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LEON-G100/G200

Quad Band GSM/GPRS Voice and Data Modules

Data Sheet

Abstract

Technical data sheet describing the LEON-G100/G200 Quad Band GSM/GPRS data and voice modules.
The LEON-G100/G200 are complete and cost efficient solutions, bringing full feature Quad Band GSM/GPRS data and voice transmission technology in a compact form factor.

29.5 x 18.9 x 3.01 mm

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Document Information	
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This document applies to the following products:

Name	Type number	Firmware version	PCN reference
LEON-G100	LEON-G100-00S-00	07.30	n.a.
LEON-G200	LEON-G200-00S-00	07.30	n.a.
LEON-G100	LEON-G100-01S-00	07.30	n.a.
LEON-G200	LEON-G200-01S-00	07.30	n.a.
LEON-G100	LEON-G100-02S-00	07.30	n.a.
LEON-G200	LEON-G200-02S-00	07.30	n.a.

Contents

1 Functional description

1.1 Overview

LEON-G100/G200 modules are cost efficient solutions offering full quad-band GSM / GPRS data and voice functionality in a compact SMD form factor. Featuring low power consumption and GSM/GPRS class 10 data transmission with voice capability, LEON-G100/G200 combine baseband, RF transceiver, power management unit, and power amplifier in a single, easy-to-integrate solution.

LEON-G100/G200 are fully qualified and certified solutions, reducing cost and enabling short time to market. These modules are ideally suited for M2M and automotive applications such as: Automatic Meter Reading (AMR), Remote Monitoring Automation and Control (RMAC), surveillance and security, e-call, road pricing, asset tracking, fleet management, anti theft systems and Point of Sales (PoS) terminals.

LEON-G100/G200 support full access to u-blox GPS receivers via the GSM modem. GSM and GPS can be controlled through a single serial port from any host processor. LEON-G100/G200's compact 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

	UART	DDC (I^2C)	GPIO	ADC	Analogue Audio	Digital Audio	Battery Charging	Antenna Supervisor	Jamming Detection	TCP/IP UDP/IP	FTP, HTTP, SMTP	GPS via GSM Modem	Embedded AssistNow Client	FW update over UART	FW update over-the-air
LEON-G100	1	1	2	1	2			•	•	•	•	•	•	•	
LEON-G200	1	1	2		2	1	•	•	•	•	•	•	•	•	•[1]

Table 1: Features of the LEON-G100/G200

[1] Available with next release of LEON-G200

1.3 Block diagram

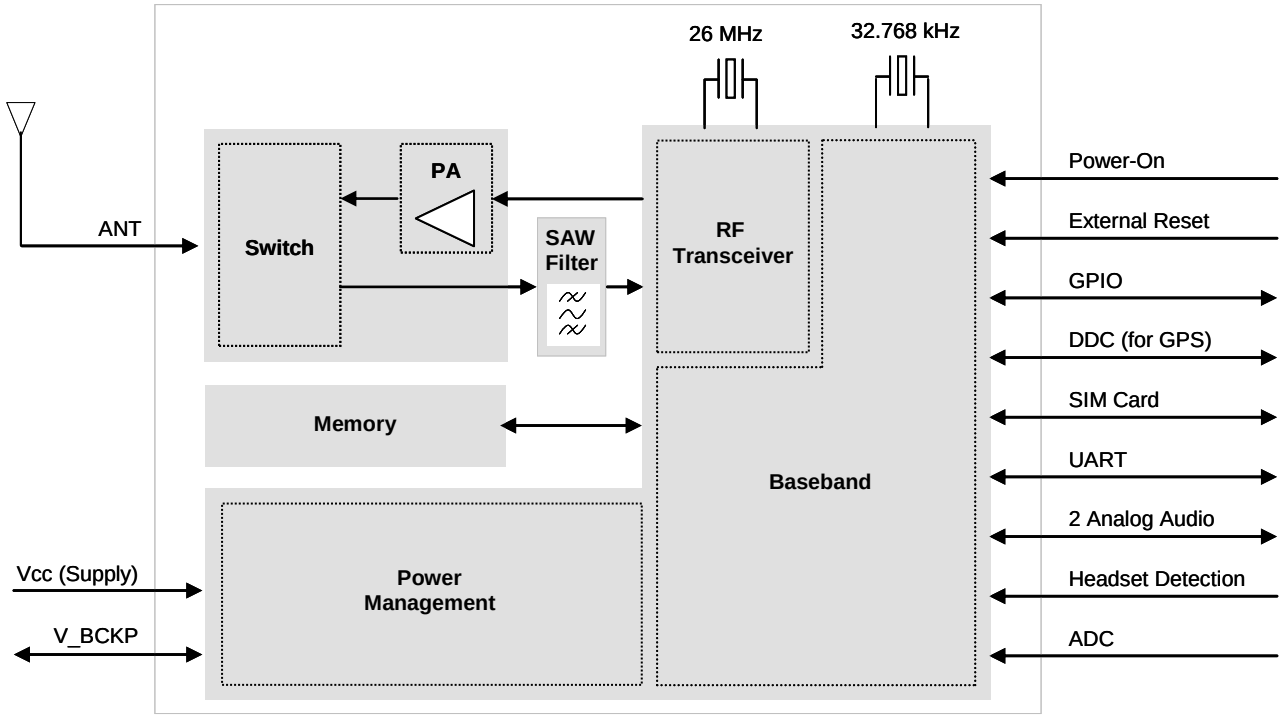


Figure 1: LEON-G100 block diagram

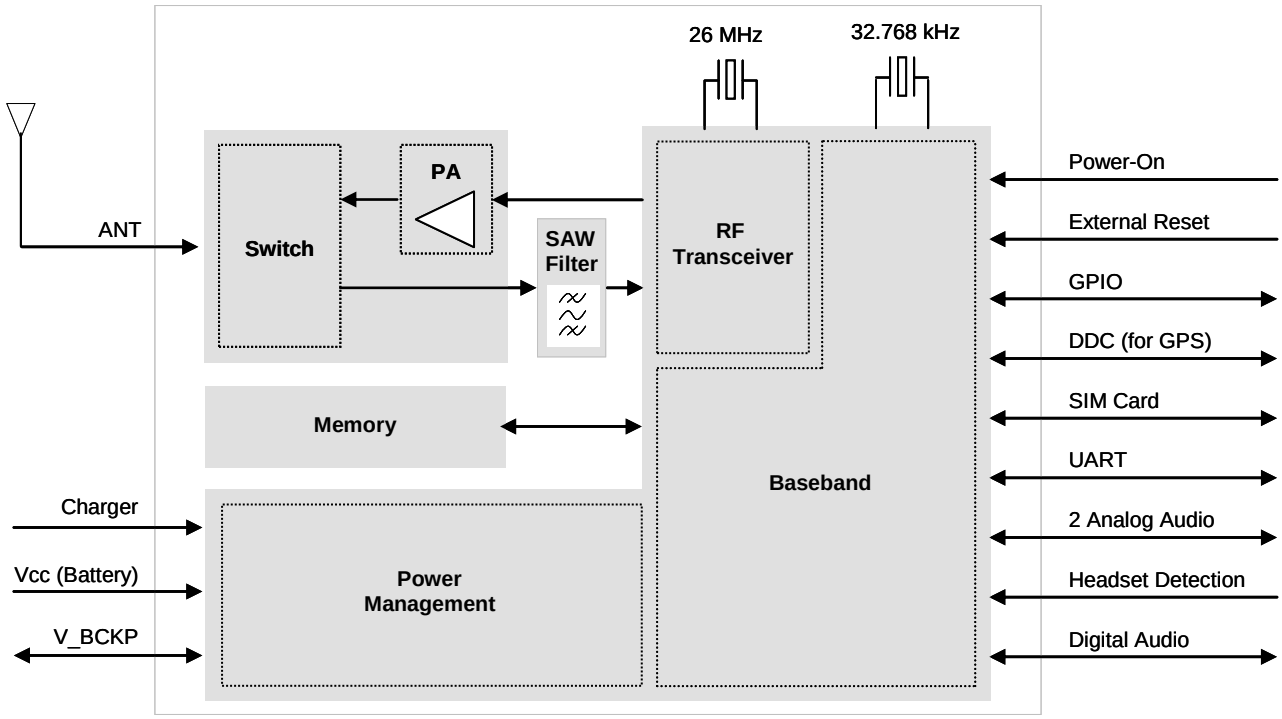


Figure 2: LEON-G200 block diagram

1.4 Product description

LEON-G100/G200 modules from u-blox integrate a full-feature Release 99 GSM-GPRS protocol stack:

- Quad-band support: GSM 850 MHz, EGSM 900 MHz, DCS 1800 MHz and PCS 1900 MHz;
- Power Class 4 (33 dBm nominal maximum output power) for GSM/EGSM bands;
- Power Class 1 (30 dBm nominal maximum output power) for DCS/PCS bands;
- GPRS multislot class 10;
- All GPRS coding schemes from CS1 to CS4 are supported;
- GPRS bit rate: 85.6 kb/s (max.), 53.6 kb/s (typ.) in down-link; 42.8 kb/s (max.), 26.8 kb/s (typ.) in up-link;
- CS (Circuit Switched) Data calls are supported in transparent/non transparent mode up to 9.6 kb/s;
- Encryption algorithms A5/1 for GSM and GPRS are supported;
- Bearer service fax Group 3 Class 2.0 is supported.

GPRS modem is a Class B Mobile Station; this means that the module can be attached to both GPRS and GSM services, using one service at a time. Network operation modes I to III are supported, with user-definable preferred service selectable from GSM to GPRS.

Paging messages for GSM calls can be monitored during GPRS data transfer in not-coordinating network operation mode NOM II-III.

PBCCH/PCCCH logical channels are supported, as well as CBCH reception. CBCH reception when on PBCCH is supported.

LEON-G100/G200 modules function as GPRS multislot class 10 for data transfer

- 4 time-slots in downlink direction, 1 time-slot in uplink direction, or
- 3 time-slots in downlink direction, 2 time-slots in uplink direction

The network will automatically configure the number of timeslots available for usage by the module.

The network configures automatically the channel encoding used by the module, depending on the conditions of the quality of the radio link between cell phone and base station. If the channel is very noisy, the network may use the most robust coding scheme (CS-1) to ensure higher reliability. If the channel is providing a good condition, the network could use the least robust but fastest coding scheme (CS-4) to obtain optimum speed.

The maximum GPRS bit rate of the module depends on the current network settings.

1.5 Supplementary services

- Call Hold/Resume (CH)
- Call Waiting (CW)
- Multi-Party (MTPY)
- Call Forwarding (CF)
- Call Divert
- Explicit Call Transfer (ECT)
- Call Barring (CB)
- Call Completion to Busy Subscriber (CCBS)
- Advice of Charge Charging (AOCC)
- Calling Line Identification Presentation (CLIP)
- Calling Line Identification Restriction (CLIR)
- Connected Line Identification Presentation (COLP)
- Connected Line Identification Restriction (COLR)
- Unstructured Supplementary Services Data (USSD)

- Network Identify and Time Zone (NITZ)

1.6 SMS

- Mobile-Originating SMS (MO SMS)
- Mobile-Terminating SMS (MT SMS)
- SMS Cell Broadcast (SMS CB)
- Concatenated SMS
- Text and PDU mode supported
- Reception of SMS during circuit-switched calls
- Reception of SMS via GSM or GPRS
- SMS storage (customizable & configurable) provided

1.7 AT Command support

The module supports the following AT commands standards:

- AT commands according to the 3GPP TS 27.007 Technical Specification [1],
- AT commands according to the 3GPP TS 27.005 Technical Specification [2],
- AT commands according to the 3GPP TS 27.010 Technical Specification [3],
- u-blox AT command extension.

☞ For the complete list of the supported AT commands and their syntax refer to the document u-blox AT Commands Manual [4].

1.8 Other basic features

- Display of Called Number
- Indication of Call Progress Signals
- Country/PLMN Indication
- International Access Function
- Service Indicator
- Dual Tone Multi Frequency (DTMF)
- Subscription Identity Management
- Service Provider Indication
- Abbreviated Dialing
- SIM Toolkit

1.9 AssistNow clients and GPS integration

For customers using u-blox GPS receivers, LEON-G100/G200 modules feature embedded AssistNow Online and AssistNow Offline clients. AssistNow A-GPS provides better GPS performance and faster Time-to-First-Fix.

AssistNow client is fully implemented on the module, no need for is software integration on an external host micro controller. Full access to u-blox GPS receivers is available via LEON-G100/G200 modules through a dedicated DDC (I^2C) interface. This means that GSM/GPRS and GPS can be controlled through a single serial port from any host processor.

2 Interfaces

2.1 Audio

LEON-G100/G200 modules provide four analogue and one digital audio interfaces:

- Two microphone inputs:
  - First microphone input: it can be used for direct connection of the electret condenser microphone of an handset. This audio input is used when audio uplink path is set as "Handset Microphone" (for more details please refer to [4], AT+USPM command)
  - Second microphone input: it can be used for direct connection of the electret condenser microphone of an headset. This audio input is used when audio uplink path is set as "Headset Microphone" (for more details please refer to [4], AT+USPM command).
- Two speaker outputs:
  - First speaker output: a single ended low power audio output can be used to directly connect the receiver (earpiece) of an handset or an headset. This audio output is used when audio downlink path is "Normal earpiece" or "Mono headset" (for more details please refer to [4]; AT+USPM command). These two downlink path profiles use the same physical output but have different sets of audio parameters (for more details please refer to [4], AT+USGC, +UDBF, +USTN commands).
  - Second speaker output: a differential high power audio output, can be used to directly connect a speaker or a loud speaker used for ring-tones or for speech in hands-free mode. This audio output is used when audio downlink path is "Loudspeaker" (for more details please refer to [4], AT+USPM command , <main_downlink> and <alert_sound> parameters).
- Headset detection input:
  - The headset detection, if enabled, causes the automatic switch of the uplink audio path to "Headset Microphone" and downlink audio path to "Mono headset". Enabling / disabling of detection can be controlled by parameter <headset_indication> in AT+USPM command (for more details please refer to [4]).
- I2S digital audio interface:
  - This audio path is selected when parameters <main_uplink> and <main_downlink> in +USPM command (for more details please refer to [4]) are respectively "I2S input line" and "I2S output line".

☞ Not all the Input-Output audio path combinations are allowed. Please check audio command +USPM in [4] for allowed combinations of audio path and for their switching during different use cases (speech/alert tones).

☞ The default values for audio parameters tuning commands (for more details please refer to [4]; +UMGC,+UUBF, +UHFP, +USGC, +UDBF, +USTN AT commands) are tuned for audio device connected as suggested above (i.e. Handset microphone connected on first microphone input, headset microphone on second microphone input). For a different use case (i.e. connection of a Hands Free microphone) these parameters should be changed on the audio path corresponding to the connection chosen.

☞ For the default values related to the uplink, downlink path and headset detection please refer to LEON AT Commands Manual [4].

2.2 RF antenna interface

The board-to-board SMD pad has an impedance of 50 Ω and provides the RF antenna interface.

2.3 SIM interface

SIM card interface is provided on the board-to-board pins of the LEON-G100/G200 modules: the high-speed SIM/ME interface is implemented as well as the automatic detection of the required SIM supporting voltage.

Both 1.8 V and 3 V SIM type will be supported: activation and deactivation with automatic voltage switch from 1.8 V to 3 V are 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 proposed by the SIM Card.

2.4 Asynchronous serial interface (UART)

The UART interface is an 8-wire unbalanced asynchronous serial interface provided for all communications with LEON-G100/G200 modules: AT commands interface, GPRS data and CSD data, software upgrades.

UART features are:

- Complete serial port with RS-232 functionality conforming to the ITU-T V.24 Recommendation [5], with CMOS compatible signal levels (0 V for low data bit or ON state and 2.85 V for high data bit or OFF state) and different signal names
- 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 on the hardware flow control output (CTS line): the line is driven in the OFF state when the module is not prepared to accept data signals
- 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400 b/s baud rates are supported for the AT interface; to be noticed that 1200 and 230400 b/s are available in conjunction only with autobauding
- Auto baud rate detection (autobauding) is the default configuration;
- Frame format can be: 8N2 (8 data bits, No parity, 2 stop bits) or 8E1 (8 data bits, even parity, 1 stop bit) or 8O1 (8 data bits, odd parity, 1 stop bit) or 8N1 (8 data bits, No parity, 1 stop bit)
- Default frame configuration is 8N1 where there are eight (8) data bits, no (N) parity bit, and one (1) stop bit
- Automatic frame recognition is supported: this feature is enabled in conjunction with the auto baud rate detection only

2.4.1 MUX protocol

The LEON-G100/G200 modules have a software layer with MUX functionality, 3GPP TS 27.010 multiplexer protocol [3]. It 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 a number of simultaneous sessions over the physical link (UART). This permits, for example, SMS to be transferred to the DTE when a data connection is in progress.

The following channels are defined:

- Channel 0: Mux control
- Channel 1: GPS Reserved
- Channel 2-5: available for free usage

2.5 DDC (I^2C compatible) bus interface

LEON-G100/G200 modules include an I^2C compatible DDC interface exclusively for communication with u-blox GPS devices.

2.6 ADC input

One Analogue to Digital Converter (ADC) input is available with the LEON-G100 and can be configured via u-blox AT commands.

2.7 GPIO

LEON-G100/G200 modules provide 2 General Purpose Input/Output (GPIO) pins, configurable via u-blox AT commands. When connecting LEON-G100/G200 modules to u-blox GPS, GPIO2 will automatically be used to activate/deactivate the GPS device.

3 Mechanical specifications

Parameter	Description	Specification
A	Height	29.50 mm [1161.4 mil]
B	Width	18.90 mm [744.1 mil]
C	Thickness	3.01 mm [118.5 mil]
D	Edge to Pin Pitch	1.55 mm [61.0 mil]
E	Pin to Pin Pitch	1.10 mm [43.3 mil]
Weight		< 5 g

Table 2: Dimensions

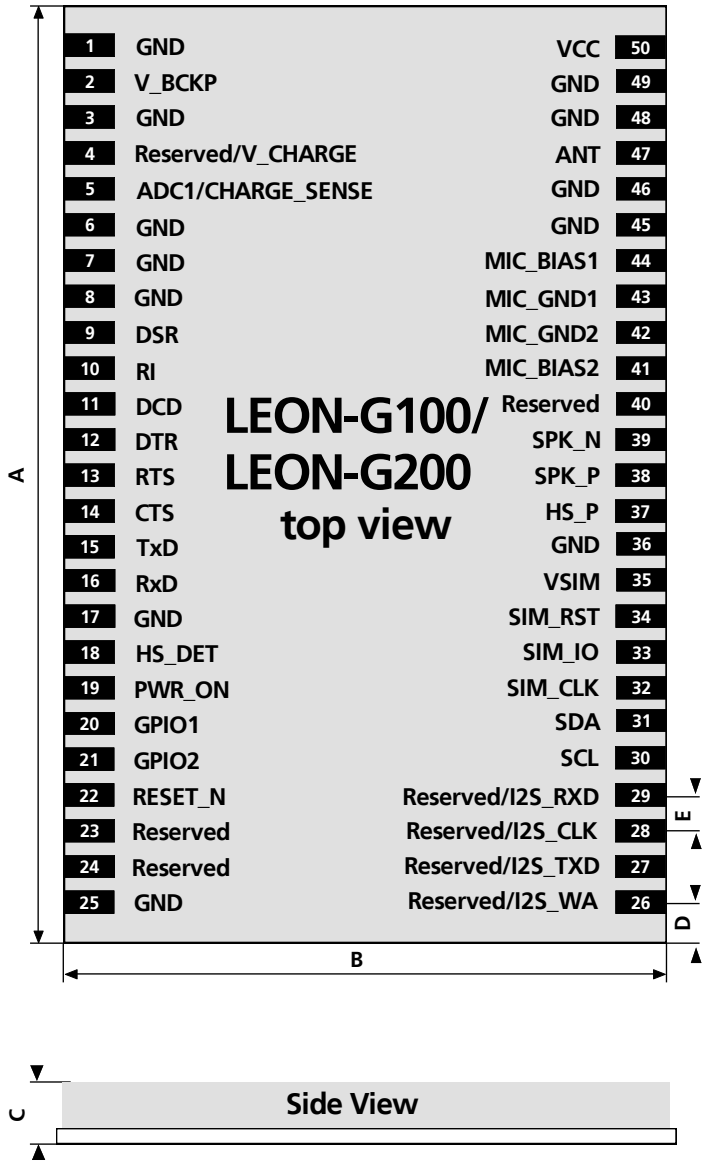


Figure 3: Dimensions and pinout

Name	Definition
PCB thickness	0.904+/-0.12 mm
Shield	2+/-0.05 mm
Shield Planarity	0.1 mm
Label	0.107 mm
Total	3.011+0.27/-0.17 mm

Table 3: LEON Thickness

☞ For information regarding the Paste Mask and Footprint see the LEON-G100/G200 System Integration Manual [6].

3.1 Pin assignment

3.1.1 Definitions

Name	Definition
ADC	Analogue/Digital Converter, ADC Pins (power domain)
AUDIO	Audio Pins (power domain)
DDC	DDC Interface (power domain)
Driver Class	Output Driver Class: see Section 4.2.2 Table 12 and Table 15 for definition
ERS	External Reset Signal (power domain)
GDI	Generic Digital Interfaces (power domain)
H	High
L	Low
OD	Open Drain
PD	Pull-Down
POS	Power-On Input (power domain)
PU	Pull-Up
PU/PD Class	Pull Class: see Section 4.2.2 Table 14 for definition
SIM	SIM Interface (power domain)
T	Tristate
TBF	Temporary Block Flow

Table 4: Explanation of abbreviations and terms used

3.1.2 Pinout

No	Module	Name	Power domain	I/O	Description	Remarks
1	All	GND		N/A	Ground	GND pins are internally connected.
2	All	V_BCKP		I/O	Real Time Clock supply	V_BCKP = 2.0 V (typical) generated by the module to supply the Real Time Clock when VCC supply voltage is within valid operating range.
3	All	GND		N/A	Ground	GND pins are internally connected.
4	LEON-G100	Reserved				
	LEON-G200	V_CHARGE		I	Charger supply input	V_CHARGE and CHARGE_SENSE must be externally connected.
5	LEON-G100	ADC1	ADC	I	ADC input	Resolution: 12 bits Input operating voltage range: 0 V – 2.0 V
	LEON-G200	CHARGE_SENSE	ADC	I	Charger sense input	V_CHARGE and CHARGE_SENSE must be externally connected.
6	All	GND		N/A	Ground	GND pins are internally connected.
7	All	GND		N/A	Ground	GND pins are internally connected.
8	All	GND		N/A	Ground	GND pins are internally connected.
9	All	DSR	GDI	O	UART data set ready	Provides functionality of Circuit 107 (Data set ready) as specified in ITU-T V.24. Driver class B slow. Value at reset: T/PU.
10	All	RI	GDI	O	UART ring indicator	Provides functionality of Circuit 125 (Calling indicator) as specified in ITU-T V.24. Driver class D. Value at reset: T/PD.
11	All	DCD	GDI	O	UART data carrier detect	Provides functionality of Circuit 109 (Data channel received line signal detector) as specified in V.24. Driver class B. Value at reset: T/PD.
12	All	DTR	GDI	I	UART data terminal ready	Provides functionality of Circuit 108/2 (Data terminal ready) as specified in ITU-T V.24. Internal active pull-up to 2.85 V enabled. PU/PD class B. Value at reset: T/PD.
13	All	RTS	GDI	I	UART ready to send	Provides functionality of Circuit 105 (Request to send) as specified in ITU-T V.24. Internal active pull-up to 2.85 V enabled. PU/PD class C. Value at reset: T/PU.
14	All	CTS	GDI	O	UART clear to send	Provides functionality of Circuit 106 (Ready for sending) as specified in ITU-T V.24. Driver class E. Value at reset: T.
15	All	TxD	GDI	I	UART transmitted data	Provides functionality of Circuit 103 (Transmitted data) as specified in ITU-T V.24. Internal active pull-up to 2.85 V enabled. PU/PD class C. Value at reset: T.
16	All	RxD	GDI	O	UART received data	Provides functionality of Circuit 104 (Received data) as specified in ITU-T V.24. Driver class E. Value at reset: T.
17	All	GND		N/A	Ground	GND pins are internally connected.
18	All	HS_DET	GDI	I	Headset detection input	Internal active pull-up to 2.85 V enabled. PU/PD class B. Value at reset: T/PD
19	All	PWR_ON	POS	I	Power-on input	The PWR_ON pin has high input impedance: avoid to keep it floating in noisy environment (external pull-up required).
20	All	GPIO1	GDI	I/O	GPIO	Driver class C. Value at reset: T/PD.
21	All	GPIO2	GDI	I/O	GPIO	Driver class C. Value at reset: T/PD.
22	All	RESET_N	ERS	I	External reset input	A series Schottky diode is integrated in the module as protection, then the equivalent circuit is represented by a 12.6 kΩ resistor that pull the level to 1.88 V.

No	Module	Name	Power domain	I/O	Description	Remarks
23	All	Reserved				
24	All	Reserved				
25	All	GND		N/A	Ground	GND pins are internally connected.
26	LEON-G100	Reserved				
	LEON-G200	I2S_WA	GDI	O	I2S word alignment	Driver class D. Value at reset: T.
27	LEON-G100	Reserved				
	LEON-G200	I2S_TXD	GDI	O	I2S transmit data	Driver class D. Value at reset: T.
28	LEON-G100	Reserved				
	LEON-G200	I2S_CLK	GDI	O	I2S clock	Driver class D. Value at reset: T.
29	LEON-G100	Reserved				
	LEON-G200	I2S_RXD	GDI	I	I2S receive data	Internal active pull-up to 2.85 V enabled. PU/PD class B. Value at reset: T.
30	All	SCL	DDC	O	I2C bus clock line	Fixed open drain. External pull-up required. Value at reset: T/OD.
31	All	SDA	DDC	I/O	I2C bus data line	Fixed open drain. External pull-up required. Value at reset: T/OD.
32	All	SIM_CLK	SIM	O	SIM clock	Driver class E. Value at reset: L.
33	All	SIM_IO	SIM	I/O	SIM data	Internal 4.7k pull-up to VSIM. Driver class E. Value at reset: OD/L.
34	All	SIM_RST	SIM	O	SIM reset	Driver class E. Value at reset: L.
35	All	VSIM		O	SIM supply output	VSIM = 1.80 V typical if SIM card = 1.8V type or VSIM = 2.85 V typical if SIM card = 3.0V type
36	All	GND		N/A	Ground	GND pins are internally connected.
37	All	HS_P	AUDIO	O	First speaker output with low power single-ended analogue audio	This audio output is used when audio downlink path is "Normal earpiece" or "Mono headset"
38	All	SPK_P	AUDIO	O	Second speaker output with high power differential analogue audio	This audio output is used when audio downlink path is "Loudspeaker"
39	All	SPK_N	AUDIO	O	Second speaker output with power differential analogue audio output	This audio output is used when audio downlink path is "Loudspeaker"
40	All	Reserved				
41	All	MIC_BIAS2	AUDIO	I	Second microphone analogue signal input and bias output	This audio input is used when audio uplink path is set as "Headset Microphone"
42	All	MIC_GND2		I	Second microphone analogue reference	Local ground of the second microphone
43	All	MIC_GND1		I	First microphone analogue reference	Local ground of the first microphone
44	All	MIC_BIAS1	AUDIO	I	First microphone analogue signal input and bias output	This audio input is used when audio uplink path is set as "Handset Microphone"
45	All	GND		N/A	Ground	GND pins are internally connected.
46	All	GND		N/A	Ground	GND pins are internally connected.
47	All	ANT		I/O	RF antenna	50 Ω nominal impedance
48	All	GND		N/A	Ground	GND pins are internally connected.
49	All	GND		N/A	Ground	GND pins are internally connected.
50	All	VCC		I	Module supply input	

Table 5: Pinout

Pins designated Reserved should not be used. For more information about Pinout see the LEON-G100/G200 System Integration Manual [6].

4 Electrical specifications

Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stressing the device above one or more of the rating listed in the Absolute Maximum Rating section may cause permanent damage. These are stress ratings only: the functional operation of the device at these or at any other conditions above those given in the Operating Conditions sections is not implied. 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.

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

4.1 Absolute maximum rating

Symbol	Description	Condition	Min.	Max.	Unit
VCC	Module supply voltage		-0.3	5.5	V
ICC_PEAK	Module supply peak current	Peak of module current consumption through the VCC pad during a GSM transmit burst, with a mismatched antenna		2.5	A
V_CHARGE	Module charge voltage	Maximum open circuit voltage of the external charger applied to the module V_CHARGE and CHARGE_SENSE pads		15.0	V
I_CHARGE	Module charge current	Maximum charging current provided by the external charger connected to the module V_CHARGE and CHARGE_SENSE pads, in the case of a battery with the maximum allowed capacity (1100 mAh) is connected to the module VCC pad.		1200	mA
GDI	Generic digital interfaces		-0.30	3.60	V
DDC	DDC interface		-0.30	3.60	V
SIM	SIM interface		-0.30	3.60	V
ERS	External reset signal		-0.15	4.20	V
POS	Power-on input		-0.15	4.20	V
AUDIO	Audio pins		-0.15	3.00	V
ADC	ADC pins		-0.15	3.00	V
Tstg	Storage temperature range		-40	+85	°C

Table 6: Absolute maximum ratings

GSM modules are Electrostatic Sensitive Devices (ESD) and require special precautions when handling.

Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. The product is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection diodes.

4.2 Operating conditions

All 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.

Symbol	Parameter	Module	Min	Typ	Max	Units	Remarks
Topr	Ambient temperature range for normal operation	All	-30	+25	+85	°C	
Tcharge	Ambient temperature range for charging mode	LEON-G200	0		+50	°C	5°C hysteresis to prevent rapid enabling/disabling of charging mode

Table 7: Environmental conditions

Symbol	Parameter	Module	Min	Typ	Max	Units	Remarks
$R_{th, C-A}$	Case-to-Ambient thermal resistance	All		14		°C/W	Module mounted on a 130 mm x 110 mm x 1.6 mm FR4 PCB with a high coverage of copper in still air conditions

Table 8: Case-to-Ambient thermal resistance

4.2.1 Supply/Power pins

Symbol	Parameter	Min.	Typ	Max.	Unit
VCC	Module supply normal operating voltage[2]	3.35	3.8	4.2	V
	Module supply extended operating voltage[3]	3.00		4.5	V
ICC_PEAK[4]	Module Supply Peak Current: peak of module current consumption through the VCC pad during a GSM transmit burst, with a matched antenna (typ. value) or with a mismatched antenna (max. value)		2.0	2.5	A
V_CHARGE	Open circuit voltage of the external charger applied to the module V_CHARGE and CHARGE_SENSE pads for valid charger detection. Charging voltage must be limited by the external charger to a value less or equal the maximum specified rate.	5.6	6.0	15.0	V
I_CHARGE	Charging current provided by the external charger connected to the module V_CHARGE and CHARGE_SENSE pads, in the case of a 500 mAh battery is connected to the module VCC pad. Charging current must be limited by the external charger to a value less or equal the maximum specified rate.	400	500	600	mA
C_BATT	Li-Ion Battery Capacity	500		1100	mAh
V_BCKP	Real Time Clock Supply voltage	1.0	2.0	2.25	V
I_BCKP	Real Time Clock Supply current consumption		2.0		µA

Table 9: Input characteristics of Supply/Power pins

[2] Input voltage at VCC must be above the normal operating range minimum limit to switch-on module. Complete functionality of the module is only guaranteed within the specified range.
[3] Ensure that input voltage at VCC never drops below the extended operating range minimum limit during module operation. Module switches off when the VCC voltage value drops below the minimum extended limit.
[4] Use this figure to dimension maximum current capability of power supply.

Symbol	Parameter	Min.	Typ	Max.	Unit
VSIM	SIM Supply	1.75	1.80	1.85	V
		2.76	2.85	2.94	V
V_BCKP	Real Time Clock Supply voltage	1.86	2.00	2.14	V

Table 10: Output characteristics of Supply/Power pins

4.2.2 Digital pins

Power domain	Parameter	Min.	Typ	Max.	Unit	Remarks
GDI	L-level input	-0.20	0.00	0.57	V	Voltage Domain = 2.85 V
	H-level input	2.00	2.85	3.30	V	Voltage Domain = 2.85 V
DDC	L-level input	-0.30	0.00	0.86	V	In accordance with I2C bus specification
	H-level input	2.00	2.85	3.30	V	In accordance with I2C bus specification
	Hysteresis	0.14			V	In accordance with I2C bus specification
SIM	L-level input		0.00	0.36	V	VSIM = 1.80 V
			0.00	0.57	V	VSIM = 2.85 V
	H-level input	1.26	1.80	3.30	V	VSIM = 1.80 V
		2.00	2.85	3.30	V	VSIM = 2.85 V
ERS	L-level input	-0.10	0.00	0.15	V	
	H-level input	1.60	2.00	3.30	V	
POS	L-level input	-0.10	0.00	0.86	V	
	H-level input	1.60	2.00	3.30	V	

Table 11: Input characteristics of Digital pins

Driver Class	Parameter	Min.	Typ	Max.	Unit	Remarks
B slow	L-level output		0.00	0.40	V	I_{OL} = +10.0 mA
			0.00	0.80	V	I_{OL} = +15.0 mA
	H-level output	2.65	2.85		V	I_{OH} = -10.0 mA
		2.50	2.85		V	I_{OH} = -15.0 mA
B	L-level output		0.00	0.20	V	I_{OL} = +2.5 mA
			0.00	0.35	V	I_{OL} = +5.0 mA
	H-level output	2.65	2.85		V	I_{OH} = -2.5 mA
		2.50	2.85		V	I_{OH} = -5.0 mA
C	L-level output		0.00	0.20	V	I_{OL} = +2.0 mA
			0.00	0.35	V	I_{OL} = +4.0 mA
	H-level output	2.65	2.85		V	I_{OH} = -2.0 mA
		2.50	2.85		V	I_{OH} = -4.0 mA
D	L-level output		0.00	0.20	V	I_{OL} = +1.0 mA
			0.00	0.35	V	I_{OL} = +2.0 mA
	H-level output	2.65	2.85		V	I_{OH} = -1.0 mA
		2.50	2.85		V	I_{OH} = -2.0 mA
E, F	L-level output		0.00	0.20	V	I_{OL} = +1.0 mA
			0.00	0.35	V	I_{OL} = +1.5 mA
	H-level output	2.65	2.85		V	I_{OH} = -1.0 mA
		2.50	2.85		V	I_{OH} = -1.5 mA

Table 12: Output characteristics of GDI pins

Power Domain	Parameter	Min.	Typ	Max.	Unit	Remarks
DDC	L-level output		0.00	0.40	V	I_{OL} = +3.0 mA
SIM	L-level output		0.00	0.20	V	VSIM = 1.80 V, I_{OL} = +1.0 mA
			0.00	0.35	V	VSIM = 1.80 V, I_{OL} = +1.5 mA
			0.00	0.20	V	VSIM = 2.85 V, I_{OL} = +1.0 mA
			0.00	0.35	V	VSIM = 2.85 V, I_{OL} = +1.5 mA
	H-level output	1.60	1.80		V	VSIM = 1.80 V, I_{OH} = -1.0 mA
		1.45	1.80		V	VSIM = 1.80 V, I_{OH} = -1.5 mA
		2.65	2.85		V	VSIM = 2.85 V, I_{OH} = -1.0 mA
		2.50	2.85		V	VSIM = 2.85 V, I_{OH} = -1.5 mA

Table 13: Output characteristics of DDC and SIM pins

PU/PD Class	Parameter	Min.	Typ	Max.	Unit	Remarks
A	Pull-up input current			-450	µA	
	Pull-down input current:			450	µA	
B	Pull-up input current			-100	µA	
	Pull-down input current			100	µA	
C	Pull-up input current			-30	µA	
	Pull-down input current			30	µA	

Table 14: Pull-up / Pull-down characteristics of DDC and SIM pins

Driver Class	Parameter	Min.	Typ	Max.	Unit	Remarks
B slow	Pad resistance (2.5-5.0 mA load): Rising edge			50	Ω	
	Pad resistance (2.5-5.0 mA load): Falling edge			50	Ω	
B	Pad resistance (2.5-5.0 mA load): Rising edge			70	Ω	
	Pad resistance (2.5-5.0 mA load): Falling edge			70	Ω	
C	Pad resistance (2.0-4.0 mA load): Rising edge			70	Ω	
	Pad resistance (2.0-4.0 mA load): Falling edge			70	Ω	
D	Pad resistance (1.0-2.0 mA load): Rising edge			115	Ω	
	Pad resistance (1.0-2.0 mA load): Falling edge			115	Ω	
E	Pad resistance (1.0-1.5 mA load): Rising edge			130	Ω	
	Pad resistance (1.0-1.5 mA load): Falling edge			120	Ω	
F	Pad resistance (1.0-1.5 mA load): Rising edge			180	Ω	
	Pad resistance (1.0-1.5 mA load): Falling edge			180	Ω	

Table 15: Pad resistance characteristics of GDI, DDC and SIM pins

4.2.3 Audio pins

Parameter	Min.	Typ	Max.	Unit	Remarks
Input signal voltage range			1.03	Vpp	Full scale single-ended voltage. Signal applied to MIC_BIAS1 with MIC_GND1 as reference, or applied to MIC_BIAS2 with MIC_GND2 as reference.
Input impedance		1.5		kΩ	At 1 kHz. Impedance between MIC_BIAS1 and MIC_GND1 pins, or between MIC_BIAS2 and MIC_GND2 pins.

Table 16: Microphones audio transmit paths (MIC_BIAS1 / MIC_GND1 and MIC_BIAS2 / MIC_GND2) input characteristics

Parameter	Min.	Typ	Max.	Unit	Remarks
Microphone supply open circuit voltage output		2.20		V	Open circuit single-ended voltage. Provided by MIC_BIAS1 with MIC_GND1 as reference, or provided by MIC_BIAS2 with MIC_GND2 as reference.
Microphone supply current			2.0	mA	Provided by MIC_BIAS1 with MIC_GND1 as reference, or provided by MIC_BIAS2 with MIC_GND2 as reference.

Table 17: Microphones supplies (MIC_BIAS1 and MIC_BIAS2) output characteristics

Parameter	Min.	Typ	Max.	Unit	Remarks[5]
Maximum single-ended output voltage	1.65	1.85	2.05	Vpp	Full scale single-ended open circuit voltage.
Internal output resistance		1.7	4	Ω	
Output load resistance		16		Ω	
Single-ended output load capacitance			10	nF	
Signal to noise	70	80		dB	Load = 16 Ω, Gain stage = +0 dB, Input signal = 0 dBFS, Code 0, A-weighted
Signal to distortion	60	70		dB	Load = 16 Ω, Gain stage = +0 dB, Input signal = 0 dBFS
	60	70		dB	Load = 16 Ω, Gain stage = +0 dB, Input signal = -1 dBFS
	60			dB	Load = 16 Ω, Gain stage = +0 dB, Input signal = -6 dBFS
Power supply rejection	60	66		dB	Gain stage = +0 dB, $U_{VDD}(t)$ = 2.5 V+0.15 V•sin(2π•1 kHz•t)
Passband ripple			0.5	dB	f < 0.45 f_s
Stopband attenuation	50			dB	f > 0.55 f_s
Absolute gain drift			±2	%	Variation due to change in supply, temperature and life time.

Table 18: Low power single-ended audio receive path (HP_P) output characteristics

[5] If not specified otherwise, all parameters are measured with a bandwidth of 20 Hz,...,20 kHz and gain setting gs = 0 dB.

Parameter	Min.	Typ	Max.	Unit	Remarks[6]
Maximum differential output voltage		7.8		Vpp	Overdrive Gain stage = +9 dB
Output load resistance		8		Ω	
Single-ended output load capacitance			10	nF	
Inductive load			400	µH	Between output pins and GND with series resistance
Signal to noise	70	80		dB	Load = 16 Ω, Gain stage = +0 dB, Input signal = 0 dBFS, Code 0, A-weighted
Signal to distortion	50			dB	Load = 8 Ω, 350 mW
Power supply rejection	60			dB	1 kHz

Table 19: High power differential audio receive path (SPK_P / SPK_N) characteristics

4.2.4 ADC pin (LEON-G100 only)

Parameter	Min.	Typ	Max.	Unit	Remarks
Resolution		12		Bits	
Differential linearity error			±0.5	LSB	
Integral linearity error			±4	LSB	
Offset error			±10	LSB	ADC input = 0 V
Absolute gain drift			±2	%	Variation due to change in supply, temperature and life time.
Input voltage span	0		2.00	V	
Throughput rate			4	Hz	
Input resistance	1.1			MΩ	With respect to GND. If mode OFF is selected.
Input resistance in measurement mode	383	580	777	kΩ	With respect to GND. Variation due to process tolerances and change in supply, temperature, and life time.
Internal voltage	0.46	0.48	0.50	V	With respect to GND. Variation due to process tolerances and change in supply, temperature, and life time.
Input leakage current			0.1	µA	

Table 20: Input characteristics of ADC pin

[6] If not specified otherwise, all parameters are measured with a bandwidth of 20 Hz,...,20 kHz and gain setting gs = 0 dB.

4.2.5 Power consumption

Status	Power Consumption[7]
Power Off Mode	< 90 µA
GSM/GPRS Power Saving (Idle) Mode @ DRX = 5[8]	< 1.6 mA
GSM/GPRS Power Saving (Idle) Mode @ DRX = 9 [9]	< 0.99 mA
GSM Talk (Connected) Mode @ 850 / 900 MHz, PCL = 5 (P = 33dBm) [10]	< 300 mA
GSM Talk (Connected) Mode @ 1800 / 1900 MHz, PCL = 0 (P = 30dBm) [10]	< 250 mA
GPRS 2 Tx + 3 Rx slots TBF (Connected) Mode @ 850 MHz, GAMMA_TN = 3 [10]	< 410 mA
GPRS 2 Tx + 3 Rx slots TBF (Connected) Mode @ 900 MHz, GAMMA_TN = 3 [10]	< 350 mA
GPRS 2 Tx + 3 Rx slots TBF (Connected) Mode @ 1800 MHz, GAMMA_TN = 3 [10]	< 330 mA
GPRS 2 Tx + 3 Rx slots TBF (Connected) Mode @ 1900 MHz, GAMMA_TN = 3 [10]	< 340 mA

Table 21: Power consumption

4.2.6 RF Performance

Parameter	Min.	Typ	Max.	Unit	Remarks
Frequency Range - Uplink GSM 850	824		849	MHz	
Frequency Range - Uplink E-GSM 900	880		915	MHz	
Frequency Range - Uplink DCS 1800	1710		1785	MHz	
Frequency Range - Uplink PCS 1900	1850		1910	MHz	
Frequency Range - Downlink GSM 850	869		894	MHz	
Frequency Range - Downlink E-GSM 900	925		960	MHz	
Frequency Range - Downlink DCS 1800	1805		1880	MHz	
Frequency Range - Downlink PCS 1900	1930		1990	MHz	
Maximum output power GSM 850			33	dBm	
Maximum output power E-GSM 900			33	dBm	
Maximum output power DCS 1800			30	dBm	
Maximum output power PCS 1900			30	dBm	
Receiver input sensitivity @ ARP BER Class II < 2.4 % GSM 850	-102	-110		dBm	
Receiver input sensitivity @ ARP BER Class II < 2.4 % E-GSM 900	-102	-110		dBm	

[7] Maximum values for module average current consumption through the VCC pad in the listed status/conditions, at 25°C, with VCC = 3.8 V, with a matched antenna.
[8] Module is registered or attached to the network, with a paging period of 1177 ms (GSM network DRX setting of 5).
[9] Module is registered or attached to the network, with a paging period of 2118 ms (GSM network DRX setting of 9).
[10] Module transmits at the maximum power level

Parameter	Min.	Typ	Max.	Unit	Remarks
Receiver input sensitivity @ ARP BER Class II < 2.4 % DCS 1800	-102	-109		dBm	
Receiver input sensitivity @ ARP BER Class II < 2.4 % PCS 1900	-102	-109		dBm	
Modulation			GMSK		

Table 22: ANT port RF characteristics

5 Reliability tests and approvals

5.1 Reliability tests

Tests for product family qualifications according to ISO 16750 "Road vehicles - Environmental conditions and testing for electrical and electronic equipment".

5.2 Approvals

Products marked with this lead-free symbol on the product label comply with the "Directive 2002/95/EC of the European Parliament and the Council on the Restriction of Use of certain Hazardous Substances in Electrical and Electronic Equipment" RoHS).

LEON-G100/G200 GSM/GPRS modules are RoHS compliant.

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

LEON-G100/G200 modules have been approved by the following regulatory bodies:

- R&TTE, CE, GCF, FCC, PTCRB

LEON-G100/G200 modules are approved by the following regulatory bodies in the following countries:

- Canada IC
- China SRRC

LEON-G100/G200 modules will be approved by the following regulatory bodies in the following countries:

- Brazil (Anatel)
- Russia
- Mexico
- Israel
- South Africa
- Turkey

LEON-G100/G200 modules are approved by the following network operators:

- AT&T (USA)

LEON-G100/G200 modules to be approved by the following network operators:

- Jasper Wireless (outside of USA)

6 Product handling

6.1 Packaging

LEON-G100/G200 modules are delivered as hermetically sealed, reeled tapes in order to enable efficient production, production lot set-up and tear-down.

Figure 4: Reeled LEON-G100/G200 modules

6.1.1 Reels

LEON-G100/G200 modules are deliverable in quantities of 250 pcs on a reel. The dimension of the reel is shown in Figure 5.

☞ Quantities of less than 250 pieces are also available. Contact u-blox for more information.

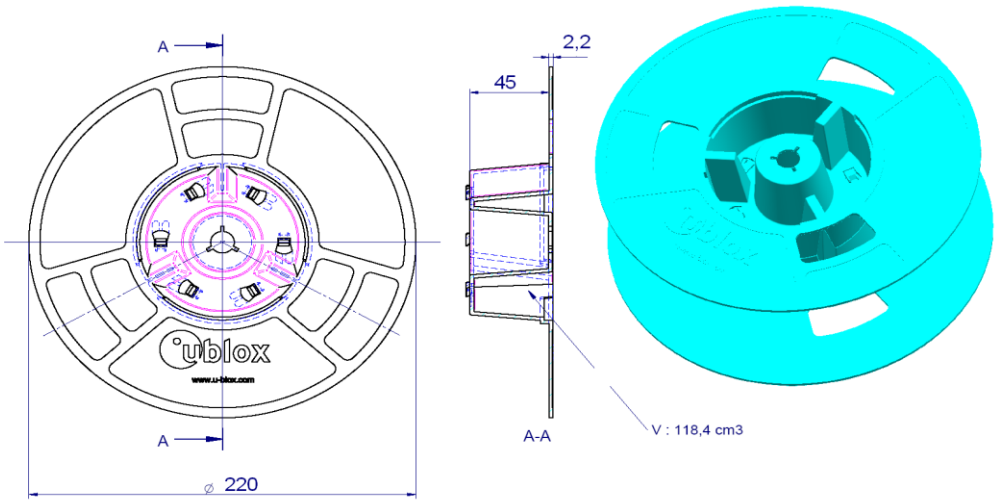


Figure 5: Dimensions of reel (measurements are in mm, unless otherwise specified)

6.1.2 Tapes

The dimensions and orientations of the tapes for LEON-G100/G200 modules are specified in Figure 6.

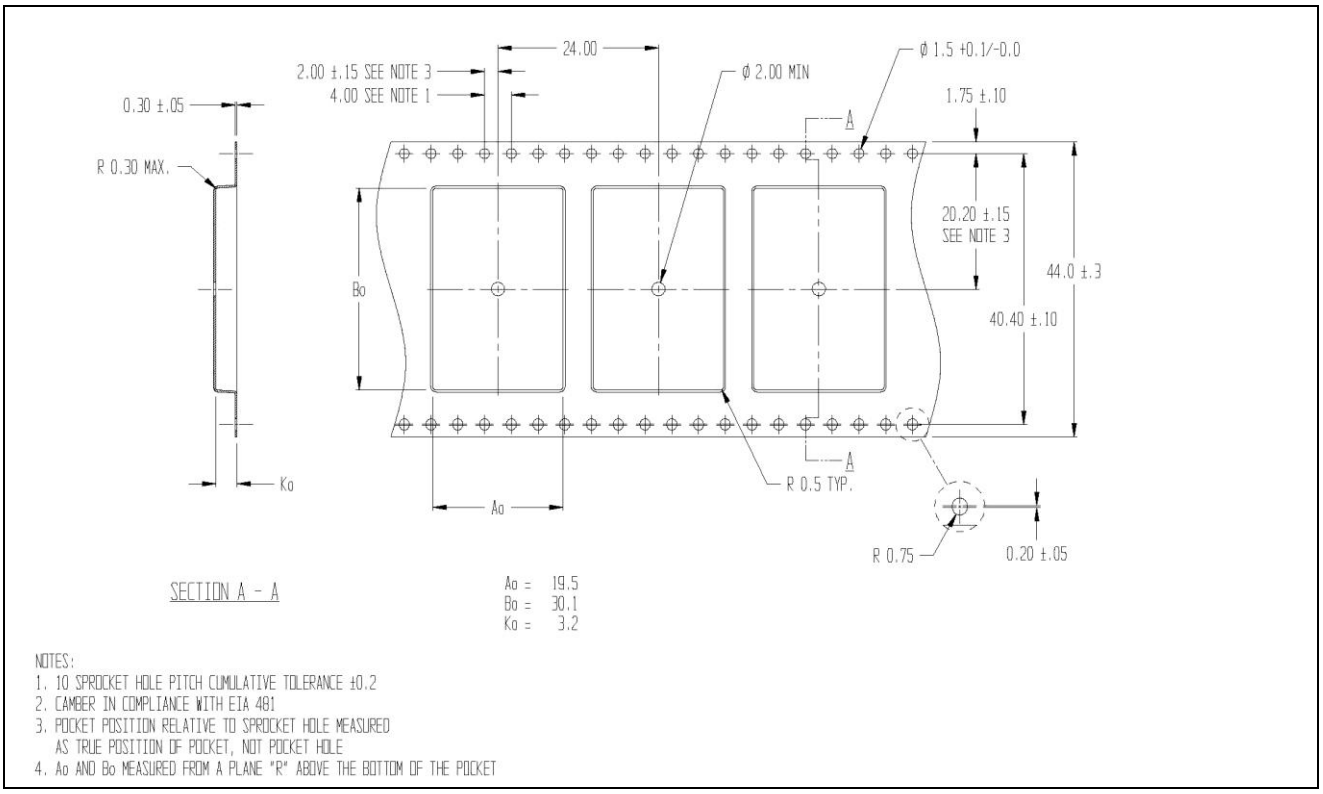


Figure 6: Dimensions for LEON-G100/G200 on tape

6.2 Shipment, storage and handling

LEON-G100/G200 modules are designed and packaged to be processed in an automatic assembly line, and are shipped in Tape-and-Reel.

LEON-G100/G200 modules are Moisture Sensitive Devices (MSD) in accordance to the IPC/JEDEC specification. Appropriate MSD handling instructions and precautions are summarized in Sections 6.2.1 to 6.2.4. Read them carefully to prevent permanent damage due to moisture intake.

LEON-G100/G200 modules contain highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Handling LEON-G100/G200 modules without proper ESD protection may destroy or damage them permanently. See Section 6.2.6 for ESD handling instructions.

6.2.1 Moisture sensitivity levels

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. LEON-G100/G200 modules are rated at MSL level 4.

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

6.2.2 Shipment

Table 23 summarizes the dry pack requirements for different MSL levels in the IPC/JEDEC specification.

MSL Level	Dry Pack Requirement
1	Optional
2	Required
2a	Required
3	Required
4	Required

Table 23: JEDEC specification of dry pack requirements

According to IPC/JEDEC specification J-STD-020, if a device passes MSL level 1, it is classified as not moisture sensitive and does not require dry pack. If a device fails level 1 but passes a higher numerical level, it is classified as moisture sensitive and must be dry packed in accordance with J-STD-033.

LEON-G100/G200 modules are delivered on Tape-and-Reels in a hermetically sealed package ("dry bag") to prevent moisture intake and protect against electrostatic discharge. For protection from physical damage, the reels are individually packed in cartons.

Carrier materials such as trays, tubes, reels, etc., that are placed in the Moisture Barrier Bag (MBB) can affect the moisture level within the MBB. Therefore, the effect of these materials is compensated by adding additional desiccant in the MBB to ensure the shelf life of the SMD packages.

The dry bag provides an IPC/JEDEC compliant MSD label describing the handling requirements to prevent humidity intake. IPC/JEDEC specifications require that MSD sensitive devices be packaged together with a Humidity Indicator Card (HIC) and desiccant to absorb humidity. If no moisture has been absorbed, the three fields in the HIC indicate blue color. Figure 7 shows examples of an MSD label and HIC.

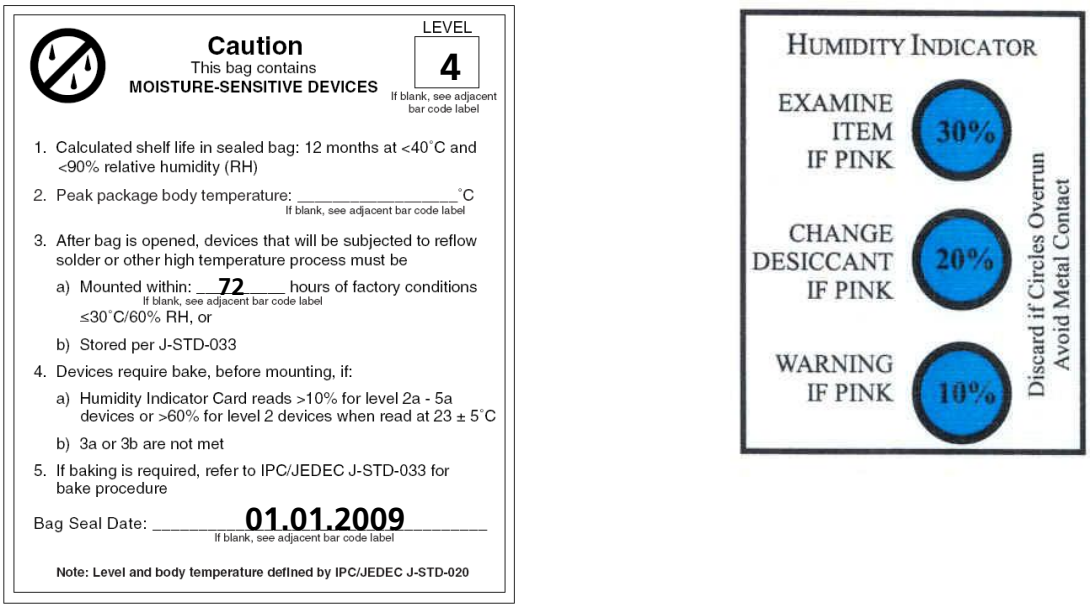


Figure 7: Examples of MSD Label and Humidity Indicator Card

6.2.3 Storage and floor life

The calculated shelf life for dry packed SMD packages is a minimum of 12 months from the bag seal date, when stored in a noncondensing atmospheric environment of <40°C/90% RH.

Table 24 lists floor life for different MSL levels in the IPC/JEDEC specification.

MSL Level	Floor life (out of bag) at factory ambient ≤30°C/60% RH or as stated
1	Unlimited at ≤30°C/85% RH
2	1 year
2a	4 weeks
3	168 hours
4	72 hours

Table 24: JEDEC specification of floor life

The parts must be processed and soldered within the time specified for the MSL level. If this time is exceeded, or the humidity indicator card in the sealed package indicates that they have been exposed to moisture, the devices need to be pre-baked before the reflow solder process (see Section 6.2.4).

6.2.4 Drying

Both encapsulant and substrate materials absorb moisture. IPC/JEDEC specification J-STD-020 must be observed to prevent cracking and delamination associated with the "popcorn" effect during reflow soldering. The popcorn effect can be described as miniature explosions of evaporating moisture. Baking before processing is required in the following cases:

- Humidity indicator card: At least one circular indicator is no longer blue
- Floor life or environmental requirements after opening the seal have been exceeded, e.g. exposure to excessive seasonal humidity.

Refer to Section 4 of IPC/JEDEC J-STD-033 for recommended baking procedures. Table 4-1 of the specification lists the required bake times and conditions for drying. For example, a LEON-G100 that has exceeded its floor life by >72 hours shall be baked at 125°C for 9 hours. (Floor life begins counting at time = 0 after bake).

Do not attempt to bake LEON-G100/G200 modules while contained in tape and rolled up in reels. For baking, place parts individually onto oven tray.

Oxidation risk: Baking SMD packages may cause oxidation and/or intermetallic growth of the terminations, which if excessive can result in soldering problems during board assembly. The temperature and time for baking SMD packages are therefore limited by solderability considerations. The cumulative bake time at a temperature greater than 90°C and up to 125°C shall not exceed 96 hours. If the bake temperature is not greater than 90°C, there is no limit on bake time. Bake temperatures higher than 125°C are not allowed.

6.2.5 Reflow soldering

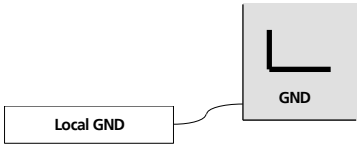
Reflow profiles are to be selected according to IPC/JEDEC J-STD-020.

6.2.6 ESD precautions

LEON-G100/G200 modules are Electrostatic Sensitive Devices (ESD) and require special precautions when handling.

Particular care must be exercised when handling patch antennas, due to the risk of electrostatic charges. In addition to standard ESD safety practices, the following measures should be taken into account whenever handling the receiver:

- Unless there is a galvanic coupling between the local GND (i.e. the work table) and the PCB GND, then the first point of contact when handling the PCB shall always be between the local GND and PCB GND.
- Before mounting an antenna patch, connect ground of the device



- When handling the RF pin, do not come into contact with any charged capacitors and be careful when contacting materials that can develop charges (e.g. patch antenna ~10 pF, coax cable ~50-80 pF/m, soldering iron, …)

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

7 Labeling and ordering information

7.1 Product labeling

The labeling LEON-G100 / LEON-G200 modules include important product information. The location of the product type number is shown in Figure 9.

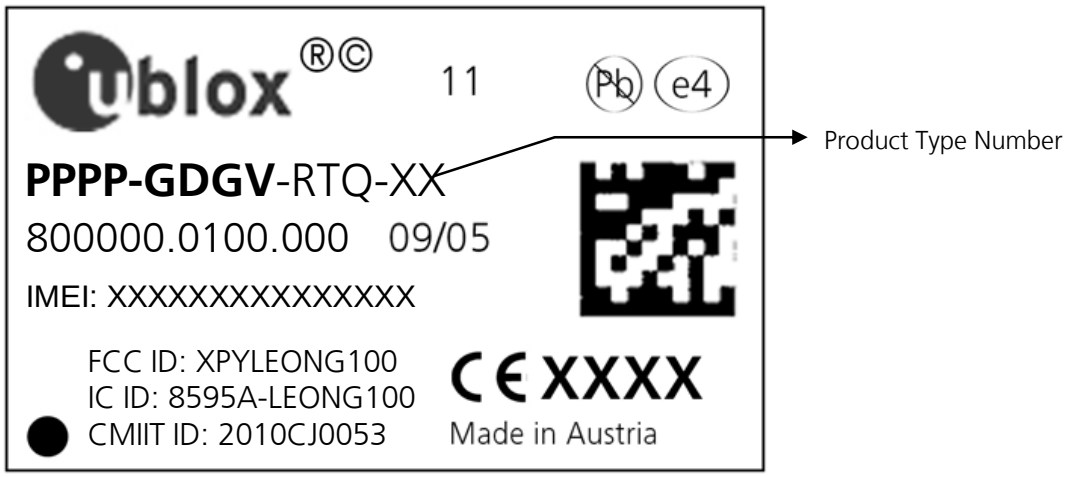


Figure 8: Location of product type number on LEON-G100 module label

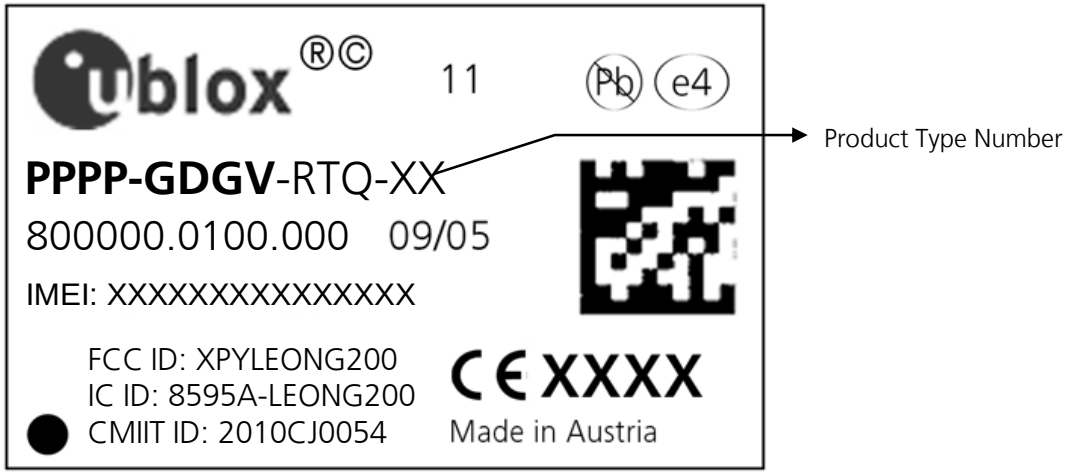


Figure 9: Location of product type number on LEON-G200 module label

7.2 TAC

- For LEON-G100: 35785203.
- For LEON-G200: 35785303.

The first 8 digits of IMEI are the TAC number.

7.3 Explanation of codes

3 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 25 below details these 3 different formats:

Format	Structure
Product Name	PPPP-CDGV
Ordering Code	PPPP-CDGV-RTQ
Type Number	PPPP-CDGV-RTQ-XX

Table 25: Product Code Formats

The parts of the product code are explained in Table 26.

Code	Meaning	Example
PPPP	Product Family	LEON
C	Cellular standard (i.e. G: GSM; E: Edge; H HSxpA; C: CDMA)	G: GSM
D	Wireless variant, i.e. chip or function set range: [0…9, A..Z]	1
G	GPS generation (if GPS functionality available)	5: u-blox 5, 0: no GPS functionality
V	GPS variant (if GPS functionality available)	H: u-blox 5H, 0: no GPS functionality
R	Reserved for future use	default: 0
T	Firmware Version range: [0…9, A..Z]	0
Q	Quality grade (S = standard, A = automotive)	S
XX	HW version plus GSM SW (not relevant for GSM certification)	00

Table 26: part identification code

7.4 Ordering information

Ordering No.	Product
LEON-G100-02S	Quad-Band GSM/GPRS Module, 29.5 x 18.9 x 3.01 mm, 250 pcs/reel
LEON-G200-02S	Quad-Band GSM/GPRS module with extended feature set, 29.5 x 18.9 x 3.01 mm, 250 pcs/reel

Table 27: Product Ordering Codes

Related documents

[1] 3GPP TS 27.007 Technical Specification Group Core Network and Terminals; AT command set for User Equipment (UE)

[2] 3GPP TS 27.005 - Technical Specification Group Terminals; Use of Data Terminal Equipment - Data Circuit terminating Equipment (DTE-DCE) interface for Short Message Services (SMS) and Cell Broadcast Service (CBS)

[3] 3GPP TS 27.010 - Terminal Equipment to User Equipment (TE-UE) multiplexer protocol (Release 1999)

[4] u-blox AT Commands Manual, Docu. No GSM.G1-SW-09002

[5] ITU-T Recommendation V24, 02-2000. List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Connection Equipment (DCE)

[6] LEON-G100/G200 System Integration Manual, Docu. No GSM.G1-HW-09002

☞ For regular updates to u-blox documentation and to receive product change notifications please register on our homepage.

Revision history

Revision	Date	Name	Status / Comments
-	18/03/2009	tgri	Initial release
A	04/06/2009	lpah	New CI, pin table, labeling information, contact information, change of document status to advance information.
B	28/10/2009	tgri	Change of document status to advance information. Section 1.3 new block diagrams. Section 1.4 revised product description. Section 1.7 updated list of supported AT commands. Revised Section 2.4 UART. Section 3.1.2 update of pinout. Chapter 4, updated Section 4.1 table 5, section 4.2 table 7, section 4.2.1, section 4.2.2, section 4.2.5. Update of section 7.3, explanation of product codes.
B1	30/11/2009	tgri	Update of Figure 3.
B2	02/12/2009	tgri	Corrected revision history table
C	26/01/2010	lpah	Update after China SRRC achievement

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