



CINTERION
a Gemalto company

Hardware Interface Description

BGS2T

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Hardware Interface Description**

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0 Document History

New document: "BGS2T Hardware Interface Description" Version **01.301**

Chapter	What is new
---	Initial document setup.

1 Introduction

This document¹ describes the hardware of the Cinterion BGS2T. The BGS2T comes in two variants depending on the type of serial interface:

- BGS2T RS232 implements a V.24 / V.28 RS-232 interface with a D-sub 9-pole female socket and a 6-pole Western jack as plug-in power supply connector.
- BGS2T RS485 implements a 6-pin header for the RS-485 interface including power supply and ignition line.

Wherever necessary and appropriate this document distinguishes between these two variants.

The scope of this document includes interface specifications, electrical issues and mechanical characteristics of BGS2T. It specifies standards pertaining to wireless applications and outlines requirements that must be adhered to for successful product design. The BGS2T is a compact GSM modem for the transfer of data in GSM networks. Industrial standard interfaces and an integrated SIM card reader allow using BGS2T easily as a quad band GSM/GPRS terminal.

1.1 Related Documents

- [1] BGS2T AT Command Set
- [2] BGS2T Release Notes

Prior to using the GSM/GPRS terminal read the latest product information provided in the Release Notes.

You can use the following link to visit the Cinterion Website:

<http://www.cinterion.com>

¹ The document is effective only if listed in the appropriate Release Notes as part of the technical documentation delivered with your Cinterion wireless product.

1.2 Terms and Abbreviations

Table 1: Terms and abbreviations

Abbreviation	Description
ARP	Antenna Reference Point
ATC	AT Command
BTS	Base Transceiver Station
CB	Cell Broadcast
CODEC	Coder-Decoder
DCE	Data Circuit terminating Equipment
DSR	Data Set Ready
DTR	Data Terminal Ready
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FDMA	Frequency Division Multiple Access
G.C.F.	GSM Conformity Forum
GSM	Global Standard for Mobile Communication
HW	Hardware
IC	Integrated Circuit
IF	Intermediate Frequency
IMEI	International Mobile Equipment Identifier
I/O	Input/ Output
IGT	Ignition
ISO	International Standards Organization
ITU	International Telecommunications Union
kbps	kbits per second
LVD	Low voltage Directive
Mbps	Mbits per second
MMI	Machine Machine Interface
MO	Mobile Originated
MS	Mobile Station
MT	Mobile Terminated
NC	Not Connected
NTC	Negative Temperature Coefficient

Table 1: Terms and abbreviations

Abbreviation	Description
PA	Power Amplifier
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PCS	Personal Communication System
PD	Power Down
PDU	Protocol Data Unit
R&TTE	Radio and Telecommunication Terminal Equipment
RF	Radio frequency
RI	Ring Indication
RX	Receive direction
SIM	Subscriber Identification Module
SMS	Short Message Service
SW	Software
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TX	Transmit direction
UART	Universal Asynchronous Receiver and Transmitter

1.3 Regulatory and Type Approval Information

1.3.1 Directives and Standards

BGS2T has been designed to comply with the directives and standards listed below.

Table 2: Directives


99/05/EC	<p>Directive of the European Parliament and of the council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (in short referred to as R&TTE Directive 1999/5/EC).</p> <p>The product is labeled with the CE conformity mark CE 0682</p>
2002/95/EC	<p>Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)</p> 
2002/96/EC	<p>Directive of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE)</p>
2003/108/EC	<p>Directive of the European Parliament and of the Council of 8 December 2003 amending directive 2002/96/ec on waste electrical and electronic equipment (WEEE)</p>

Table 3: Standards of North American type approval

CFR Title 47	<p>“Code of Federal Regulations, Part 15 B, Part 22 and Part 24 (Telecommunications, PCS)”; US Equipment Authorization FCC</p>
NAPRD.03 V5.6	<p>“Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control” PCS Type Certification Review board (PTCRB)</p>
RSS133 (Issue 2)	<p>Canadian Standard</p>
IEEE Std. C95.1-1999	<p>IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz</p>

Table 4: Standards of European type approval

3GPP TS 51.010-1	<p>“Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification”</p>
ETSI EN 301 511 V9.0.2	<p>Candidate Harmonized European Standard (Telecommunications series) Global System for Mobile communications (GSM); Harmonized standard for mobile stations in the GSM 900 and DCS 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC) (GSM 13.11 version 7.0.1 Release 1998)</p>
GCF-CC V3.40.0	<p>Global Certification Forum - Certification Criteria</p>
ETSI EN 301 489-1 V1.8.1	<p>Candidate Harmonized European Standard (Telecommunications series) Electro Magnetic Compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common Technical Requirements</p>

Table 4: Standards of European type approval

ETSI EN 301 489-7 V1.3.1	Candidate Harmonized European Standard (Telecommunications series) Electro Magnetic Compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)
EN 62311-2008	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)
EN 60950-1 (2006)	Safety of information technology equipment

Table 5: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

Table 6: Standards of the Ministry of Information Industry of the People's Republic of China


SJ/T 11363-2006	“Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products” (2006-06).
SJ/T 11364-2006	<p>“Marking for Control of Pollution Caused by Electronic Information Products” (2006-06).</p> <p>According to the “Chinese Administration on the Control of Pollution caused by Electronic Information Products” (ACPEIP) the EPUP, i.e., Environmental Protection Use Period, of this product is 20 years as per the symbol shown here, unless otherwise marked. The EPUP is valid only as long as the product is operated within the operating limits described in the Hardware Interface Description.</p> <p>Please see Table 1.3.2 for an overview of toxic or hazardous substances or elements that might be contained in product parts in concentrations above the limits defined by SJ/T 11363-2006.</p> 

Table 7: Toxic or hazardous substances or elements with defined concentration limits






部件名称 Name of the part	有毒有害物质或元素 Hazardous substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
金属部件 (Metal Parts)	○	○	○	○	○	○
电路模块 (Circuit Modules)	X	○	○	○	○	○
电缆及电缆组件 (Cables and Cable Assemblies)	○	○	○	○	○	○
塑料和聚合物部件 (Plastic and Polymeric parts)	○	○	○	○	○	○




O:
表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。
Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X:
表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。
Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part *might exceed* the limit requirement in SJ/T11363-2006.

1.3.2 Safety Precautions

The following safety precautions must be observed during all phases of the operation, usage, service or repair of any cellular terminal or mobile incorporating BGS2T. Manufacturers of the cellular terminal are advised to convey the following safety information to users and operating personnel and incorporate these guidelines into all manuals supplied with the product. Failure to comply with these precautions violates safety standards of design, manufacture and intended use of the product. Cinterion Wireless Modules GmbH assumes no liability for customer's failure to comply with these precautions.

	<p>When in hospitals or other health care facilities, observe the restrictions on the use of mobiles. Switch off the cellular terminal or mobile if to be instructed to do so by the guidelines posted in sensitive areas. Medical equipment may be sensitive to RF energy.</p> <p>The operation of cardiac pacemakers, other implanted medical equipment and hearing aids can be affected by interference from cellular terminals or mobiles placed close to the device. If in doubt about potential danger, contact the physician or the manufacturer of the device to verify that the equipment is properly shielded. Pacemaker patients are advised to keep their hand-held mobile away from the pacemaker, while it is on. This personal subgroup always should check the distance to the mobile.</p>
	<p>Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it cannot be switched on inadvertently. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communications systems. Failure to observe these instructions may lead to the suspension or denial of cellular services to the offender, legal action, or both.</p> <p>Check the local and actual laws about these themes.</p>
	<p>Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.</p>
	<p>Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. Remember that interference can occur if it is used close to TV sets, radios, computers or inadequately shielded equipment. Follow any special regulations and always switch off the cellular terminal or mobile wherever forbidden, or when you suspect that it may cause interference or danger.</p>
	<p>Road safety comes first! Do not use a hand-held cellular terminal or mobile while driving a vehicle unless it is securely mounted in a holder for speakerphone operation. Before making a call with a hand-held terminal or mobile park the vehicle. Speakerphones must be installed by qualified personnel. Faulty installation or operation can constitute a safety hazard.</p> <p>Check the actual and local laws about these themes.</p>

	<p>IMPORTANT! Cellular terminals or mobiles operate using radio signals and cellular networks. In that case connections cannot be guaranteed at all times under all conditions. Therefore, you should never rely solely upon any wireless device for essential communications, for example emergency calls.</p> <p>Remember, in order to make calls or receive calls the cellular terminal or mobile must be switched on in a service area with adequate cellular signal strength.</p> <p>Some networks do not allow for emergency calls if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may need to deactivate those features before you can make an emergency call. Some networks require a valid SIM card to be properly inserted in the cellular terminal or mobile.</p>
	<p>If a power supply unit is used to supply the device it must meet the demands placed on SELV circuits in accordance with EN60950. The maximum permissible connection length between the device and the supply source should not exceed 3m.</p>
	<p>According to the guidelines for human exposure to radio frequency energy, an antenna connected to the FME jack of the device should be placed at least 20cm away from human bodies.</p>

1.4 Product Label

The label fixed to the bottom of the BGS2T terminal comprises the following information.



Figure 1: BGS2T label

Table 8: BGS2T label information

No.	Information
1	Cinterion logo
2	Product name
3	Product variant
4	Marking "Made in Germany"
5	Product ordering number
6	Barcode (Code128)
7	Product IMEI
8	Date code
9	CE logo with fixed number 0682 (may be replaced for samples with "Not for sale")
10	WEEE symbol (see Table 2).
11	Chinese RoHS symbol (see Table 6).
12	FCC ID
13	IC ID
14	Manufacturer code
15	Power supply unit ratings
16	Manufacturer code

2 Product Concept

2.1 Key Features at a Glance

Feature	Implementation
General	
Incorporates BGS2 module	The BGS2 module handles all signal and data processing within the BGS2T. Internal software runs the application interface and the complete GSM/GPRS protocol stack.
Frequency bands	Quad band: GSM 850/900/1800/1900MHz
GSM class	Small MS
Output power (according to Release 99, V5)	Class 4 (+33dBm \pm 2dB) for EGSM850 Class 4 (+33dBm \pm 2dB) for EGSM900 Class 1 (+30dBm \pm 2dB) for GSM1800 Class 1 (+30dBm \pm 2dB) for GSM1900 The values stated above are maximum limits. According to Release 99, the maximum output power in a multislot configuration may be lower. The nominal reduction of maximum output power varies with the number of uplink timeslots used and amounts to 3.0dB for 2Tx.
Power supply	Single supply voltage 8V to 30V
Operating temperature (BGS2 module)	Normal operation: -30°C to +85°C Restricted operation: -40°C to -30°C and +85°C to +90°C
Physical	Dimensions: 80mm x 55mm x 23mm (excluding antenna and serial interface connectors) Weight: 65g (approx.)
RoHS, WEEE	All hardware components are fully compliant with the EU RoHS and WEEE Directives
GSM / GPRS features	
Data transfer	GPRS: <ul style="list-style-type: none"> • Multislot Class 10 • Full PBCCH support • Mobile Station Class B • Coding Scheme 1 – 4 CSD: <ul style="list-style-type: none"> • V.110, RLP, non-transparent • 2.4, 4.8, 9.6, 14.4kbps • USSD PPP-stack for GPRS data transfer
SMS	<ul style="list-style-type: none"> • Point-to-point MT and MO • Cell broadcast • Text and PDU mode
Fax	Group 3; Class 2 and Class 1
Software	
AT commands	Hayes 3GPP TS 27.007, TS 27.005, Cinterion AT commands
SIM Application Toolkit	SAT Release 99

Feature	Implementation
TCP/IP stack	Protocols: TCP server/client, UDP, HTTP, FTP, SMTP, POP3 Access by AT commands
Firmware update	Upgradeable via serial interface
Interfaces	
Serial interface	<p>BGS2T RS232:</p> <ul style="list-style-type: none"> • RS-232 interface for AT commands and data • Supports RTS/CTS hardware handshake • Supports software XON/XOFF flow control • Multiplex ability according to GSM 07.10 Multiplexer protocol • Baud rates from 1200bps to 230400bps <p>BGS2T RS485:</p> <ul style="list-style-type: none"> • RS-485 interface for AT commands and data • Baud rates from 1200bps to 115200bps <p>Both variants:</p> <ul style="list-style-type: none"> • Autobauding supported
SIM card reader	Supported SIM cards: 3V, 1.8V
Antenna	Antenna connected via female SMA connector
Power on/off, Reset	
Power on	<p>BGS2T RS232:</p> <ul style="list-style-type: none"> • DTR line at RS-232 interface or IGT_IN line at power connector <p>BGS2T RS485:</p> <ul style="list-style-type: none"> • IGT_IN line at RS-485 interface
Power off	Normal switch-off by AT^SMSO or external On/Off push button Automatic switch-off in case of critical temperature and voltage conditions
Reset	Orderly shutdown and reset by AT command Emergency restart via RST_IN line at power connector (BGS2T RS232 only)
Special features	
Real time clock	Timer functions via AT commands
Phonebook	SIM card and terminal

3 Interface Description

3.1 Overview

BGS2T provides the following interfaces for power supply, antenna, SIM card and data transfer:

- 6-pole Western connector (female) for power supply, ignition, power down signal (BGS2T RS232 only)
- SMA antenna connector (female)
- SIM card reader
- 9-pole (female) D-sub connector for BGS2T RS232 or 6-pin (female) connector for BGS2T RS485

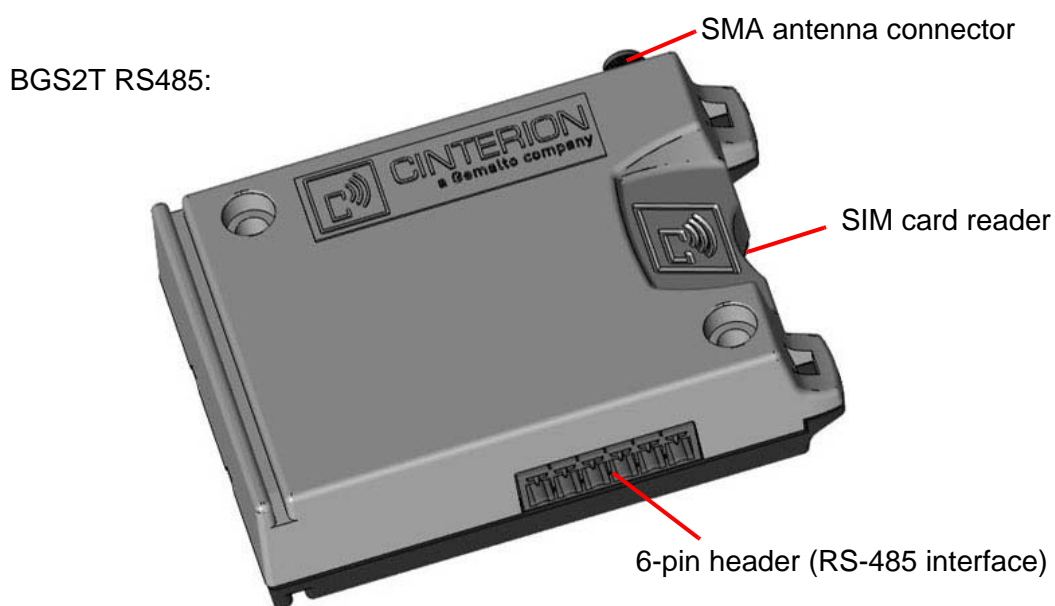
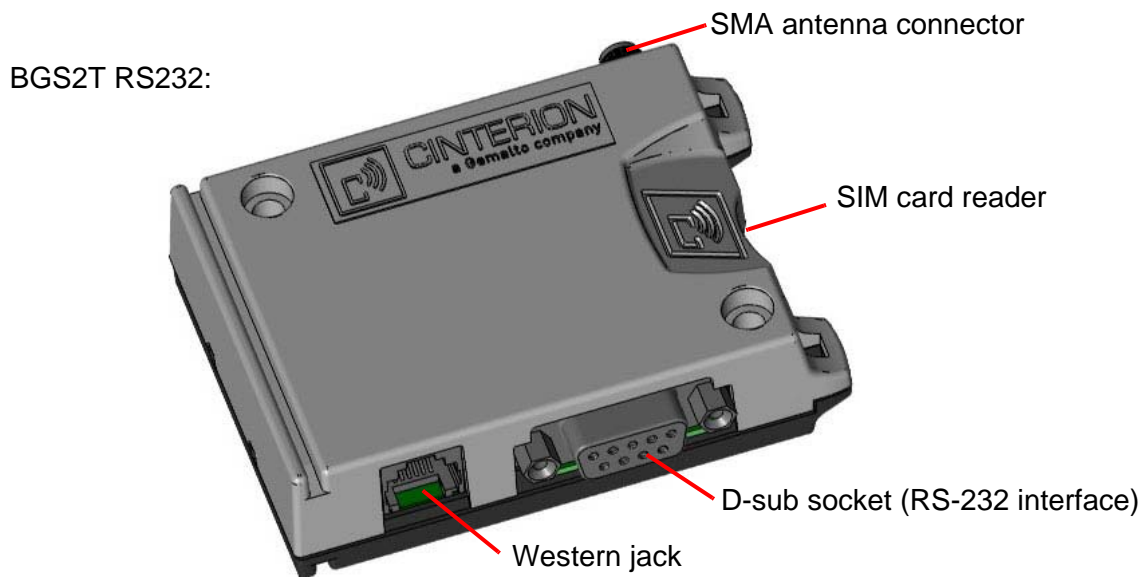


Figure 2: BGS2T 3D view

3.2 Block Diagram

Figure 3 shows a block diagram of a sample configuration that incorporates a BGS2T and typical accessories.

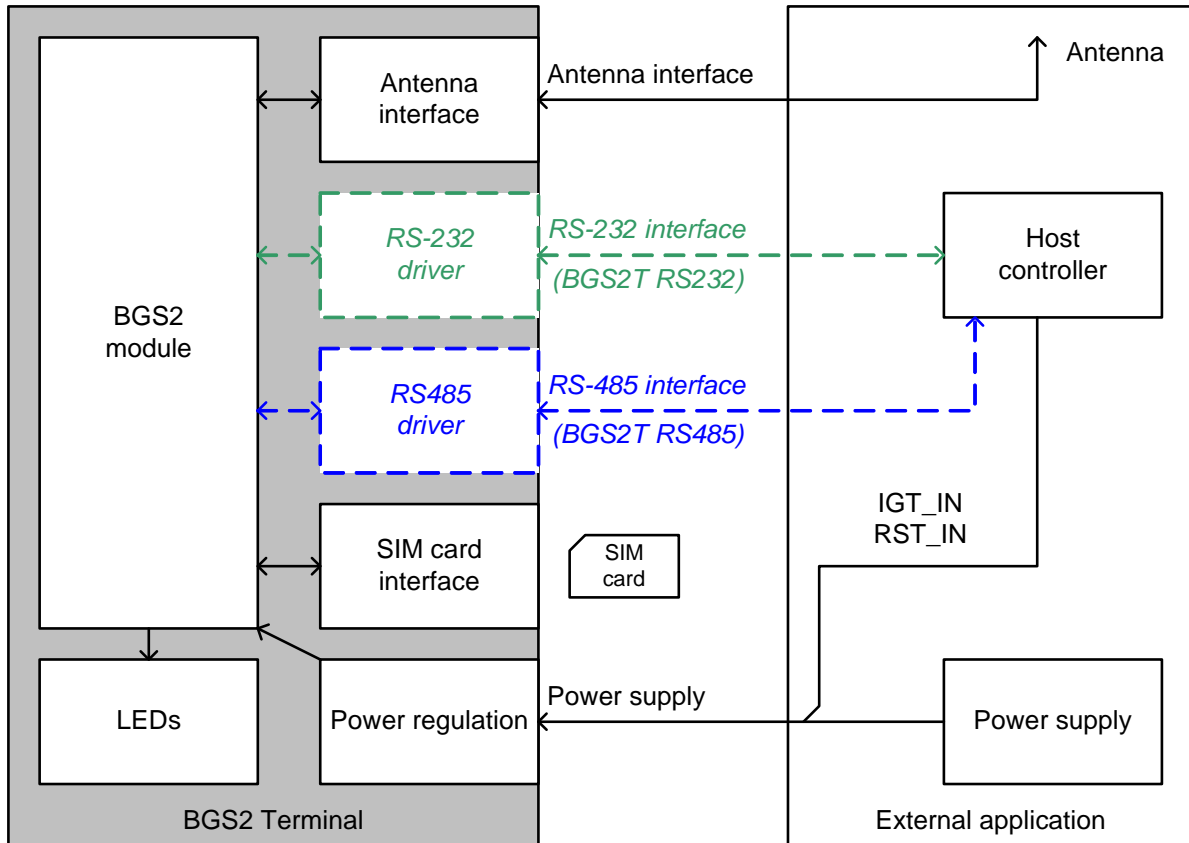


Figure 3: Block diagram

3.3 Terminal Circuit

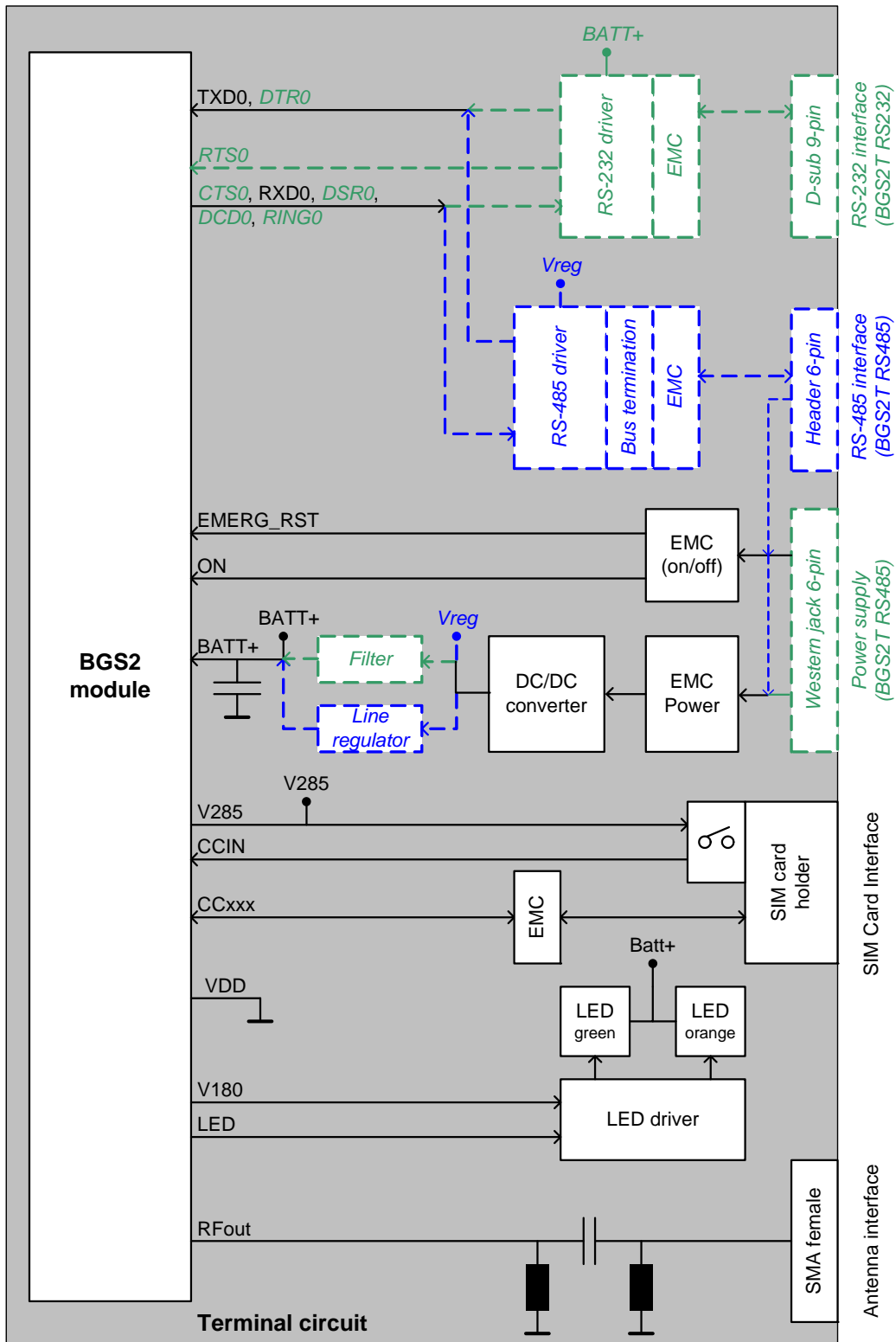


Figure 4: BGS2T circuit block diagram

With BGS2T RS232 there are separate connectors for data interface and power supply (D-sub RS-232 socket and Western jack). With BGS2T RS485 there is a single connector for these interfaces (6-pin header socket).

3.4 Operating Modes

The table below briefly summarizes the various operating modes referred to in the following chapters.

Table 9: Overview of operating modes

Normal operation	GSM IDLE	Software is active. Once registered to the GSM network paging with BTS is carried out. The Terminal is ready to send and receive.
	GSM TALK	Connection between two subscribers is in progress. Power consumption depends on network coverage individual settings, such as DTX off/on, FR/EFR/HR, hopping sequences, antenna.
	GPRS IDLE	Terminal is ready for GPRS data transfer, but no data is currently sent or received. Power consumption depends on network settings and GPRS configuration (e.g. multislot settings).
	GPRS DATA	GPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates, GPRS configuration (e.g. used multislot settings) and reduction of maximum output power.
POWER DOWN	Normal shutdown after sending the AT^SMSO command. The RTC works continuously, but the software is not active. Interfaces are not accessible.	

3.5 RS-232 Interface Variant

The RS-232 interface is implemented as a serial asynchronous transmitter and receiver conforming to ITU-T V.24 Interchange Circuits DCE. It is configured for 8 data bits, no parity and 1 stop bit, and can be operated at bit rates from 1200bps to 230kbps. Autobauding supports bit rates from 1.2kbps to 230kbps.

For more information see also [Section 3.5.1](#) and [Section 3.5.2](#).

3.5.1 Power Supply

The power supply of BGS2T RS232 has to be a single voltage source of $V_{PLUS}=8V...30V$ capable of providing a peak current (pulsed 2x577ms at $T=4.615ms$) of about 1.2A at 12V during an active transmission. The uplink burst causes strong ripple (drop) on the power lines. The drop voltage should not exceed 1V, but the absolute minimum voltage during drops must be >7.6V.

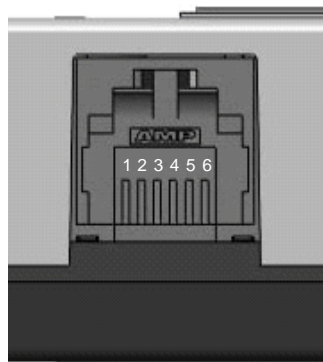
The BGS2T is protected from supply voltage reversal. An external fast acting fuse $\geq 0.4A$ with melting integral I^2t (0.15 ... 0.25)A²s is necessary to use the BGS2T at a 12V or 24V unlimited power supply system.

The power supply must be compliant with the EN60950 guidelines. A switching regulator regulates the input voltage for the internal supply.

When power fails for >1ms, BGS2T resets or switches off. When power fails for >15s the RTC will be reset.

Table 10: Female 6-pole Western plug for power supply, ignition, power down

Pin	Signal name	Use	Parameters
1	GND	Ground	0V
2	GND	Ground	0V
3	IGT_IN	Ignition	$U_{IH} \geq 8V$ Ignition $\geq 8V$ for more than 200ms switches the BGS2T on. Ignition is activated only by a rising edge. The rise time is <20ms
4	RST_IN	Signal for module reset	$U_{IH} \geq 8V$ for $t > 10ms$ resets the terminal. $U_{IL} < 2V$ and low level for normal operation.
5	PLUS	Power supply	8V – 30V DC, max. 33V for 1 min
6	PLUS	Power supply	8V – 30V DC, max. 33V for 1 min



Pin assignment and typical connection:

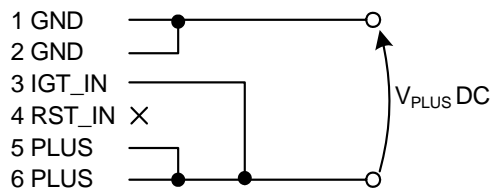


Figure 5: 6-pole Western jack for power supply, ignition, reset, typical connection

Mains adapter: If it fits into the design of your GSM application we recommend the plug-in supply unit used with the type approved Cinterion reference setup. Ordering information can be found in [Chapter 7](#). This 12V mains adapter comes with a 6-pole Western plug and provides an internal connection between IGT_IN pin and PLUS pin for auto ignition (power up).

3.5.1.1 Turn BGS2T on

BGS2T is turned on by plugging an appropriate power supply unit between PLUS and GND of the 6-pole Western jack.

While the RST_IN pin (pin4) is not active (voltage <2V) you can start the BGS2T by activating the RS-232 DTR line if in POWER DOWN mode.

The IGT_IN signal (pin3) may be used to switch on BGS2T if in POWER DOWN mode.

After startup of the BGS2T the RS-232 lines are in an undefined state for approx. 900ms. This may cause undefined characters to be transmitted over the RS-232 lines during this period.

3.5.1.2 Reset BGS2T

An easy way to reset the BGS2T is entering the command AT+CFUN=x,1. For details on AT+CFUN please see [\[1\]](#).

As an alternative, you can shut down the BGS2T as described in [Section 3.5.1.3](#) and then restart it as described in [Section 3.5.1.1](#).

3.5.1.3 Turn BGS2T off

Normal shutdown:

- To turn off the BGS2T use the AT[^]SMSO command, rather than disconnecting the mains adapter.

This procedure lets the BGS2T log off from the network and allows the software to enter a secure state and save data before disconnecting the power supply. After AT[^]SMSO has been entered the BGS2T returns the following result codes:

```
^SMSO: MS OFF
OK
^SHUTDOWN
```

The "[^]SHUTDOWN" result code indicates that the BGS2T turns off in less than 1 second. After the shutdown procedure is complete the BGS2T enters the POWER DOWN mode. The orange LED stops flashing (see [Section 3.10](#) for a detailed LED description). The RTC is still fed from the voltage regulator in the power supply ASIC. Please note that if there is an auto ignition connection between PLUS and IGT_IN the module will restart automatically after a normal shutdown.

Emergency restart:

- In the event of software hang-ups etc. the BGS2T can be restarted by applying a voltage >8V to the RST_IN pin (pin 3) for more than 10ms. The RST_IN signal restarts the BGS2T.

Caution: Use the RST_IN pin only when, due to serious problems, the software is not responding for more than 5 seconds. Pulling the RST_IN pin causes the loss of all information stored in the volatile memory since power is cut off immediately. Therefore, this procedure is intended only for use in case of emergency, e.g. if BGS2T fails to shut down properly.

When the BGS2T enters the POWER DOWN mode, e.g. after you have issued the AT[^]SMSO command or activated the RST_IN signal, all RS-232 interface lines are active for a period of 50ms to max. 3.5s. This may cause undefined characters to be transmitted on the RS-232 lines which can be ignored.

3.5.1.4 Disconnecting power supply

Before disconnecting the power supply from the PLUS pin, make sure that the BGS2T is in a safe condition. The best way is to wait 1s after the "[^]SHUTDOWN" result code has been indicated.

3.5.2 9-Pole D-sub Connector

Via RS-232 interface, the host controller controls the BGS2T and transports data.

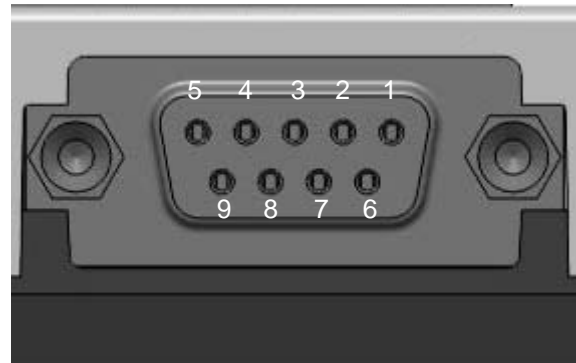


Figure 6: Pin assignment RS-232 (D-sub 9-pole female)

Table 11: 9-pole D-sub (female) RS-232

Pin no.	Signal name	I/O	Function
1	DCD	O	Data Carrier Detected
2	RXD	O	Receive Data
3	TXD	I	Transmit Data
4	DTR	I	Data Terminal Ready Attention: The ignition of BGS2T is activated via a rising edge of high potential (+3 ... +15 V)
5	GND	-	Ground
6	DSR	O	Data Set Ready
7	RTS	I	Request To Send
8	CTS	O	Clear To Send
9	RING	O	Ring Indication

BGS2T is designed for use as a DCE. Based on the conventions for DCE-DTE connections it communicates with the customer application (DTE) using the following signals:

- Port TxD @ application sends data to TXD of BGS2T
- Port RxD @ application receives data from RXD of BGS2T

Hardware handshake using the RTS and CTS signals and XON/XOFF software flow control are supported.

In addition, the modem control signals DTR, DSR, DCD and RING are available. The modem control signal RING (Ring Indication) can be used to indicate, to the cellular device application, that a call or Unsolicited Result Code (URC) is received. There are different modes of operation, which can be set with AT commands.

Note: The DTR signal will only be polled once per second from the internal firmware of BGS2T.

3.6 RS-485 Interface Variant

The RS-485 interface is based on the TIA/EIA-485 standard defining electrical characteristics of drivers and receivers for use in balanced multidrop communication systems. RS-485 is used in a lot of different fieldbus systems like Profibus, Interbus, Modbus and P-net.

RS-485 uses a shielded twisted pair cable where the shield is used as ground return, and the inner pairs are used for balanced communication. The two conductors in each pair are called A and B. RS-485 is usually half-duplex.

Data transmission speed depends on the length of the RS-485 bus cable and may be up to 115kbps.

3.6.1 6-Pin Header and Power Supply

Via RS-485 interface, the host controller controls BGS2T RS485 including power supply and data transmission.

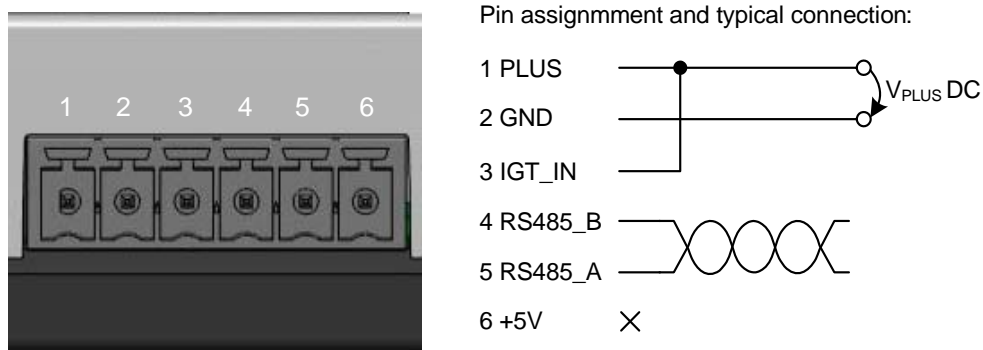


Figure 7: Pin assignment RS-485 (6-pin header female), typical connection

Table 12: 6-pin header pin assignment

Pin	Signal name	Use	Parameters
1	PLUS	Power supply	8V-30V DC
2	GND	Ground	0V
3	IGT_IN	Ignition	$U_{IH} \geq 8V$ Ignition $\geq 8V$ for more than 200ms switches the BGS2T on. Ignition is activated only by a rising edge. The rise time is $< 20ms$
4	RS485-B	Data transmission	Receive and transmit data for conductor B
5	RS485-A	Data transmission	Receive and transmit data for conductor A
6	+5V	Power output	Output: +5V, max. TBD. A

The power supply of the BGS2T has to be a single voltage source of $V_{PLUS}=8V...30V$ capable of providing a peak current (pulsed $2 \times 577ms$ at $T=4.615ms$) of about 1.2A at 12V during an active transmission. The uplink burst causes strong ripple (drop) on the power lines. The drop voltage should not exceed 1V, but the absolute minimum voltage during drops must be $> 7.6V$.

The BGS2T is protected from supply voltage reversal. An external fast acting fuse $\geq 0.4A$ with melting integral I^2t (0.15 ... 0.25)A²s is necessary to use the BGS2T at a 12V or 24V unlimited power supply system.

The power supply must be compliant with the EN60950 guidelines. A switching regulator regulates the input voltage for the internal supply. It is recommended that the power supply provides an internal connection between IGT_IN pin and PLUS pin for auto ignition (power up).

When power fails for >1ms, BGS2T resets or switches off. When power fails for >15s the RTC will be reset.

3.6.1.1 Turn BGS2T on

Before switching BGS2T on the SIM should be inserted. Now, BGS2T is turned on by connecting an appropriate power supply between PLUS and GND of the 6-pin header.

The IGT_IN signal (pin3) may be used to switch on BGS2T if in POWER DOWN mode.

After startup of the BGS2T the RS-485 lines are in an undefined state for approx. 900ms. This may cause undefined characters to be transmitted over the RS-485 lines during this period.

3.6.1.2 Reset BGS2T

As an alternative, BGS2T can be shut down as described in [Section 3.5.1.3](#) and then restarted as described in [Section 3.5.1.1](#).

3.6.1.3 Turn BGS2T off

Normal shutdown:

- To turn off the BGS2T use the AT^SMSO command, rather than disconnecting the mains adapter. This procedure lets the BGS2T log off from the network and allows the software to enter a secure state and save data before disconnecting the power supply. After AT^SMSO has been entered the BGS2T returns the following result codes:

```
^SMSO: MS OFF
OK
^SHUTDOWN
```

The "^SHUTDOWN" result code indicates that the BGS2T turns off in less than 1 second. After the shutdown procedure is complete the BGS2T enters the POWER DOWN mode. The orange LED stops flashing (see [Section 3.10](#) for a detailed LED description). The RTC is still fed from the voltage regulator in the power supply ASIC. Please note that if there is an auto ignition connection between PLUS and IGT_IN the module will restart automatically after a normal shutdown.

When the BGS2T enters the POWER DOWN mode, e.g. after you have issued the AT^SMSO command or after emergency shutdown, all data transmission lines are active for a period of 50ms to max. 3.5s. This may cause undefined characters to be transmitted on the data transmission lines which can be ignored.

3.6.1.4 Disconnecting power supply

Before disconnecting the power supply lines, make sure that the BGS2T is in a safe condition. The best way is to wait 1s after the "^SHUTDOWN" result code has been indicated.

3.7 Automatic thermal shutdown

An on-board NTC measures the temperature of the built-in BGS2 module. If over- or undertemperature is detected on the module the BGS2T automatically shuts down to avoid thermal damage to the system. [Table 16](#) specifies the ambient temperature threshold for the BGS2T.

The automatic shutdown procedure is equivalent to the power-down initiated with the AT^SMSO command, i.e. BGS2T logs off from the network and the software enters a secure state avoiding loss of data. In IDLE mode it takes typically one minute to deregister from the network and to switch off.

Alert messages transmitted before the BGS2T switches off are implemented as Unsolicited Result codes (URCs). For details see the description of AT^SCTM command provided in [\[1\]](#).

Thermal shutdown will be deferred if a critical temperature limit is exceeded, while an emergency call or a call to a predefined phone number is in progress, or during a two minute guard period after power up. See [\[1\]](#) for details.

3.8 RTC

The internal Real Time Clock (RTC) of the BGS2T retains the time and date and handles the alarm (reminder) function. The AT+CCLK command serves to set the time and date, and AT+CALA specifies a reminder message. See [\[1\]](#) for details.

A dedicated voltage regulator backs up the RTC even in POWER DOWN mode and enables BGS2T to keep track of time and date.

However, please note that the Alarm mode described in [\[1\]](#), Section AT+CALA, is not intended for the BGS2T. The AT+CALA command can only be used to set a reminder message, but not to configure the mobile to wake up from POWER DOWN mode into Alarm mode. Therefore, after setting a timer with AT+CALA be sure not to shut down the BGS2T by AT^SMSO or RST_IN signal (BGS2T RS232 variant).

3.9 SIM Interface

The SIM interface is intended for 1.8V and 3V SIM cards in accordance with GSM 11.12 Phase 2. The card holder is a five wire interface according to GSM 11.11. A sixth pin has been added to detect whether or not a SIM card is inserted.

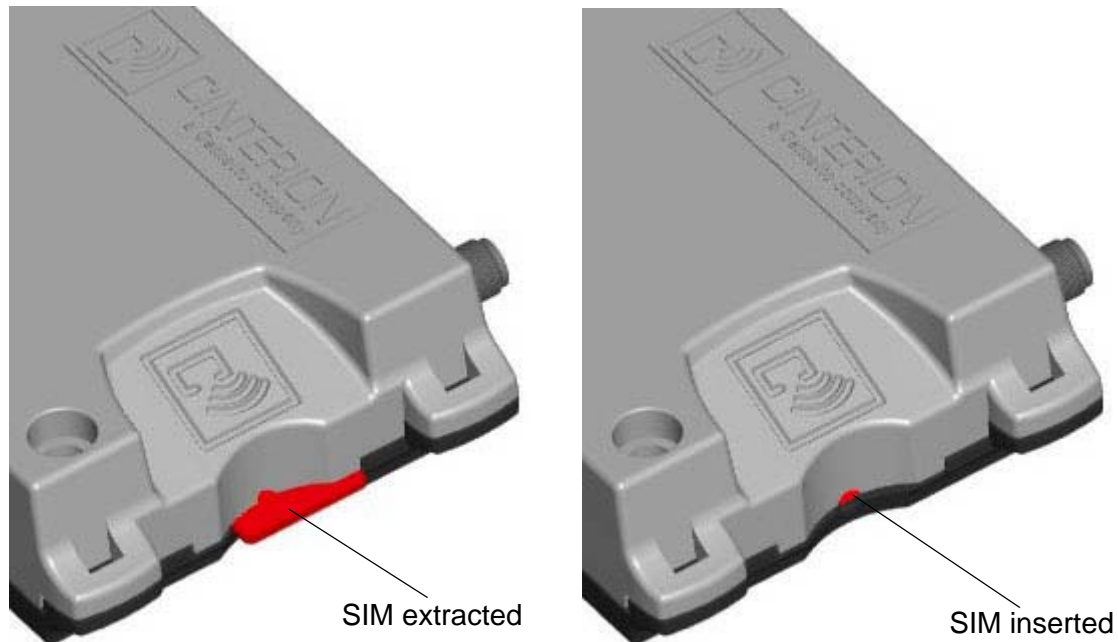


Figure 8: SIM interface

The SIM - with the circuit side facing towards the Cinterion logo - is inserted by gently pushing it into the SIM card holder until it snaps hold. It is now protected from accidental removal. The SIM can be removed from the card holder by using a flat object such as a screwdriver to carefully press the inserted SIM until it snaps out again.

All signals of the SIM interface are protected from electrostatic discharge with spark gaps to GND and clamp diodes to 1.8V resp. 2.9V and GND.

Removing and inserting the SIM card during operation requires the software to be reinitialized. Therefore, after reinserting the SIM card it is necessary to restart BGS2T.

Note: No guarantee can be given, nor any liability accepted, if loss of data is encountered after removing the SIM card during operation. Also, no guarantee can be given for properly initializing any SIM card that the user inserts after having removed a SIM card during operation. In this case, the application must restart the BGS2T.

3.10 Status LEDs

BGS2T has two LEDs indicating its operating states through the semitransparent casing:

- A green LED indicates whether the BGS2T is ready to operate.
- An orange LED indicates the various operating states of the terminal.

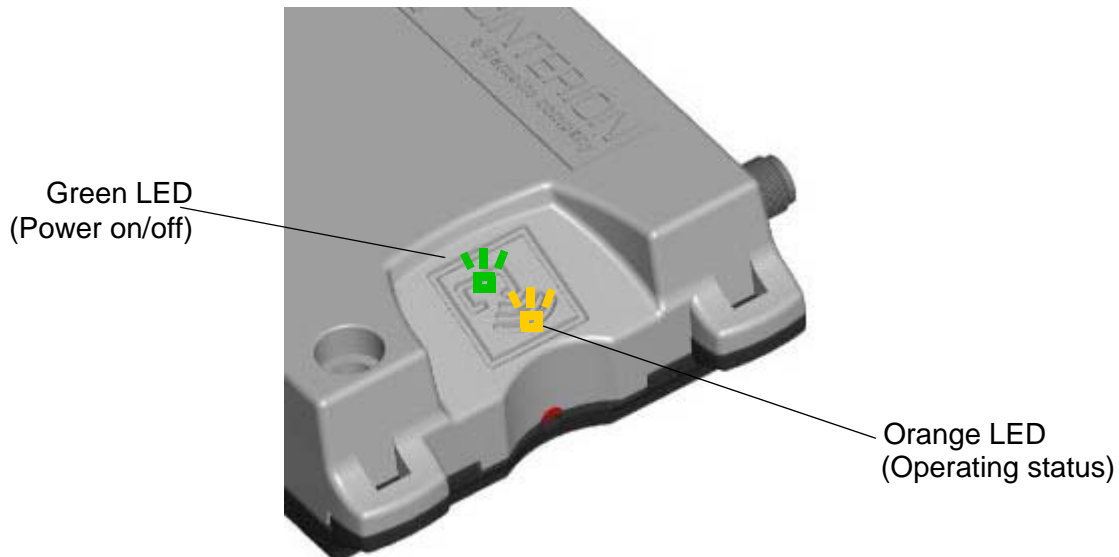


Figure 9: Status LED

The orange LED is driven by a line of the integrated BGS2 module which can be configured by using the AT^SSYNC command. For the purpose of the BGS2T it is recommended to retain the default setting of AT^SSYNC=1 (AT^SSYNC=0 is not applicable).

The following table lists the possible LED patterns and describes the operating status of the BGS2T indicated by each pattern if AT^SSYNC=1.

During the transition from one LED pattern to another the "on" and/or "off" periods of the LED may vary in length. This is because an event that triggers the change may occur any time and, thus, truncate the current LED pattern at any point.

Table 13: Coding of the orange status LED

LED mode	Operating status of BGS2T
Permanently off	BGS2T is in POWER DOWN mode
600 ms on / 600 ms off	Limited Network Service: No SIM card inserted or no PIN entered, or network search in progress, or ongoing user authentication, or network login in progress.
75 ms on / 3 s off	IDLE mode: The mobile is logged to the network (monitoring control channels and user interactions). No call in progress.
75 ms on / 75 ms off / 75 ms on / 3 s off	One or more GPRS contexts activated.
500 ms on / 25 ms off	Packet switched data transfer in progress.
Permanently on	Connected to remote party or exchange of parameters while setting up or disconnecting a call.

3.11 Antenna Interface

An external antenna is connected via the terminal's female SMA connector that is also the antenna reference point (ARP).

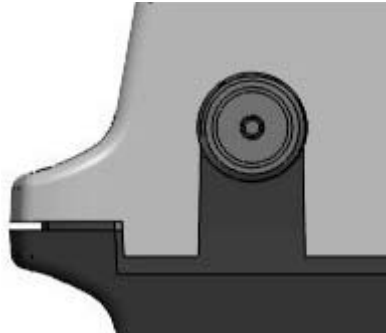


Figure 10: Antenna connector

The system impedance is 50Ω . In any case, for good RF performance, the return loss of the customer application's antenna should be better than 10dB (VSWR < 2). BGS2T withstands a total mismatch at this connector when transmitting with power control level for maximum RF power.

Inside the BGS2 module an inductor to ground provides additional ESD protection to the antenna connector. To protect the inductor from damage no DC voltage must be applied to the antenna circuit.

For the application it is recommended to use an antenna with an SMA (male) connector:

Please note that the terminal should be installed and operated with a minimum distance of 20cm between the antenna connected to the terminal and any human bodies. Also, the transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. The allowed maximum antenna gain for stand-alone situation is 7.24dBi (<1GHz) and 3.30dBi for the high bands (>1.7GHz).

4 Electrical and Environmental Characteristics

4.1 Absolute Maximum Ratings

Table 14: Absolute maximum ratings

Parameter	Port / Description	Min.	Max.	Unit
Supply voltage	PLUS	-50	30	V
Overvoltage	PLUS / for 1min		33	V
Input voltage for on/off control lines	IGT_IN, RST_IN	-5	30	V
RS-232 input voltage range	TXD, DTR, RTS	-25	+25	V
RS-232 output voltage range	RXD, CTS, DSR, DCD, RING	-0.3	+4.3	V
RS-485 input voltage range	RS485-A, RS485-B	-8	+13	V
Immunity against discharge of static electricity	All interfaces (lines) Contact discharge Human body model	-8 -15	+8 +15	kV kV
Protection Class	TBD. (avoid exposing BGS2T to liquid or moisture, for example do not use it in a shower or bath)		TBD.	
Mechanical vibrations amplitude	@ 5-200Hz		TBD.	mm
Mechanical pulse-acceleration	@ 18 ms duration		TBD.	g

Table 15: Operating supply voltage for BGS2T

Parameter	Min	Typ	Max	Unit
Supply voltage PLUS measured at (6-pole) western jack plug (1 to 6)	5.5 lowest voltage (minimum peak) incl. all ripple and drops	12	30	V
Supply voltage PLUS for RS-485 at 6-pin header	7.6 lowest voltage (minimum peak) incl. all ripple and drops	12	30	V

4.2 Operating Temperatures

Table 16: Board temperature of BGS2 module

Parameter	Min	Max	Unit
Normal operation	-30	+85	°C
Restricted operation ¹	-40 to -30	+85 to +90	°C
Automatic thermal shutdown ²	<-40	>+90	°C

¹. Restricted operation according to 3GPP TS 45.005 V6.7.0 (2004-11), Annex D, D.2.1, Temperature (GSM 400, GSM 900 and DCS 1 800): “Outside this temperature range the MS, if powered on, shall not make ineffective use of the radio frequency spectrum. In no case shall the MS exceed the transmitted levels as defined in 3GPP TS 45.005 for extreme operation.”

². Due to temperature measurement uncertainty, a tolerance of $\pm 3^{\circ}\text{C}$ on these switching thresholds may occur.

If the BGS2 module temperature rises close to the limit specified for normal operation, while data is transmitted over GPRS, the module automatically reverts from GPRS Multislot Class 10 (2Tx slots) to GPRS Multislot Class 8 (1Tx). This reduces the power consumption and, consequently, causes the board’s temperature to decrease. Once the temperature drops by 5 degrees, the module returns to the higher Multislot Class.

4.3 Storage Conditions

Table 17: Storage conditions

Type	Condition	Unit	Reference
Air temperature: Low High	-30 +75	°C	ETS 300 019-2-1: T1.2, IEC 60068-2-1 Ab ETS 300 019-2-1: T1.2, IEC 60068-2-2 Bb
Humidity relative: Low High Condens.	10 90 at 30°C 90-100 at 30°C	%	--- ETS 300 019-2-1: T1.2, IEC 60068-2-56 Cb ETS 300 019-2-1: T1.2, IEC 60068-2-30 Db
Air pressure: Low High	70 106	kPa	IEC TR 60271-3-1: 1K4 IEC TR 60271-3-1: 1K4
Movement of surrounding air	1.0	m/s	IEC TR 60271-3-1: 1K4
Water: rain, dripping, icing and frosting	Not allowed	---	---
Radiation: Solar Heat	1120 600	W/m ²	ETS 300 019-2-1: T1.2, IEC 60068-2-2 Bb ETS 300 019-2-1: T1.2, IEC 60068-2-2 Bb
Chemically active substances	Not recommended		IEC TR 60271-3-1: 1C1L
Mechanically active substances	Not recommended		IEC TR 60271-3-1: 1S1
Vibration sinusoidal: Displacement Acceleration Frequency range	1.5 5 2-9 9-200	mm m/s ² Hz	IEC TR 60271-3-1: 1M2
Shocks: Shock spectrum Duration Acceleration	semi-sinusoidal 1 50	ms m/s ²	IEC 60068-2-27 Ea

The conditions stated above are only valid for devices in their original packed state in weather protected, non-temperature-controlled storage locations. Normal storage time under these conditions is 12 months maximum.

4.4 Electrical Specifications of the Application Interface

4.4.1 On/Off Control (BGS2T RS232)

Table 18: RS-232 On/Off control line specifications (requirements)

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V_{high}	Input voltage IGT_IN, RST_IN	active high	5			V
V_{low}						
V_{high}	Input voltage DTR	active high	3		+15	V
V_{low}						
R_{IN}	Input resistance of IGT_IN, RST_IN		1			M Ω
R_{IN}	Input resistance of DTR		3	5	7	k Ω

4.4.2 On/Off Control (BGS2T RS485)

Table 19: RS-485 On/Off control line specifications (requirements).

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V_{high}	Input voltage IGT_IN	active high	5			V
V_{low}						
R_{IN}	Input resistance of IGT_IN		1			M Ω

4.4.3 RS-232 Interface

Table 20: RS-232 interface specifications (requirements)

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V _{OUT}	Transmitter output voltage for RXD, CTS, DSR, DCD, RING	@ 3kΩ load	±5	±6	±7	V
R _{OUT}	Transmitter output resistance RXD, CTS, DSR, DCD, RING		300			Ω
R _{IN}	Resistance TXD, RTS, DTR		3	5	7	kΩ
V _{In}	Receiver input voltage range TXD, RTS, DTR		-25		+25	V
V _{RIHYS}	Input hysteresis			0.5		V
V _{llow}	Input threshold low		0.6	1.2		V
V _{lhigh}	Input threshold high			1.5	2.4	V
Baudrate		Autobauding	1.2		230	kbps
		Fixed range	1.2		230	kbps
LE _{Cable}	Length of RS-232 cable			1.8	2	m

4.4.4 RS-485 Interface

Table 21: RS-485 interface specifications (requirements)

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V _{OUT}	Transmitter output voltage for RS485-A, -B	R _{Diff} = 100Ω	2		5	V
R _{IN}	Resistance RS485-A, -B			48		kΩ
V _{In}	Receiver input voltage range RS485-A, -B		-7		+12	V
V _{RIHYS}	Input hysteresis			25		mV
Threshold voltage	Receiver diff. threshold voltage		-200		+200	mV
Bus termination				120		Ω
Baudrate		Autobauding	1.2		230	kbps
		Fixed range	1.2		230	kbps
LE _{Cable}	Length of RS-485 indoor cable				10	m

4.5 Power Supply Ratings

Table 22: Power supply specifications

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V_{PLUS}	Allowed voltage ripple (peak-peak), drop during transmit burst peak current	TALK mode, power control level for $P_{out\ max}^1$			1	V
I_{PLUS}^2	Average supply current (average time 3 min.)	Power Down mode	@8V	9		mA
			@30V	3,7		
		IDLE mode (GSM/GPRS, 850/900MHz, 1800/1900MHz)	@8V	25		mA
			@30V	10		
		GSM TALK mode, 850/900MHz	@8V	135		mA
			@30V	40		
		GSM TALK mode, 1800/1900MHz	@8V	100		mA
			@30V	35		
		GPRS DATA mode(1 Tx, 4 Rx, 850/900MHz)	@8V	125		mA
			@30V	35		
		GPRS DATA mode(1 Tx, 4 Rx, 1800/1900MHz)	@8V	90		mA
			@30V	30		
		GPRS DATA mode(2 Tx, 3 Rx, 850/900MHz)	@8V	215		mA
			@30V	60		
GPRS DATA mode(2 Tx, 3 Rx, 1800/1900MHz)	@8V	150		mA		
	@30V	45				
Peak supply current (during 577 μ s transmission slot every 4.6ms)	Power control level for $P_{out\ max}$ (850/900MHz)	@8V	810		mA	
		@30V	200			
		@8V	490			mA
Power control level for $P_{out\ max}$ (1800/1900MHz)	@30V	130				

¹: Lowest voltage (minimum peak) incl. all ripple and drops >7.6V including voltage drop, ripple and spikes, measured at western jack (6-pole) pins (BGS2T RS232) and 6-pin header (BGS2T RS485).

²: Typical values measured with antenna impedance = 50 Ohm (return loss >20dB).

4.6 Antenna Interface

Table 23: Antenna interface characteristics

Parameter		Min	Typ	Max	Unit
Frequency range Uplink (MS → BTS)	GSM 850	824		849	MHz
	E-GSM 900	880		915	MHz
	GSM 1800	1710		1785	MHz
	GSM 1900	1850		1910	MHz
Frequency range Downlink (BTS → MS)	GSM 850	869		894	MHz
	E-GSM 900	925		960	MHz
	GSM 1800	1805		1880	MHz
	GSM 1900	1930		1990	MHz
RF power @ ARP with 50Ω load	GSM 850 ¹	31		35	dBm
	E-GSM 900 ¹	31		35	dBm
	GSM 1800 ²	28		32	dBm
	GSM 1900 ²	28		32	dBm
Number of carriers	GSM 850		124		
	E-GSM 900		174		
	GSM 1800		374		
	GSM 1900		299		
Duplex spacing	GSM 850		45		MHz
	E-GSM 900		45		MHz
	GSM 1800		95		MHz
	GSM 1900		80		MHz
Carrier spacing			200		kHz
Multiplex, Duplex	TDMA / FDMA, FDD				
Time slots per TDMA frame			8		
Frame duration			4.615		ms
Time slot duration			577		μs
Modulation	GMSK				
Receiver input sensitivity @ ARP BER Class II < 2.4% (static input level)	GSM 850	-102 ³	-107 ⁴		dBm
	E-GSM 900	-102 ³	-107 ⁴		dBm
	GSM 1800	-102 ³	-107 ⁴		dBm
	GSM 1900	-102 ³	-107 ⁴		dBm

1. Power control level PCL 5

2. Power control level PCL 0

3. Under fading conditions

4. Typical value is at least -107dBm.

5 Mechanics, Mounting and Packaging

5.1 Mechanical Dimensions

Figure 11 shows a 3D view of the BGS2T and provides an overview of the mechanical dimensions of the board. To allow for an easier mechanical implementation into an external application a set of 3D STP data for BGS2T RS232 is attached to this PDF. Please open the [Attachments](#) navigation panel to view and save these files.

- Length: 80mm (including fixtures for cable straps)
- Width: 55mm (excluding antenna and serial interface connectors)
- Height: 23mm

- Weight: 65g

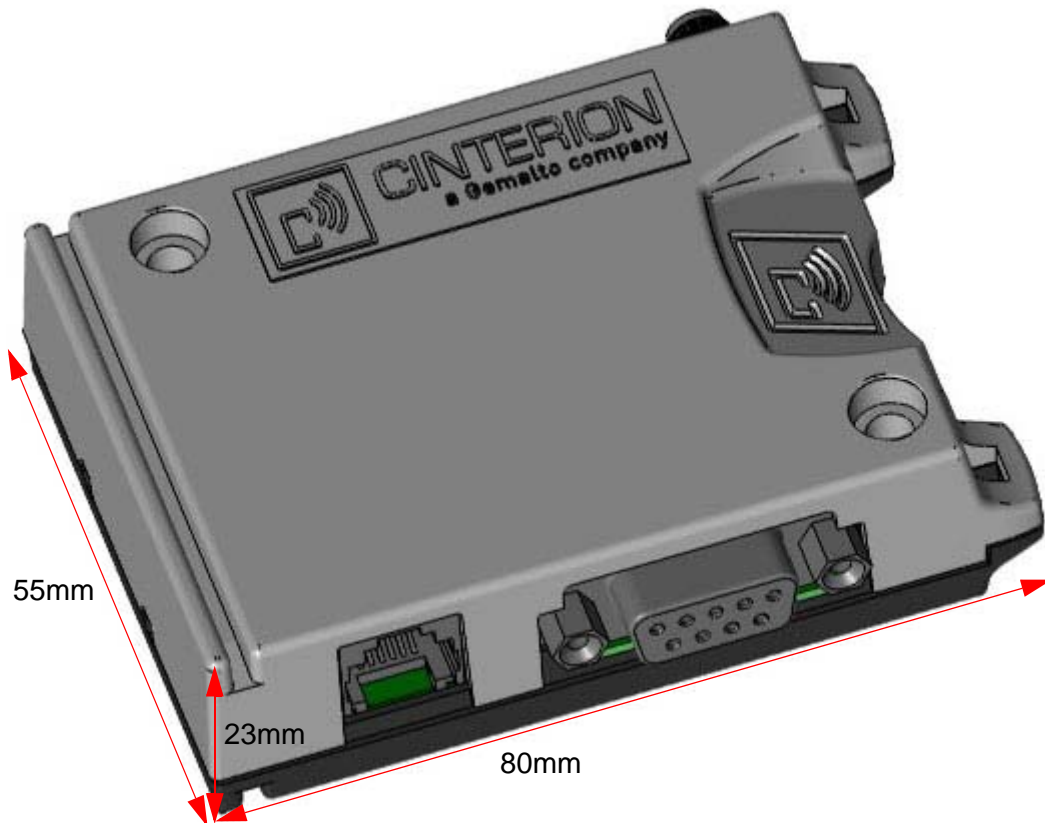


Figure 11: Mechanical dimensions

5.2 Mounting the BGS2T

There are a number of ways to mount the BGS2T:

- BGS2T can be attached to a rail installation or other surface using the two provided screw holes.
- BGS2T can be fastened to a rack or holding using the two provided fixtures for cable straps.
- BGS2T can be slid onto a specific DIN rail made according to DIN EN 60715 - C section, C30 format. A catch at the terminal's bottom side will have to be removed to slide multiple terminals onto a single rail.
- Using a Wago 209-118 mounting foot for terminal blocks the BGS2T can be fitted onto another special type of DIN rail made according to DIN EN 60715 - Top hat section, 35mm (e.g., Wago 210-113 steel carrier rail).

The following figure shows the various possibilities provided to mount the BGS2T.

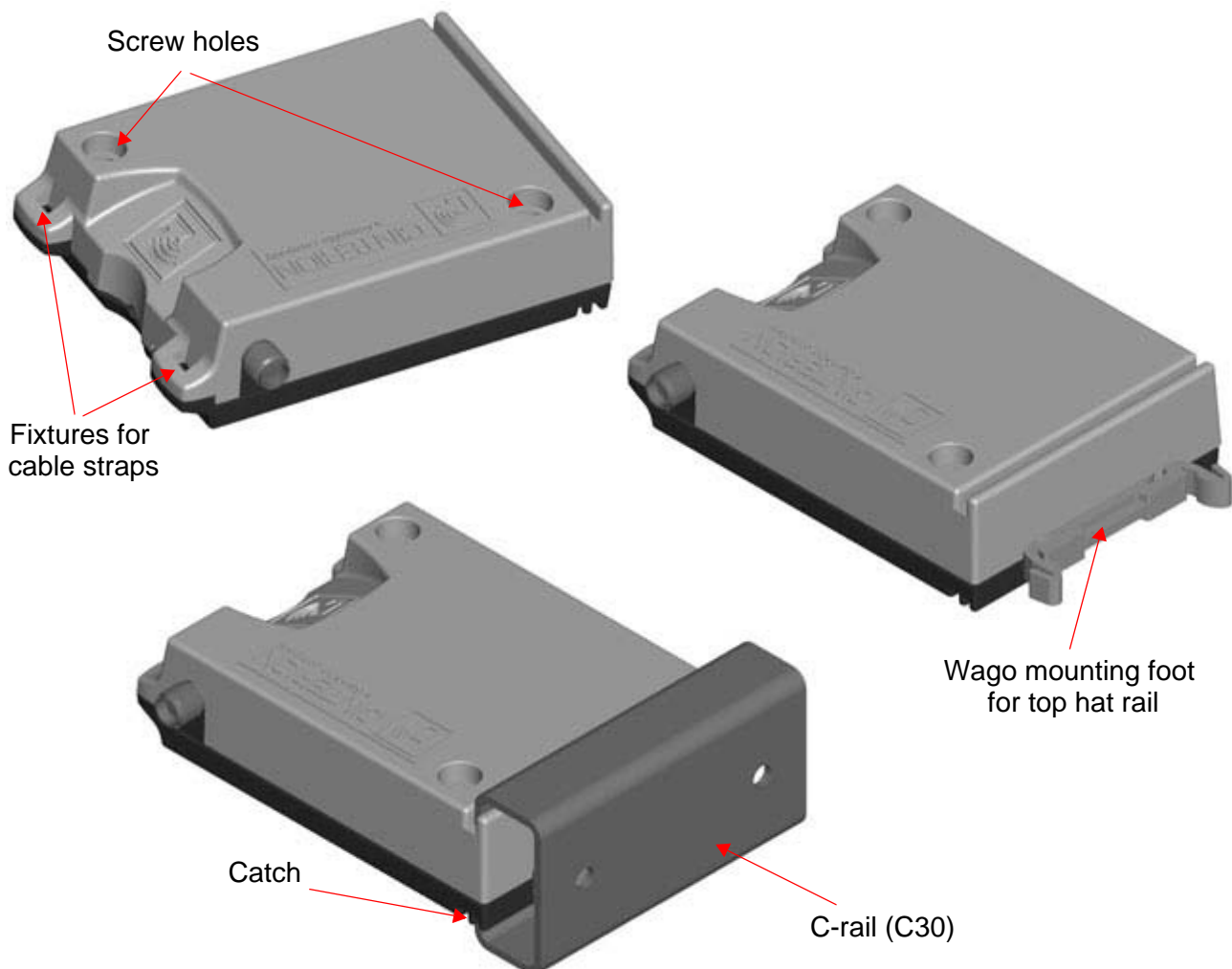


Figure 12: Mounting the BGS2T

The various ways to mount the BGS2T may be combined where appropriate. It is for example possible to slide the terminal onto a DIN rail and in addition use cable straps to fasten it to a holding.

5.3 Packaging

BGS2T comes in terminal boxes and is shipped in transportation cardboards:

- Terminal box size: 35mm x 83mm x 67mm.
- Transportation cardboard size: TBD.

Each transportation cardboard contains 100 terminal boxes.

6 Full Type Approval

6.1 Cinterion Reference Setup

The Cinterion reference setup submitted to type approve BGS2T consists of the following components:

- BGS2T with approved GSM module (BGS2T RS232 or BGS2T RS485)
- PC as MMI
- Power Supply

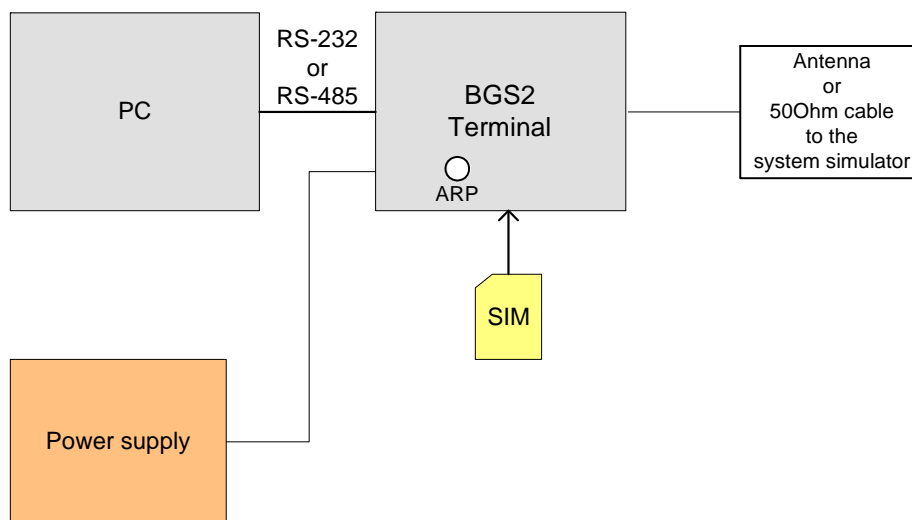


Figure 13: Reference equipment for approval

For ordering information please refer to [Chapter 7](#).

6.2 Restrictions

Later enhancements and modifications beyond the certified configuration require extra approvals. Each supplementary approval process includes submittal of the technical documentation as well as testing of the changes made.

- No further approvals are required for customer applications that comply with the approved BGS2T configuration.
- Extra approval must be obtained for applications using other accessories than those included in the approved BGS2T configuration (power supply, MMI implementation supported by AT commands).

6.3 CE Conformity

The BGS2T meets the requirements of the EU directives listed below:

- R&TTE Directive 1999/5/EC

6.4 EMC

The BGS2T complies with the equipment requirements specified in EN 301489-1, -7 and is covered by the R&TTE Directive.

6.5 Compliance with FCC Rules and Regulations

As an integrated product, the BGS2T is fully compliant with the grant of the FCC Equipment Authorization issued for the built-in BGS2 module, and therefore, bears the label “Contains FCC ID QIPBGS2”.

The Equipment Authorization Certification for the BGS2 module is listed under the following identifiers:

FCC Identifier: QIPBGS2

Industry Canada Certification Number: 7830A-BGS2

Granted to Cinterion Wireless Modules GmbH

Radiofrequency radiation exposure Information:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Note: This terminal equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

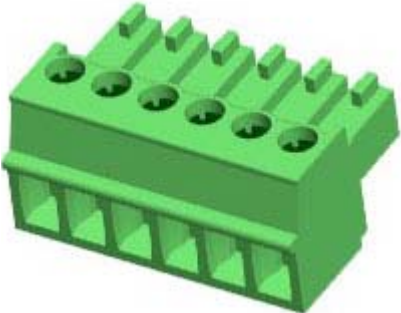
Changes or modifications made to this equipment not expressly approved by Cinterion may void the FCC authorization to operate this equipment.

This device contains GSM and GPRS Class10 functions in the 900 and 1800MHz Band which are not operational in U.S. Territories. This device is to be used only for mobile and fixed applications.

Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

7 List of Parts and Accessories

Table 24: List of parts and accessories

Description	Supplier	Ordering information
BGS2T	Cinterion	Ordering number BGS2T RS232: L30960-N2700-A100 BGS2T RS485: L30960-N2710-A100
Power supply unit	Cinterion	Terminal Power Supply Ordering number: L36880-N8490-A12 UK adapter for Terminal Power Supply Ordering number: L36880-N8490-A13 US adapter for Terminal Power Supply Ordering number: L36880-N8490-A14 AU adapter for Terminal Power Supply Ordering number: L36880-N8490-A15
Mounting foot (209-118) Top hat rail, i.e., 35mm DIN rail (210-113)	Wago	WAGO Kontakttechnik GmbH & Co. KG Hansastr. 27 32423 Minden Phone: +49-571-887-0 Fax: +49-571-887-169 Email: info@wago.com Web: http://www.wago.com/
Antenna - SMARTEQ-MiniMAG Dualband, 0dBd, 2.6m RG174, SMA (m)	KÖBEL Mobile Communication	Ordering number: 1140.26 with crimped SMA connector KÖBEL Mobile Communication Sesamstrasse 12 D-24632 Lentföhrden
RS-232 cable with 9-pin D-sub connector (male)	Tecline	Ordering number: 300574 Tecline GmbH Behrener Straße 8 D-66117 Saarbrücken Phone: +49-681-926-78-70 Fax: +49-681-926-78-555 Web: http://www.tecline-edv.de/
6-pin header connector (male) for RS-485 interface 	PHOENIX CONTACT	Ordering number: 1803617 PHOENIX CONTACT Deutschland GmbH Flachmarktstr. 8 D-32825 Blomberg Phone: +49 52 35/3-1 20 00 Fax: +49 52 35/3-1 29 99 Email: iinfo@phoenixcontact.de Web: http://www.phoenixcontact.com