CELLULAR

SARA-G450

Quad-band GSM/GPRS modules

Data Sheet

Abstract

Technical data sheet describing the SARA-G450 GSM/GPRS cellular modules.
These modules are complete and cost efficient solutions offering quad-band GSM/GPRS voice and/or data transmission technology in a compact form factor.

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This document applies to the following products:

Product name	Type number	Modem version	Application version	PCN reference	Product status
SARA-G450	SARA-G450-00C-00	--	--	--	Functional Sample

Contents

1 Functional description

1.1 Overview

SARA-G450 modules are versatile 2.5G GSM/GPRS cellular modules in the miniature SARA 96-pin LGA form factor (26.0 x 16.0 mm). Featuring low power consumption, the SARA-G450 modules combine baseband, RF transceiver, power management unit, and power amplifier in a single solution allowing an easy integration into compact designs and a seamless drop-in migration from other u-blox cellular module families supporting 2G, 3G, LTE and LPWA (Cat M1 and Cat NB1) radio access technologies.

SARA-G450 modules provide a fully qualified and certified solution, 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, road pricing, asset tracking, fleet management, anti-theft systems and Point of Sales (PoS) terminals.

SARA-G450 modules are full-feature GSM/GPRS quad band cellular modules with a comprehensive feature set including an extensive set of internet protocols. The modules are also designed to provide fully integrated access to u-blox GNSS positioning chips and modules, with embedded A-GPS (AssistNow Online and AssistNow Offline) functionality. Any host processor connected to the cellular module through a single serial port can control both the cellular module and the positioning chip / module.

The SARA-G450 modules' compact form factor and LGA pads allow fully automated assembly with standard pick & place and reflow soldering equipment for cost-efficient, high-volume production.

1.2 Product features

Model	Data Rate	Bands	Positioning				Interfaces					Audio		Features								Grade		
	GPRS multi-slot class 12	GSM/GPRS 4-band	Integrated GNSS receiver	GNSS via modem	AssistNow Software	CellLocate®	UARTs	SPI	USB 2.0	GPIOs	DDC (I²C)	Analog Audio	Digital Audio	Network indication	Antenna supervisor	Jamming detection	Embedded TCP, UDP stack	Embedded FTP, HTTP	Embedded SSL, TLS	Dual stack IPv4/IPv6	FW update via serial interface	Standard	Professional	Automotive
SARA-G450	•	•		○	○	○	•			•	○	○	○	•	•	○	•	•	•	•	•			

● = supported by all FW versions ○ = supported by future FW versions

Table 1: SARA-G450 modules' main features summary

1.3 Block diagram

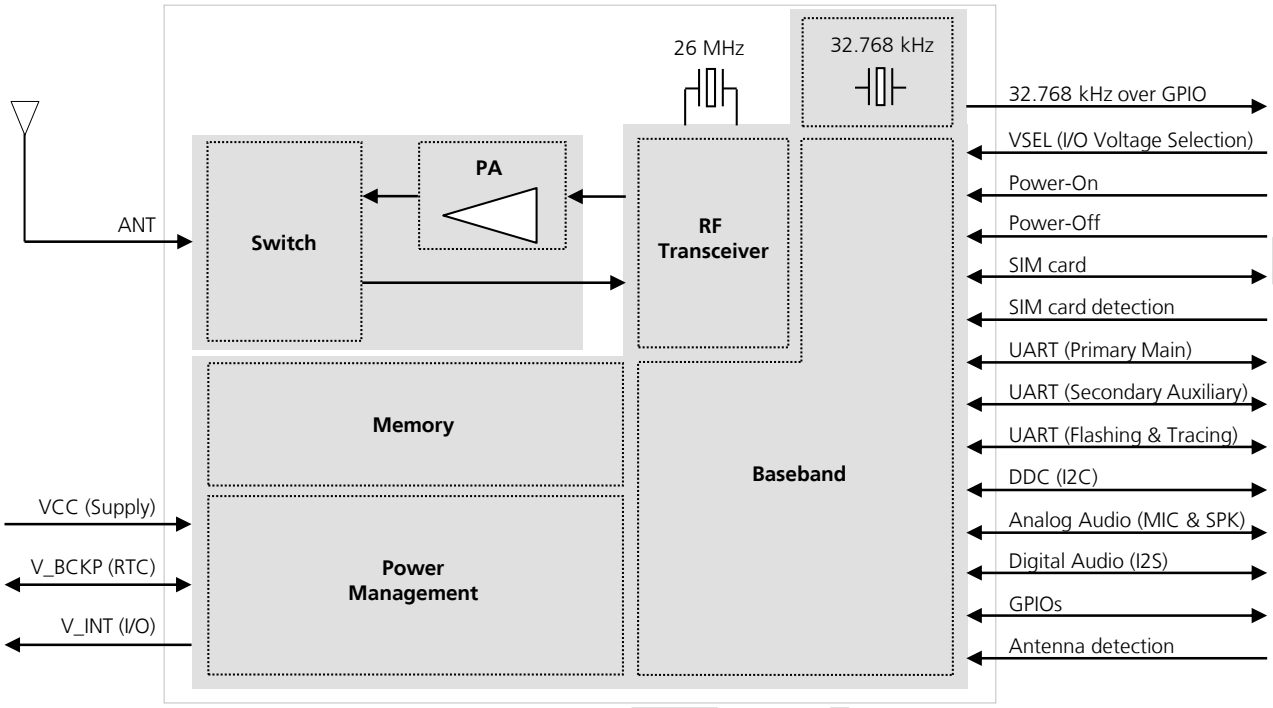

Figure 1: SARA-G450 modules' block diagram

SARA-G450-00C modules, i.e. the "00" product version of the SARA-G450 modules, do not support the following interfaces, which should be left unconnected and should not be driven by external devices:

- Secondary auxiliary UART interface
- DDC (I^2C) interface
- Analog audio interface
- Digital audio interface

1.4 Product description

Item	SARA-G450
GSM/GPRS Protocol Stack	3GPP Release 99
Mobile Station Class	Class B[1]
GSM/GPRS Bands	GSM 850 MHz E-GSM 900 MHz DCS 1800 MHz PCS 1900 MHz
GSM/GPRS Power Class	Class 4 (33 dBm) for 850/900 bands Class 1 (30 dBm) for 1800/1900 bands
Packet Switched Data Rate	GPRS multi-slot class 12[2] Coding scheme CS1-CS4 Up to 85.6 kb/s DL[3] Up to 85.6 kb/s UL[3]
Circuit Switched Data Rate	Up to 9.6 kb/s DL/UL[3] Transparent mode Non-transparent mode
Network Operation Modes	I to III

Table 2: SARA-G450 modules' GSM/GPRS characteristics summary

The network automatically configures the channel encoding used by the module, depending on conditions and 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 provides good conditions, the network can use the least robust but fastest coding scheme (CS-4) to obtain optimum speed.

1.5 AT command support

The module supports AT commands according to 3GPP standards TS 27.007 [3], 27.005 [4] and 27.010 [5], plus u-blox proprietary AT commands.

☞ For the complete list of the AT commands supported by SARA-G450 modules, please contact the u-blox office or sales representative nearest you.

1.6 Supported features

Table 3 lists some of the main features supported by SARA-G450 modules.

Feature	Description
Network Indication	GPIO configured to indicate the network status: registered home network, registered roaming, voice or data call enabled, no service.

[1] Device can be attached to both GPRS and GSM services (i.e. Packet Switch and Circuit Switch mode) using one service at a time.
[2] GPRS multi-slot class 12 implies a maximum of 4 slots in Down-Link (reception) and 4 slots in Up-Link (transmission) with 5 slots in total. The SARA-G450 modules can be configures as GPRS multi-slot class 10 by means of AT command.
[3] The maximum bit rate of the module depends on the current network settings.

Feature	Description
Antenna Detection	The **ANT_DET** pin provides antenna presence detection capability, evaluating the resistance from the **ANT** pin to GND by means of an external antenna detection circuit implemented on the application board.
Jamming detection[4]	Detects "artificial" interference that obscures the operator's carriers providing access to the GSM service and reports the start and stop of such conditions to the application processor (AP). The AP can react appropriately, e.g. by switching off the radio transceiver to reduce power consumption and monitoring the environment at constant periods.
Second AT interface[4]	AT command mode available on both the Primary UART interface and the Secondary Auxiliary UART interface.
Embedded TCP/IP and UDP/IP	Embedded TCP/IP and UDP/IP stack including direct link mode for TCP and UDP sockets. The sockets can be configured in Direct Link mode to establish a transparent end-to-end communication with an already connected TCP or UDP socket via serial interface.
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 Hyper-Text 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 simultaneously used.
Embedded TLS 1.2	With the support of X.509 certificates, Embedded TLS 1.2 provides server and client authentication, data encryption, data signature and enables TCP/IP applications like HTTPS and FTPS to communicate over a secured and trusted connection.
IPv4/IPv6 dual-stack	Capability to move between IPv4 and dual stack network infrastructures. IPv4 and IPv6 addresses can be used.
GPS/GNSS via Modem[4]	Full access to u-blox positioning chips and modules is available through a dedicated DDC (I^2C) interface. A single serial port from any host processor can control both the u-blox SARA-G450 cellular module and the u-blox positioning chip / module.
AssistNow Software[4]	Embedded AssistNow Online and AssistNow Offline clients to provide full developed to provide better GNSS performance and faster Time-to-First-Fix.
CellLocate®[4]	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: parameters of the visible home network cells are only sent • Deep scan: parameters of all surrounding cells of all mobile operators are sent
Hybrid Positioning	Provides the module's current position 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.
Firmware update Over AT commands (FOAT)	Firmware module upgrade over the UART interface, using AT command.
Power saving	When power saving configuration is enabled, the module automatically enters the low power idle-mode whenever possible, reducing current consumption. During the 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.

Table 3: Some of the main features supported by SARA-G450 modules

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

[4] Supported by future FW versions

2 Interfaces

2.1 Power management

2.1.1 Module supply input (VCC)

SARA-G450 modules must be supplied through the three **VCC** pins 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.

SARA-G450 modules provide separate supply inputs over the three **VCC** pins:

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

It is important that the system power supply circuit is able to withstand the maximum pulse current during a transmit burst at maximum power level (see Table 11).

2.1.2 RTC supply input/output (V_BCKP)

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

2.1.3 Digital I/O interfaces supply output (V_INT)

SARA-G450 modules provide supply rail output on the **V_INT** pin, which is internally generated when the module is switched on. The same voltage domain is used internally to supply the generic digital I/O interfaces of the modules (UART interfaces, I^2C interface, I^2S interface and GPIO pins).

The voltage value of the **V_INT** supply output can be set to 1.8 V or 2.8 V according to the configuration of the **VSEL** input pin (see section 2.3.4). The **V_INT** supply output can be used in place of an external regulator.

☞ It is recommended to provide a Test-Point connected to the **V_INT** pin for diagnostic purpose.

2.2 Antenna

2.2.1 Antenna RF interface (ANT)

The **ANT** pin has an impedance of 50 Ω and provides the RF antenna interface of SARA-G450 modules.

2.2.2 Antenna detection (ANT_DET)

The **ANT_DET** pin is an Analog to Digital Converter (ADC) input to sense the antenna presence (as optional feature), evaluating the resistance from the **ANT** pin to GND by means of an external antenna detection circuit implemented on the application board.

2.3 System functions

2.3.1 Module power-on (PWR_ON)

SARA-G450 modules can be switched on in one of the following ways:

- Forcing a low level at the **PWR_ON** input pin, which is normally high due to internal pull-up. The **PWR_ON** line is intended to be driven by open drain, open collector or contact switch.
- Programming an RTC alarm at a scheduled time

☞ It is recommended to provide a Test-Point connected to the **PWR_ON** pin for diagnostic purpose.

2.3.2 Module power-off

SARA-G450 modules can be properly switched off, with storage of current settings and network detach, by:

- AT+CPWROFF command

An abrupt under-voltage shutdown occurs on SARA-G450 modules 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 proper network detach.

An abrupt shutdown occurs when a low level is applied to the **PWR_OFF** pin, but in this case the module does not perform the storing of the current parameter settings as well as the proper network detach. The **PWR_OFF** line is intended to be driven by open drain, open collector or contact switch.

☞ It is recommended to provide a Test-Point connected to the **PWR_OFF** pin for diagnostic purpose.

2.3.3 Module reset

SARA-G450 modules can be properly reset (rebooted), with storage of current settings and network detach, by:

- AT+CFUN command. This causes an "internal" or "software" reset of the module.

An abrupt shutdown occurs when a low level is applied to the **PWR_OFF** pin: in this case the module does not perform the storing of the current parameter settings as well as the proper network detach (see section 2.3.2). The module can be subsequently rebooted forcing a low level at the **PWR_ON** input pin (see section 2.3.1).

2.3.4 Digital I/O interfaces voltage selection (VSEL)

The digital I/O interfaces of SARA-G450 modules (the UART interfaces, I^2C interface, I^2S interface and GPIO pins) can operate at 1.8 V or 2.8 V voltage rail. The operating voltage can be selected using the **VSEL** input pin:

- If the **VSEL** input pin is connected to ground, the digital I/O interfaces operate at 1.8 V
- If the **VSEL** input pin is unconnected, the digital I/O interfaces operate at 2.8 V

The operating voltage cannot be changed dynamically: the **VSEL** input pin configuration has to be set before the boot of SARA-G450 modules and then it cannot be changed after switched on.

2.4 SIM

2.4.1 SIM interface

A SIM interface is available via the **VSIM**, **SIM_IO**, **SIM_CLK**, **SIM_RST** pins of SARA-G450 modules for the direct connection of an external SIM card/chip: 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 types are 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 procedure for baud-rate selection, according to the values proposed by the SIM.

2.4.2 SIM card detection (SIM_DET)

The **SIM_DET** pin of SARA-G450 modules is a digital input provided to sense the SIM card presence (as an optional feature), when it is properly connected to the mechanical switch of the SIM card holder.

2.5 Serial interfaces

2.5.1 Primary main UART interface (UART)

The UART interface is a 9-wire unbalanced asynchronous serial interface provided on SARA-G450 modules for communication with an application processor, supporting:

- AT command mode
- Data mode and Online command mode[5]
- MUX functionality
- FW upgrades by means of the FOAT feature

UART characteristics are:

- Complete serial port with RS-232 functionality conforming to ITU-T V.24 Recommendation [2], with CMOS compatible signal levels (0 V for low data bit or ON state and 1.8 V / 2.8 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

2.5.1.1 Multiplexer protocol

SARA-G450 module has a software layer with MUX functionality, 3GPP TS 27.010 [5], available on the UART physical link. 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 a number of simultaneous sessions over the physical link (UART): the user can concurrently use AT command interface on one MUX channel and data communication on another MUX channel.

[5] See the u-blox AT Commands Manual 0 for the definition of the interface data mode and online command mode.

2.5.2 Secondary auxiliary UART interface (AUX UART)

☞ The secondary auxiliary UART interface will be supported by future FW versions.

The AUX UART interface is a 3-wire unbalanced asynchronous serial interface available on SARA-G450 modules, supporting

- AT command mode
- FW upgrades by means of the FOAT feature

Auxiliary UART characteristics are:

- Only the **RXD_AUX** data output and the **TXD_AUX** data input are provided, with CMOS compatible signal levels (0 V for low data bit or ON state and 1.8 V / 2.8 V for high data bit or OFF state)

2.5.3 Additional UART interface for FW upgrade and Tracing (FT UART)

The FT UART interface is a 3-wire unbalanced asynchronous serial interface available on SARA-G450 modules, supporting

- FW upgrades by means of the u-blox dedicated tool
- Trace log capture (diagnostic purpose)

FT UART characteristics are:

- Only the **RXD_FT** data output and the **TXD_FT** data input are provided, with CMOS compatible signal levels (0 V for low data bit or ON state and 1.8 V / 2.8 V for high data bit or OFF state)

☞ It is recommended to provide Test-Points connected to the **RXD_FT** and **TXD_FT** pins for FW upgrades and diagnostic purposes.

2.5.4 DDC (I^2C compatible) interface

☞ The DDC (I^2C compatible) interface will be supported by future FW versions.

SARA-G450 modules provide an I^2C compatible DDC interface on the **SCL** and **SDA** pins exclusively for the communication with u-blox GNSS positioning chips / modules.

2.6 Audio interfaces

☞ The audio interfaces will be supported by future FW versions.

SARA-G450 modules provide analog and digital audio interfaces:

- Analog audio input:
  - Differential analog audio input (**MIC_P**, **MIC_N**) shared for all the analog audio path modes: the pins can be connected to the output of an external analog audio device or can be connected to an external microphone by means of a simple circuit implemented on the application board
  - Supply output for an external microphone (**MIC_BIAS**): the pin can provide the bias to an external microphone by means of a simple circuit implemented on the application board
  - Local ground for the external microphone (**MIC_GND**): the pin can provide the reference for the differential analog audio input as sense ground line for the external microphone circuit
- Analog audio output:
  - Differential audio output (**SPK_P**, **SPK_N**) shared for all the analog audio path modes: the pins can be connected to the input of an external analog audio device or can be connected to an external speaker
- I^2S digital audio interface:
  - 4-wire digital audio interface (**I2S_TXD**, **I2S_RXD**, **I2S_CLK**, **I2S_WA**)

2.7 GPIO

SARA-G450 modules provide 4 GPIO pins (**GPIO1**-**GPIO4**) that can be configured for general purpose input/output, or to provide custom functions via u-blox AT commands.

Table 4 summarizes the custom functions available on the GPIO pins of SARA-G450 modules.

Function	Description	Default GPIO	Configurable GPIOs
Network status indication	Indicates network status: registered home network, registered roaming, data transmission, no service	--	GPIO1, GPIO2, GPIO3, GPIO4
GSM Tx-burst indication	Indicates when a GSM Tx burst/slot occurs	--	GPIO1
32.768 kHz output	32.768 kHz clock output	--	GPIO3
General purpose input	Input to sense high or low digital level	--	GPIO1, GPIO2, GPIO3, GPIO4
General purpose output	Output to set the high or the low digital level	--	GPIO1, GPIO2, GPIO3, GPIO4
Pad disabled	Tri-state with an internal active pull-down enabled	GPIO1, GPIO2, GPIO3, GPIO4	GPIO1, GPIO2, GPIO3, GPIO4

Table 4: GPIO custom functions configuration

3 Pin definition

3.1 Pin assignment

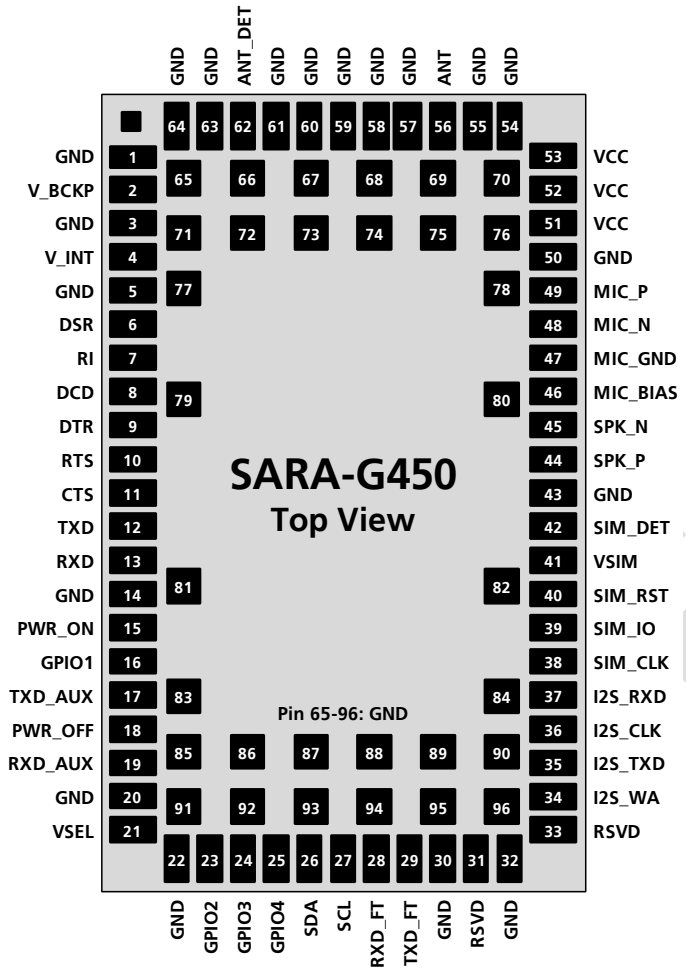

Figure 2: SARA-G450 modules – pin assignments

No	Name	Power domain	I/O	Description	Remarks
1	GND	-	N/A	Ground	All the GND pads must be connected to ground.
2	V_BCKP	-	I/O	Real Time Clock supply input/output	If the VCC module main supply input voltage is below the operating range, the internal RTC can be supplied through the V_BCKP pin.
3	GND	-	N/A	Ground	All the GND pads must be connected to ground.
4	V_INT	-	O	Digital I/O Interfaces supply output	Test-Point recommended for diagnostic purpose. V_INT supply output, rail of the Digital I/O Interfaces, generated by the module when it is switched-on. V_INT = 1.8 V (typical), if VSEL is connected to GND. V_INT = 2.8 V (typical), if VSEL is unconnected. See section 4.2.2 for detailed electrical specs.
5	GND	-	N/A	Ground	All the GND pads must be connected to ground.

No	Name	Power domain	I/O	Description	Remarks
6	DSR	GDI	O	UART data set ready	Circuit 107 (DSR) in ITU-T V.24. See section 4.2.6 for detailed electrical specs.
7	RI	GDI	O	UART ring indicator	Circuit 125 (RI) in ITU-T V.24. See section 4.2.6 for detailed electrical specs.
8	DCD	GDI	O	UART data carrier detect	Circuit 109 (DCD) in ITU-T V.24. See section 4.2.6 for detailed electrical specs.
9	DTR	GDI	I	UART data terminal ready	Circuit 108/2 (DTR) in ITU-T V.24. See section 4.2.6 for detailed electrical specs.
10	RTS	GDI	I	UART ready to send	Circuit 105 (RTS) in ITU-T V.24. See section 4.2.6 for detailed electrical specs.
11	CTS	GDI	O	UART clear to send	Circuit 106 (CTS) in ITU-T V.24. See section 4.2.6 for detailed electrical specs.
12	TXD	GDI	I	UART transmitted data	Circuit 103 (TxD) in ITU-T V.24. See section 4.2.6 for detailed electrical specs.
13	RXD	GDI	O	UART received data	Circuit 104 (RxD) in ITU-T V.24. See section 4.2.6 for detailed electrical specs.
14	GND	-	N/A	Ground	All the GND pads must be connected to ground.
15	PWR_ON	-	I	Power-on input	Test-Point recommended for diagnostic purpose.
16	GPIO1	GDI	I/O	GPIO	GPIO configurable as described in Table 4. See section 4.2.6 for detailed electrical specs.
17	TXD_AUX	GDI	I	AUX UART transmitted data	Circuit 103 (TxD) in ITU-T V.24. Secondary auxiliary UART for AT commands. See section 4.2.6 for detailed electrical specs.
18	PWR_OFF	-	I	Power-off input	Test-Point recommended for diagnostic purpose.
19	RXD_AUX	GDI	O	AUX UART received data	Circuit 104 (RxD) in ITU-T V.24. Secondary auxiliary UART for AT commands. See section 4.2.6 for detailed electrical specs.
20	GND	-	N/A	Ground	All the GND pads must be connected to ground.
21	VSEL	-	I	Voltage Selection	Input to select the operating voltage of the digital I/O interfaces of the module (the UART interfaces, I^2C interface, I^2S interface and GPIO pins). If VSEL is connected to GND, the interfaces work at 1.8 V If VSEL is unconnected, the interfaces work at 2.8 V
22	GND	-	N/A	Ground	All the GND pads must be connected to ground.
23	GPIO2	GDI	I/O	GPIO	GPIO configurable as described in Table 4. See section 4.2.6 for detailed electrical specs.
24	GPIO3	GDI	I/O	GPIO	GPIO configurable as described in Table 4. See section 4.2.6 for detailed electrical specs.
25	GPIO4	GDI	I/O	GPIO	GPIO configurable as described in Table 4. See section 4.2.6 for detailed electrical specs.
26	SDA	DDC	I/O	I^2C bus data line	Fixed open drain. No internal pull-up. See section 4.2.7 for detailed electrical specs.
27	SCL	DDC	O	I^2C bus clock line	Fixed open drain. No internal pull-up. See section 4.2.7 for detailed electrical specs.
28	RXD_FT	GDI	O	FT UART received data	Test-Point recommended for diagnostic purpose. Circuit 104 (RxD) in ITU-T V.24. Additional UART for FW upgrade and Tracing. See section 4.2.6 for detailed electrical specs.
29	TXD_FT	GDI	I	FT UART transmitted data	Test-Point recommended for diagnostic purpose. Circuit 103 (TxD) in ITU-T V.24. Additional UART for FW upgrade and Tracing. See section 4.2.6 for detailed electrical specs.
30	GND	-	N/A	Ground	All the GND pads must be connected to ground.
31	RSVD	-	N/A	RESERVED pin	Internally not connected. Leave unconnected.
32	GND	-	N/A	Ground	All the GND pads must be connected to ground.
33	RSVD	-	N/A	RESERVED pin	This pin must be connected to GND.

No	Name	Power domain	I/O	Description	Remarks
34	I2S_WA	GDI	O	I²S word alignment	See section 4.2.6 for detailed electrical specs.
35	I2S_TXD	GDI	O	I²S transmit data	See section 4.2.6 for detailed electrical specs.
36	I2S_CLK	GDI	O	I²S clock	See section 4.2.6 for detailed electrical specs.
37	I2S_RXD	GDI	I	I²S receive data	See section 4.2.6 for detailed electrical specs.
38	SIM_CLK	SIM	O	SIM clock	See section 4.2.5 for detailed electrical specs.
39	SIM_IO	SIM	I/O	SIM data	Internal 4.7k pull-up to VSIM. See section 4.2.5 for detailed electrical specs.
40	SIM_RST	SIM	O	SIM reset	See section 4.2.5 for detailed electrical specs.
41	VSIM	-	O	SIM supply output	VSIM = 1.8 V typical, if external SIM = 1.8 V type. VSIM = 2.8 V typical, if external SIM = 3.0 V type. See section 4.2.2 for detailed electrical specs.
42	SIM_DET	GDI	I	SIM detection	SIM card presence detection function. See section 4.2.6 for detailed electrical specs.
43	GND	-	N/A	Ground	All the GND pads must be connected to ground.
44	SPK_P	AUDIO	O	Differential analog audio output (positive)	Differential analog audio output.
45	SPK_N	AUDIO	O	Differential analog audio output (negative)	Differential analog audio output.
46	MIC_BIAS	AUDIO	O	Microphone supply output	Supply output for the external microphone.
47	MIC_GND	AUDIO	I	Microphone analog reference	Local ground for the external microphone (reference for the differential analog audio input).
48	MIC_N	AUDIO	I	Differential analog audio input (negative)	Differential analog audio input.
49	MIC_P	AUDIO	I	Differential analog audio input (positive)	Differential analog audio input.
50	GND	-	N/A	Ground	All the GND pads must be connected to ground.
51	VCC	-	I	Module supply input	All VCC pins must be connected to external supply. Supply input for internal Base-Band PMU. See section 4.2.2, 4.2.3 for detailed electrical spec.
52	VCC	-	I	Module supply input	All VCC pins must be connected to external supply. Supply input for the internal RF Power Amplifier. See section 4.2.2, 4.2.3 for detailed electrical spec.
53	VCC	-	I	Module supply input	All VCC pins must be connected to external supply. Supply input for the internal RF Power Amplifier. See section 4.2.2, 4.2.3 for detailed electrical spec.
54	GND	-	N/A	Ground	All the GND pads must be connected to ground.
55	GND	-	N/A	Ground	All the GND pads must be connected to ground.
56	ANT	-	I/O	RF antenna	50 Ω nominal impedance See section 4.2.4 for detailed electrical specs.
57	GND	-	N/A	Ground	All the GND pads must be connected to ground.
58	GND	-	N/A	Ground	All the GND pads must be connected to ground.
59	GND	-	N/A	Ground	All the GND pads must be connected to ground.
60	GND	-	N/A	Ground	All the GND pads must be connected to ground.
61	GND	-	N/A	Ground	All the GND pads must be connected to ground.
62	ANT_DET	ADC	I	Antenna detection	Antenna presence detection function.
63	GND	-	N/A	Ground	All the GND pads must be connected to ground.
64	GND	-	N/A	Ground	All the GND pads must be connected to ground.
65-96	GND	-	N/A	Ground	All the GND pads must be connected to ground.

Table 5: SARA-G450 module pin-out

☞ For an explanation of 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 (chapter 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 the verification on a representative number of samples or according to the simulation.

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

4.1 Absolute maximum rating

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

Symbol	Description	Condition	Min	Max	Unit
VCC	Module supply voltage	Input DC voltage at VCC pins	-0.15	5.0	V
Tstg	Storage temperature range		-40	+85	°C

Table 6: Absolute maximum ratings

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

4.1.1 Maximum ESD

Parameter	Min	Typical	Max	Unit	Remarks
ESD sensitivity for all pins			1000	V	Human Body Model according to JESD22-A114

Table 7: Maximum ESD ratings

u-blox cellular modules are Electrostatic Sensitive Devices (ESD) and require special precautions when handling. See Section 7.3 for ESD handling instructions.

4.2 Operating conditions

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

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

4.2.1 Operating temperature range

Parameter	Min.	Typical	Max.	Unit	Remarks
Normal operating temperature	–20	+25	+70	°C	Normal operating temperature range (fully functional and meet 3GPP specifications)
Extended operating temperature	–40		+75	°C	Extended operating temperature range (RF performance may be affected outside normal operating range, though module is fully functional)

Table 8: Environmental conditions

4.2.2 Supply/Power pins

Symbol	Parameter	Min	Typical	Max	Unit
VCC	Module supply normal operating voltage	3.4	3.8	4.2	V
V_BCKP	Real Time Clock Supply input voltage	2.9		3.3	V

Table 9: Input characteristics of Supply/Power pins

Symbol	Parameter	Min	Typical	Max	Unit
VSIM	SIM interface supply output voltage, external SIM = 1.8V type		1.8		V
	SIM interface supply output voltage, external SIM = 3.0V type		2.8		V
V_BCKP	Real Time Clock Supply output voltage		3.1		V
V_INT	Digital I/O Interfaces supply output voltage, VSEL = GND		1.8		V
	Digital I/O Interfaces supply output voltage, VSEL unconnected		2.8		V

Table 10: Output characteristics of Supply/Power pins

4.2.3 Current consumption

Mode	Condition	Tx power	Min	Typ[6]	Max[7]	Unit
Power off mode (module switched off)	Averaged current value	--		0.1		mA
Idle mode (low power mode, no Tx in progress)	Averaged current value	--		1.5		mA
Connected Mode (Tx / Rx data call in progress)	Averaged current value, 850 MHz / 900 MHz operating bands	Maximum		230		mA
	Pulse current value[8] during 1-slot Tx burst, 850 MHz / 900 MHz operating bands	Maximum		1.5	1.9	A

Table 11: VCC current consumption

4.2.4 RF performance

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

Table 12: Operating RF frequency bands

Parameter	Min	Typical	Max	Unit	Remarks
Receiver input sensitivity GSM 850		-109		dBm	Downlink RF level @ BER Class II < 2.4 %
Receiver input sensitivity E-GSM 900		-109		dBm	Downlink RF level @ BER Class II < 2.4 %
Receiver input sensitivity DCS 1800		-109		dBm	Downlink RF level @ BER Class II < 2.4 %
Receiver input sensitivity PCS 1900		-109		dBm	Downlink RF level @ BER Class II < 2.4 %
Condition: 50 Ω source					

Table 13: Receiver sensitivity performance

[6] Typical values with a matched antenna.
[7] Maximum values with a mismatched antenna.[8] Use this figure to dimension maximum current capability of power supply.
[8] Use this figure to dimension maximum current capability of power supply.

4.2.5 SIM pins

Parameter	Min	Typical	Max	Unit	Remarks
Low-level input			0.5	V	External SIM type = 1.8 V
			0.8	V	External SIM type = 3.0 V
High-level input	1.2		2.0	V	External SIM type = 1.8 V
	2.0		3.0	V	External SIM type = 3.0 V
Low-level output		0.0		V	External SIM type = 1.8 V
		0.0		V	External SIM type = 3.0 V
High-level output		1.8		V	External SIM type = 1.8 V
		2.8		V	External SIM type = 3.0 V
Internal pull-up resistor on SIM_IO		4.7		kΩ	Pulled up to VSIM

Table 14: SIM pins characteristics

4.2.6 Generic Digital Interfaces pins

Parameter	Min	Typical	Max	Unit	Remarks
Internal supply for GDI domain		1.8		V	Digital Interfaces supply (V_INT). VSEL connected to GND
		2.8		V	Digital Interfaces supply (V_INT). VSEL unconnected
Low-level input			0.5	V	VSEL connected to GND
			0.8	V	VSEL unconnected
High-level input	1.2		2.0	V	VSEL connected to GND
	2.0		3.0	V	VSEL unconnected
Low-level output		0.0		V	VSEL connected to GND
		0.0		V	VSEL unconnected
High-level output		1.8		V	VSEL connected to GND
		2.8		V	VSEL unconnected

Table 15: GDI pins characteristics

4.2.7 DDC (I^2C) pins

Parameter	Min	Typical	Max	Unit	Remarks
Internal supply for DDC domain		1.8		V	Digital Interfaces supply (V_INT). VSEL connected to GND
		2.8		V	Digital Interfaces supply (V_INT). VSEL unconnected
Low-level input			0.5	V	VSEL connected to GND
			0.8	V	VSEL unconnected
High-level input	1.2		2.0	V	VSEL connected to GND
	2.0		3.0	V	VSEL unconnected
Low-level output		0.0		V	VSEL connected to GND
		0.0		V	VSEL unconnected
Clock frequency on SCL		100		kHz	

Table 16: DDC pins characteristics

5 Mechanical specifications

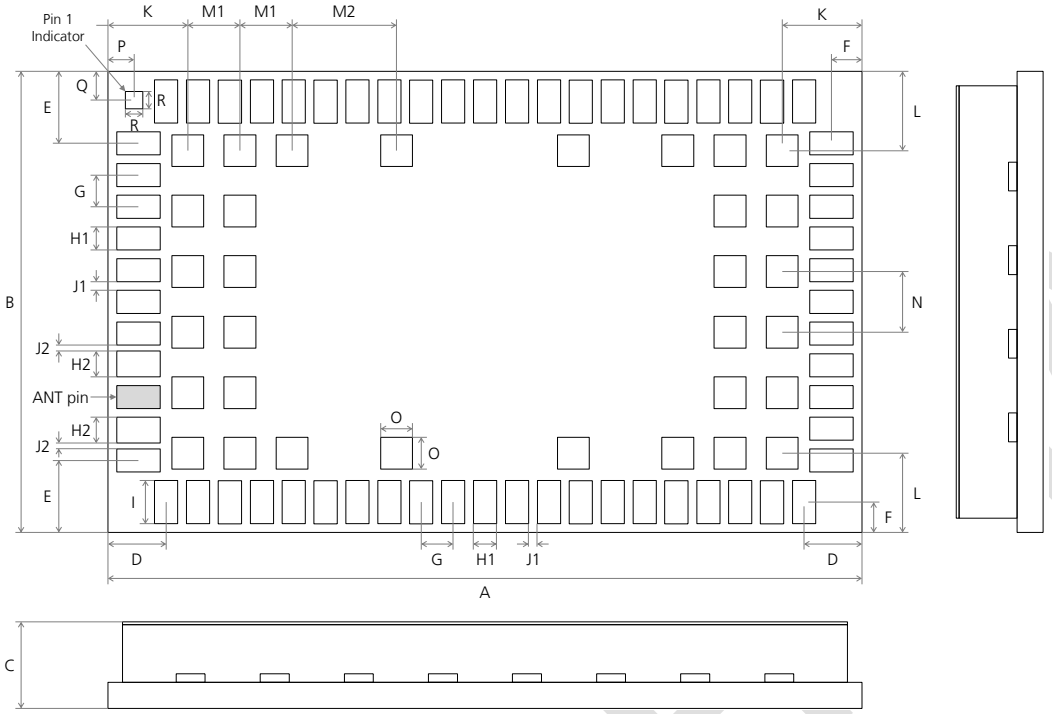

Figure 3: SARA-G450 module dimensions (bottom and sides views)

Parameter	Description	Typical		Tolerance	
A	Module Height [mm]	26.0	(1023.6 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
B	Module Width [mm]	16.0	(629.9 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
C	Module Thickness [mm]	2.4	(94.5 mil)	+0.25/-0.15	(+9.8/-5.9 mil)
D	Horizontal Edge to Lateral Pin Pitch [mm]	2.0	(78.7 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
E	Vertical Edge to Lateral Pin Pitch [mm]	2.5	(98.4 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
F	Edge to Lateral Pin Pitch [mm]	1.05	(41.3 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
G	Lateral Pin to Pin Pitch [mm]	1.1	(43.3 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
H1	Lateral Pin Height [mm]	0.8	(31.5 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
H2	Lateral Pin close to ANT Height [mm]	0.9	(35.4 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
I	Lateral Pin Width [mm]	1.5	(59.1 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
J1	Lateral Pin to Pin Distance [mm]	0.3	(11.8 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
J2	Lateral Pin to Pin close to ANT Distance [mm]	0.2	(7.9 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
K	Horizontal Edge to Central Pin Pitch [mm]	2.75	(108.3 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
L	Vertical Edge to Central Pin Pitch [mm]	2.75	(108.3 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
M1	Central Pin to Pin Horizontal Pitch [mm]	1.8	(70.9 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
M2	Central Pin to Pin Horizontal Pitch [mm]	3.6	(141.7 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
N	Central Pin to Pin Vertical Pitch [mm]	2.1	(82.7 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
O	Central Pin Height and Width [mm]	1.1	(43.3 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
P	Horizontal Edge to Pin 1 Indicator Pitch [mm]	0.9	(35.4 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
Q	Vertical Edge to Pin 1 Indicator Pitch [mm]	1.0	(39.4 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
R	Pin 1 Indicator Height and Width [mm]	0.6	(23.6 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
Weight	Module Weight [g]	< 3			

Table 17: SARA-G450 module dimensions

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

For information regarding suggested footprint (i.e. copper mask) and stencil (i.e. paste mask) layout to be implemented on the application board, see section 7.5.

6 Qualification 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

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).

SARA-G450 GSM/GPRS modules are RoHS compliant.

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

Table 18 lists the SARA-G450 modules main planned approvals.

Certification Scheme	SARA-G450
GCF (Global Certification Forum)	•
CE (European Conformity)	•
Anatel (Agência Nacional de Telecomunicações Brazil)	•
CCC (Chinese Compulsory Certification)	•
SRRC (State Radio Regulation of China)	•
ICASA (Independent Communications Authority South Africa)	•

Table 18: SARA-G450 main certification approvals

For the complete list of approvals and for specific details on all country and network operators' certifications, see our website (www.u-blox.com) or please contact the u-blox office or sales representative nearest you.

7 Product handling

7.1 Packaging

SARA-G450 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 Guide [1].

Figure 4: Reeled SARA-G450 modules

7.1.1 Reels

SARA-G450 modules are deliverable in quantities of 250 pieces on a reel. SARA-G450 modules are delivered using reel Type B2 as described in the u-blox Package Information Guide [1].

Parameter	Specification
Reel Type	B2
Delivery Quantity	250

Table 19: Reel information for SARA-G450 modules

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

7.1.2 Tapes

Figure 5 and Table 20 specify the dimensions of the tapes for SARA-G450 module.

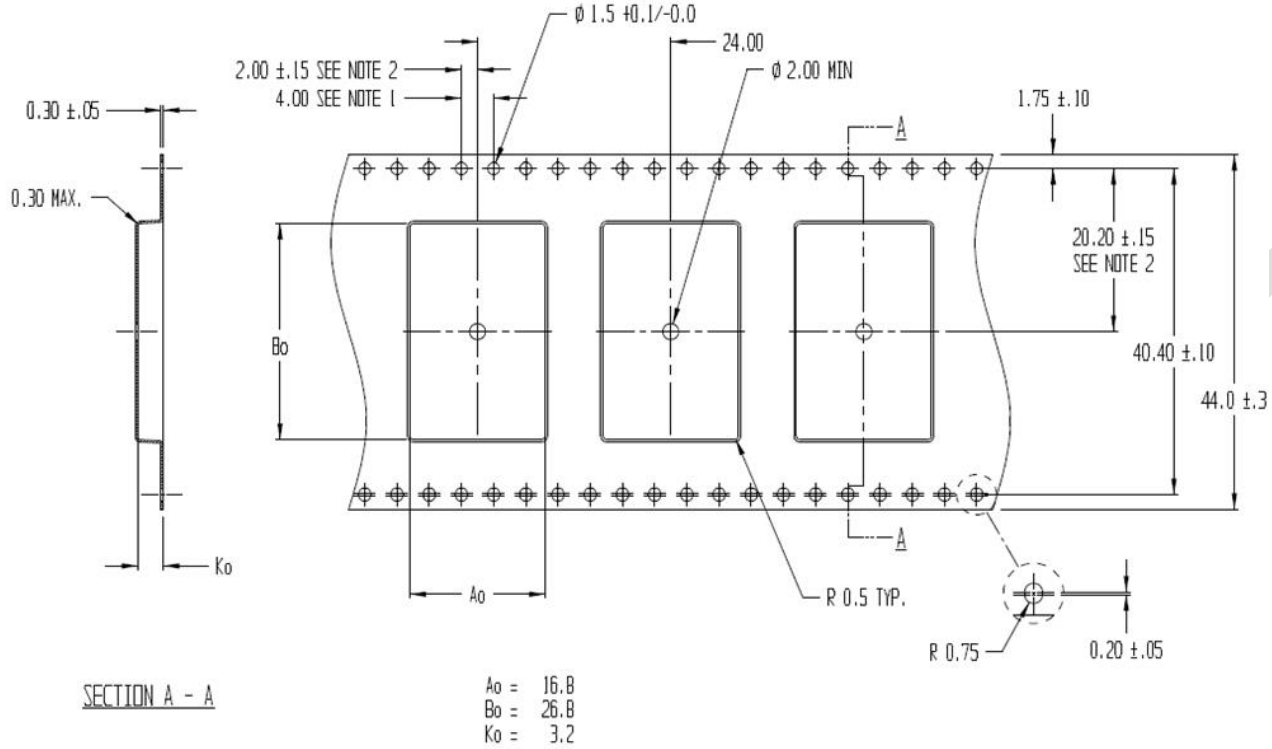

Figure 5: Dimensions for SARA-G450 modules on tape

Parameter	Typical value	Tolerance	Unit
A_0	16.8	0.2	mm
B_0	26.8	0.2	mm
K_0	3.2	0.2	mm

Table 20: SARA-G450 module tape dimensions (mm)

Note 1: 10 sprocket hole pitch cumulative tolerance ± 0.2 mm.

Note 2: Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

Note 3: 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

SARA-G450 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. SARA-G450 modules are rated at MSL level 4. For more information regarding moisture sensitivity levels, labeling, storage and drying see the u-blox Package Information Guide [1].

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

7.3 ESD precautions

SARA-G450 modules contain highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Handling SARA-G450 modules without proper ESD protection may destroy or damage them permanently.

Ensure ESD precautions are implemented during handling of the module.

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

Table 7 reports the maximum ESD ratings of the SARA-G450 modules.

ESD precautions should be appropriately implemented on the application board where the module is mounted, for the relevant lines externally accessible on the application board.

Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates SARA-G450 modules.

ESD prevention is based on establishing an Electrostatic Protective Area (EPA). The EPA can be a small working station or a large manufacturing area. The main principle of an EPA is that there are no highly charging materials near ESD sensitive electronics, all conductive materials are grounded, workers are grounded, and charge build-up on ESD sensitive electronics is prevented. International standards are used to define typical EPA and can be obtained for example from International Electrotechnical Commission (IEC) or American National Standards Institute (ANSI).

In addition to standard ESD safety practices, the following measures should be taken into account whenever handling the SARA-G450 modules:

- 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 must always be between the local GND and PCB GND.
- Before mounting an antenna patch, connect ground of the device.
- When handling the module, do not come into contact with any charged capacitors and be careful when contacting materials that can develop charges (e.g. patch antenna, coax cable, soldering iron,…).
- To prevent electrostatic discharge through the RF pin, do not touch any exposed antenna area. If there is any risk that such exposed antenna area is touched in non ESD protected work area, implement proper ESD protection measures in the design.
- When soldering the module and patch antennas to the RF pin, make sure to use an ESD safe soldering iron.

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

7.4 Soldering

Soldering paste

Use of "No Clean" soldering paste is strongly recommended, as it does not require cleaning after the soldering process has taken place. The paste listed in the example below meets these criteria.

Soldering Paste:	OM338 SAC405 / Nr.143714 (Cookson Electronics)
Alloy specification:	95.5% Sn / 4.0% Ag / 0.5% Cu (95.5% Tin / 4.0% Silver / 0.5% Copper)
Melting Temperature:	217 °C
Stencil Thickness:	150 µm for base boards

The final choice of the soldering paste depends on the approved manufacturing procedures.

The paste-mask geometry for applying soldering paste should meet the recommendations in section 7.5.

☞ The quality of the solder joints should meet the appropriate IPC specification.

Reflow soldering

A convection type-soldering oven is strongly recommended over the infrared type radiation oven. Convection heated ovens allow precise control of the temperature and all parts will be heated up evenly, regardless of material properties, thickness of components and surface color.

Consider the "IPC-7530 Guidelines for temperature profiling for mass soldering (reflow and wave) processes, published 2001".

Reflow profiles are to be selected according to the following recommendations.

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

Preheat phase

Initial heating of component leads and balls. Residual humidity will be dried out. Note that this preheat phase will not replace prior baking procedures.

- Temperature rise rate: max 3 °C/s — If the temperature rise is too rapid in the preheat phase it may cause excessive slumping.
- Time: 60 to 120 s — If the preheat is insufficient, rather large solder balls tend to be generated. Conversely, if performed excessively, fine balls and large balls will be generated in clusters.
- End Temperature: 150 to 200 °C — If the temperature is too low, non-melting tends to be caused in areas containing large heat capacity.

Heating/ reflow phase

The temperature rises above the liquidus temperature of 217 °C. Avoid a sudden rise in temperature as the slump of the paste could become worse.

- Limit time above 217 °C liquidus temperature: 40 to 60 s
- Peak reflow temperature: 245 °C

Cooling phase

A controlled cooling avoids negative metallurgical effects (solder becomes more brittle) of the solder and possible mechanical tensions in the products. Controlled cooling helps to achieve bright solder fillets with a good shape and low contact angle.

- Temperature fall rate: max 4 °C/s

☞ To avoid falling off, modules should be placed on the topside of the motherboard during soldering.

The soldering temperature profile chosen at the factory depends on additional external factors like choice of soldering paste, size, thickness and properties of the base board, etc.

Exceeding the maximum soldering temperature and the maximum liquidus time limit in the recommended soldering profile may permanently damage the module.

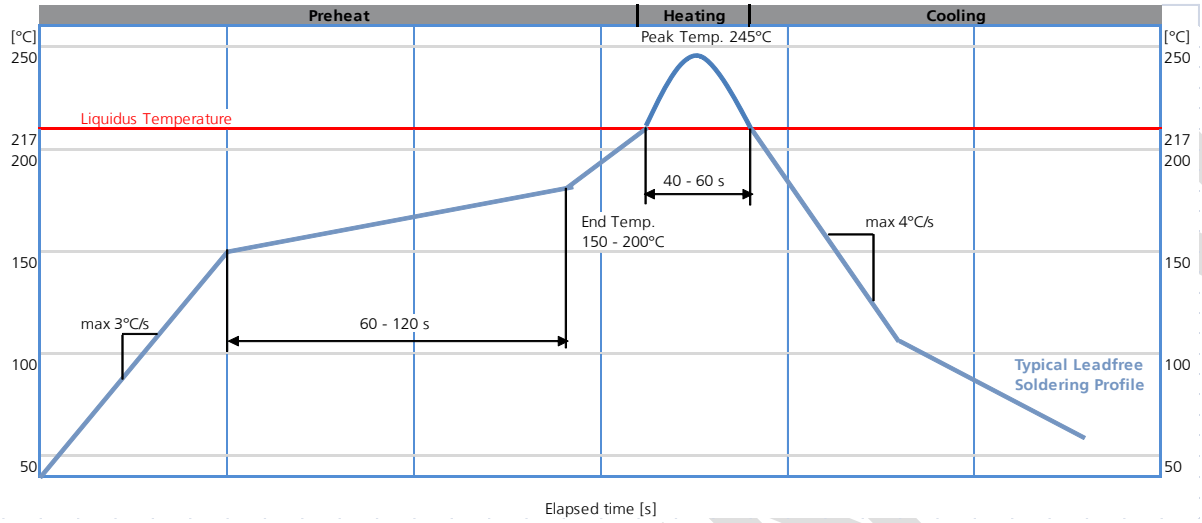

Figure 6: Recommended soldering profile

SARA-G450 modules must not be soldered with a damp heat process.

Optical inspection

After soldering the module, inspect it optically to verify that the module is properly aligned and centered.

Cleaning

Cleaning the soldered SARA-G450 modules is not recommended. Residues underneath the modules cannot be easily removed with a washing process.

- Cleaning with water will lead to capillary effects where water is absorbed in the gap between the baseboard and the module. The combination of residues of soldering flux and encapsulated water leads to short circuits or resistor-like interconnections between neighboring pads. Water will also damage the sticker and the ink-jet printed text.
- Cleaning with alcohol or other organic solvents can result in soldering flux residues flooding into the two housings, areas that are not accessible for post-wash inspections. The solvent will also damage the sticker and the ink-jet printed text.
- Ultrasonic cleaning will permanently damage the module, in particular the quartz oscillators.

For best results use a "no clean" soldering paste and eliminate the cleaning step after the soldering.

Repeated reflow soldering

Repeated reflow soldering processes and soldering the module upside down are not recommended.

Boards with components on both sides may require two reflow cycles. In this case, the module should always be placed on the side of the board that is submitted into the last reflow cycle. The reason for this (besides others) is the risk of the module falling off due to the significantly higher weight in relation to other components.

u-blox gives no warranty against damages to the SARA-G450 modules caused by performing more than a total of two reflow soldering processes (one reflow soldering process to mount the SARA-G450 module, plus one reflow soldering process to mount other parts populated on the application board).

Wave soldering

SARA-G450 LGA modules must not be soldered with a wave soldering process.

Boards with combined through-hole technology (THT) components and surface-mount technology (SMT) devices require wave soldering to solder the THT components. No more than one wave soldering process is allowed for board with a SARA-G450 module already populated on it.

Performing a wave soldering process on the module can result in severe damage to the device!

u-blox gives no warranty against damages to the SARA-G450 modules caused by performing more than a total of two soldering processes (one reflow soldering process to mount the SARA-G450 module, plus one wave soldering process to mount other THT parts populated on the application board).

Hand soldering

Hand soldering is not recommended.

Rework

Rework is not recommended.

Never attempt a rework on the module itself, e.g. replacing individual components. Such actions immediately terminate the warranty.

Conformal coating

Certain applications employ a conformal coating of the PCB using HumiSeal® or other related coating products.

These materials affect the RF properties of the SARA-G450 modules and it is important to prevent them from flowing into the module.

The RF shields do not provide 100% protection for the module from coating liquids with low viscosity, therefore care is required in applying the coating.

Conformal Coating of the module will void the warranty.

Casting

If casting is required, use viscose or another type of silicon pottant. The OEM is strongly advised to qualify such processes in combination with the SARA-G450 modules before implementing this in the production.

Casting will void the warranty.

Grounding metal covers

Attempts to improve grounding by soldering ground cables, wick or other forms of metal strips directly onto the EMI covers is done at the customer's own risk. The numerous ground pins should be sufficient to provide optimum immunity to interferences and noise.

u-blox gives no warranty for damages to the SARA-G450 modules caused by soldering metal cables or any other forms of metal strips directly onto the EMI covers.

Use of ultrasonic processes

SARA-G450 modules contain components which are sensitive to Ultrasonic Waves. Use of any Ultrasonic Processes (cleaning, welding etc.) may cause damage to the module.

u-blox gives no warranty against damages to the SARA-G450 modules caused by any Ultrasonic Processes.

7.5 Footprint, solder mask and stencil

Figure 7 and Table 17 illustrate the suggested footprint (i.e. copper mask) and stencil (i.e. paste mask) layout to be implemented on the application board where the SARA modules have to be mounted: the proposed land pattern layout reflects the modules' pins layout illustrated in section 5, while the proposed stencil apertures layout is slightly different (see the F'', H'', I'', J'', O'' parameters compared to the F', H', I', J', O' ones).

The Non Solder Mask Defined (NSMD) pad type is recommended over the Solder Mask Defined (SMD) pad type, implementing the solder mask opening 50 µm larger per side than the corresponding copper pad.

The recommended solder paste thickness is 150 µm, according to application production process requirements.

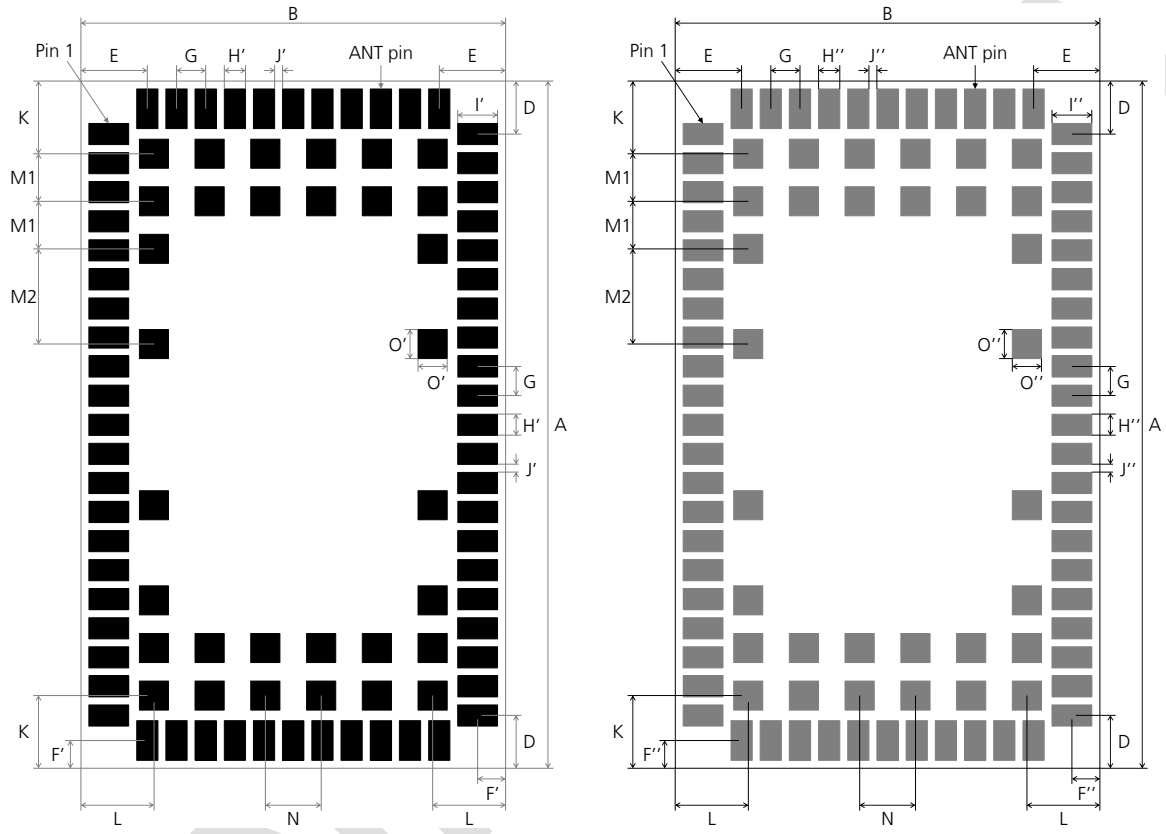

Figure 7: Recommended footprint and stencil design for SARA-G450 modules (application board top view)

Parameter	Value	Parameter	Value	Parameter	Value
A	26.0 mm	G	1.10 mm	K	2.75 mm
B	16.0 mm	H'	0.80 mm	L	2.75 mm
C	3.00 mm	H''	0.75 mm	M1	1.80 mm
D	2.00 mm	I'	1.50 mm	M2	3.60 mm
E	2.50 mm	I''	1.55 mm	N	2.10 mm
F'	1.05 mm	J'	0.30 mm	O'	1.10 mm
F''	1.00 mm	J''	0.35 mm	O''	1.05 mm

Table 21: Dimensions of the footprint and stencil recommended for SARA-G450 modules

☞ These are recommendations only and not specifications. The exact copper, solder and paste mask geometries, distances, stencil thicknesses and solder paste volumes must be adapted to the specific production processes (e.g. soldering etc.) of the customer.

8 Labeling and ordering information

8.1 Product labeling

Figure 8 illustrates the label of the SARA-G450 modules, including: u-blox logo, production lot, Pb-free marking, product Type Number, IMEI number, certification info, and production country.

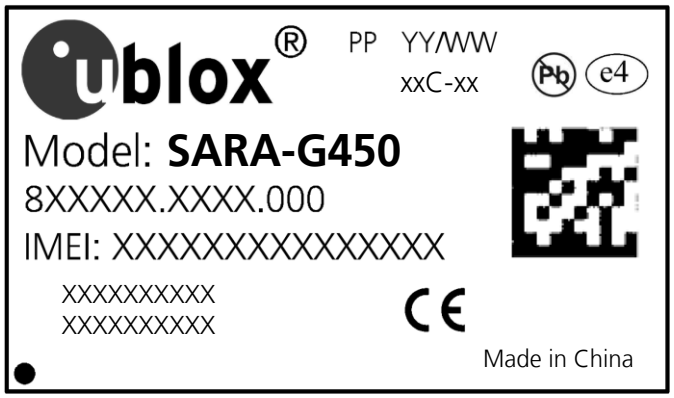

Figure 8: Label of SARA-G450 modules

☞ For information about the approval codes and for all the certificates of compliancy of SARA-G450 modules, see our website (www.u-blox.com), or please Contact the u-blox office or sales representative nearest you.

8.2 Explanation of codes

Three different product code formats are used. The **Product Name** is used in documentation such as this data sheet and identifies all 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 22 below details these three different formats:

Format	Structure
Product Name	PPP(P)-TGVV(D)
Ordering Code	PPP(P)-TGVV(D)-TTQ
Type Number	PPP(P)-TGVV(D)-TTQ-XX

Table 22: Product Code Formats

Table 23 explains the parts of the product code.

Code	Meaning	Example
PPP(P)	Form factor	SARA
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 within the technology: 1…9	G4
VV	Variant based on the same platform: 00…99	50
(D)	Optional LTE category: 6,4,3,1,M …	
TT	Product Version: 00…99	00
Q	Product grade • A = automotive • B = professional • C = standard	C
XX		Default value is 00

Table 23: Part identification code

8.3 Ordering information

Ordering No.	Description
SARA-G450-00C	4-band GSM/GPRS module, Standard grade, 26.0 x 16.0 x 2.4 mm, 250 pcs/reel

Table 24: Product ordering codes

Appendix

A Glossary

Name	Definition
ADC	Analog to Digital Converter
AT	AT Command Interpreter Software Subsystem, or attention
BER	Bit Error Rate
DCE	Data Communication Equipment
DDC	Display Data Channel (I^2C compatible) Interface
DL	Down-link (Reception)
DRX	Discontinuous Reception
DTE	Data Terminal Equipment
ERS	External Reset Input Signal
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 logic digital level
HBM	Human Body Model
I^2C	Inter-Integrated Circuit Interface
I^2S	Inter-IC Sound Interface
L	Low logic digital level
LGA	Land Grid Array
LPWA	Low Power Wide Area
N/A	Not Applicable
OD	Open Drain
PA	Power Amplifier
PCN	Product Change Notification / Information Note / Sample Delivery Note
PD	Pull-Down
PMU	Power Management Unit
POS	Power-On Input Signal
PU	Pull-Up
RMC	Reference Measurement Channel
SAW	Surface Acoustic Wave
SIM	Subscriber Identity Module
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
TBD	To Be Defined
UART	Universal Asynchronous Receiver-Transmitter serial interface
UL	Up-link (Transmission)
USB	Universal Serial Bus interface

Table 25: Explanation of abbreviations and terms used

Related documents

[1] u-blox Package Information Guide, Docu No UBX-14001652

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

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

[4] 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)

[5] 3GPP TS 27.010 – Terminal Equipment to User Equipment (TE-UE) multiplexer protocol

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Revision history

Revision	Date	Name	Comments
R01	22-Jan-2018	sses	Initial release
R02	12-Apr-2018	sses	Updated pin 18 name from RESET_N to PWR_OFF Updated module power on, power off and reset sections Added 32 kHz clock output alternative function of GPIO3 Added V_BCKP characteristics

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