminary (Early Production Information)
B2	29-Aug-2013	smos	Changes in Tables 1 and 36 (variant 61S removed)
R12	14-Apr-2014	lpah	First release for LISA-U200-52S, LISA-U200-82S Section 1.5: added Windows Mobile 6.5 and Android 4.2 and 4.3
R13	15-May-2015	sfal	Extended applicability to LISA-U200-03S and LISA-U201-03S. Added related features. Removed LISA-U200-00S (which is in EOL). Updated approvals section 6.2 and current consumption table of section 4.2.4.
R14	26-Jun-2015	sfal	Advance Information document status
R15	10-Aug-2015	sfal	Early Production Information document status Extended applicability to LISA-U200-83S and LISA-U270-68S
R16	17-Feb-2016	sfal	Extended applicability to LISA-U201-83S
R17	12-May-2016	lpah	Extended applicability to LISA-U201-03A and LISA-U270-63S
R18	07-Oct-2016	lpah	Updated status to Production Information Extended applicability to the LISA-U200-62S-02 and removed LISA-U201-03A, LISA-U200-82S
R19	03-Jan-2018	lpah	"Disclosure restriction" replaces "Document status" on page 2 and document footer. Extended document applicability to new type numbers
R20	24-Jan-2019	sses	Extended applicability to the LISA-U200-01S-03, LISA-U200-03S-02, LISA-U200-52S-03, LISA-U200-62S-04, LISA-U230-01S-03, LISA-U270-63S-02 Updated products' status. Revised approvals info. Updated RESET_N specifications for LISA-U201 modules.
R21	10-Apr-2019	sses	LISA-U200-01S-03, LISA-U200-03S-02, LISA-U200-52S-03, LISA-U200-62S-04, LISA-U230-01S-03, LISA-U270-63S-02 product status update Revised approvals info. Updated RESET_N specifications for LISA-U201 modules Updated RoHS statement. Minor other clarifications.
R22	03-Dec-2019	lpah / sses	Extended applicability to LISA-U200-04B and LISA-U201-04B. Minor other clarifications.

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