Cinterion® Java Terminals

Hardware Interface Description

Version: 02
DocId: EHSxT_BGS5T_HID_v02

Document Name:	**Cinterion® Java Terminals Hardware Interface Description**
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0 Document History

Preceding document: "Cinterion® Java Terminals Hardware Interface Description" Version 01
New document: "Cinterion® Java Terminals Hardware Interface Description" Version 02

Chapter	What is new
1.4	Revised product label shown in Figure 1.
3.7	Revised section with regard to the Weidmueller pin availability.
4.1	Completed Table 15 giving absolute maximum ratings.
4.2	Added remarks on board temperature.
4.5	Revised and completed section listing power supply ratings.
6.3	Added CE conformity mark.
6.5	Revised section to include notes for IC (also in the Frensh language).
8	Revised and updated Appendix A: (Hardware) Watchdog.

New document: "Cinterion® Java Terminals Hardware Interface Description" Version 01

Chapter	What is new
---	Initial document setup.

1 Introduction

This document[1] describes the hardware of the Cinterion® Java Terminals. The Java Terminals come in three variants depending on the included Cinterion® module and the available interfaces:

- **EHS5T RS485** contains a Cinterion® EHS5-E module and implements a USB 2.0 interface with a USB-B connector as well as a 6-pole Western jack as plug-in power supply connector. Via a Weidmüller GPIO connectors it also implements a RS-485 interface including power supply and ignition line.
- **EHS6T USB** contains a Cinterion® EHS6 module and implements a USB 2.0 interface with a USB-B connector and also a V.24 / V.28 RS-232 interface with a D-sub 9-pole female socket as well as a 6-pole Western jack as plug-in power supply connector.
- **BGS5T USB** contains a Cinterion® BGS5 module and implements a USB 2.0 interface with a USB-B connector and also a V.24 / V.28 RS-232 interface with a D-sub 9-pole female socket as well as a 6-pole Western jack as plug-in power supply connector.

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

Table 1 gives a short overview of the available interfaces for the different Java Terminals.

Table 1: Cinterion® Java Terminals overview

Module/Interface	EHS5T RS485	EHS6T USB	BGS5T USB
Cinterion® module	EHS5-E	EHS6	BGS5
RS-232 (Sub-D)	-	✓	✓
USB (USB-B)	✓	✓	✓
Weidmüller connector (GPIOs, SPI, I^2C, RS-485)	✓	✓ (no RS-485)	✓ (no RS-485, no SPI)
Power supply (RJ-11)	✓	✓	✓
RF antenna	✓	✓	✓

The scope of this document includes interface specifications, electrical as well as mechanical characteristics of the Java Terminals. It specifies standards pertaining to wireless applications and outlines requirements that must be adhered to for successful product design. The Java Terminals are compact GSM/UMTS modems for the transfer of data in GSM/UMTS networks. Industrial standard interfaces and an integrated SIM card reader allow using the Java Terminals easily as GSM/GPRS/UMTS terminals.

1. The document is effective only if listed in the appropriate Release Notes as part of the technical documentation delivered with your Gemalto M2M product.

1.1 Related Documents

[1] AT Command Set for your Java Terminal product
[2] Release Notes for your Java Terminal product

To visit the Gemalto M2M GmbH Website please use the following link:
http://m2m.gemalto.com

1.2 Terms and Abbreviations

Table 2: 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

Table 2: Terms and abbreviations

Abbreviation	Description
Mbps	Mbits per second
MMI	Machine Machine Interface
MO	Mobile Originated
MS	Mobile Station
MT	Mobile Terminated
NC	Not Connected
NTC	Negative Temperature Coefficient
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

Java Terminals have been designed to comply with the directives and standards listed below[1].

Table 3: Directives

99/05/EC	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). The product is labeled with the CE conformity mark CE 0682
2002/95/EC (RoHS 1) 2011/65/EC (RoHS 2)	Directive of the European Parliament and of the Council of 27 January 2003 (and revised on 8 June 2011) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
2002/96/EC	Directive of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE)
2003/108/EC	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)

Table 4: Standards of North American type approval

CFR Title 47	“Code of Federal Regulations, Part 15 B, Part 22 and Part 24 (Telecommunications, PCS)”; US Equipment Authorization FCC
OET Bulletin 65 (Edition 97-01)	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
UL 60 950-1	Product Safety Certification (Safety requirements)
NAPRD.03 V5.15	“Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control” PCS Type Certification Review board (PTCRB)
RSS102 (Issue 4) RSS132 (Issue 3) RSS133 (Issue 6)	Canadian Standard
IEEE Std. C95.1-1999	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

Table 5: Standards of European type approval

3GPP TS 51.010-1	“Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification”
ETSI EN 301 511 V9.0.2	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)
GCF-CC V3.49	Global Certification Forum - Certification Criteria

1. Standards of North American type approval do not apply to EHS5T RS485, 3G/WCDMA related standards do not apply to BGS5T USB.

Table 5: Standards of European type approval

ETSI EN 301 489-1 V1.9.2	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
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)
ETSI EN 301 489-24 V1.5.1	Electromagnetic Compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
ETSI EN 301 908-01 V5.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000 Third Generation cellular networks; Part 1: Harmonized EN for IMT-2000, introduction and common requirements of article 3.2 of the R&TTE Directive
ETSI EN 301 908-02 V5.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000 Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive
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)+ A11:2009+A1:2010+ AC:2011+A12:2011	Safety of information technology equipment

Table 6: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

Table 7: 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	"Marking for Control of Pollution Caused by Electronic Information Products" (2006-06).  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. 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.

Table 8: 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)	O	O	O	O	O	O
电路模块 (Circuit Modules)	X	O	O	O	O	O
电缆及电缆组件 (Cables and Cable Assemblies)	O	O	O	O	O	O
塑料和聚合物部件 (Plastic and Polymeric parts)	O	O	O	O	O	O

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 Java Terminals. 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. Gemalto M2M GmbH assumes no liability for customer's failure to comply with these precautions.

	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. 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.
	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. Check the local and actual laws about these themes.
	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.
	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.
	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. Check the actual and local laws about these themes.

	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. 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. 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.
	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.
	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.

1.4 Product Label

The label fixed to the bottom of a Java Terminal comprises the following information.

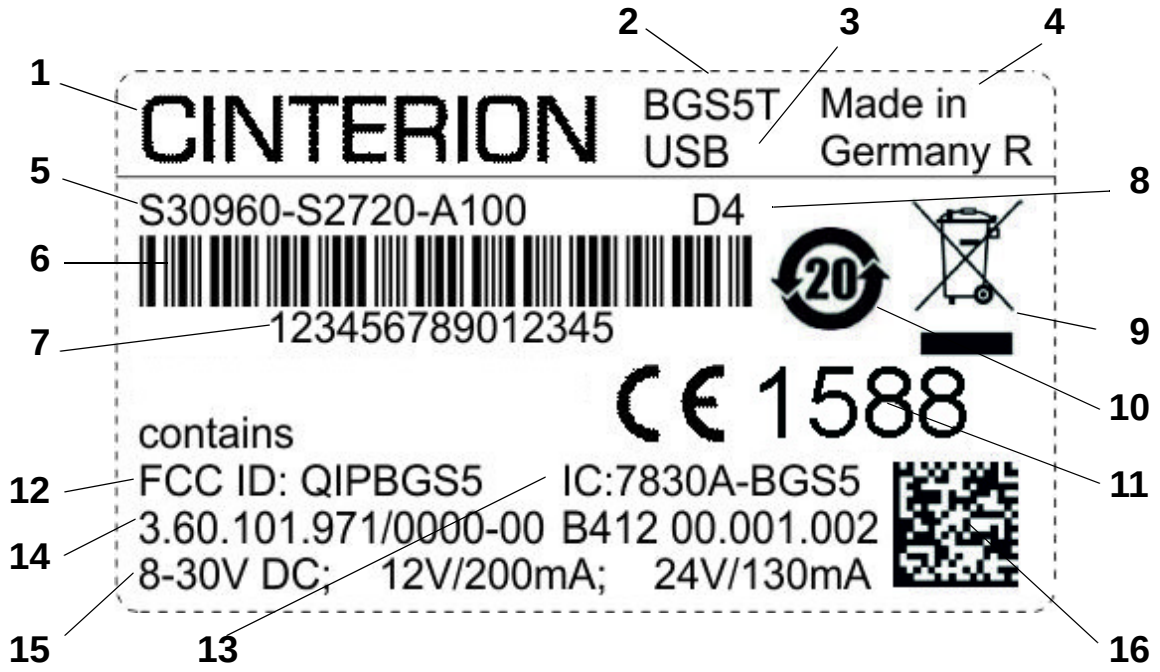


Figure 1: Sample Java Terminal label (BGS5T USB)

Table 9: Java Terminals 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	WEEE symbol (see Table 3)
10	Chinese RoHS symbol (see Table 7)
11	CE logo with fixed notified body number (may be replaced for samples with "Not for sale")
12	FCC ID
13	IC ID
14	Manufacturer code
15	Power supply unit ratings
16	Manufacturer code (2D)

2 Product Concept

2.1 Key Features at a Glance

Feature	Implementation
General	
Incorporates Cinterion® Java module	The Java module handles all signal and data processing within the Java Terminals. Internal software runs the application interface and the complete GSM/UMTS protocol stack.
Frequency bands	EHS5T RS485 (with EHS5-E module): GSM/GPRS/EDGE: Dual band GSM 900/1800MHz UMTS/HSPA+: Dual band UMTS 900/2100MHz EHS6T USB (with EHS6 module): GSM/GPRS/EDGE: Quad band 850/900/1800/1900MHz UMTS/HSPA+: Five band 800/850/900/1900/2100MHz BGS5T USB (with BGS5 module): GSM/GPRS: Quad band 850/900/1800/1900MHz
GSM class	Small MS
Output power (according to Release 99, V5) depending on frequency band supported by module	Class 4 (+33dBm ±2dB) for EGSM850 Class 4 (+33dBm ±2dB) for EGSM900 Class 1 (+30dBm ±2dB) for GSM1800 Class 1 (+30dBm ±2dB) for GSM1900 Class E2 (+27dBm ± 3dB) for GSM 850 8-PSK Class E2 (+27dBm ± 3dB) for GSM 900 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1800 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1900 8-PSK Class 3 (+24dBm +1/-3dB) for UMTS 2100, WCDMA FDD BdI Class 3 (+24dBm +1/-3dB) for UMTS 1900,WCDMA FDD BdII Class 3 (+24dBm +1/-3dB) for UMTS 900, WCDMA FDD BdVIII Class 3 (+24dBm +1/-3dB) for UMTS 850, WCDMA FDD BdV Class 3 (+24dBm +1/-3dB) for UMTS 800, WCDMA FDD BdVI 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	Normal operation: -30°C to +85°C Extended operation: -40°C to -30°C and +85°C to +90°C
Physical	Dimensions: 113.5mm x 75mm x 25.5mm (excluding antenna and serial interface connectors) Weight: 120g (approx.)
RoHS, WEEE	All hardware components are fully compliant with the EU RoHS and WEEE Directives
HSPA features	
3GPP Release 6,7 (EHSxT only)	DL 7.2Mbps, UL 5.7Mbps HSDPA Cat.8 / HSUPA Cat.6 data rates Compressed mode (CM) supported according to 3GPP TS25.212

Feature	Implementation
UMTS features	
3GPP Release 4 (EHSxT only)	PS data rate – 384 kbps DL / 384 kbps UL CS data rate – 64 kbps DL / 64 kbps UL
GSM / GPRS / EDGE features	
Data transfer	GPRS: • Multislot Class 12 • Full PBCCH support • Mobile Station Class B • Coding Scheme 1 – 4 EGPRS (EHSxT only): • Multislot Class 12 • EDGE E2 power class for 8 PSK • Downlink coding schemes – CS 1-4, MCS 1-9 • Uplink coding schemes – CS 1-4, MCS 1-9 • SRB loopback and test mode B • 8-bit, 11-bit RACH • PBCCH support • 1 phase/2 phase access procedures • Link adaptation and IR • NACC, extended UL TBF • Mobile Station Class B CSD: • V.110, RLP, non-transparent • 2.4, 4.8, 9.6, 14.4kbps • USSD
SMS	• Point-to-point MT and MO • Cell broadcast • Text and PDU mode •
Software	
AT commands	Hayes 3GPP TS 27.007, TS 27.005, Gemalto M2M
Java™ Open Platform	Java™ Open Platform with • Java™ profile IMP-NG & CLDC 1.1 HI • Secure data transmission via HTTPS/SSL • Multi-threading programming and multi-application execution Major benefits: seamless integration into Java applications, ease of programming, no need for application microcontroller, extremely cost-efficient hardware and software design – ideal platform for industrial GSM applications. The memory space available for Java programs is around 10MB in the flash file system and around 6MB RAM. Application code and data share the space in the flash file system and in RAM.
SIM Application Toolkit	SAT Release 99
TCP/IP stack	Protocols: TCP server/client, UDP, HTTP, FTP, SMTP, POP3 Access by AT commands
Firmware update	Upgradeable via serial or USB interface

Feature	Implementation
Interfaces	
USB interfaces	USB 2.0 Slave interface
RS232	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 • Autobauding supported
Weidmueller connector	20-pin (8-pin and 12-pin) header with GPIO interface, external power supply, ADC, SPI, I²C and RS-485 option, depending on variant
Power connector	6-pole Western connector (female) for power supply, ignition, power down signal
SIM card reader	Supported SIM cards: 3V, 1.8V
Antenna	Antenna connected via female SMA connector
Power on/off, Reset	
Power on	DTR line at RS-232 interface, IGT_IN line at power connector or watchdog
Power off	Normal switch-off by AT^SMSO or external On/Off push button Automatic switch-off in case of critical temperature conditions
Reset	Orderly shutdown and reset by AT command Emergency restart via RST_IN line at power connector or via watchdog
Special features	
Real time clock	Timer functions via AT commands
Phonebook	SIM card and terminal
(Hardware) Watchdog	Configurable watchdog to control module

3 Interface Description

3.1 Overview

Java Terminals provide the following interfaces for power supply, antenna, SIM card and data transfer:

- 6-pin Western connector (female) for power supply, ignition, power down signal
- SMA antenna connectors (female) for RF antenna and future Rx diversity or GPS antennas
- SIM card reader
- 9-pin (female) D-sub connector (RS-232 interface)
- 4-pin (female) USB-B connector
- 12-pin and 8-pin Weidmueller GPIO connectors (including RS-485)

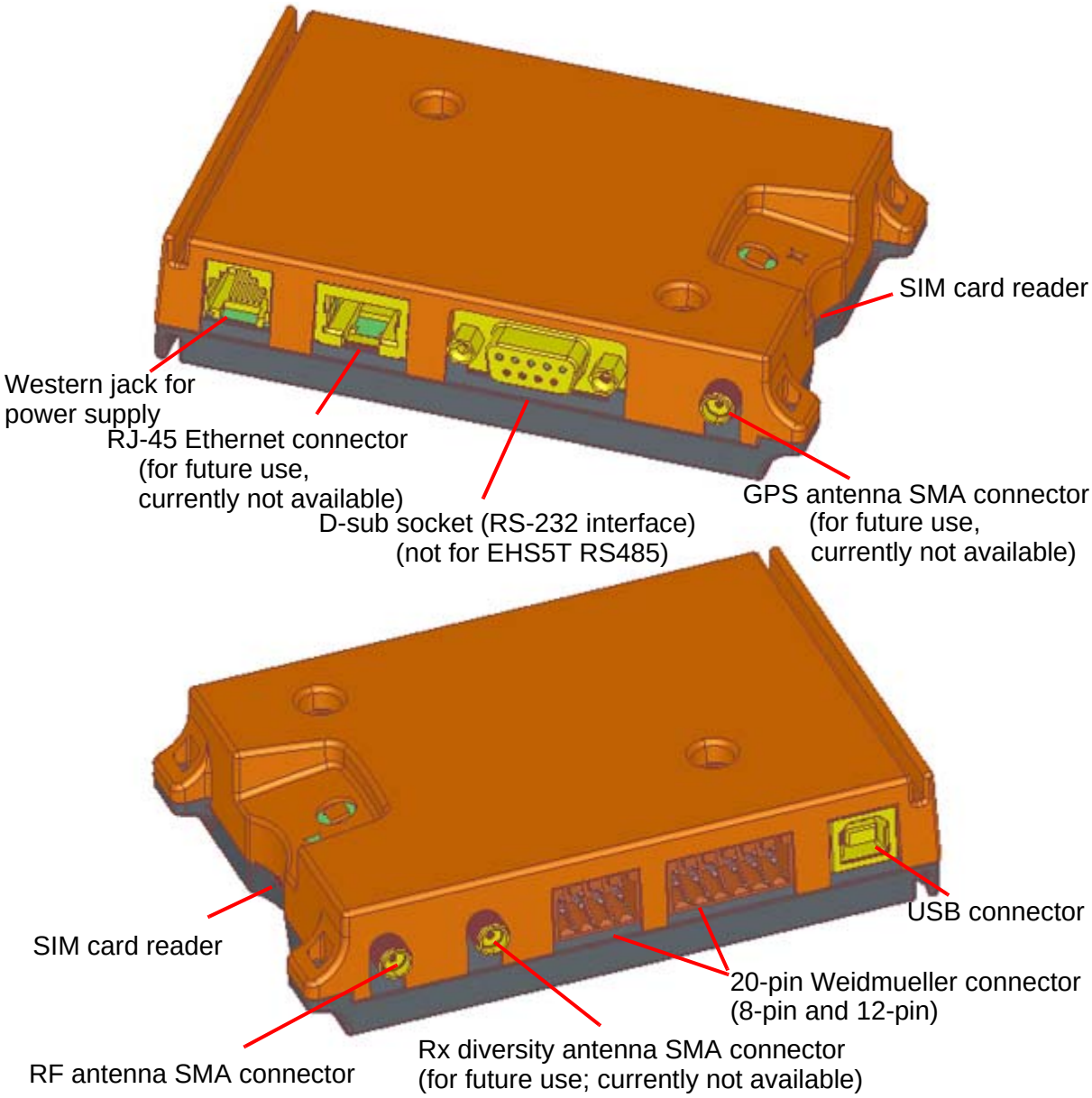


Figure 2: Java Terminals 3D view

3.2 Block Diagram

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

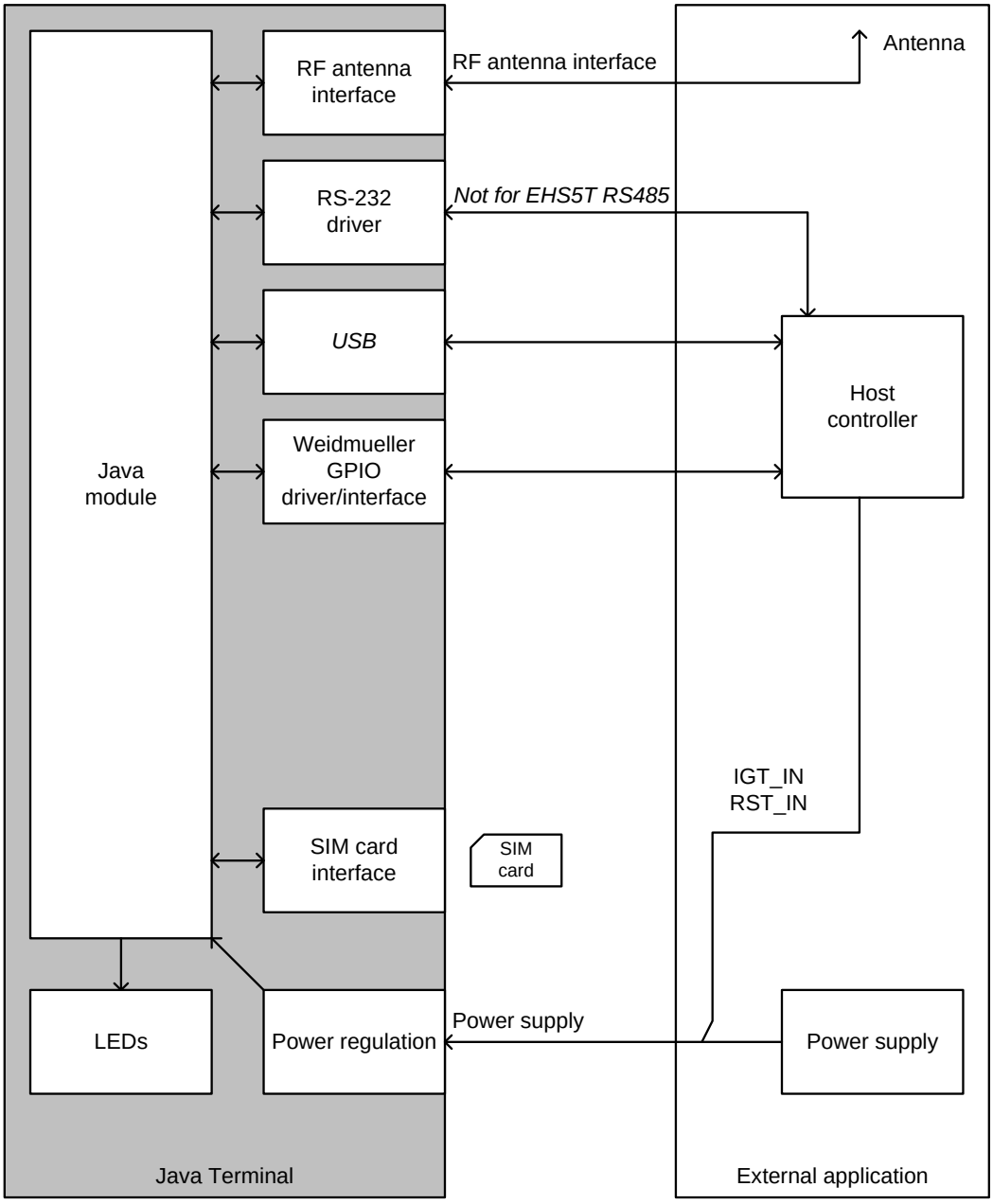


Figure 3: Block diagram

3.3 Terminal Circuit

Figure 4 shows a general Java Terminal block diagram that includes all variants. Not every interface is available for all Terminal products.

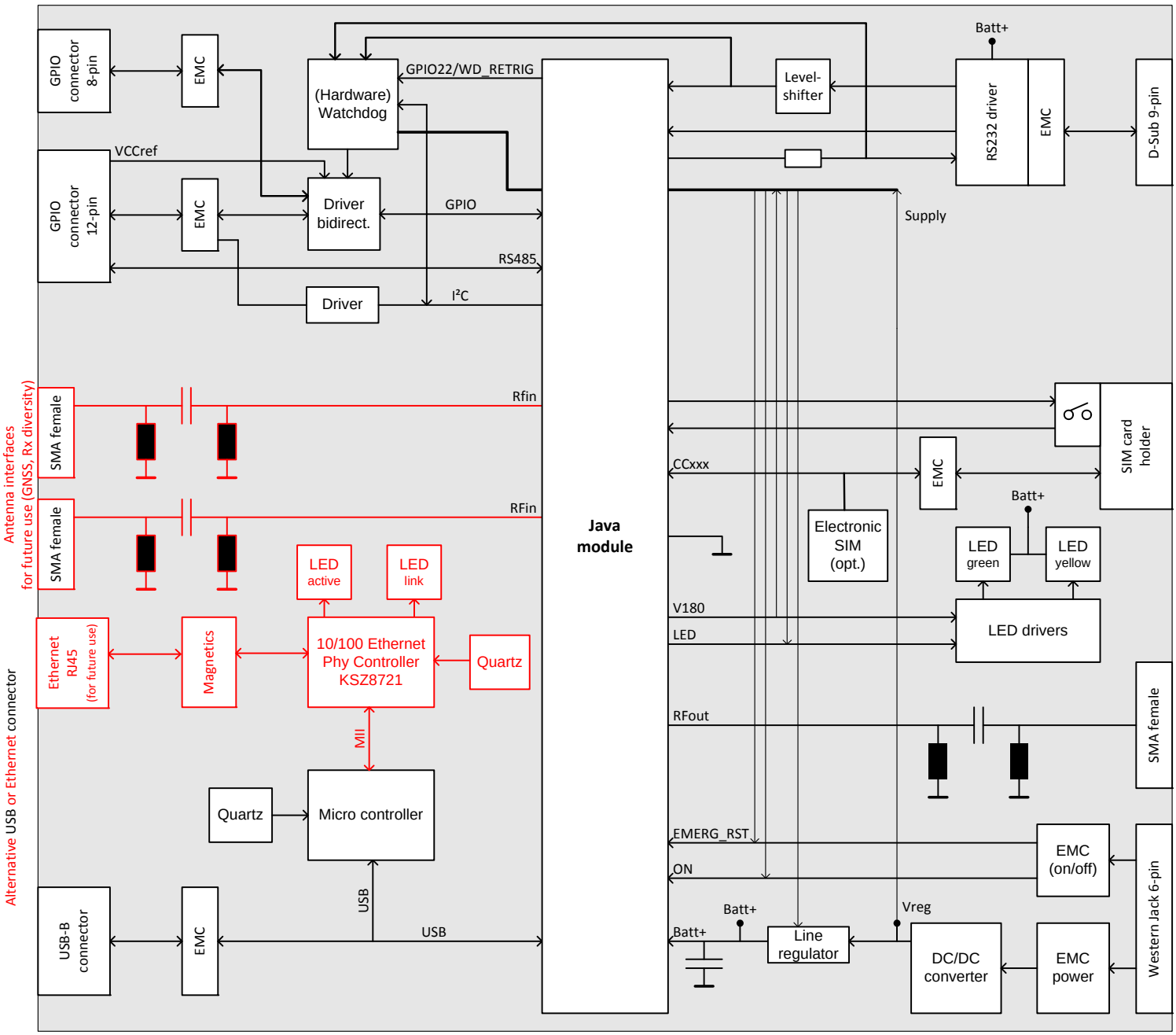


Figure 4: Java Terminals circuit block diagram

3.4 Operating Modes

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

Table 10: 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. Watchdog active.
	GSM TALK GSM DATA	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. Watchdog active.
	GPRS / UMTS / HSPA 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). Watchdog active.
	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. Watchdog active.
	EGPRS DATA (EHSxT only)	EGPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates, EGPRS configuration (e.g. used multislot settings) and reduction of maximum output power. Watchdog active.
	UMTS TALK UMTS DATA (EHSxT only)	UMTS data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate. Watchdog active.
	HSPA DATA (EHSxT only)	HSPA data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate. Watchdog active.
POWER DOWN	Normal shutdown after sending the AT^SMSO command. The RTC works continuously, but the software is not active. Interfaces are not accessible. Watchdog continues to operate, depending on its configuration.	

3.5 RS-232 Interface

The RS-232 interface is not available for EHS5T RS485. The 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 921kbps. Autobauding supports bit rates from 1.2kbps to 230kbps.

For more information see also Section 3.5.1.

3.5.1 9-Pole D-sub Connector

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

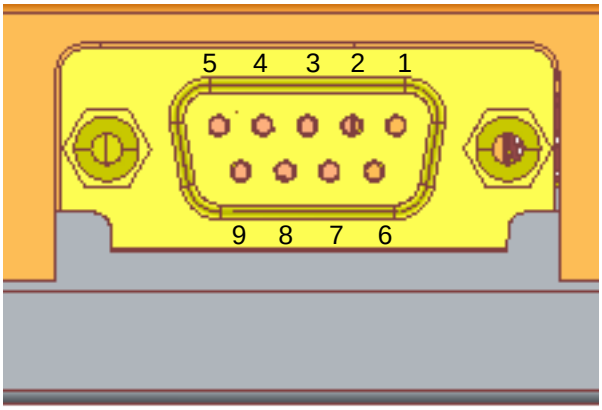


Figure 5: Pin assignment RS-232 (D-sub 9-pole female)

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 Java Terminals 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

Java Terminals are 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 the Java Terminals
- Port RxD @ application receives data from RXD of the Java Terminals

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 Java Terminals.

3.6 USB Interface

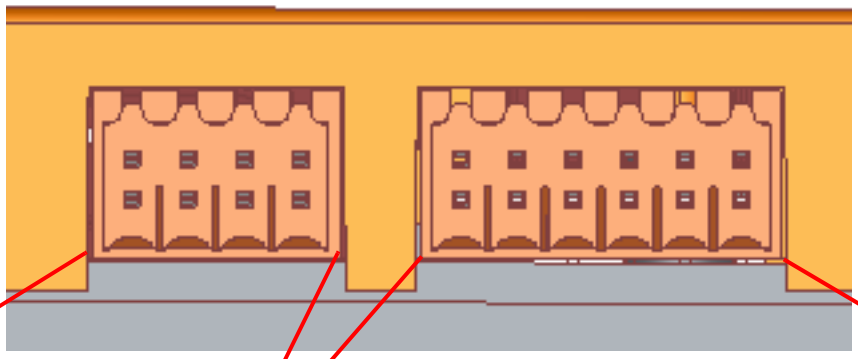
The Java Terminals support a USB 2.0 High Speed (480Mbit/s) device interface that is Full Speed (12Mbit/s) compliant.

The USB interface can be used as command and data interface and for downloading firmware. It is only available as a slave device and not able to act as a USB host.

3.7 Weidmueller GPIO Interface

The Weidmueller connectors (8-pin and 12-pin) provide access to various module signals including a number of configurable GPIOs. Note that not all of the Weidmueller pins are available for every Java Terminal variant. The following figures show the available pins for the Java Terminal variants and the below Table 12 lists the overall availablility of the Weidmueller pins.

EHS5T RS485:



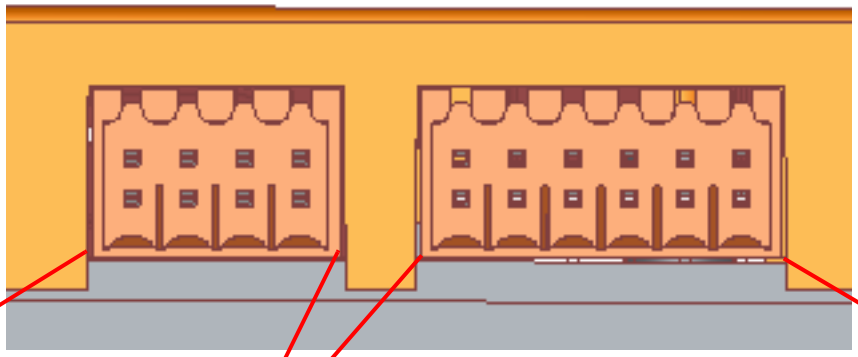
1	2	3	4
GPIO6	GPIO7	GPIO8	n/a
5	**6**	**7**	**8**
n/a	n/a	n/a	n/a

1	2	3	4	5	6
VCCref	GND	TXD1/ SPI_MISO	RXD1/ SPI_MOSI	A+ (RS485)	B- (RS485)
7	**8**	**9**	**10**	**11**	**12**
+5Vout	DSR0/ ADC1_IN/ SPI_CLK	I2CDAT	I2CCLK	GPIO20	GPIO21

n/a: not applicable

Figure 6: EHS5T RS485: Weidmueller connectors (8-pin and 12-pin)

EHS6T USB:

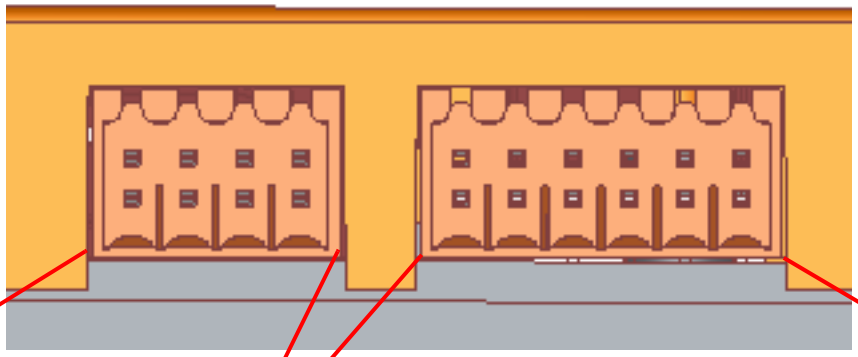


1	2	3	4
GPIO6	GPIO7	GPIO8	GPIO11
5	**6**	**7**	**8**
GPIO12	GPIO13	GPIO14	GPIO15

1	2	3	4	5	6
VCCref	GND	TXD1/ SPI_MISO	RXD1/ SPI_MOSI	CTS1 (RS232)/ SPI_CS	RTS1 (RS232/
7	**8**	**9**	**10**	**11**	**12**
+5Vout	DSR0/ ADC1_IN/ SPI_CLK	I2CDAT	I2CCLK	GPIO20	GPIO21

Figure 7: EHS6T USB: Weidmueller connectors (8-pin and 12-pin)

BGS5T USB:



1	2	3	4
GPIO6	GPIO7	GPIO8	n/a
5	**6**	**7**	**8**
n/a	n/a	n/a	n/a

1	2	3	4	5	6
VCCref	GND	TXD1	RXD1	CTS1 (RS232)/	RTS1 (RS232/
7	**8**	**9**	**10**	**11**	**12**
+5Vout	DSR0/ ADC1_IN	I2CDAT	I2CCLK	GPIO20	GPIO21

n/a: not applicable

Figure 8: BGS5T USB: Weidmueller connectors (8-pin and 12-pin)

The following Table 12 shows the availablility of the Weidmueller pins for various Java Terminal variants.

Table 12: Weidmueller pin availability

PIN	Signal	Comment	EHS5T RS485	EHS6T USB	BGS5T USB
8-pin connector					
1	GPIO6	Configurable via AT command, also as PWM2 signal	✓	✓	✓
2	GPIO7	Configurable via AT command, also as PWM1 signal	✓	✓	✓
3	GPIO8	Configurable via AT command, also as COUNTER signal	✓	✓	✓
4	GPIO11	Configurable via AT command	-	✓	-
5	GPIO12	Configurable via AT command	-	✓	-
6	GPIO13	Configurable via AT command	-	✓	-
7	GPIO14	Configurable via AT command	-	✓	-
8	GPIO15	Configurable via AT command	-	✓	-
12-pin connector					
1	VCCref	Input supply for level converter to specify external power level (e.g., connect +5Vout for 5V power level)	✓	✓	✓
2	GND		✓	✓	✓
3	TXD1 or SPI_MISO	Configurable via AT command, also as SPI_MISO signal	TXD1 or SPI_MISO	TXD1 or SPI_MISO	TXD1
4	RXD1 or SPI_MOSI	Configurable via AT command, also as SPI_MOSI signal	RXD1 or SPI_MOSI	RXD1 or SPI_MOSI	RXD1
5	CTS1 or SPI_CS or A+	Either CTS1 (for RS-232) or SPI_CS or A+ (for RS-485) depending on product variant	A+ (RS-485)	CTS1 or SPI_CS	CTS1
6	RTS1 or B-	Either RTS1 (for RS-232) or B- (for RS-485) depending on product variant	B- (RS-485	RTS1	RTS1
7	+5Vout	External power supply up to 100mA, usable as VCCref input	✓	✓	✓
8	DSR0 or ADC1_IN or SPI_CLK	Configurable via AT command	✓	✓	✓ (no SPI)
9	I2CDAT	I^2C interface	✓	✓	✓
10	I2CCLK	I^2C interface	✓	✓	✓
11	GPIO20	Configurable via AT command	✓	✓	✓
12	GPIO21	Configurable via AT command	✓	✓	✓

Please refer to the respective “AT Command Set“ for details on how to configure the GPIO pins.

EHS5T‘s 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.

3.8 Power Supply

The power supply of the Java Terminals 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 8V 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 Java Terminals are protected from supply voltage reversal. An external fast acting fuse ≥0.4A with melting integral I^2t (0.15 … 0.25)A^2s is necessary to use the Java Terminals 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, Java Terminals reset or switch off. The watchdog can be configured to restart the Java Terminals. When power fails for >15s the RTC will be reset.

Table 13: Female 6-pole Western plug for power supply, ignition, power down

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

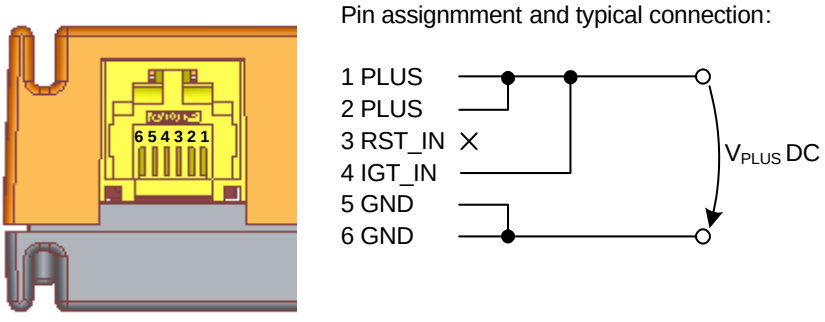


Figure 9: 6-pole Western jack for power supply, ignition, reset, typical connection

Mains adapter: If it fits into the design of your application we recommend the plug-in supply unit used with the type approved Gemalto M2M 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).

3.8.1 Turn Java Terminals on

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

While the RST_IN pin (pin 3) is not active (voltage <2V) you can start the Java Terminals by activating the RS-232 DTR line if in POWER DOWN mode.

The IGT_IN signal (pin 4) may be used to switch on Java Terminals if in POWER DOWN mode.

The watchdog can also be configured to turn the Java Terminals on if in POWER DOWN mode.

After startup of the Java Terminals 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.

3.8.2 Reset Java Terminals

An easy way to reset the Java Terminals is entering the command AT+CFUN=x,1. For details on AT+CFUN please see [1].

The watchdog can also be configured to reset the Java Terminals if in POWER DOWN mode.

As an alternative, you can shut down the Java Terminals as described in Section 3.8.3 and then restart it as described in Section 3.8.1.

3.8.3 Turn Java Terminals off

Normal shutdown:

- To turn off the Java Terminals use the AT^SMSO command, rather than disconnecting the mains adapter.
  This procedure lets the Java Terminals 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 Java Terminals returns the following result codes:

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

  The "^SHUTDOWN" result code indicates that the Java Terminals turns off in less than 1 second. After the shutdown procedure is complete the Java Terminals enters the POWER DOWN mode. The yellow LED stops flashing (see Section 3.13 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 Java Terminals 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 Java Terminals.

  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 Java Terminals fails to shut down properly.

Watchdog shutdown:

- The watchdog can also be configured to turn the Java Terminals off.

When the Java Terminals enter 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.

3.8.4 Disconnecting power supply

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

3.9 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 Java Terminals automatically shut down to avoid thermal damage to the system. Table 17 specifies the ambient temperature threshold for the Java Terminals.

The automatic shutdown procedure is equivalent to the power-down initiated with the AT^SMSO command, i.e. Java Terminals log 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 Java Terminals switch 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.

The watchdog can be configured to restart the Java Terminals after a defined period.

3.10 Hardware Watchdog

The Java Terminals feature a programmable hardware watchdog that permanently monitors the terminals‘ hardware and can be configured to react to various hardware states. The watchdog may for example be configured to periodically restart the terminal, independant of its current operating state. Figure 4 shows how the watchdog is integrated into the Java Terminals.

Please refer to Chapter 8 for details on how to control and configure the hardware watchdog.

3.11 RTC

The internal Real Time Clock (RTC) of the Java Terminals 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 Java Terminals 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 Java Terminals. 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 Java Terminals by AT^SMSO or RST_IN signal.

3.12 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.

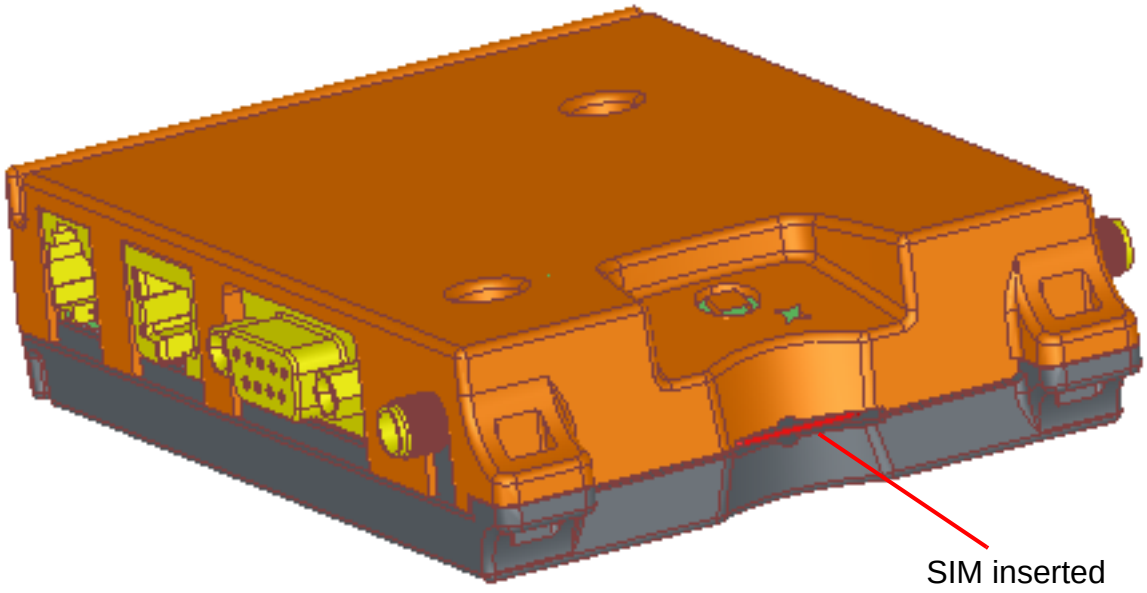


Figure 10: SIM interface

The SIM - with the circuit side facing upwards - 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 Java Terminals.

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 Java Terminals.

3.13 Status LEDs

Java Terminals have two LEDs indicating its operating states through the semitransparent casing:

- A green LED indicates whether the Java Terminals are ready to operate.
- A yellow LED indicates the network registration state of the Java Terminals.

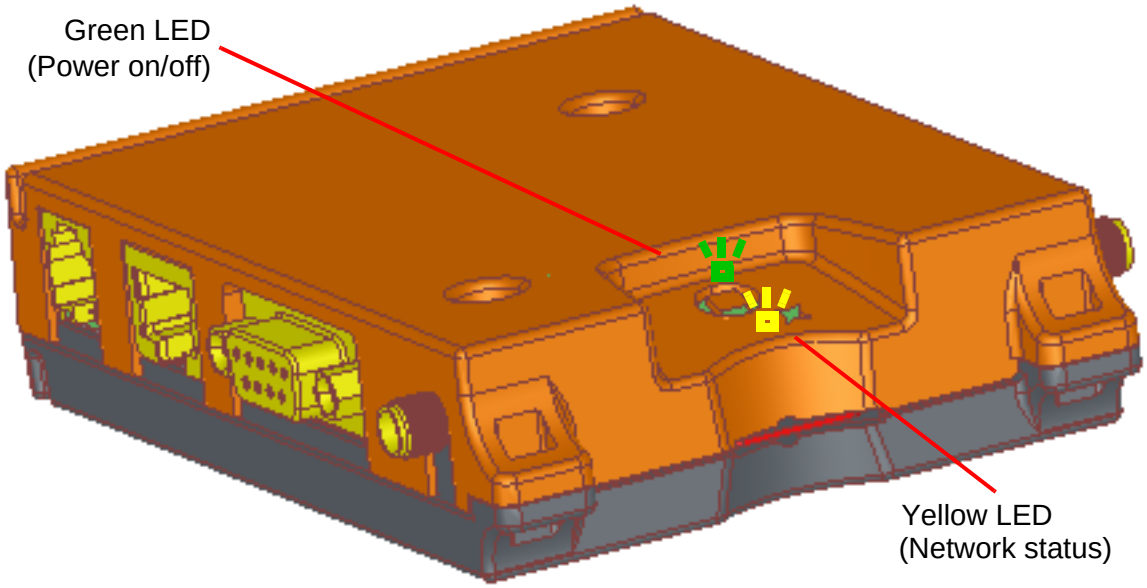


Figure 11: Status LED

The yellow LED is driven by a line of the integrated module that can be configured by using the AT^SLED command to either light permanently or to flash. For details on the AT command please refer to [1].

3.14 RF Antenna Interface

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

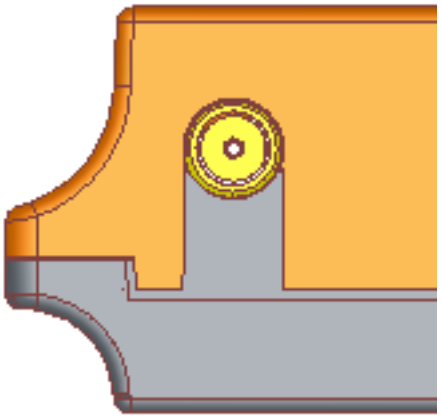


Figure 12: Antenna connector

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). Java Terminals withstand a total mismatch at this connector when transmitting with power control level for maximum RF power.

Inside the Java 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 (including cable loss) for stand-alone situation is given below in Table 14.

Table 14: Allowed maximum antenna gain (including cable loss)

Module	850MHz	900MHz	1800MHz	1900MHz	2100MHz
EHS6T USB	3.42dBi	4.18dBi	9.64dBi	2.51dBi	15.54dBi
BGS5T USB	2.15dBi	2.15dBi	2.15dBi	2.15dBi	na
EHS5T RS485	na	6.10dBi	12.30dBi	na	12.30dBi

4 Electrical and Environmental Characteristics

4.1 Absolute Maximum Ratings

Table 15: Absolute maximum ratings

Parameter	Port / Description	Min.	Max.	Unit
Supply voltage	PLUS	-40	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	TXD, DTR, RTS	-25	+25	V
Weidmueller pins input voltage (incl. VCCref)	8-pin and 12-pin connectors (if pins specified/configured as input pins)	-0.3	6	V
Weidmueller pins output current	8-pin and 12-pin connectors (if pins specified/configured as output pins)	0	50mA drawn @each pin[1]	--
USB interface	All electrical characteristics according to USB Implementers' Forum, USB 2.0 Specification.	--	--	--
Immunity against discharge of static electricity	All interfaces (lines) Contact discharge Human body model	 -8 -15	 +8 +15	 kV kV

1. Please note that if the VCCref pin is connected to the +5Vout pin, no more than 100mA should be drawn by **all** pins. In this case it is no longer allowed to draw a maximum of 50mA for each pin.

Table 16: Operating supply voltage for Java Terminals

Parameter	Min	Typ	Max	Unit
Supply voltage PLUS measured at (6-pole) western jack plug (1 to 6) @any time, incl. all ripple and drops	5.5	12	30	V

4.2 Operating Temperatures

Table 17: Board temperature of Java module

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

1. Extended operation allows normal mode speech calls or data transmission for limited time until automatic thermal shutdown takes effect. Within the extended temperature range (outside the normal operating temperature range) the specified electrical characteristics may be in- or decreased.
2. Due to temperature measurement uncertainty, a tolerance of ±3°C on these switching thresholds may occur.

Note: Within the specified operating temperature ranges the board temperature may vary to a great extent depending on operating mode, used frequency band, radio output power and current supply voltage. Note also the differences and dependencies that usually exist between board (PCB) temperature of the Java module and its ambient temperature.

4.3 Storage Conditions

Table 18: 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

Table 19: On/Off control line specifications

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V_{high}	Input voltage IGT_IN, RST_IN	active high	4		28	V
V_{low}			0		3	V
V_{high}	Input voltage DTR	active high	3		+15	V
V_{low}			-15		1.2	V
R_{IN}	Input resistance of IGT_IN, RST_IN		1			MΩ
R_{IN}	Input resistance of DTR		3	5	7	kΩ

4.4.2 RS-232 Interface

Table 20: RS-232 interface specifications

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_{Ilow}	Input threshold low		0.6	1.2		V
V_{Ihigh}	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

4.4.3 USB Interface

All electrical characteristics according to USB Implementers' Forum, USB 2.0 Specification.

4.4.4 Weidmueller GPIO Interface

Table 21: Weidmueller GPIO interface specifications (requirements)

Function	Signal name	IO	Signal form and level	Comment
8-pin, 12-pin connectors for: GPIO, Power, I^2C and ASC1, SPI, RS-485	GPIO 6-8 GPIO 11-15 GPIO 20-21	IO	V_{OL}max = 0.1V at I = 100µA V_{OL}max = 0.55V at I = 32mA V_{OH}min = VCCref - 0.1V at I = 100µA V_{OH}min = VCCref - 0.4V at I < 12mA V_{OH}min = VCCref - 0.7V at I < 32mA V_{IL}max = 0.3 * VCCref V_{IH}min = 0.7 * VCCref	If unused keep lines open. Please note that some GPIO lines are or can be configured for functions other than GPIO: GPIO6/GPIO7: PWM GPIO8: Pulse Counter
	VCCref	I	Vimax = 5.5V Vimin = 1.8V	
	GND	--	--	
	TXD1/ SPI_MISO	I	V_{OL}max = 0.1V at I = 100µA V_{OL}max = 0.55V at I = 32mA V_{OH}min = VCCref - 0.1V at I = 100µA V_{OH}min = VCCref - 0.4V at I < 12mA V_{OH}min = VCCref - 0.7V at I < 32mA V_{IL}max = 0.3 * VCCref V_{IH}min = 0.7 * VCCref	If unused keep lines open. SPI interface is not available for BGS5.
	RXD1/ SPI_MOSI	O		
	CTS1/A+/ SPI_CS	O		
	RTS1/B-	I		
	+5Vout	O	5V, +0.05V, -0.2V Ioutmax = 100mA	Regulated output for external supply. Can be connected to VCCref. If unused, keep open.
	DSR0/ ADC1_IN (Analog-to-Digital converter)/ SPI_CLK	I	R_I = 1MΩ V_{Imax} = 0V...VCCref + 0.3V Valid range 0V…5V Resolution 1024 steps Tolerance 0.3%	ADC1_IN can be used as input for external measurements. If unused keep line open.
	I2CDAT	IO	Open drain IO V_{OL}min = 0.3V at I = -3mA V_{OH}max = VCCref Rpullup = 2.2kOhm V_{IL}max = 0.35V V_{IH}min = 1.3V V_{IH}max = 1.85V	According to the I^2C Bus Specification Version 2.1 for the fast mode a rise time of max. 300ns is permitted. There is also a maximum V_{OL}=0.4V at 3mA specified. The value of the pull-up depends on the capactive load of the whole system (I^2C Slave + lines). The maximum sink current of I2CDAT and I2CCLK is 4mA. If unused keep lines open.
	I2CCLK	IO		

4.5 Power Supply Ratings

Table 22: Power supply specifications

Parameter	Description	Conditions		Typical			Unit
				EHS5T RS485	EHS6T USB	BGS5T USB	
V_{PLUS}	Allowed voltage ripple (peak-peak), drop during transmit burst peak current	Power control level for P_{out} max[1]		1	1	1	V
I_{PLUS} [2]	Average supply current (average time 3 min.)	Power Down mode	@8V	12.4	20.7	33.5	mA
			@30V	6.5	9.8	13.7	
	Average GSM supply current (average time 3 min.)[3]	IDLE mode (GSM/GPRS, 850/900MHz, 1800/1900MHz)	@8V	27	39.6	29.5	mA
			@30V	10.4	15.9	12.7	
		GPRS DATA mode(1 Tx, 4 Rx, 850/900MHz)	@8V	169.3	175	160	mA
			@30V	47.2	50.3	46.2	
		GPRS DATA mode(1 Tx, 4 Rx, 1800/1900MHz)	@8V	63.9	136.4	117.3	mA
			@30V	21.2	38	36.1	
		GPRS DATA mode(4 Tx, 1 Rx, 850/900MHz)	@8V	234.6	245	286.3	mA
			@30V	67	100	81	
		GPRS DATA mode(4 Tx, 1 Rx, 1800/1900MHz)	@8V	109.5	186	208.8	mA
			@30V	34.1	56	61.8	
		EDGE DATA mode(1 Tx, 4 Rx, 850/900MHz)	@8V	170.1	175	160	mA
			@30V	47.4	50.2	46.2	
		EDGE DATA mode(1 Tx, 4 Rx, 1800/1900MHz)	@8V	64.4	130.7	117.4	mA
			@30V	21.3	39.7	36.2	
		EDGE DATA mode(4 Tx, 1 Rx, 850/900MHz)	@8V	234.4	237.6	284.9	mA
			@30V	67	69.6	81	
		EDGE DATA mode(4 Tx, 1 Rx, 1800/1900MHz)	@8V	109.5	186.7	208.9	mA
			@30V	34.2	56.4	62	
	Peak supply current (during 577µs transmission slot every 4.6ms)	Power control level for Pout max (850/900MHz)	@8V	1100	1130	1200	mA
			@30V	260	270	260	
		Power control level for Pout max (1800/1900MHz)	@8V	815	820	630	mA
			@30V	195	200	160	

Table 22: Power supply specifications

Parameter	Description	Conditions		Typical			Unit
				EHS5T RS485	EHS6T USB	BGS5T USB	
I_{PLUS}	Average UMTS supply current (average time 3 min.)	IDLE mode	@8V	27	79	---	mA
			@30V	10.7	12.3	---	
		UMTS DATA (Band I; 23dBm)	@8V	313	411	---	mA
			@30V	88.3	113.9	---	
		UMTS DATA Band II; 23dBm	@8V	---	447.6	---	mA
			@30V	---	123.8	---	
		UMTS DATA Band V/VI; 23dBm	@8V	---	413.9	---	mA
			@30V	---	115	---	
		UMTS DATA Band VIII; 23dBm	@8V	367	410.1	---	mA
			@30V	103	114.2	---	
		HSPA DATA (Band I; 23dBm)	@8V	313	411	---	mA
			@30V	88.3	113.9	---	
		HSPA DATA Band II; 23dBm	@8V	---	447.6	---	mA
			@30V	---	123.8	---	
		HSPA DATA Band V/VI; 23dBm	@8V	---	413.9	---	mA
			@30V	---	115	---	
		HSPA DATA Band VIII; 23dBm	@8V	367	410.1	---	mA
			@30V	103	114.2	---	

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.
2. Typical values measured with antenna impedance = 50 Ohm (return loss >20dB).
3. BGS5T USB does not support EDGE.

4.6 Antenna Interface

Table 23 lists RF antenna interface specifications for the Java Terminals. Please note that the specified conditions may not apply to or be supported by all terminals.

Table 23: RF Antenna interface GSM / UMTS

Parameter		Conditions	Min.	Typical	Max.	Unit
UMTS/HSPA connectivity		Band I, II, V, VI, VIII (not every module variant supports all bands)				
Receiver Input Sensitivity @ ARP		UMTS 800/850 Band VI/V	-104.7/ -106.7	-110		dBm
		UMTS 900 Band VIII	-103.7	-110		dBm
		UMTS 1900 Band II	-104.7	-109		dBm
		UMTS 2100 Band I	-106.7	-110		dBm
RF Power @ ARP with 50Ohm Load Board temperature <85°C		UMTS 800/850 Band VI/V	+21	+24	+25	dBm
		UMTS 900 Band VIII	+21	+24	+25	dBm
		UMTS 1900 Band II	+21	+24	+25	dBm
		UMTS 2100 Band I	+21	+24	+25	dBm
GPRS coding schemes		Class 12, CS1 to CS4				
EGPRS		Class 12, MCS1 to MCS9				
GSM Class		Small MS				
Static Receiver input Sensitivity @ ARP		GSM 850 / E-GSM 900	-102	-109		dBm
		GSM 1800 / GSM 1900	-102	-108		dBm
RF Power @ ARP with 50Ohm Load	GSM	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm

Table 23: RF Antenna interface GSM / UMTS

Parameter		Conditions	Min.	Typical	Max.	Unit
RF Power @ ARP with 50Ohm Load, (with maximum reduction) BGS5T USB does not support EDGE, deviating values are given in brackets	GPRS, 1 TX	GSM 850 / E-GSM 900		33		dBm
		GSM 1800 / GSM 1900		30		dBm
	EDGE, 1 TX	GSM 850 / E-GSM 900		27		dBm
		GSM 1800 / GSM 1900		26		dBm
	GPRS, 2 TX	GSM 850 / E-GSM 900		30		dBm
		GSM 1800 / GSM 1900		27 (28.3)		dBm
	EDGE, 2 TX	GSM 850 / E-GSM 900		24		dBm
		GSM 1800 / GSM 1900		23		dBm
	GPRS, 3 TX	GSM 850 / E-GSM 900		28.2 (27.7)		dBm
		GSM 1800 / GSM 1900		25.2 (27.4)		dBm
	EDGE, 3 TX	GSM 850 / E-GSM 900		22.2		dBm
		GSM 1800 / GSM 1900		21.2		dBm
	GPRS, 4 TX	GSM 850 / E-GSM 900		27 (25.4)		dBm
		GSM 1800 / GSM 1900		24 (25.2)		dBm
	EDGE, 4 TX	GSM 850 / E-GSM 900		21		dBm
		GSM 1800 / GSM 1900		20		dBm

5 Mechanics, Mounting and Packaging

5.1 Mechanical Dimensions

Figure 13 shows a 3D view of the Java Terminal and provides an overview of the mechanical dimensions of the board. For further details see Figure 14. To allow for an easier mechanical implementation into an external application a set of 3D STP data for the Java Terminals is attached to this PDF. Please open the Attachments navigation panel to view and save these files.

Length:	113.5mm (including fixtures for cable straps)
Width:	75mm (excluding antenna and serial interface connectors)
Height:	25.5mm
Weight:	120g

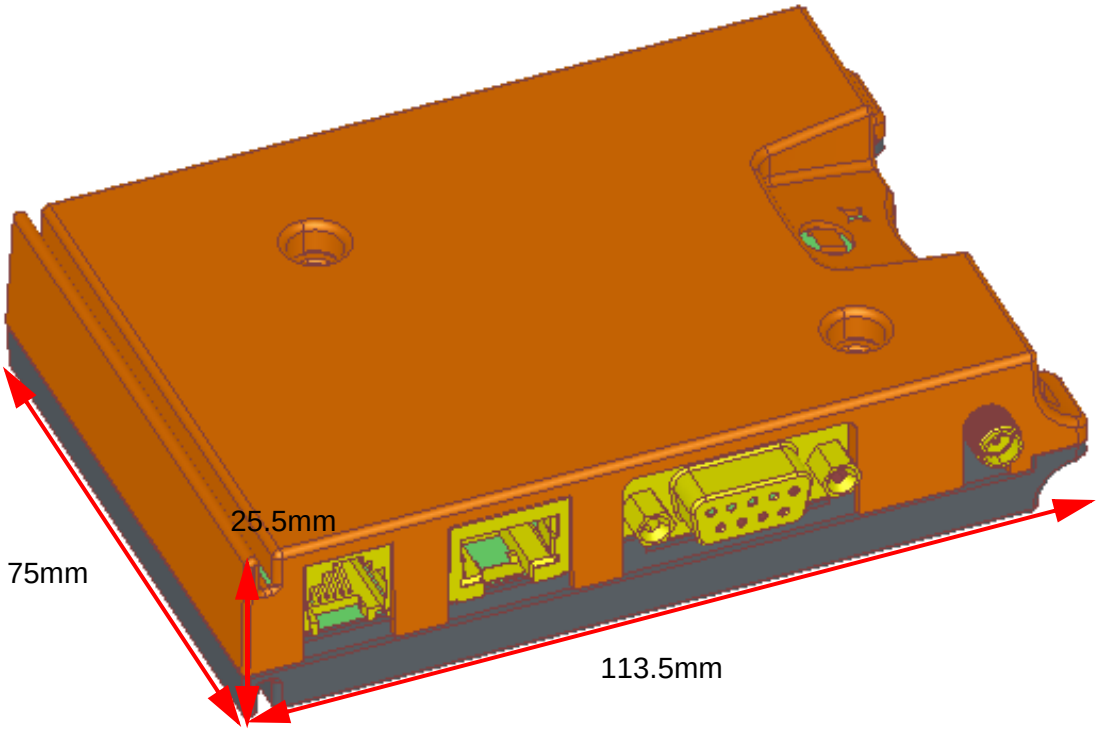


Figure 13: Java Terminals 3D overview

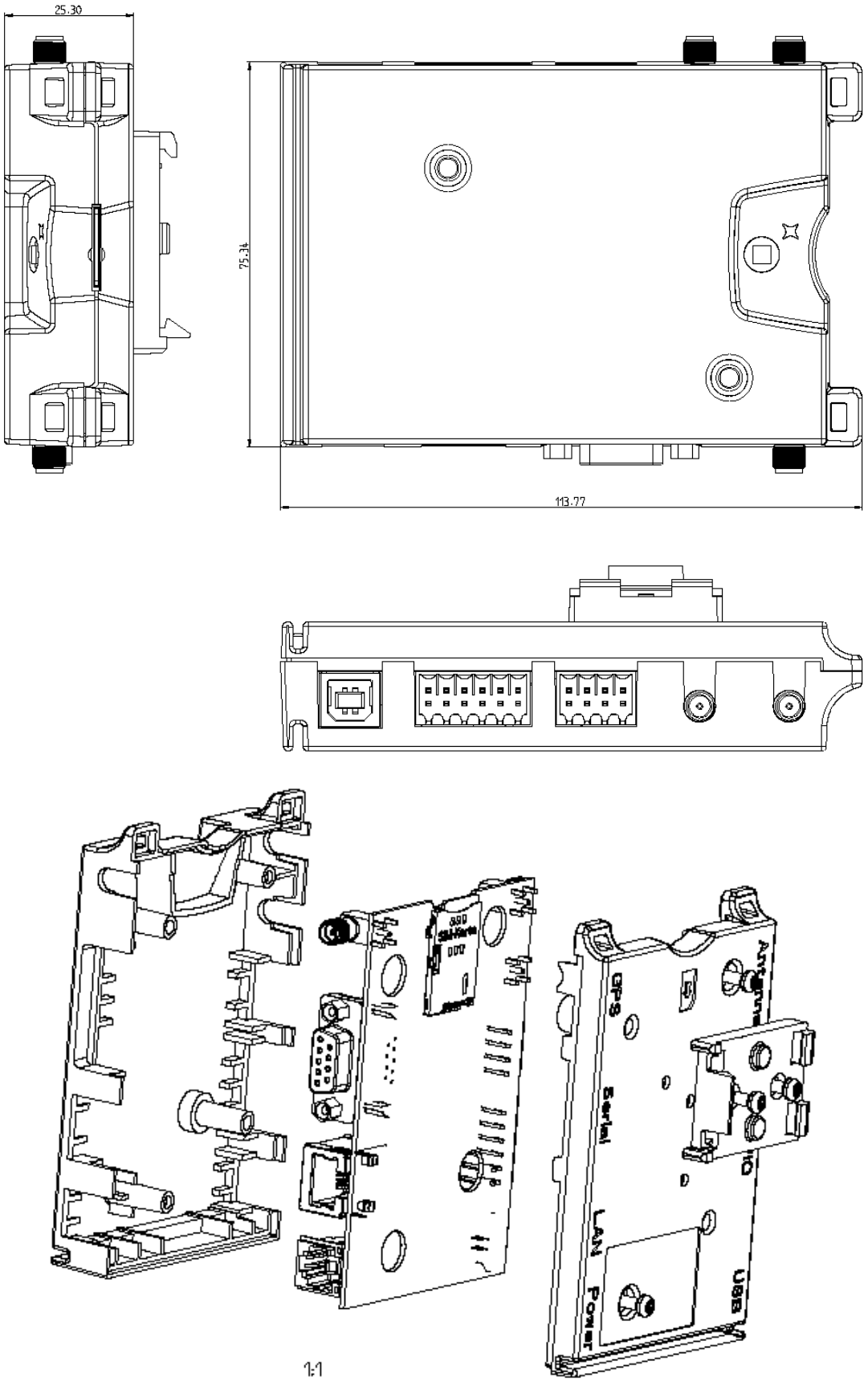


Figure 14: Java Terminals mechanical dimensions

5.2 Mounting the Java Terminals

There are a number of ways to mount the Java Terminals:

- Java Terminals can be attached to a rail installation or other surface using the two provided screw holes.
- Java Terminals can be fastened to a rack or holding using the two provided fixtures for cable straps.
- Java Terminals 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 BOPLA TSH 35-2 universal DIN rail holder the Java Terminals 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 Java Terminals.

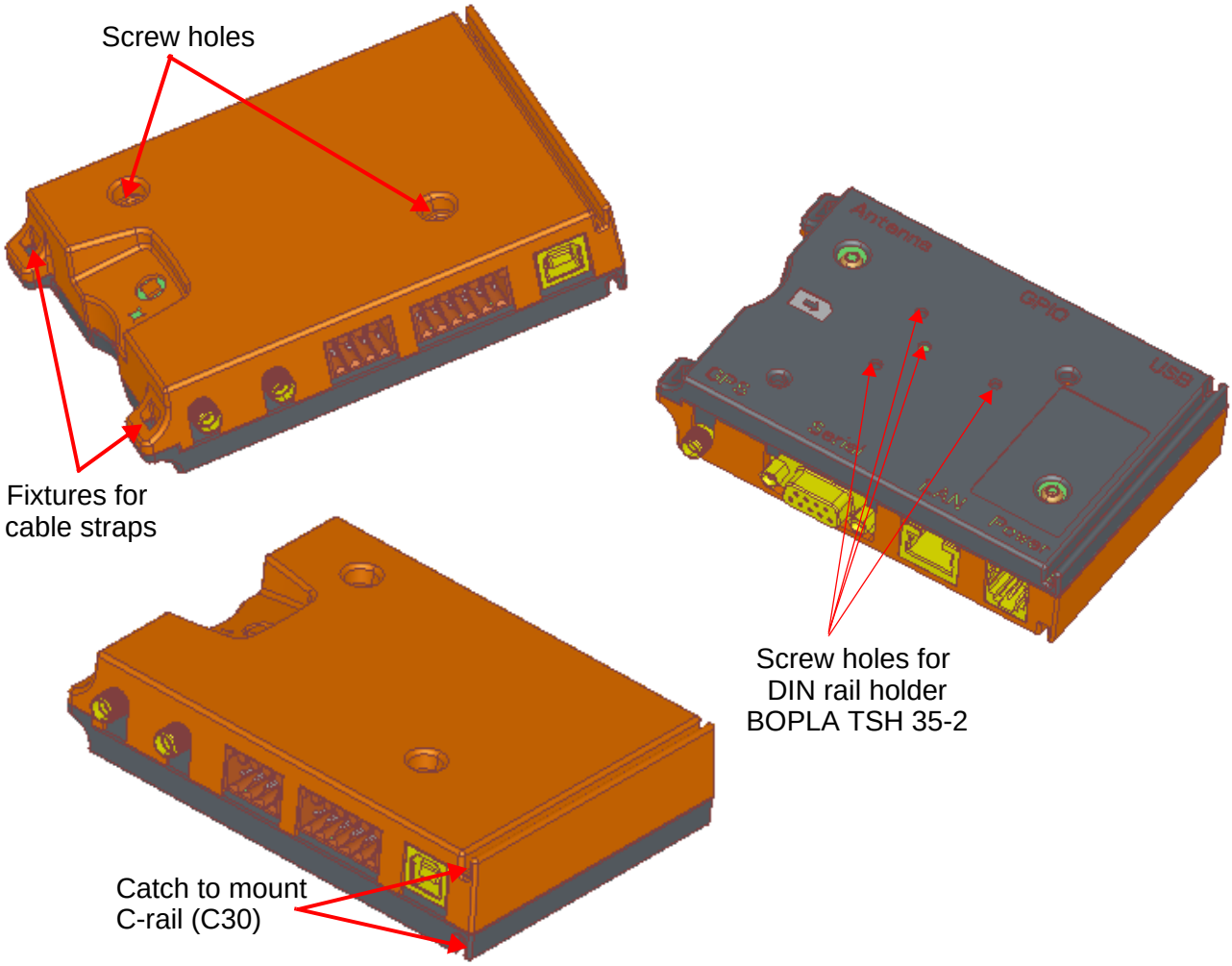


Figure 15: Mounting the Java Terminals

The various ways to mount the Java Terminals 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

Java Terminals come in terminal boxes:

- Terminal box size: 191mm x 143mm x 44mm.

6 Full Type Approval

6.1 Gemalto M2M Reference Setup

The Gemalto M2M reference setup submitted to type approve Java Terminals consists of the following components:

- Java Terminals with approved Java module
- PC as MMI
- Power Supply

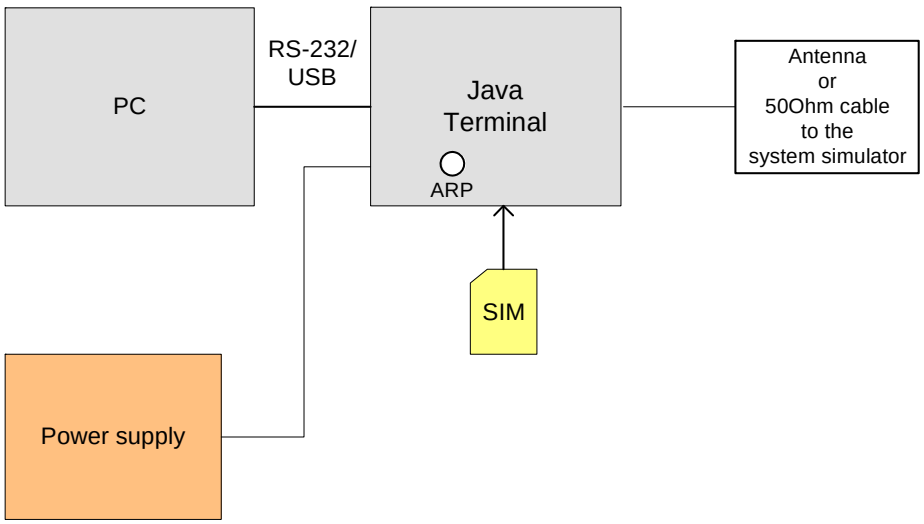


Figure 16: Reference equipment for approval

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 Java Terminals configuration.
- Extra approval must be obtained for applications using other accessories than those included in the approved Java Terminals configuration (power supply, MMI implementation supported by AT commands).

6.3 CE Conformity

The Java Terminals meet the requirements of the EU directives listed below:

- R&TTE Directive 1999/5/EC

The Java Terminals are marked with the CE conformity mark (including notified body number):

EHSxT	BGS5T USB
CE 0682	CE 1588

6.4 EMC

The Java Terminals comply with the equipment requirements specified in EN 301489-1, -7 and -24 are covered by the R&TTE Directive.

6.5 Compliance with FCC and IC Rules and Regulations

As an integrated product, the Java Terminals EHS6T USB and BGS5T RS485 are fully compliant with the grant of the FCC Equipment Authorization and the Industry Canada Certificates issued for the built-in Java modules, and therefore, bear the labels “Contains FCC ID QIPEHS6” or “Contains FCC ID QIPBGS5.

The Equipment Authorization Certification for the Cinterion® Java modules is listed under the following identifiers:

FCC Idenitifier: QIPEHS6 or QIPBGS5
Industry Canada Certification Number: 7830A-EHS6 or 7830A-BGS5
Granted to Gemalto M2M GmbH

Notes (FCC):
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.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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 Gemalto M2M may void the FCC authorization to operate this equipment.

This device contains UMTS, GSM and GPRS class functions in the 900, 1800 and 2100MHz bands that 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: For more information on the RF antenna interface please refer to Section 3.14 and Section 4.6.

Notes (IC):
(EN) This Class B digital apparatus complies with Canadian ICES-003 and RSS-210. Operation is subject to the following two conditions: (1) this devive may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

(FR) Cet appareil numérique de classe B est conforme aux normes canadiennes ICES-003 et RSS-210. Son fonctionnement est soumis aux deux conditions suivantes: (1) cet appareil ne doit pas causer d'interférence et (2) cet appareil doit accepter toute interférence, notamment les interférences qui peuvent affecter son fonctionnement.

(EN) Radio frequency (RF) Exposure Information
The radiated output power of the Wireless Device is below the Industry Canada (IC) radio frequency exposure limits. The Wireless Device should be used in such a manner such that the potential for human contact during normal operation is minimized.
This device has also been evaluated and shown compliant with the IC RF Exposure limits under mobile exposure conditions. (antennas are greater than 20cm from a person‘s body).

(FR) Informations concernant l'exposltion aux fréquences radio (RF)
La puissance de sortie émise par l'appareil de sans fiI est inférieure à la limite d'exposition aux fréquences radio d‘Industry Canada (IC). Utilisez l'appareil de sans fil de façon à minimiser les contacts humains lors du fonctionnement normal.

Ce périphérique a également été évalué et démontré conforme aux limites d'exposition aux RF d'IC dans des conditions d'exposition à des appareils mobiles (les antennes se situent à moins de 20cm du corps d'une personne).

7 List of Parts and Accessories

Table 24: List of parts and accessories

Description	Supplier	Ordering information
Java Terminals	Gemalto M2M	Ordering number EHS5T RS485: L30960-N2730-A100 EHS6T USB: L30960-N2740-A100 BGS5T USB: L30960-N2720-A100
Power supply unit	Gemalto M2M	Terminal Power Supply (incl. EU adapter) Ordering number: L36880-N8490-A12 UK adapter for above Terminal Power Supply Ordering number: L36880-N8490-A13 US adapter for above Terminal Power Supply Ordering number: L36880-N8490-A14 AU adapter for above Terminal Power Supply Ordering number: L36880-N8490-A15
DIN rail holder - BOPLA TSH 35-2 	BOPLA	Ordering number: 20035000 BOPLA Gehäuse Systeme GmbH Borsigstr. 17-25 D-32257 Bünde Phone: +49 (0)5223 / 969 - 0 Fax: +49 (0)5223 / 969 - 100 Email: iinfo@bopla.de Web: http://www.bopla.de
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/
8-pin and 12-pin header connector (male) for Weidmueller GPIO interface 	Weidmueller	Ordering number (12-pin): 1277510000 Ordering number (8-pin): 1277480000 Weidmüller Interface GmbH & Co. KG Klingenbergstraße 16 D-32758 Detmold Phone: +49 5231 14-0 Fax: +49 5231 14-2083 Email: iinfo@weidmueller.de Web: http://www.weidmueller.com

8 Appendix A: (Hardware) Watchdog

The watchdog is part of the Java Terminals and connected to the Java module itself (see also Figure 4). It can be used to

- Safely reset the module in certain conditions
- Restart the module when it has turned off
- Configure GPIOs and DSR0/ADC1_IN available at the Weidmueller connector

The complete watchdog functionality can be configured via the serial interface ASC0 (for details see Section 8.3). Some configuration commands can also be specified via I^2C interface (for details see Section 8.4). Figure 17 shows how the watchdog may be accessed.

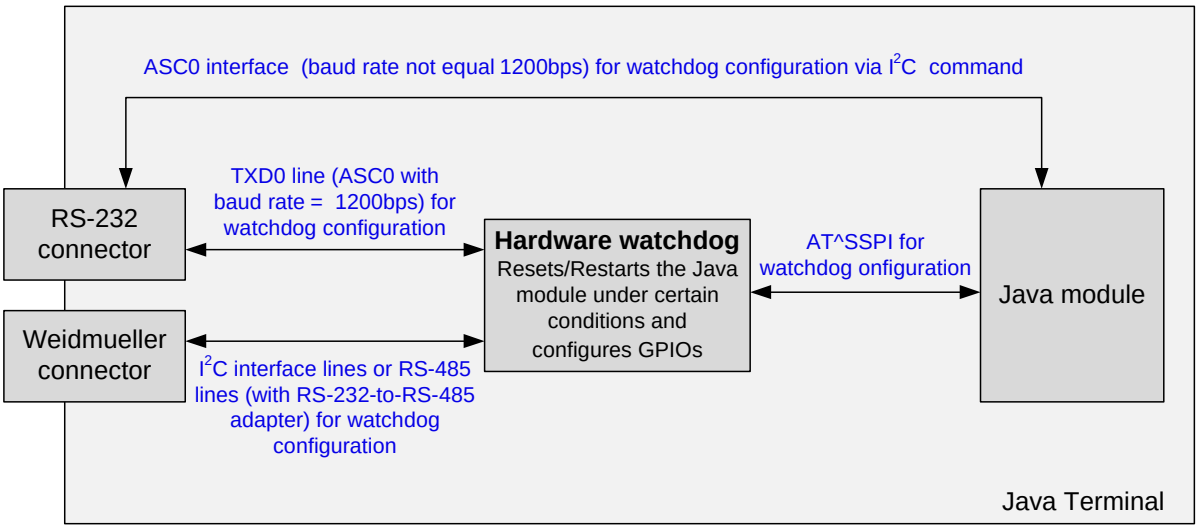


Figure 17: Hardware watchdog

8.1 Reset Conditions

The watchdog implements three conditions, under which a reset of the module is automatically performed:

- Repetitive: A module reset is performed frequently and repetitive. This reset condition can be used to force the module to reconnect to the mobile network once in a while. Typical frequencies are 24 hours or more. This feature can be configured via the RST_REP timeout.
- UART activity: The watchdog can be used to reset the module, when no activity from the module on the UART interface is recognized for a specified amount of time. To prevent the reset, the module has to be active frequently on the UART interface. This reset condition can be configured via the RST_UART timeout, it is deactivated when timeout parameter = 0.
- GPIO activity: The watchdog can be used to reset the module, when no activity on the designated GPIO signal is recognized for a specified amount of time. To prevent the reset, the module has to be active frequently by toggling this GPIO signal. This reset condition can be configured via the RST_GPIO timeout, it is deactivated when timeout parameter = 0.

When the watchdog is enabled, it will observe the activities on the UART and GPIO interfaces, depending on timeout parameter setting and perform frequent resets, if it is configured to do so.

8.1.1 Reset stages

There are up to three possible escalation stages during a module reset:

- First stage (regular fast shutdown): The watchdog shuts down the module via an internal fast shutdown signal. The fast shutdown procedure will then still finish any data activities on the Java module's flash file system, thus ensuring data integrity, but will no longer deregister gracefully from the network, thus saving the time required for network deregistration. Afterwards, i.e. after an internal V180 signal has gone low, the module is regularly restarted.
- Second stage (emergency restart): The watchdog resets the module via an internal EMERG_RST signal. The emergency restart procedure causes the loss of all information stored in the Java module‘s volatile memory.
- Third stage (power off): The watchdog switches the module off.

After the first and second stage the watchdog waits for up to three seconds for the internal V180 signal to go LOW. If the V180 signal does not change, the watchdog escalates to the next stage, until it finally ends up switching off the module. The watchdog can be configured to automatically switch on resp. power up the module after a shutdown (always-on mode).

8.1.2 Reset Delay

The watchdog implements a protection mechanism to prevent too frequent module resets. When the delayed reset mechanism is enabled, the watchdog will start its activity only after the specified amount of time, MIN_START_TIME. A reasonable value for this timeout is 30 minutes. After the watchdog startup, after a module reset and also after enabling the watchdog, no reset of the module is performed before the timeout of MIN_START_TIME.

When the watchdog is enabled, resets can be prevented once for a certain amount of time. This timeout, TRG_DEL, can be configured via the I^2C interface. It can be particularly useful when a software update shall be performed. Using the TRG_DEL timeout will prevent the watchdog from resetting the module during the running TRG_DEL timeout, so that the update can be performed safely. An upcoming reset event will be shifted and catch up after the TRG_DEL timeout.

8.2 Restart Conditions

When the watchdog is enabled, it will observe the modules on/off state. When it is configured to keep the module "always on", it will restart the module after the specified amount of time after it has discovered that the module has turned off. This important feature is useful in rough environments with often power losses and out-of-temperature conditions where it secures a safe module operation. The timeout condition for the restart feature is called ALWAYS_ON.

8.3 Configuration via ASC0 Interface

The complete hardware watchdog functionality can be configured via the serial interface ASC0 as described in this section.

The watchdog listens on the module's TXD0 line exclusively at the low baudrate 1200bps, and gives no feedback. This means that if using the watchdog this low baud rate is reserved and should not be configured for the module‘s asynchronous serial interface ASC0. The TXD0 line can be accessed either via RS-232 interface or via RS-485 interface (in conjunction with an RS232-to-RS485 adapter).

So, to control and configure the watchdog, a terminal program MUST be set to 1200bps, before a command (see Section 8.3.1) can be sent to the watchdog. Once completed, the terminal program should be changed to higher baud rates again to enable proper communication with the module.

Please note that some configuration commands can also be configured via I^2C interface (see Section 8.4 for details).

8.3.1 Command Specification

The general watchdog command syntax is as follows:

WD=<command>,<argument>,<checksum><NL>

Where
- <command> specifies the command name
- <argument> gives the numeric argument
- <checksum> is the sum of the digits of the argument. (e.g. the argument 124 produces a checksum 7, because 1+2+4=7).

Whenever a non-volatile command is executed, it is saved in the watchdog's flash memory. At watchdog start, the last state is loaded from flash memory.

If a config command was successfully executed by the watchdog, the green ON led flashes two times. The watchdog commands are implemented as text commands. In case a command error occours - e.g., a checksum failure - the green ON led flashes 4 times.

The following watchdog configuration commands are available:

- Watchdog on/off - see Section 8.3.1.1
- Test mode - see Section 8.3.1.2
- Repetitive module reset - see Section 8.3.1.3
- UART reset - see Section 8.3.1.4
- GPIO reset - see Section 8.3.1.5
- Restart delay - see Section 8.3.1.6
- Always on - see Section 8.3.1.7
- Load default values - see Section 8.3.1.8
- Change the Watchdogs I^2C Address - see Section 8.3.1.9
- Set GPIO Direction - see Section 8.3.1.10
- Configure ADC1_IN/DSR0/SPI_CLK Line - see Section 8.3.1.11

Note: Changing the watchdog configuration using any of the following commands disables the watchdog: Repetitive module reset, UART reset, GPIO reset, Restart delay and Always on. With these commands the new configuration setting becomes effective only after the hardware watchdog is enabled again.

8.3.1.1 Watchdog On/Off

Command	ON
Parameter	<on|off>
Type	Boolean
Range	0: Off (watchdog disabled) 1: On (watchdog enabled)
Default	0: Off
Non-volatile	Yes

Example	WD=ON,0,0 // disables the watchdog
	WD=ON,1,1 // enables the watchdog

This command is used to enable or disable the watchdog function. When disabled, all timers are stopped and the watchdog doesn't perform a module reset. When enabled, all configured timers start after a delay time of MIN_START_TIME. If MIN_START_TIME=0, all reset timers start immediately. Also, when the watchdog is enabled and ALWAYS_ON>0, the watchdog observes the modules on/off state, and starts the module in case it detects that the module is off.

8.3.1.2 Test Mode

Command	TEST_MODE
Parameter	<on|off>
Type	Boolean
Range	0: Off (Exit test mode) 1: On (Enter test mode)
Default	0: Off
Non-volatile	Yes

Example	WD=TEST_MODE,0,0 // Exit test mode
	WD=TEST_MODE,1,1 // Enter test mode

This commands configures the watchdog‘s test mode. In test mode the watchdog operates normally, but does not actually perform a module reset. Instead, it signals the (simulated) reset via the LED by flashing the green ON LED two times to visualize the watchdog trigger. Entering the test mode disables the actual watchdog functionality.

8.3.1.3 Repetitive Module Reset

Command	RST_REP
Parameter	<timeout>
Type	Milliseconds
Range	0 .. 2^{32}-1
Default	0: Feature is disabled
Non-volatile	Yes
Example	WD=RST_REP,1800000,9 // Reset every 30 minutes

This command configures a repetitive module resets, if the watchdog is enabled. The parameter sets the RST_REP timeout value. If the watchdog is enabled, an unconditional module reset every RST_REP milliseconds is performed.

Changing this configuration disables the watchdog. The feature becomes active, if the watchdog is enabled again, and after the MIN_START_TIME has passed.

For normal operation, this value should be set to a value greater than 30 minutes.

8.3.1.4 UART Reset

Command	RST_UART
Parameter	<timeout>
Type	Milliseconds
Range	0 .. 2^{32}-1
Default	0: Feature is disabled
Non-volatile	Yes
Example	WD=RST_UART,600000,6 // Resets the module if there was no activity on the RXD0 line for 10 minutes

This command configures a module reset, if no UART activity from the module was observed for the specified amount of time - RST_UART. The module has to be active on the RXD0 signal within the specified time period; otherwise the watchdog will reset the module.

Changing this configuration disables the watchdog. The feature becomes active, if the watchdog is enabled again, and after the MIN_START_TIME has passed.

For normal operation, this value should be set to a value greater than 10 minutes (600000).

8.3.1.5 GPIO Reset

Command	RST_GPIO
Parameter	<timeout>
Type	Milliseconds
Range	0 .. 2^{32}-1
Default	0: Feature is disabled
Non-volatile	Yes
Example	WD=RST_UART,600000,6 // Resets the module if there was no activity on the internal WD_RETRIG line for 10 minutes

This command configures a module reset, if no activity from the module was observed on the internal signal WD_RETRIG for the specified amount of time. The module has to be active on the WD_RETRIG signal by toggling the GPIO22 module output within the specified time period. Otherwise the watchdog will reset the module. If enabled, each GPIO22 toggling resets the timer to its configured value.

Changing this configuration disables the watchdog. The feature becomes active, if the watchdog is enabled again, and after the MIN_START_TIME has passed.

For normal operation, this value should be set to a value greater than 10 minutes (600000).

8.3.1.6 Restart Delay

Command	MIN_START_TIME	
Parameter	<timeout>	
Type	Milliseconds	
Range	0 .. 2^{32}-1	
Default	18000000ms (30 minutes)	
Non-volatile	Yes	
Example	WD=MIN_START_TIME,18000000,9	// Prevents module resets for 30 minutes after each module startup, and after the watchdog becomes active

This command configures the MIN_START_TIME timeout value. By setting the MIN_START_TIME, the watchdog no longer performs a module reset for the given amount of time, after module startup. Whenever the module has been reset and restarted, as well as after the watchdog has been enabled, the watchdog will wait for MIN_START_TIME before performing any (further) resets. The watchdog‘s reset timer only starts after the MIN_START_TIME has expired.

Changing this configuration disables the watchdog. The feature becomes active, if the watchdog is enabled again.

It is strongly recommended to set this value to a time period of more than 30 minutes for normal operation. During development it may be set to values of less than 30 minutes, but should always be greater than the time the module needs for a complete start up including Java. Also, a module firmware or userware update right after startup should be taken into account which may take up to 15 min.

8.3.1.7 Always On

Command	ALWAYS_ON
Parameter	<timeout>
Type	Milliseconds
Range	0 .. 2^{32}-1
Default	0: Feature is disabled
Non-volatile	Yes
Example	WD= ALWAYS_ON,60000,6 // Observes the module and restarts it 60 seconds after it has been turned off

This command configures the on/off-state observation of the module by specifying a timeout value for ALWAYS_ON. If enabled, the watchdog observes the module‘s internal V180 signal. If the watchdog detects that the module is OFF, it will restart the module after the timeout of ALWAYS_ON milliseconds.

Changing this configuration disables the watchdog. The feature becomes active, If the watchdog is enabled.

It is strongly recommended to set this value to a time period of more than 1 minute for normal operation to avoid oscillation in e.g. out-of-temperature events. In case of over/under temperature shut down it can be expected that the temperature does not change significantly within a minute. During development the timeout may be set to a period of less than 1 minute.

8.3.1.8 Load Default Values

Command	DFT_VAL
Parameter	<1>
Type	Fixed
Range	1
Default	---
Non-volatile	No
Example	WD= DFT_VAL,1,1 // Loads the default values

This command loads the default configuration values. This disables the watchdog. If the watchdog is enabled, the reset timeout values, the MIN_START_TIME timeout and the ALWAYS_ON timeout become active. Other configuration values become active immediately. The loaded default values are also persistent, i.e. written to the flash memory.

8.3.1.9 Change the Watchdog‘s I²C Address

Command	I2C_ADDR
Parameter	<address>
Type	Number
Range	1-127
Default	106 (0x6A)
Non-volatile	Yes
Example	WD= I2C_ADDR,87,15 // Changes the I^2C address to 87d (0x57)

The watchdog‘s I^2C slave address can be changed to any 7-bit address. This may become necessary to avoid address conflicts on the I^2C bus, if used in an environment, where the default I^2C address "0x6A" is already in use by other slave devices connected to the Java Terminal.

Changing the I^2C address takes effect immediately and has no impact on the watchdog‘s enabled/disabled state.

8.3.1.10 Set GPIO Direction

Command	GPIO_DIR
Parameter	<pin-config>
Type	Number
Range	0-1023
Default	993 (0x3E1, 1111100001b)
Non-volatile	Yes
Example	WD= GPIO_DIR,682,16 // Sets the GPIOs alternating to output and input (binary value: 1010101010b)

This command configures the input/output direction of level-shifters to the module‘s externally available GPIO pins. The argument is a 10-bit number, representing the 10 adjustable directions of the GPIO level-shifters. A set bit (value 1) sets the respective level-shifter to the output direction. A cleared bit changes the respective level-shifter to input direction. The following table describes the connection between the 10-bit argument number, the modules GPIO pins, and the Java Terminals Weidmueller connectors 8-pin and 12-pin:

10-Bit number	GPIO	8-pin connector	12-pin connector	Default
0	GPIO6	1	-	Output
1	GPIO7	2	-	Input
2	GPIO8	3	-	Input
3	GPIO11	4	-	Input
4	GPIO12	5	-	Input
5	GPIO13	6	-	Output
6	GPIO14	7	-	Output
7	GPIO15	8	-	Output
8	GPIO21	-	12	Output
9	GPIO20	-	11	Output

Changing the directions of the level-shifters must be executed with great care. They may only be set in accordance with the modules GPIO‘s input/output configuration. Special care must be taken that no outputs are cross-connected during the switching phase.

Configuring a Java terminal output, the level shifter output must be set first, followed by the module output configuration.

Configuring a Java terminal input, the module input must be set first, followed by the level shifter input.

Please note that the GPIO direction can also be configured via I^2C interface. It is recommended to use the I^2C interface to configure the GPIO direction.

Note: Not every GPIO is supported by every Java Terminal variant - see Section 3.7.

8.3.1.11 Configure ADC1_IN/DSR0/SPI_CLK Line

Command	ADC_DSR0
Parameter	<input/output>
Type	Boolean
Range	0: Analog input (ADC1_IN) 1: Digital output (DSR0/SPI_CLK)
Default	0: Analog input (ADC1_IN)
Non-volatile	Yes

Example	WD= ADC_DSR0,0,0 // Configures the line to be analog input
	WD= ADC_DSR0,1,1 // Configures the line to be digital output

This command configures the the ADC/DSR0/SPI_CLK signal on the Weidmueller connector to be either an analog input line (ADC) or a digital output line (DSR0/SPI_CLK). If configured as analog input, the signal is connected to the Java module‘s ADC1_IN line. If configured as digital output, the signal is connected to the Java module‘s DSR0/SPI_CLK line that can be configured to be either DSR0 or SPI_CLK (SPI_CLK not available for BGS5T USB).

Note: If configuring the ADC1_IN/DSR0/SPI_CLK line please take great care to be in accordance with the Java module‘s current configuration of the ADC1_IN and DSR0/SPI_CLK signals.

8.4 Configuration via I²C Interface

While the complete watchdog functionality may be configured via ASC0 interface (for details see Section 8.3) some of the configuration commands can also be configured during runtime via I²C interface as described in this section.

The I²C interface is accessible either via the external Weidmueller connector - I2CDAT and I2CCLK, or via the Java module's AT command interface (e.g., ASC0), or through a Java MIDlet during runtime.

The I²C interface implements the write and the read protocol as described in Section 8.4.1. The 7-bit device address is 0x6A (binary: 1101010). The default address can be changed by configuration command (see Section 8.3.1.9).

8.4.1 Command Specification

8.4.1.1 WRITE Command Syntax

S	Slave address (including write bit "W")	A	Register address	A	Data byte	A	P

Example setting the GPIO12 signal direction to "output" (see also section Examples):

S	0xD4 (including write bit "0")	A	0x14	A	0x01	A	P

Legend:
S: Start Condition, W: Write bit (=0), A: Acknowledge, P: Stop Condition.

8.4.1.2 READ Command Syntax

S	Slave address (including read bit "R")	A	Register address	A	Data length (only one byte)	N	P

Example reading the last status = OK (see also section Examples):

S	0xD5 (including read bit "1")	A	0x00	A	0x01 (only one byte)	N	P

Legend:
S: Start Condition, R: Read bit (=1), A: Acknowledge, N: Not Acknowledge, P: Stop Condition.

8.4.1.3 I²C Protocol Overview

In write mode (i.e., slave address “0xD4“), one address byte and one data byte is sent to the Java Terminal/Watchdog. The address byte specifies a register to write the data byte to. The data byte value is only written, if it is valid, i.e., in the specified range. After a write attempt, the status code of the operation is saved and the read address register (RAR) is automatically set to the status register address (SR). A subsequent read command from the status register (SR) will then return the latest status code (see Table 26). Only when the address byte is the RAR, i.e. another register is selected to be read, the RAR is not automatically set to the SR register. See Section 8.4.1.4 for sample watchdog configurations via I²C.

In read mode, one data byte can be read from the Java Terminal/Watchdog. Attempts to read more bytes will result in undefined values being returned by the device. The device will always return the value that is addressed by the RAR. To read a specific register, a write command with RAR as the address byte and the register to be read as the data byte has to be issued first. The next read will then return the value at this address. Note that there are only a few registers that can be read (see register table - Table 25). When the RAR is written with a non-read address, the RAR is set to the SR, and the status code ILLEGAL_ARGUMENT is saved. Note also that a consecutive read is not valid, as the return value will be ILLEGAL_ARGUMENT, but the caller cannot determine whether the result is the value at the faulty address or an error status code. See Section 8.4.1.4 for sample watchdog configurations via I²C.

8.4.1.4 I²C Commands

The following table lists the address register for configuration commands via I²C interface.

Table 25: Address register for I²C commands

Register address	Read/ Write	Description	Name	Non-volatile	Default	Value range
0x00	R	Status; only address register to read directly from.	SR	-	OK	See result codes Table 26
0x10	W	GPIO6	GPIOxR	Yes	1	0: Input 1: Output
0x11	W	GPIO7		Yes	1	
0x12	W	GPIO8		Yes	1	
0x13	W	GPIO11		Yes	1	
0x14	W	GPIO12		Yes	0	
0x15	W	GPIO13		Yes	0	
0x16	W	GPIO14		Yes	0	
0x17	W	GPIO15		Yes	0	
0x18	W	GPIO21		Yes	0	
0x19	W	GPIO20		Yes	1	
0x30	R	GPIO direction Low Byte: Read out 8 bits for the GPIOs [15,14,13,12,11,8,7,6]	GPIOLBR	-		[0..0xFF]
0x31	R	GPIO direction High Byte: Read out 2 bits for the GPIOs 20 and 21 in the representation: [0,0,0,0,0,0,<20>,<21>]	GPIOHBR	-		[0..0xFF]

Table 25: Address register for I²C commands

Register address	Read/ Write	Description	Name	Non-volatile	Default	Value range
0x50	R/W	ADC1_IN/DSR0	ADCDSRR	Yes	0x00	0: Analog In 1: Digital Out
0x80	W	Trigger delay. Specifies delay time for a reset. If a trigger delay time is specified, the watchdog is prevented from resetting the module for the given time.	TDR	No	0x00	Set time in minutes. 1...255: Minutes 0: Disable
0xFD	R	Hardware watchdog's firmware version	VER	--		[0x00..0x99] [MAJ MIN] 4:MSB: MAJ 4:LSB: MIN MAJ: Main release number (e.g., 1.x) MIN: Sub release number (e.g., x.0) as in version v1.0
0xFF	W	Read address register (RAR)	RAR	No	0x00	0x00..0xFF Only valid addresses contain valid values

Possible result codes for status command (see Section 8.4.1.3 and above Table 25):

Table 26: I²C status result codes

Result	Code	Comment
OK	0x00	Last command was executed successfully
PROTOCOL_ERROR	0x01	Protocol error, i.e. wrong number of bytes
ILLEGAL_ADDRESS	0x02	Illegal register address
ILLEGAL_ARGUMENT	0x03	Illegal argument. Argument is out of allowed range.
UNDEFINED	0xFF	

Examples

The following two samples show how the watchdog can be configured via the I²C interface, using the AT^SSPI command (at RS-232/ASC0) to transfer the I²C user data. Please refer to [1] for more information on the AT command AT^SSPI and on how to configure and control the data transfer over the I²C interface.

The above Table 25 specifies the address register that can be used in I²C configuration commands.

The **first** example sets GPIO12 to “output“. It therefore configures a write register marked as “W“ in Table 25.

AT^SSPI=	Open the Java Terminals I²C data connection.
CONNECT	Indicates that the connection is open.
<aD41401>	WRITE command enclosed by <>: “a“ is a command ID to better identify and match acknowledgments, “D4“ indicates the slave address (write mode), “14“ specifies the address register GPIO12, and “01“ sets the data byte (i.e., line is “output“). **Note**: The data byte value is only written if valid, i.e., if in the specified range. After a WRITE command, the status code of the operation is saved to the status register (SR) and a subsequent READ command from the status register will then return the latest status code as listed in Table 26.
{a+}	Acknowledgement enclosed in curly brackets of a successful data transmission.
<bD50001>	READ command enclosed by <>: “b“ is a command ID to better identify and match acknowledgements, “D5“ indicates the slave address (read mode), “00“ specifies the address register SR, and “01“ sets the data length to be read. **Note:** The READ command can only be called in conjunction with the SR address “00“ and the data length of one byte “01“.
{b+00}	Acknowledgement enclosed in curly brackets of a successful data transmission, together with the response code “00“ indicating that the command was successfully executed.
#	Close data connection.
OK	Connection closed.

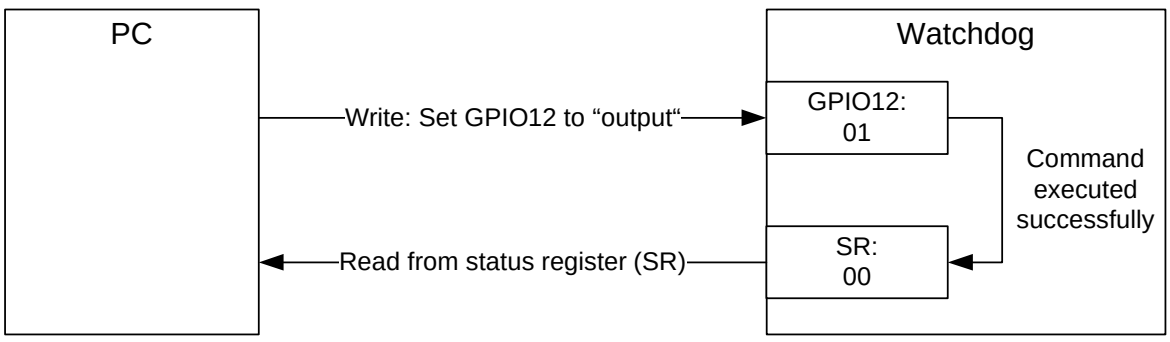


Figure 18: Write data to address register

The **second** example listed below reads out the firmware version, it therefore uses a read register marked as “R“ in Table 25.

However, except for the status address register (SR) no information can be directly retrived from an address register itself, but only indirectly by means of a so-called read-address-register (RAR). An initial WRITE command has to link the register to be read to the RAR first. Now the RAR is linked to the register to be read, and the content of this register can be read from the SR.

AT^SSPI=	Open the Java Terminals I²C data connection.
CONNECT	Indicates that the connection is open.
<aD4FFFD>	WRITE command enclosed by <>: “a“ is a command ID to better identify and match acknowledgments, “D4“ indicates the slave address (write mode), “FF“ specifies the read address register RAR, and “FD“ sets the data byte to the watchdogs firmware version register VER (i.e., RAR and VER are linked by this command). **Note**: The data byte value is only written if valid, i.e., if in the specified range. After a WRITE command, the status code of the operation, in this case, i.e., where the register address is the RAR, the content of the register given as data byte is saved to the status register (SR) and a subsequent READ command from the status register will then return the register value, i.e., the firmware version.
{a+}	Acknowledgement enclosed in curly brackets of a successful data transmission.
<bD50001>	READ command enclosed by <>: “b“ is a command ID to better identify and match acknowledgements, “D5“ indicates the slave address (read mode), “00“ specifies the address register SR, and “01“ sets the data length to be read. **Note:** The READ command can only be called in conjunction with the SR address “00“ and the data length of one byte “01“.
{b+10}	Acknowledgement enclosed in curly brackets of a successful data transmission, together with the response code “10“ indicating that the command was successfully executed. The resposne code gives the watchdog‘s firmware version as v1.0.
#	Close data connection.
OK	Connection closed.

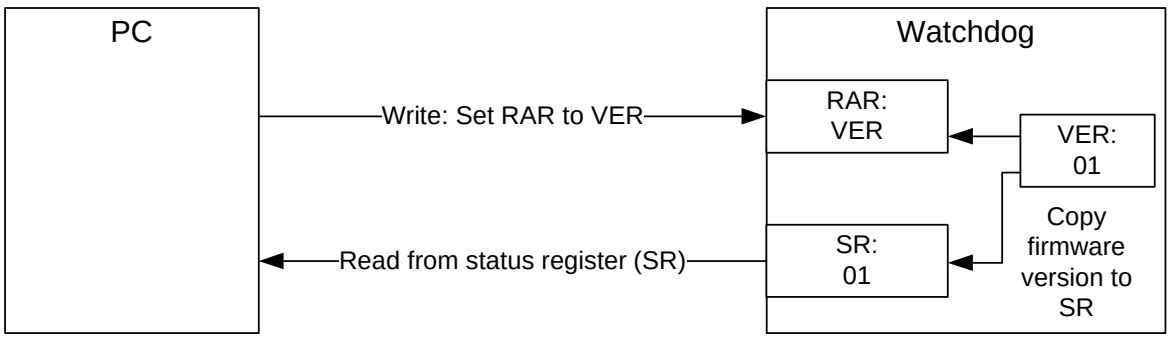


Figure 19: Read data from address register

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