THALES

Cinterion® Java Terminals

Hardware Interface Description

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Contents

0 Document History 8

1 Introduction 11
1.1 Related Documents 12
1.2 Terms and Abbreviations 12
1.3 Regulatory and Type Approval Information 14
1.3.1 Directives and Standards 14
1.3.2 Safety Precautions 17
1.4 Product Label 19

2 Product Concept 20
2.1 Key Features at a Glance 20

3 Interface Description 23
3.1 Overview 23
3.2 Block Diagram 24
3.3 Terminal Circuit 25
3.4 Operating Modes 26
3.5 RS-232 Interface 27
3.5.1 9-Pole D-sub Connector 27
3.6 USB Interface 28
3.7 GPIO Interface 28
3.7.1 Serial Interface ASC1 31
3.7.2 Digital Audio Interface 32
3.7.3 I^2C Interface 34
3.7.4 SPI Interface 35
3.7.5 PWM Interface 36
3.7.6 Pulse Counter 36
3.7.7 Analog-to-Digital Converter (ADC) 36
3.7.8 DSR0 signal 36
3.8 Ethernet Interface 37
3.9 Power Supply 38
3.10 Power Up/Power Down Scenarios 39
3.10.1 Turn Java Terminals on 39
3.10.2 Reset/Restart Java Terminals 39
3.10.3 Turn Java Terminals off 40
3.10.4 Disconnecting power supply 40
3.11 Automatic thermal shutdown 41
3.12 Hardware Watchdog 41
3.13 RTC 41
3.14 SIM Interface 42
3.15 Status LEDs 43
3.16 RF Antenna Interface 44

4 Electrical and Environmental Characteristics 45
4.1 Absolute Maximum Ratings 45
4.2 Electrical Specifications of the Application Interface 46
4.2.1 On/Off Control 46
4.2.2 RS-232 Interface 46
4.2.3 USB Interface 46
4.2.4 GPIO Interface 47
4.2.5 RS-485 Interface 48
4.2.6 Ethernet Interface 48
4.3 Power Supply Ratings 49
4.4 Operating Temperatures 51
4.5 Antenna Interface 52
4.6 Storage Conditions 54

5 Mechanics, Mounting and Packaging 55
5.1 Mechanical Dimensions 55
5.2 Mounting the Java Terminals 58
5.3 Packaging 59

6 Full Type Approval 60
6.1 Thales Reference Setup 60
6.2 Restrictions 61
6.3 CE Conformity 61
6.4 EMC 61
6.5 Compliance with FCC and IC Rules and Regulations 62

7 List of Parts and Accessories 64

8 Appendix A: (Hardware) Watchdog 65
8.1 Reset Conditions 66
8.1.1 Reset stages 66
8.1.2 Reset Delay 67
8.2 Restart Conditions 67
8.3 Complete Watchdog Configuration 68
8.3.1 Watchdog (WD) Command Specification 68
8.4 Qualified Watchdog Configuration 78
8.4.1 I^2C Interface Command Specification 78
8.5 Configuring GPIO Directions 83
8.5.1 Configuration using I^2C Interface 84
8.5.2 Configuration using TXD0 Line of ASC0 Interface 85

9 Appendix B: Ethernet Setup and Usage 86
9.1 Connection Setup 86
9.2 Connection Usage 88
9.2.1 Access EHS6T LAN via Telnet (or SSH) 88
9.2.2 Access EHS6T LAN via FTP 89
9.2.3 Security Notes 90
9.2.4 Configure IP Address 90
9.2.5 Edit APN List 90
9.2.6 Enter SIM Pin 91
9.2.7 Transparent Data Exchange 91
9.2.8 Update EHS6 Module Firmware 92
9.2.9 Update Ethernet Sub-System Software 92

Tables

Table 1: Cinterion® Java Terminals overview 11
Table 2: Terms and abbreviations 12
Table 3: Directives 14
Table 4: Standards of North American type approval 14
Table 5: Standards of European type approval 14
Table 6: Requirements of quality 15
Table 7: Standards of the Ministry of Information Industry of the People's Republic of China 16
Table 8: Toxic or hazardous substances or elements with defined concentration limits 16
Table 9: Java Terminals label information 19
Table 10: Java Terminals' interfaces 23
Table 11: Overview of operating modes 26
Table 12: 9-pole D-sub (female) RS-232 27
Table 13: GPIO connector pin availability and alternate pin functionalities 30
Table 14: Overview of DAI/PCM signals 32
Table 15: Female 8-pole RJ-45 Ethernet connector 37
Table 16: Female 6-pole Western plug for power supply, ignition, power down 38
Table 17: Allowed maximum antenna gain (including cable loss) 44
Table 18: Absolute maximum ratings 45
Table 19: Operating supply voltage for Java Terminals 45
Table 20: On/Off control line specifications 46
Table 21: RS-232 interface specifications 46
Table 22: GPIO interface specifications (requirements) 47
Table 23: RS-485 interface specifications (requirements) 48
Table 24: Power supply specifications 49
Table 25: Temperature characteristics 51
Table 26: RF Antenna interface GSM / UMTS 52
Table 27: Storage conditions 54
Table 28: List of parts and accessories 64
Table 29: Address register for I^2C commands 79
Table 30: I^2C status result codes 80

Figures

Figure 1: Sample Java Terminal label (BGS5T USB) 19
Figure 2: Java Terminals 3D view 23
Figure 3: Block diagram 24
Figure 4: Java Terminals circuit block diagram 25
Figure 5: Pin assignment RS-232 (D-sub 9-pole female) 27
Figure 6: EHS5T RS485: GPIO connectors (8-pin and 12-pin) 28
Figure 7: EHS6T USB/EHS6T LAN: GPIO connectors (8-pin and 12-pin) 29
Figure 8: BGS5T USB: GPIO connectors (8-pin and 12-pin) 29
Figure 9: Long frame PCM timing, 256kHz 32
Figure 10: Block circuit for DAI/PCM to analog converter 33
Figure 11: Sample circuit for analog to DAI/PCM circuit 33
Figure 12: Characteristics of SPI modes 35
Figure 13: 8-pole RJ-45 Ethernet connector (female) 37
Figure 14: 6-pole Western jack for power supply, ignition, reset, typical connection 38
Figure 15: SIM interface 42
Figure 16: Status LED 43
Figure 17: Antenna connector 44
Figure 18: Java Terminals 3D overview 55
Figure 19: Java Terminals mechanical dimensions 56
Figure 20: Java Terminals exploded view 57
Figure 21: Mounting the Java Terminals 58
Figure 22: Reference equipment for approval 60
Figure 23: Hardware watchdog configuration 65
Figure 24: Write data to address register 81
Figure 25: Read data from address register 82
Figure 26: Setting GPIO direction to OUTPUT via I^2C interface 84
Figure 27: Setting GPIO direction to INPUT via I^2C interface 84
Figure 28: Setting GPIO direction to OUTPUT via TXD0 line (at 1200bps) 85
Figure 29: Setting GPIO direction to INPUT via TXD0 line (at 1200bps) 85

0 Document History

Preceding document: "Cinterion® Java Terminals Hardware Interface Description" Version 09
New document: "Cinterion® Java Terminals Hardware Interface Description" Version **09a**

Chapter	What is new
-	New document layou
7	Revised Table 28 related to power supply and antenna

Preceding document: "Cinterion® Java Terminals Hardware Interface Description" Version 08
New document: "Cinterion® Java Terminals Hardware Interface Description" Version 09

Chapter	What is new
1.3, 1.4, 6.3	Revised information with regard to the new Radio Equipment Directive (RED). Added IP code (IP40) the Java Terminals comply with (DIN EN 60529).
8.4, 8.5.1	Added note for guard time between I^2C commands.

Preceding document: "Cinterion® Java Terminals Hardware Interface Description" Version 07a
New document: "Cinterion® Java Terminals Hardware Interface Description" Version 08

Chapter	What is new
2.1	Added power supply range for EHS6T LAN.
3.3	Revised Figure 4.
3.8	Added further information on Power over Ethernet. Added Link/Activity LED and showing position in Figure 13.
3.15	Changed color of Network Status LED.
4.1	Added footnote regarding EHS6T LAN to Table 18 and Table 19.
4.3	Added power consumption ratings for EHS6T LAN to Table 24.

Preceding document: "Cinterion® Java Terminals Hardware Interface Description" Version 06a
New document: "Cinterion® Java Terminals Hardware Interface Description" Version 07

Chapter	What is new
Throughout document	EHS6T LAN terminal is now available. Adapted descriptions accordingly.
8.3.1.6	New section I^2C Reset.

Preceding document: "Cinterion® Java Terminals Hardware Interface Description" Version 06
New document: "Cinterion® Java Terminals Hardware Interface Description" Version 06a

Chapter	What is new
Throughout document	EHS6T LAN terminal set to “for future use; currently not available“.

Preceding document: "Cinterion® Java Terminals Hardware Interface Description" Version 05

New document: "Cinterion® Java Terminals Hardware Interface Description" Version 06

Chapter	What is new
Throughout document	Added EHS5T-US RS485 as new product.
3.7	Added note on switch off and power saving behavior if using EHS5T's RS-485 interface.
4.2.5	New section RS-485 Interface.
4.2.6	Added Ethernet characteristics.
4.3	Revised power supply ratings.

Preceding document: "Cinterion® Java Terminals Hardware Interface Description" Version 04
New document: "Cinterion® Java Terminals Hardware Interface Description" Version 05

Chapter	What is new
Throughout document	Removed SPI option for EHS5T RS485. Added digital audio interface (DAI/PCM) lines as option for GPIO20 to GPIO23. Replaced GPIO14 / GPIO15 with GPIO22 / GPIO23 respectively. Assigned WD_RETRIG line to GPIO8 instead of the GPIO22.
3.7.1	New section Serial Interface ASC1.
3.7.2	New section Digital Audio Interface.
3.7.3	New section I^2C Interface.
3.7.4	New section SPI Interface.
3.7.5	New section PWM Interface.
3.7.6	New section Pulse Counter.
3.7.7	New section Analog-to-Digital Converter (ADC).
3.7.8	New section DSR0 signal.
8.3.1.11 8.4.1.4	Revised GPIO default direction settings - all are set to INPUT now. Adapted configuration samples given in Section 8.5.1 and Section 8.5.1 accordingly.
9.4	Added Figure 34 showing result of a firmware update command.

Preceding document: "Cinterion® Java Terminals Hardware Interface Description" Version 03
New document: "Cinterion® Java Terminals Hardware Interface Description" Version 04

Chapter	What is new
Throughout document	Added information for product variant EHS6T LAN.

Preceding document: "Cinterion® Java Terminals Hardware Interface Description" Version 02
New document: "Cinterion® Java Terminals Hardware Interface Description" Version 03

Chapter	What is new
Throughout document	Replaced the term “Weidmueller connector“ with “GPIO connector“. Added notes that GPIOs 14/15 will be replaced by GPIOs 22/23 in the next product release.

Chapter	What is new
1.4	Updated label shown in Figure 1.
3.9	Revised section and spun off new section 3.10 Power Up/Power Down Scenarios.
3.10.3	Removed note that watchdog can be configured to turn off Java Terminals.
4.1	Revised ESD ratings (in Table 18) and minimum voltage rating (in Table 19).
4.2.1	Revised input voltage ratings listed in Table 20.
4.2.2	Revised ratings given in Table 21.
4.2.4	Revised description for VCCref.
4.4	Added thermal resistance and thermal power values for Java Terminals.
4.3	Revised power supply ratings.
5.1	Added new figure showing mechanical dimensions (Figure 19).
7	Revised Table 7.
8, 8.1.1	Slightly revised (hardware) watchdog introduction and modified Reset stages.
8.5	New section Configuring GPIO Directions.

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 GPIO connector pin availability.
4.1	Completed Table 18 giving absolute maximum ratings.
4.4	Added remarks on board temperature.
4.3	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 five 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 GPIO interface it also implements a RS-485 interface including power supply and ignition line.
- **EHS5T-US RS485** is identical to EHS5T RS485, but contains a Cinterion® EHS5-US module instead of a Cinterion® EHS5-E module. Note: Unless otherwise mentioned EHS5T RS485 refers to both product variants.
- **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.
- **EHS6T LAN** contains a Cinterion® EHS6 module and implements an Ethernet interface with a RJ-45 8-pin 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 five 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 and EHS5T-US RS485	EHS6T USB	EHS6T LAN	BGS5T USB
Cinterion® module	EHS5-E or EHS5-US	EHS6	EHS6	BGS5
RS-232 (Sub-D)	-	✓	✓	✓
USB (USB-B)	✓	✓	-	✓
GPIO interface (GPIOs, Power, ASC1, DAI, SPI, I²C, RS-485)	✓ (no SPI)	✓ (no RS-485)	✓ (no RS-485)	✓ (no RS-485, no SPI)
Ethernet (RJ-45)	-	-	✓	-
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 Thales product.

1.1 Related Documents

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

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
DAI	Digital Audio Interface
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
I^2C	Inter Integrated Circuit
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
MCU	Microprocessor Controll Unit
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
PoE	Power over Ethernet
RED	Radio Equipment Directive
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

2014/53/EU	Directive of the European Parliament and of the council of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/ 05/EC. The product is labeled with the CE conformity mark - see Section 6.3.
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 RSS132 RSS133	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 V12.5.1	Global System for Mobile communications (GSM); Mobile Stations (MS) equipment; Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
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

Draft ETSI EN 301 489-1 V2.2.0	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonized Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU
Draft ETSI EN 301 489-52 V1.1.0	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication Mobile and portable (UE) radio and ancillary equipment; Harmonized Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
ETSI EN 301 908-1 V11.1.1	IMT cellular networks; Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 1: Introduction and common requirements
ETSI EN 301 908-2 V11.1.1	IMT cellular networks; Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 2: CDMA Direct Spread (UTRA FDD) User Equipment (UE)
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+ A12:2011+A2:2013	Safety of information technology equipment

Table 6: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes. The Java Terminals comply with IP40.

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. THALES DIS AIS Deutschland 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	Bar code (Code128)
7	Product IMEI
8	Date code
9	WEEE symbol (see Table 3)
10	Chinese RoHS symbol (see Table 7)
11	CE logo. May be replaced for samples with "Not for sale" (see also Section 6.3)
12	FCC Declaration of Conformity (DoC) logo (BGS5T USB, EHS6T LAN only; with EHS6T LAN, a smaller FCC logo is placed between bar code and Chinese RoHS symbol)
13	FCC ID for Java Terminal (EHS5T-US RS485, EHS6T USB), or FCC and IC ID (EHS6T LAN)
14	FCC ID for Java module contained in Java Terminal (BGS5T USB, EHS5T-US RS485 and EHS6T USB/LAN only)
15	IC ID for Java module contained in Java Terminal (BGS5T USB, EHS6T USB/LAN only)
16	Manufacturer code
17	Power supply unit ratings
18	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 EHS5T-US RS485 (with EHS5-US module): GSM/GPRS/EDGE: Dual band GSM 850/1900MHz UMTS/HSPA+: Dual band UMTS 850/1900MHz EHS6T USB (with EHS6 module): GSM/GPRS/EDGE: Quad band 850/900/1800/1900MHz UMTS/HSPA+: Five band 800/850/900/1900/2100MHz EHS6T LAN (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 EHS6T LAN only: 8V to 57V (because of Power-over-Ethernet support)
Operating temperature (Java module board 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.)

Feature	Implementation
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
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, Thales 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 micro-controller, 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 10MB RAM. Application code and data share the space in the flash file system and in RAM.

Feature	Implementation
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 ASC0 (RS-232 or RS-485) or USB interface
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
GPIO connector	20-pin (8-pin and 12-pin) header with GPIO interface, external power supply, serial interface ASC1, ADC, DAI/PCM, SPI, I²C and RS-485 option, depending on variant
Ethernet	8-pole RJ-45 Ethernet connector Support for Power over Ethernet (PoE)
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 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:

Table 10: Java Terminals' interfaces

No.	Description
1	6-pin Western connector (female) for power supply, ignition, power down signal
2	8-pin (female) RJ-45 Ethernet connector
3	9-pin (female) D-sub connector (RS-232 interface)
4	SMA connector (female) for GPS antennas (for future use, currently not available)
5	SIM card reader
6	SMA connector (female) for RF antenna
7	SMA connector (female) for Rx diversity antenna (for future use, currently not available)
8	12-pin and 8-pin GPIO connectors (male) (including RS-485)
9	4-pin (female) USB-B connector

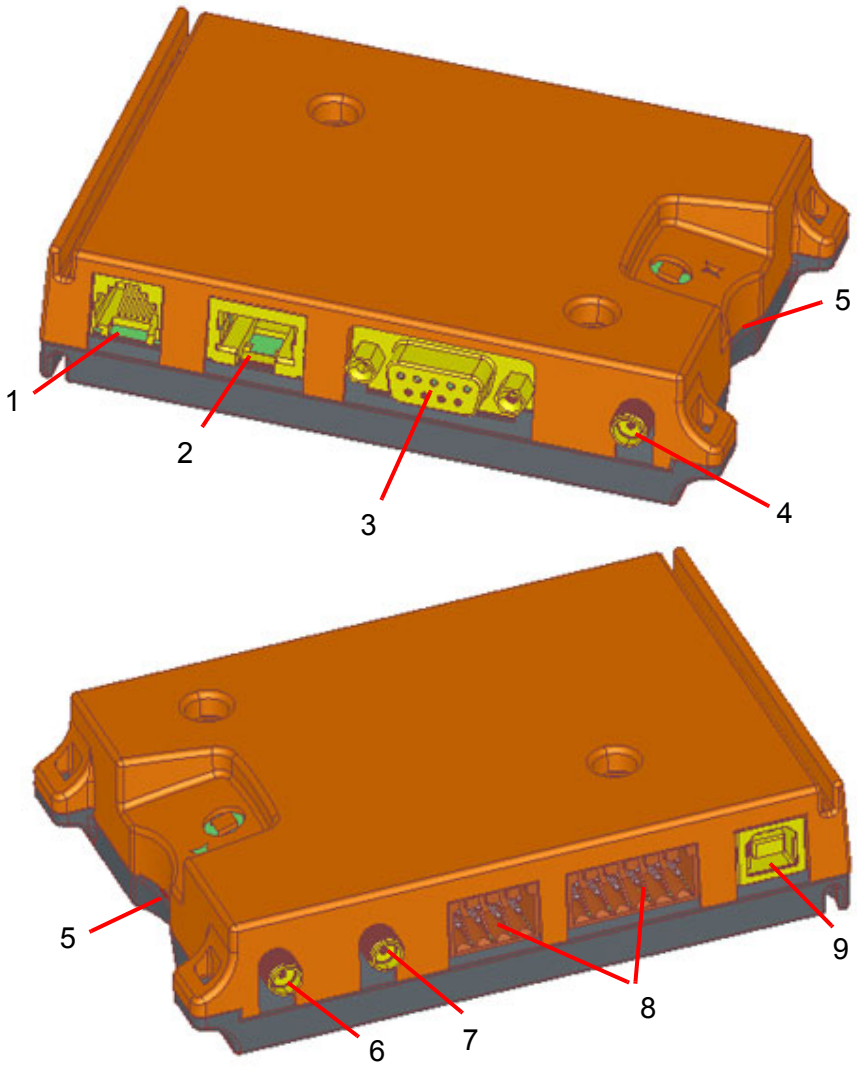


Figure 2: Java Terminals 3D view

3.2 Block Diagram

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

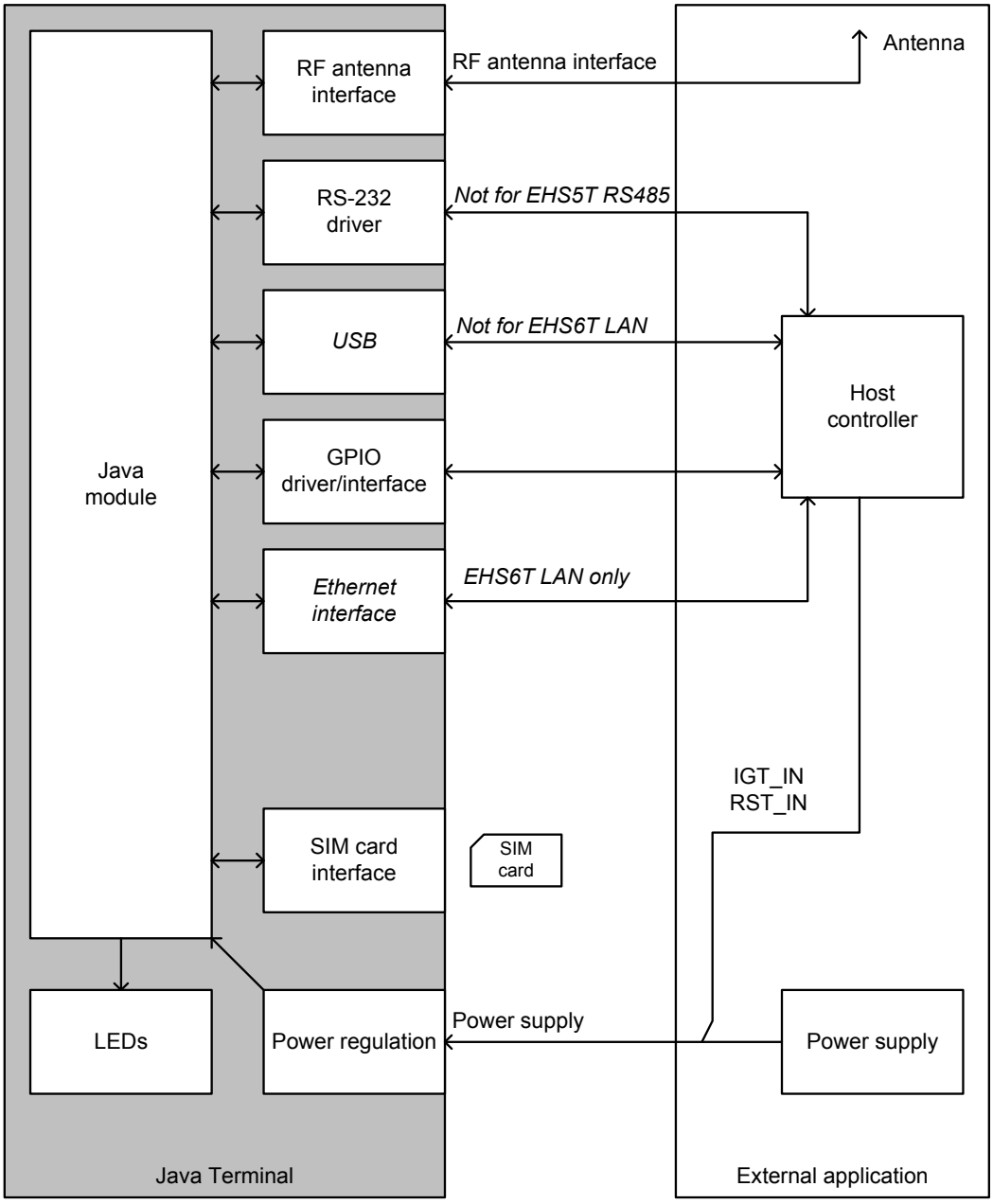


Figure 3: Block diagram

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.

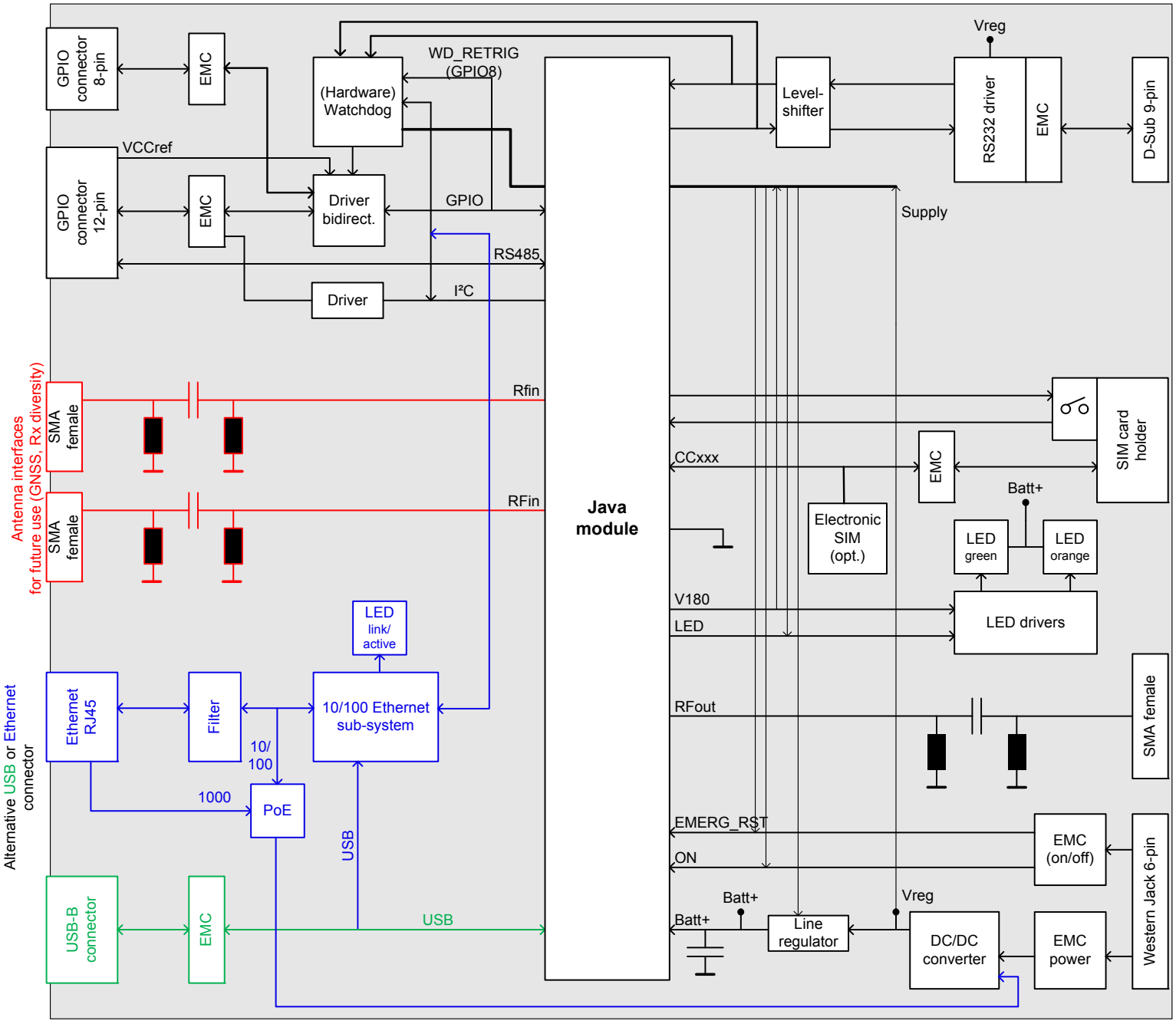


Figure 4: Java Terminals circuit block diagram

3.4 Operating Modes

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

Table 11: 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.

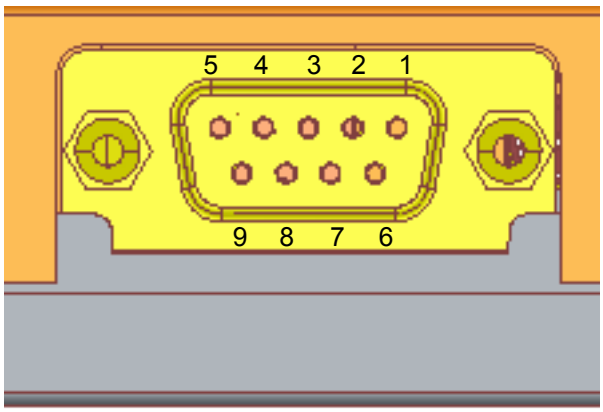


Figure 5: Pin assignment RS-232 (D-sub 9-pole female)

Table 12: 9-pole D-sub (female) RS-232

Pin no.	Signal name	I/O	Function
1	DCD0	O	Data Carrier Detected
2	RXD0	O	Receive Data
3	TXD0	I	Transmit Data
4	DTR0	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	DSR0[1]	O	Data Set Ready
7	RTS0	I	Request To Send
8	CTS0	O	Clear To Send
9	RING0	O	Ring Indication

1. Note that DSR0 may also be available via GPIO connector pin - see Section 3.7.

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 TXD0 of the Java Terminals
- Port RxD @ application receives data from RXD0 of the Java Terminals

Hardware handshake using the RTS0 and CTS0 signals and XON/XOFF software flow control are supported.

In addition, the modem control signals DTR0, DSR0, DCD0 and RING0 are available. The modem control signal RING0 (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 DTR0 signal will only be polled once per second from the internal firmware of Java Terminals.

3.6 USB Interface

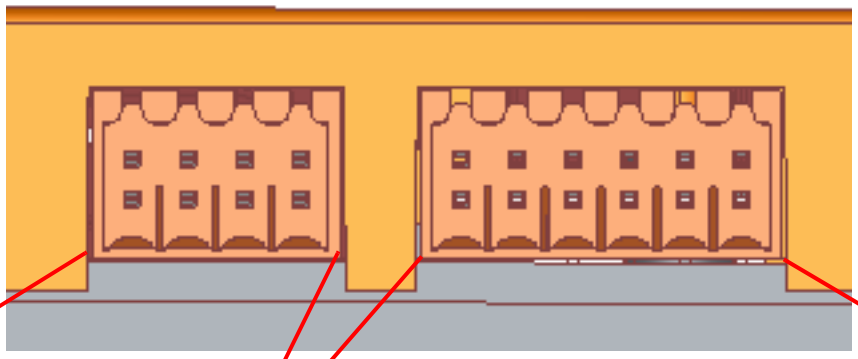
The USB interface is not available for EHS6T LAN. The other Java Terminals support a USB 2.0 High Speed (480Mbit/s) device interface that is Full Speed (12Mbit/s) compliant.

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

3.7 GPIO Interface

The GPIO connectors (8-pin and 12-pin) provide access to various module signals including a number of configurable GPIOs. Note that not all of the pins are available for every Java Terminal variant. The following figures show the available pins for the Java Terminal variants and the below Table 13 lists the overall availablility of the pins.

EHS5T RS485:



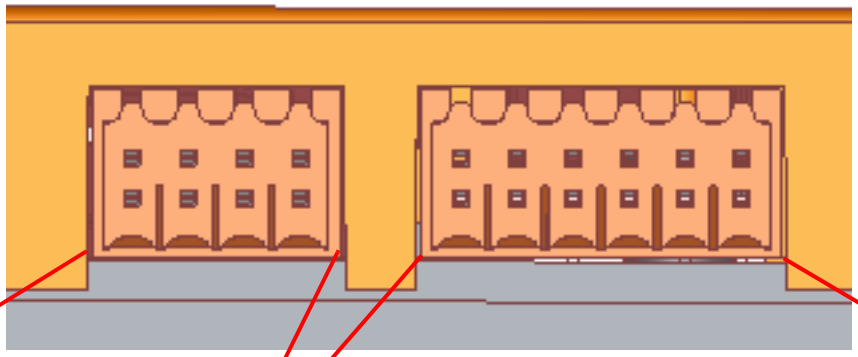
1	2	3	4
GPIO6	GPIO7	GPIO8	n/a
5	**6**	**7**	**8**
n/a	n/a	GPIO22	GPIO23

1	2	3	4	5	6
VCCref	GND	TXD1	RXD1	A+ (RS-485)	B- (RS-485)
7	**8**	**9**	**10**	**11**	**12**
+5Vout	DSR0/ ADC1_IN	I2CDAT	I2CCLK	GPIO20	GPIO21

n/a: not applicable

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

EHS6T USB/LAN:



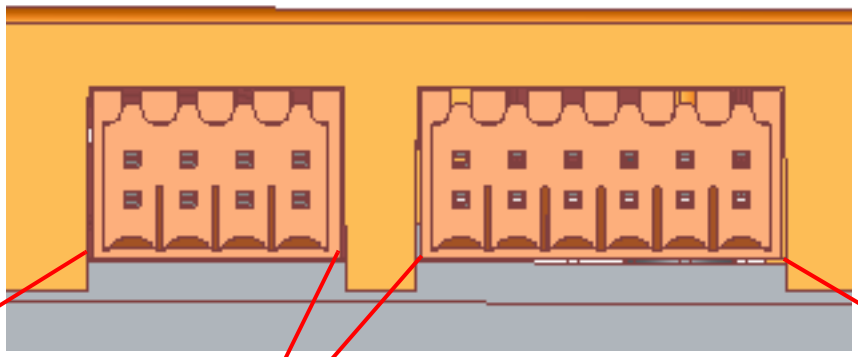
1	2	3	4
GPIO6	GPIO7	GPIO8	GPIO11
5	**6**	**7**	**8**
GPIO12	GPIO13	GPIO22	GPIO23

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

n/a: not applicable

Figure 7: EHS6T USB/EHS6T LAN: GPIO 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	GPIO22	GPIO23

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: GPIO connectors (8-pin and 12-pin)

The following Table 13 shows the availablility of the GPIO connector pins for various Java Terminal variants.

Table 13: GPIO connector pin availability and alternate pin functionalities

PIN	Signal	Comment	EHS5T RS485	EHS6T USB	EHS6T LAN	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	GPIO22	Configurable via AT command also as TFSDAI	✓	✓	✓	✓
8	GPIO23	Configurable via AT command also as SCLK	✓	✓	✓	✓
12-pin connector						
1	VCCref	Input supply for level adjustment. E.g., connect +5Vout for 5V IO operation	✓	✓	✓	✓
2	GND		✓	✓	✓	✓
3	TXD1 or SPI_MISO	Configurable via AT command, also as SPI_MISO signal	TXD1	TXD1 / SPI_MISO	TXD1 / SPI_MISO	TXD1
4	RXD1 or SPI_MOSI	Configurable via AT command, also as SPI_MOSI signal	RXD1	RXD1 / SPI_MOSI	RXD1 / SPI_MOSI	RXD1
5	CTS1 or SPI_CS or A+	CTS1 (RS-232) or SPI_CS or A+ (for RS-485) depending on product variant	A+ (RS-485)	CTS1 / SPI_CS	CTS1 / SPI_CS	CTS1
6	RTS1 or B-	RTS1 (RS-232) or B- (for RS-485) depending on product variant	B- (RS-485	RTS1	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	DSR0 / ADC1_IN	✓	✓	DSR0 / ADC1_IN
9	I2CDAT	I^2C interface	✓	✓	✓	✓
10	I2CCLK	I^2C interface	✓	✓	✓	✓
11	GPIO20	Configurable via AT command also as TXDDAI	✓	✓	✓	✓
12	GPIO21	Configurable via AT command also as RXDDAI	✓	✓	✓	✓

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

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 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.

Note: If employing EHS5T's RS-485 interface be sure not to switch off the EHS5 module, e.g., by calling AT^SMSO, to put the module into Power Down mode. This completely occupies and therefore blocks the RS-485 bus, and may thus lead to a higher current consumption.

Also, be sure not to activate SLEEP mode, e.g., by setting AT^SPOW with <mode>=2, for the EHS5 module, as the module may no longer be able to wake up from SLEEP mode, and will then have to be reset.

3.7.1 Serial Interface ASC1

With EHS5T and EHS6T Java Terminals two respectively four pins at the GPIO connector can be configured as ASC1 interface signals to provide a 2- or 4-wire serial modem interface ASC1. For electrical characteristics please refer to Table 22.

The following pins at the GPIO connector can be configured as ASC1 interface signals: RXD1, TXD1, RTS1 and CTS1 (see also Table 13). The configuration is done by AT command AT^SCFG - see [1]. It is non-volatile and becomes active after a Java Terminal restart.

Java Terminals are designed for use as a DCE. Based on the conventions for DCE-DTE connections they communicate with the customer application (DTE) using the following signals:
- Port TXD @ application sends data to Java Terminal's TXD1 signal line
- Port RXD @ application receives data from the Java Terminal's RXD1 signal line

Hardware handshake using the RTS1 and CTS1 signals is only supported for EHS6T.

3.7.2 Digital Audio Interface

Four pins at the Java Terminals‘ GPIO connector can be configured as digital audio interface (DAI). The DAI can be used to connect audio devices capable of pulse code modulation (PCM). The PCM functionality allows for the use of an external codec like the W681360.

The DAI interface supports a 256kHz, long frame synchronization master mode with the following features:

- 16 Bit linear
- 8kHz sample rate / 125µs frame duration
- The most significant bit MSB is transferred first
- Data write at rising edge / data read at falling edge
- Common frame sync signal for transmit and receive

The following pins at the GPIO connector can be configured as DAI/PCM interface signals: TXDDAI, RXDDAI, TFSDAI and SCLK (see also Table 13). The configuration is done by AT^SCFG command - see [1]. It is non-volatile and becomes active after a module restart. DAI/PCM and GPIO functionalities for these lines are mutually exclusive. Table 14 describes the available DAI/PCM lines at the digital audio interface[1]. For electrical details see Table 22.

Table 14: Overview of DAI/PCM signals

Signal name	Input/Output	Description
TXDDAI (GPIO20)	O	PCM data from Java Terminals to external codec.
RXDDAI (GPIO21)	I	PCM data from external codec to Java Terminals.
TFSDAI (GPIO22)	O	Frame synchronization signal to external codec: Long frame (8kHz)
SCLK (GPIO23)	O	Bit clock to external codec: 256kHz

Figure 9 shows the PCM timing for the master mode available with Java Terminals.

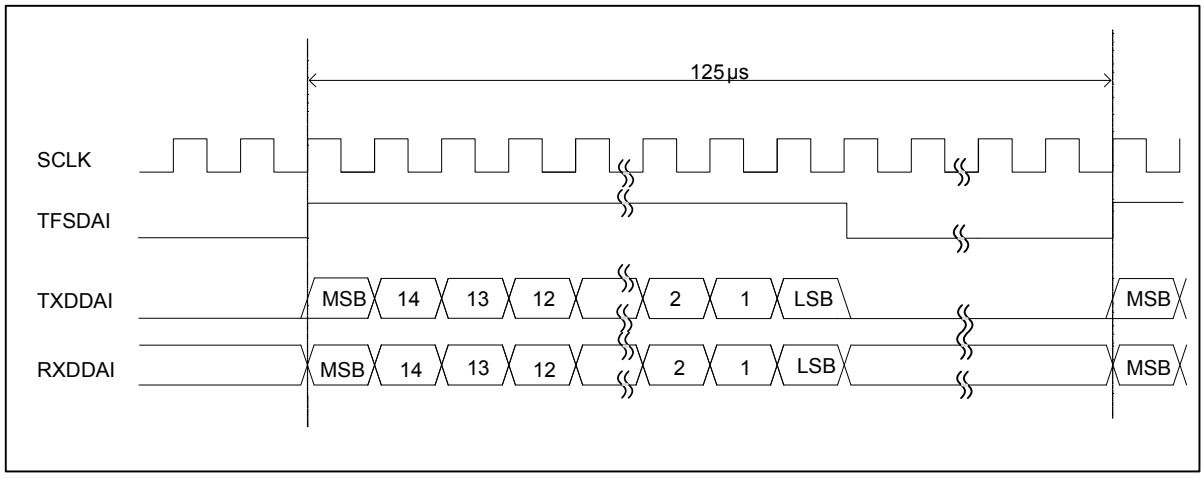


Figure 9: Long frame PCM timing, 256kHz

Section 3.7.2.1 gives an example of how the DAI can be employed.

1. **Note:** For the DAI interface to operate, the directions of the Java Terminals‘ GPIO level shifters must be set according to the defined directions of the DAI signals. See Section 8.3.1.11 and Section 8.5 for more information on how to change level shifter directions.

3.7.2.1 Solutions for the Digital Audio Interface (DAI/PCM)

Figure 10 and Figure 11 show an example of using the digital audio interface of the Java Terminal. The below mentioned sample Nuvoton codec W681360 can be replaced with a DSP. In the example, framesync and clock master is the module (TFSDAI line) and thus the GSM network.

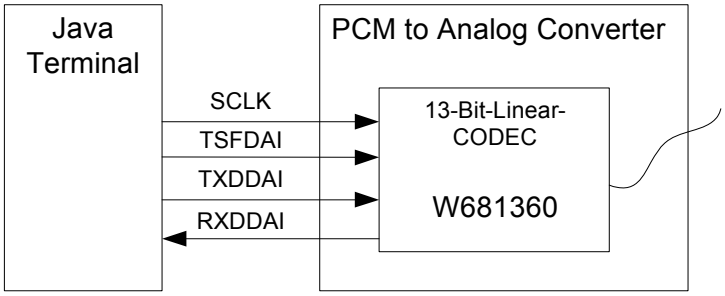


Figure 10: Block circuit for DAI/PCM to analog converter

This DAI/PCM analog converter is well suited for evaluating and testing a telephone handset.

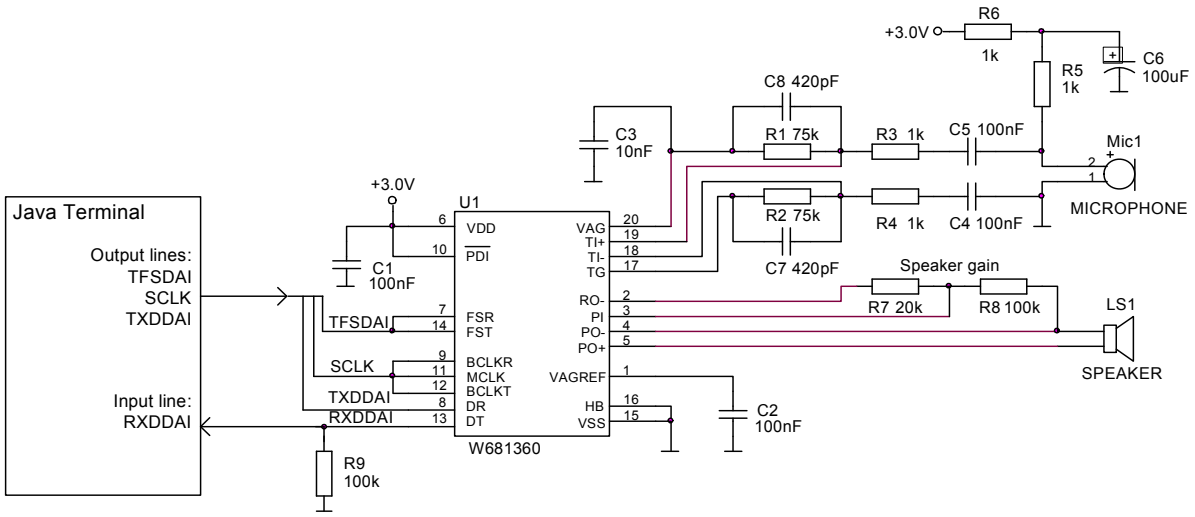


Figure 11: Sample circuit for analog to DAI/PCM circuit

On the module side, the PCM interface has to be enabled. This can be done by using the following AT command: AT^SCFG="GPIO/mode/DAI","std".

Please note that level converters may be required between the the 3.0V audio codec interface lines and the module‘s digital audio lines and - depending on VCCref settings for the GPIO interface lines.

3.7.3 I²C Interface

Two lines of the Java Terminals' GPIO connector are I²C lines. I²C is a serial, 8-bit oriented data transfer bus for bit rates up to 400kbps in Fast mode. It consists of two lines, the serial data line I2CDAT and the serial clock line I2CCLK. The Java Terminals' internal Java module act as a single master device, e.g. the clock I2CCLK is driven by the Java module. I2CDAT is a bi-directional line. Each device connected to the bus is software addressable by a unique 7-bit address, and simple master/slave relationships exist at all times. The Java module operates as master-transmitter or as master-receiver. An external application transmits or receives data only on request of the module.

To configure and activate the I2C bus use the AT^SSPI command. Detailed information on the AT^SSPI command as well explanations on the protocol and syntax required for data transmission can be found in [1].

With the external application, I2CDAT and I2CCLK lines need to be connected to a positive supply voltage via a pull-up resistor. For electrical characteristics please refer to Table 22.

Note: Good care should be taken when connecting the I2C lines to the external application: The wires of I2CCLK and I2CDAT should be equal in length and as short as possible.

3.7.4 SPI Interface

For EHS6T Java Terminals four GPIO interface pins can be configured as Serial Peripheral Interface (SPI). The SPI is a synchronous serial interface for control and data transfer between Java Terminals and the external application. Only one application can be connected to the SPI and the interface supports only master mode. The transmission rates are up to 6.5Mbit/s. The SPI interface comprises the two data lines MOSI and MISO, the clock line SPI_CLK a well as the chip select line SPI_CS.

The following pins at the GPIO connector can be configured as SPI interface signals: SPI_CLK, SPI_MOSI, SPI_MISO and SPI_CS (see also Table 13). The configuration is done by AT command (see [1]). It is non-volatile and becomes active after a module restart. For electrical characteristics please refer to Table 22.

To configure and activate the SPI interface use the AT^SSPI command. Detailed information on the AT^SSPI command as well explanations on the SPI modes required for data transmission can be found in [1]. SPI, ADC1_IN and DSR0 functionalities are mutually exclusive.

In general, SPI supports four operation modes. The modes are different in clock phase and clock polarity. The module's SPI mode can be configured by using the AT command AT^SSPI. Make sure the module and the connected slave device works with the same SPI mode.

Figure 12 shows the characteristics of the four SPI modes. The SPI modes 0 and 3 are the most common used modes.

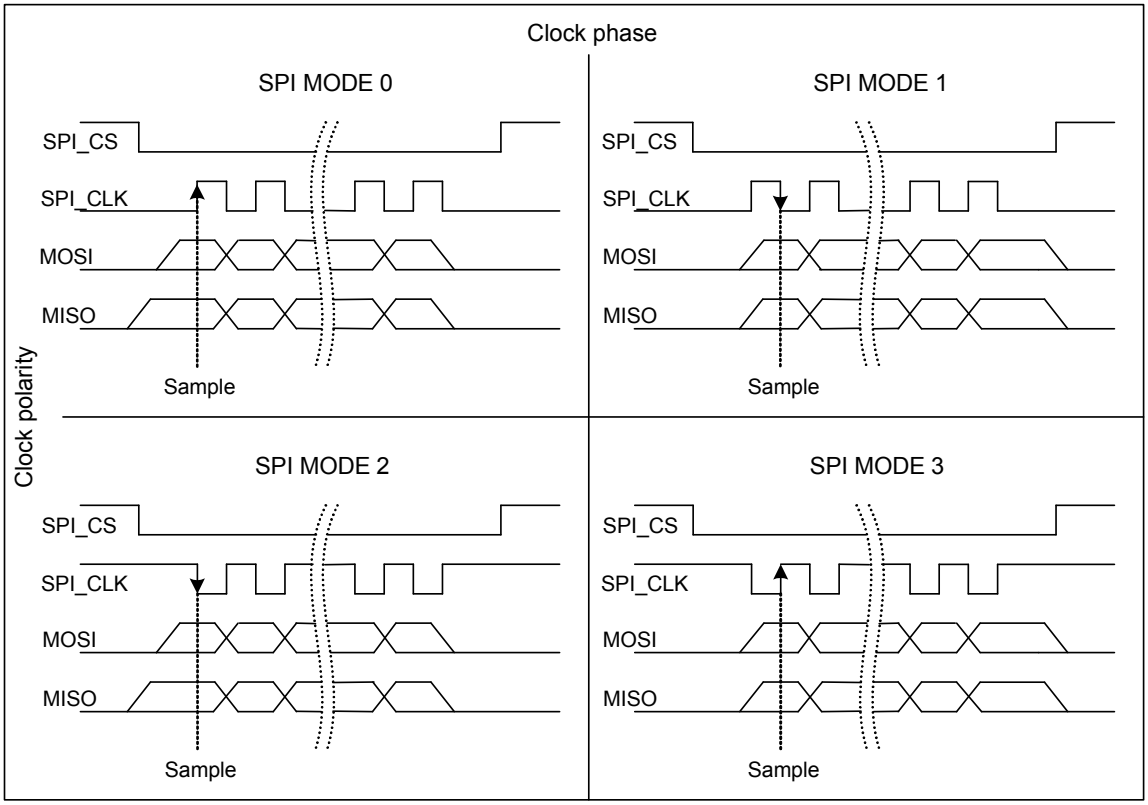


Figure 12: Characteristics of SPI modes

3.7.5 PWM Interface

The GPIO6 and GPIO7 pins at the GPIO connector can be configured as Pulse Width Modulation signals PWM1 and PWM2 by AT^SCFG command - see [1]. The PWM interface lines are output lines and can be used, for example, to connect buzzers. The PWM1 line is shared with GPIO7 and the PWM2 line is shared with GPIO6 (see also Table 13). GPIO and PWM functionalities are mutually exclusive[1].

3.7.6 Pulse Counter

The GPIO8 pin at the GPIO connector can be configured as pulse counter line COUNTER by AT^SCFG command - see [1]. The pulse counter interface is an input line and can be used, for example, as a clock (see also Table 13). GPIO and COUNTER functionalities are mutually exclusive[1].

3.7.7 Analog-to-Digital Converter (ADC)

ADC1_IN can be used for general purpose voltage measurements. For electrical characteristics see Section 4.2.4. ADC1_IN is configured and read by the AT^SRADC command - see [1]. ADC1_IN, DSR0 and SPI functionalities are mutually exclusive.

3.7.8 DSR0 signal

The DSR0 line available at the RS-232 interface is also routed to the GPIO connector and available as a separate pin. For electrical characteristics see Section 4.2.4. DSR0 can be configured by AT^SCFG command - see [1]. DSR0, ADC1_IN and SPI functionalities are mutually exclusive.

1. **Note:** For the PWM interface and pulse counter to operate, the directions of the Java Terminals' GPIO level shifters must be set according to the defined directions of the PWM and COUNTER signals. See Section 8.3.1.11 and Section 8.5 for more information on how to change level shifter directions.

3.8 Ethernet Interface

The Ethernet interface is available for EHS6T LAN only. The other Java Terminals do not support an Ethernet interface.

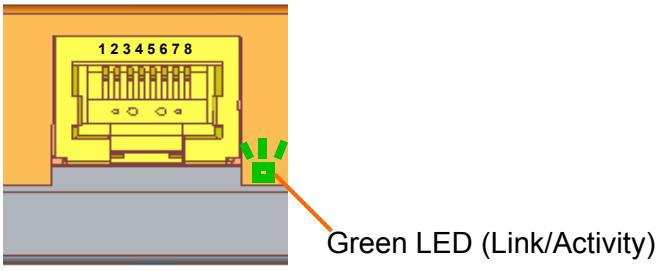


Figure 13: 8-pole RJ-45 Ethernet connector (female)

Table 15: Female 8-pole RJ-45 Ethernet connector

Pin	Signal name	Use	Comment
1	TX+	Transmit +	All lines available for Power over Ethernet (42V – 57V)
2	TX-	Transmit -	
3	RX+	Receive +	
4	n/c	Reserved	
5	n/c	Reserved	
6	RX-	Receive +	
7	n/c	Reserved	
8	n/c	Reserved	

The Ethernet interface can be used as transparent data interface, for downloading new Java Terminal firmware releases - module firmware as well as Ethernet sub-system software, and also to access the implemented EHS6 module via AT command interface.

The Ethernet interface supports Power over Ethernet (i.e., PoE+ (Class 0) according to IEEE 802.3at, and backward compatible to IEEE 802.3af.). This means that if connected to a PoE enabled router or PoE injector, the EHS6T LAN does no longer need a separate power supply unit such as the mains adapter mentioned in Section 3.9. The mains adapter and PoE may be connected in parallel, but one of the supplies suffices to operate the Java Terminal (the other may be used a power supply backup).

Note: The maximum cable length between EHS6T LAN and the nearest network socket should be 10m, and it is recommended that the cable should be shielded.

Using the Ethernet interface it is also possible to maintain a database containing possible APNs for the EHS6T LAN. Please refer to Appendix B: Ethernet Setup and Usage for details on how to setup and use Java Terminals with Ethernet interface. For further characteristics of Ethernet interface refer to Section 4.2.6.

A green LED near to the RJ-45 Ethernet connector shows the Link/Activity status of the Ethernet interface (refer to Figure 13).

3.9 Power Supply

The Java Terminals power supply via Western jack 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[1]. The uplink burst causes strong ripple (drop) on the power lines. The drop voltage should not exceed 1V. The absolute minimum voltage during drops is given in Section 4.1.

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

Pin	Signal name	Use	Parameters
1	PLUS	Power supply	8V – 30V (EHS6T LAN only: 8V – 57V) DC
2	PLUS	Power supply	8V – 30V (EHS6T LAN only: 8V – 57V) DC
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

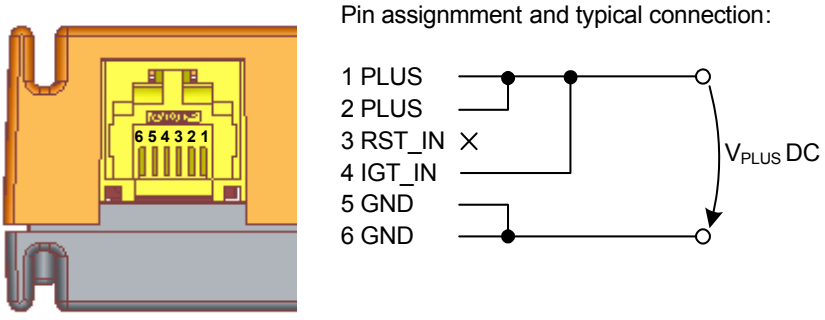


Figure 14: 6-pole Western jack for power supply, ignition, reset, typical connection

1. As an alternative to the power supply via Western jack, Power over Ethernet (PoE) can be employed. The PoE feature complies with IEEE 802.3 standards, and can be made available in Ethernet networks via PoE enabled devices such as PoE routers or injectors.

Mains adapter: If it fits into the design of your application we recommend the plug-in supply unit used with the type approved Thales 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. If there is such an “auto ignition” connection between PLUS and IGT_IN, the module will restart automatically after a normal shutdown. Note that if employing PoE for EHS6T LAN, the module will also restart automatically after a normal shutdown.

3.10 Power Up/Power Down Scenarios

In general, be sure not to turn on the Java Terminals while it is beyond the safety limits of voltage and temperature stated in Section 4.1. Java Terminals immediately switch off after having started and detected these inappropriate conditions. In extreme cases this can cause permanent damage to the Java Terminals.

3.10.1 Turn Java Terminals on

There are various possibilities to turn on Java Terminals and start into normal mode, depending on connecting and/or operating states.

If powered off (i.e., if Java Terminals‘ power supply is disconnected):
- Java Terminals can simply be started up by plugging an appropriate power supply unit between PLUS and GND of the 6-pole Western jack. If using the PoE feature, EHS6T LAN can also be started up by connecting simply the Ethernet interface

If switched off (i.e., while in Power Down mode):
- Java Terminals can be started up by activating the IGT_IN signal (pin 4).
- Java Terminals can be started up by activating the RS-232 DTR line (as long as RST_IN signal (pin 3) is not active (voltage <2V)
- Java Terminals can be started up by configuring the watchdog appropriately. For details see Chapter 8.

Note: With an “auto-ignition“ connection between IGT_IN and PLUS, or if employing PoE (see Section 3.9), Java Terminals will automatically restart into normal mode after switch off (see Section 3.10.3). The start up variant from Power Down mode is therefore only applicable if there is no such “auto-ignition“ connection at the power supply unit.

3.10.2 Reset/Restart Java Terminals

There are various possibilities to reset/restart Java Terminals:
- Java Terminals can be reset/restarted by entering the command AT+CFUN=x,1. For details on AT+CFUN please see [1].
- Java Terminals can be reset/restarted by configuring the watchdog appropriately. For details see Chapter 8.
- Java Terminals can be reset/restarted by configuring a wake-up alarm (see Section 3.13) before using AT^SMSO to turn them off and send them into Power Down mode.

- Java Terminals can be reset/restarted by simply shutting them down as described in Section 3.10.3 and then restarting them as described in Section 3.10.1. Note: With an “auto ignition“ connection between IGT_IN and PLUS, or if employing PoE (see Section 3.9), it is ensured that the module will automatically restart after a normal shutdown using AT^SMSO.

Emergency restart:

- Finally, Java Terminals can be reset/restarted in the event of software hang-ups etc. by applying a voltage >8V to the RST_IN pin (pin 3) for more than 10ms.
  The RST_IN signal then 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.

3.10.3 Turn Java Terminals off

Normal shutdown:

- To turn off the Java Terminals use the AT^SMSO command, rather than disconnecting the mains adapter.
  This switch off 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 3.15 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, or if employing PoE (see Section 3.9), the module will restart automatically after a normal shutdown.

3.10.4 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.

3.11 Automatic thermal shutdown

An on-board NTC measures the temperature of the built-in Java module. If over- or undertemperature is detected on the module the Java Terminals automatically shut down to avoid thermal damage to the system. Table 25 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.

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].

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

3.12 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, independent 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.

3.13 RTC

The internal Real Time Clock (RTC) of the Java Terminals retains the time and date and handles the alarm function. The AT+CCLK command serves to set the time and date, and AT+CALA specifies a reminder message or sets an alarm for the .Java Terminals to wake up. 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 function described in [1], Section AT+CALA, will only work if there is no “auto ignition“ connection active between IGT_IN pin and PLUS pin at the power supply unit that will automatically trigger a restart (see Section 3.9). Otherwise, the AT+CALA command can only be used to set a reminder message, but not to configure the Java Terminals to wake up from Power Down mode.

3.14 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.

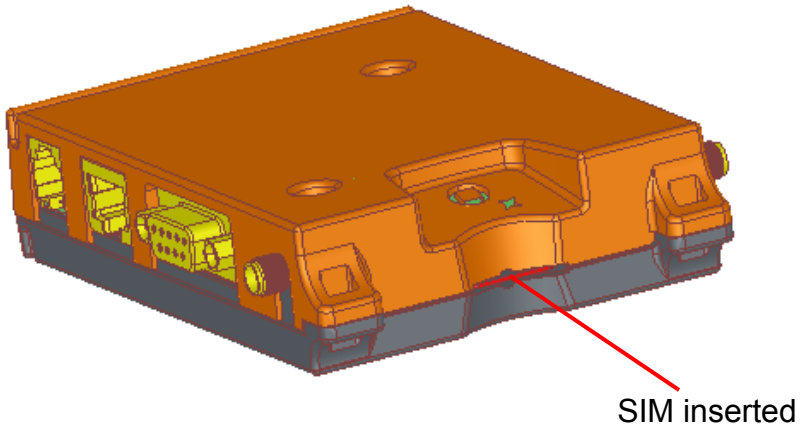


Figure 15: SIM interface

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.

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.

3.15 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 and reports certain watchdog operations.
- A orange LED indicates the network registration state of the Java Terminals.

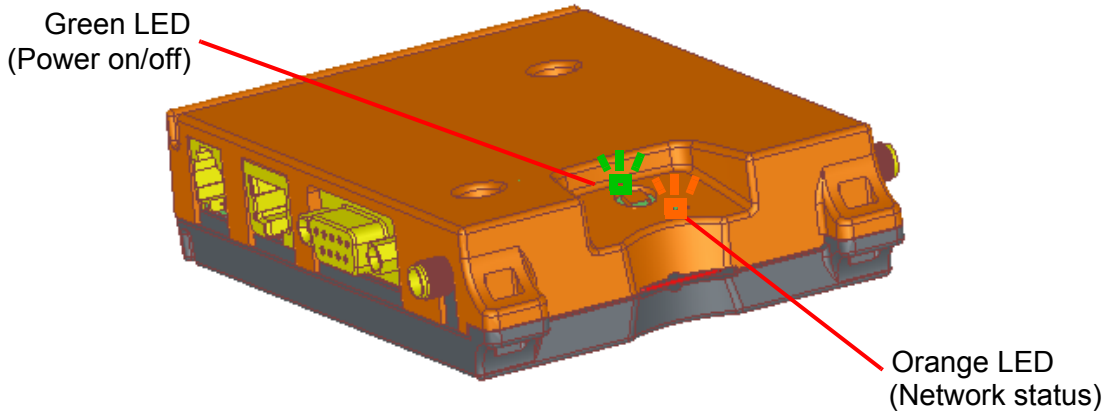


Figure 16: Status LED

The orange LED 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].

3.16 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).

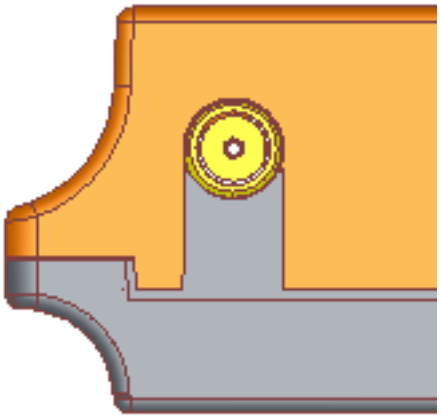


Figure 17: Antenna connector

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 maximum RF power.

Additional ESD protection to the antenna connector is provided. No DC voltage must be applied to the antenna circuit to protect it from damage.

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 17.

Table 17: Allowed maximum antenna gain (including cable loss)

Module	850MHz	900MHz	1800MHz	1900MHz	2100MHz
EHS6T USB EHS6T LAN	3.42dBi	4.18dBi	9.64dBi	2.51dBi	15.54dBi
BGS5T USB	2.15dBi	2.15dBi	2.15dBi	2.15dBi	na
EHS5T RS485 and EHS5T-US RS485	3.10dBi	6.10dBi	12.30dBi	2.50dBi	12.30dBi

4 Electrical and Environmental Characteristics

4.1 Absolute Maximum Ratings

Table 18: Absolute maximum ratings

Parameter	Port / Description	Min.	Max.	Unit
Supply voltage	PLUS	-40	30[1]	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	TXD0, DTR0, RTS0	-25	+25	V
GPIO connector pins input voltage (incl. VCCref)	8-pin and 12-pin connectors (if pins specified/configured as input pins)	-0.3	6	V
GPIO connector pins output current	8-pin and 12-pin connectors (if pins specified/configured as output pins)	0	50mA drawn @each pin[2]	--
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 Air discharge	 -4 -8	 +4 +8	 kV kV

1. EHS6T LAN only: 57V
2. 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 19: Operating supply voltage for Java Terminals

Parameter	Min	Typ	Max	Unit
Supply voltage PLUS measured at (6-pole) western jack plug (1 to 6)	8	12	30[1]	V
Minimum supply voltage PLUS measured at (6-pole) western jack plug (1 to 6) @any time, incl. all ripple, drops and temperature fluctuations	7.6			V

1. EHS6T LAN only: 57V

4.2 Electrical Specifications of the Application Interface

4.2.1 On/Off Control

Table 20: On/Off control line specifications

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V_{high}	Input voltage IGT_IN, RST_IN	active high	8		30	V
V_{low}			0		2	V
R_{IN}	Input resistance of IGT_IN, RST_IN		1			MΩ
V_{high}	Input voltage DTR	active high	2.4		+25	V
V_{low}			-25		0.8	V
R_{IN}	Input resistance of DTR		3	5	7	kΩ

4.2.2 RS-232 Interface

Table 21: RS-232 interface specifications

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V_{OUT}	Transmitter output voltage swing for RXD0, CTS0, DSR0, DCD0, RING0	@ 3kΩ load	±5	±5.4		V
R_{OUT}	Transmitter output resistance RXD0, CTS0, DSR0, DCD0, RING0		300			Ω
V_{In}	Receiver input voltage range TXD0, RTS0, DTR0		-25		+25	V
R_{IN}	Receiver input resistance TXD0, RTS0, DTR0		3	5	7	kΩ
V_{Ilow}	Input threshold low		0.8	1.5		V
V_{Ihigh}	Input threshold high			1.8	2.4	V
Baudrate		Autobauding	1.2		960	kbps
		Fixed range	1.2		960	kbps
LE_{Cable}	Length of RS-232 cable			1.8	2	m

4.2.3 USB Interface

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

4.2.4 GPIO Interface

Table 22: GPIO interface specifications (requirements)

Function	Signal name	IO	Signal form and level	Comment
8-pin, 12-pin connectors for: GPIO, Power, DAI, I^2C and ASC1, SPI, RS-485	GPIO 6-8 GPIO 11-13 GPIO 20-21 GPIO22-23	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 can be configured for functions other than GPIO: GPIO6/GPIO7: PWM GPIO8: Pulse Counter/ WD_RETRIG GPIO20-23: PCM/DAI
	VCCref	I	Vimax = 5.5V Vimin = 1.8V Input current has to at least match the positive output current required by all configured and used GPIO lines.	For level adjustment. E.g., connect 5Vout for 5V IO operation. Must be connected to 1.8...5.5V if employing signals from GPIO connector.
	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 EHS5T RS485 and BGS5T.
	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.

Table 22: 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	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 = VCCref	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		

4.2.5 RS-485 Interface

Table 23: 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

4.2.6 Ethernet Interface

The Ethernet interface is implemented as 10/100 Base-T RJ45 Ethernet according to the IEEE 802.3 Ethernet standards, including PoE+ (IEEE 802.3at, backward compatible to IEEE 802.3af). For further characteristics see also Section 3.8.

Please refer to Appendix B: Ethernet Setup and Usage for details on how to setup and use the Java Terminals with Ethernet interface.

4.3 Power Supply Ratings

Table 24: Power supply specifications

Para-meter	Description	Conditions		Typical				Unit
				EHS5T RS485	EHS6T USB	BGS5T USB	EHS6T LAN	
V_{PLUS}	Allowed voltage ripple (peak-peak), drop during transmit burst peak current	Power control level for P_{out} max[1]		1	1	1	1	V
I_{PLUS} [2]	Average supply current (average time 3 min.)	Power Down mode	@8V	40	21	18	115	mA
			@30V	15	10	10	---	
			@57V	---	---	---	30	
	Average GSM supply current (average time 3 min.)[3]	IDLE mode (GSM/GPRS, 850/900MHz, 1800/1900MHz)	@8V	25	40	40	190	mA
			@30V	11	16	13	---	
			@57V	---	---	---	45	
		GPRS DATA mode(1 Tx, 4 Rx, 850/900MHz)	@8V	170	175	180	280	mA
			@30V	47	50	50	---	
			@57V	---	---	---	50	
		GPRS DATA mode(1 Tx, 4 Rx, 1800/1900MHz)	@8V	120	140	135	225	mA
			@30V	21	38	40	---	
			@57V	---	---	---	45	
		GPRS DATA mode(4 Tx, 1 Rx, 850/900MHz)	@8V	225	245	370	410	mA
			@30V	67	100	100	---	
			@57V	---	---	---	75	
		GPRS DATA mode(4 Tx, 1 Rx, 1800/1900MHz)	@8V	160	190	240	265	mA
			@30V	50	56	70	---	
			@57V	---	---	---	50	
		EDGE DATA mode(1 Tx, 4 Rx, 850/900MHz)	@8V	175	175	200	220	mA
			@30V	48	50	50	---	
			@57V	---	---	---	45	
		EDGE DATA mode(1 Tx, 4 Rx, 1800/1900MHz)	@8V	125	130	140	205	mA
			@30V	40	40	40	---	
			@57V	---	---	---	45	
		EDGE DATA mode(4 Tx, 1 Rx, 850/900MHz)	@8V	235	240	370	350	mA
			@30V	67	70	100	---	
			@57V	---	---	---	65	
		EDGE DATA mode(4 Tx, 1 Rx, 1800/1900MHz)	@8V	160	190	240	350	mA
			@30V	50	56	70	---	
			@57V	---	---	---	65	

Table 24: Power supply specifications

Parameter	Description	Conditions		Typical				Unit
				EHS5T RS485	EHS6T USB	BGS5T USB	EHS6T LAN	
I_{PLUS}	Peak supply current (during 577µs transmission slot every 4.6ms)	Power control level for Pout max (850/900MHz)	@8V	1100	1130	1200	1320	mA
			@30V	260	270	260	---	
			@57V	---	---	---	220	
		Power control level for Pout max (1800/1900MHz)	@8V	815	820	630	850	mA
			@30V	195	200	160	---	
			@57V	---	---	---	150	
	Average UMTS supply current (average time 3 min.)	IDLE mode	@8V	27	79	---	190	mA
			@30V	11	12	---	---	
			@57V	---	---	---	45	
		UMTS DATA (Band I; 23dBm)	@8V	315	410	---	330	mA
			@30V	90	115	---	---	
			@57V	---	---	---	65	
		UMTS DATA Band II; 23dBm	@8V	---	450	---	330	mA
			@30V	---	125	---	---	
			@57V	---	---	---	70	
		UMTS DATA Band V/VI; 23dBm	@8V	---	415	---	330	mA
			@30V	---	115	---	---	
			@57V	---	---	---	70	
		UMTS DATA Band VIII; 23dBm	@8V	370	410	---	350	mA
			@30V	105	115	---	---	
			@57V	---	---	---	75	
		HSPA DATA (Band I; 23dBm)	@8V	315	415	---	475	mA
			@30V	90	115	---	---	
			@57V	---	---	---	85	
		HSPA DATA Band II; 23dBm	@8V	---	450	---	490	mA
			@30V	---	125	---	---	
			@57V	---	---	---	105	
		HSPA DATA Band V/VI; 23dBm	@8V	---	415	---	485	mA
			@30V	---	115	---	---	
			@57V	---	---	---	90	
		HSPA DATA Band VIII; 23dBm	@8V	370	410	---	510	mA
			@30V	105	115	---	---	
			@57V	---	---	---	90	

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.

4.4 Operating Temperatures

Table 25: Temperature characteristics

Parameter	Min	Typical	Max	Unit
Normal operation[1]	-30		+85	°C
Extended operation[1, 2]	-40 to -30		+85 to +90	°C
Automatic thermal shutdown[1, 3]	<-40		>+90	°C
Thermal resistance (R_{th})[4] 2G operation (with P_{th} = 1.5W) 3G operation (with P_{th} = 3.5W)		 10 11.5		K/W

1. Board temperature of Java module.
2. 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.
3. Due to temperature measurement uncertainty, a tolerance of ±3°C on these switching thresholds may occur.
4. Thermal resistance (R_{th}) of the Java Terminals at the highest possible thermal power (P_{th}) dissipation, i.e., at the worst possible network conditions. Measured in still air with an air gap of at least 100mm between the Java Terminals and other objects.

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.

4.5 Antenna Interface

Table 26 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 26: 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 26: RF Antenna interface GSM / UMTS

Parameter		Conditions	Min.	Typical	Max.	Unit
RF Power @ ARP with 50Ohm Load, (with maximum power 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

4.6 Storage Conditions

Table 27: 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.

5 Mechanics, Mounting and Packaging

5.1 Mechanical Dimensions

Figure 18 shows a 3D view of the Java Terminal and provides an overview of the mechanical dimensions of the board. For further details see Figure 19 and Figure 20. To allow for an easier mechanical implementation into an external application 3D STP data for the Java Terminals is attached to this PDF. Please open the Attachments navigation panel to view and save this information.

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

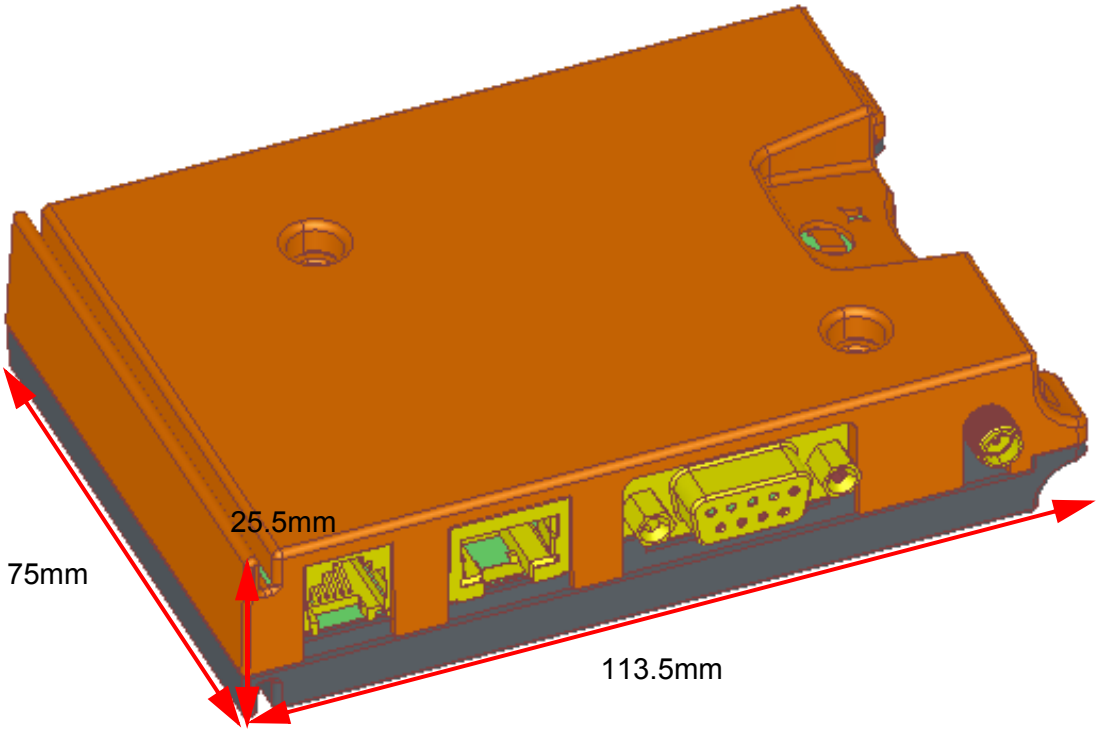


Figure 18: Java Terminals 3D overview

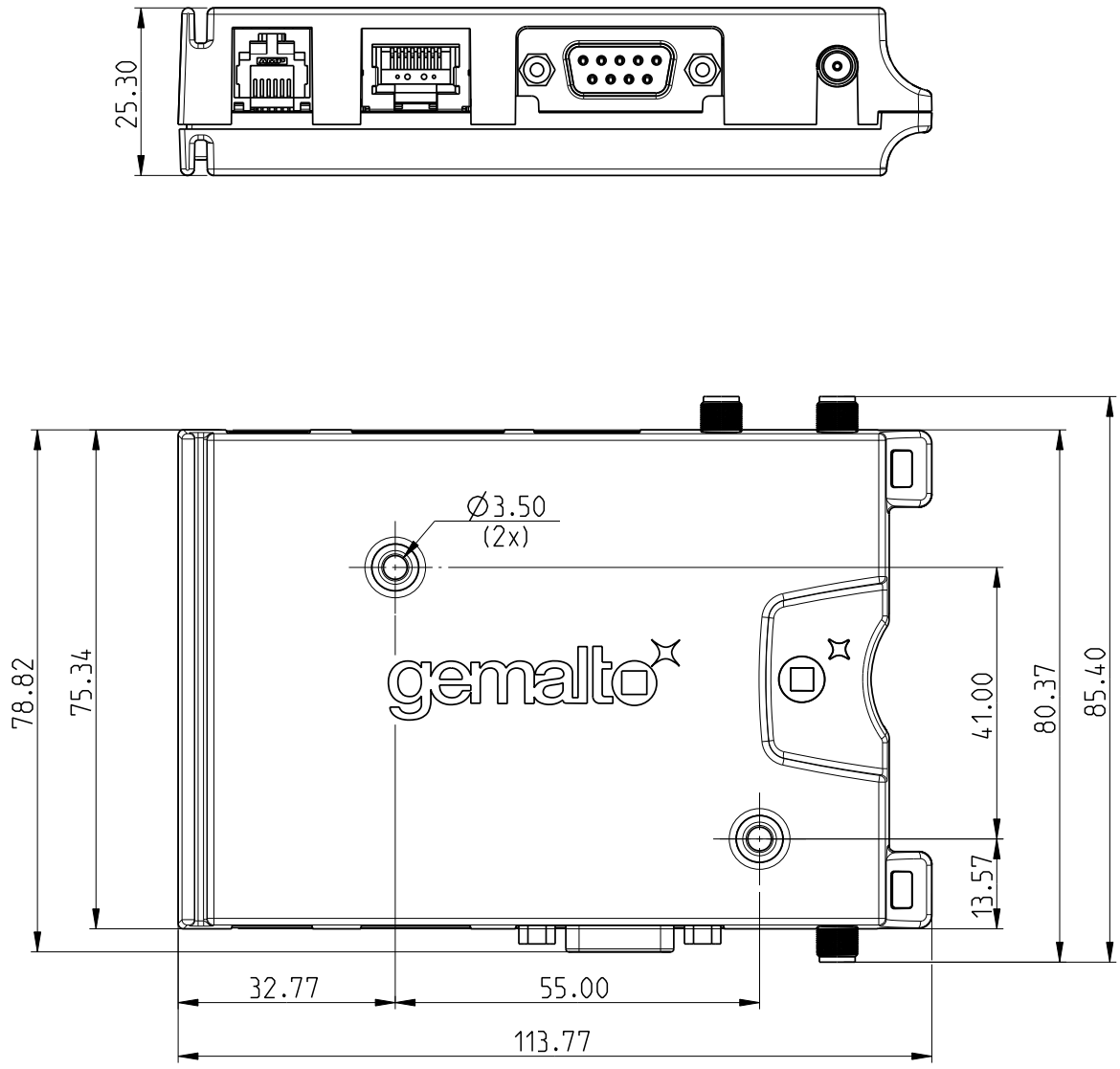


Figure 19: Java Terminals mechanical dimensions

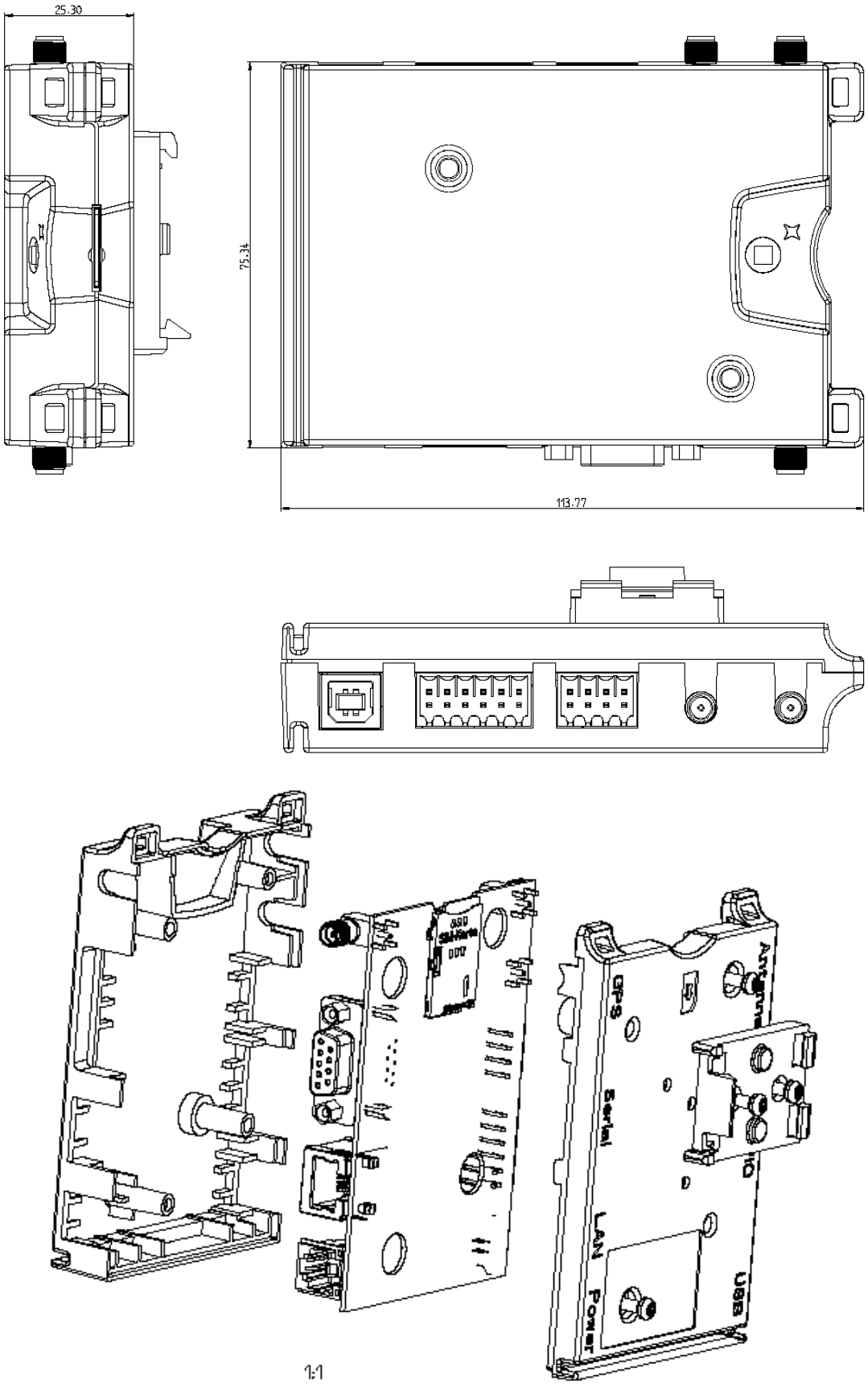


Figure 20: Java Terminals exploded view

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 for screws, e.g., size M3.
- 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.

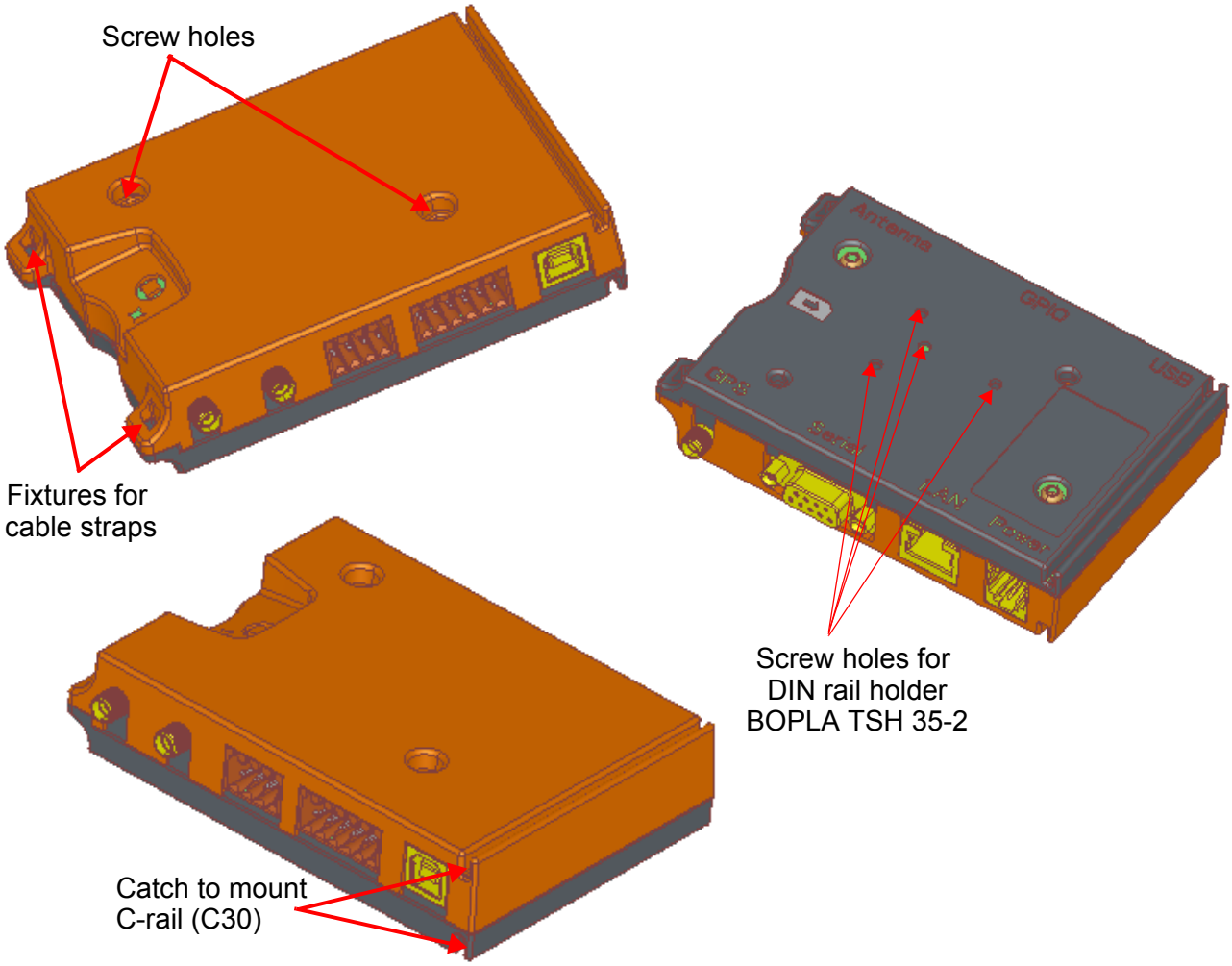


Figure 21: Mounting the Java Terminals

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 Thales Reference Setup

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

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

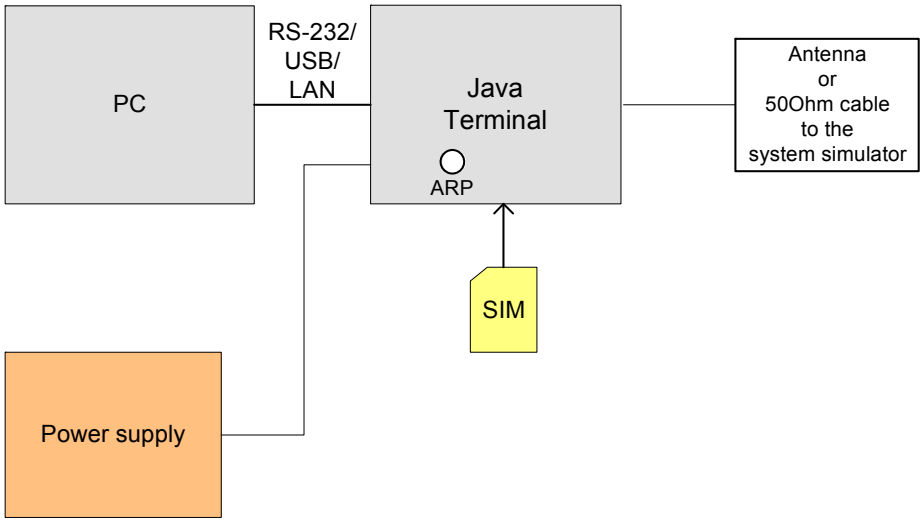


Figure 22: Reference equipment for approval

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:

- RED Directive 2014/53/EU

The Java Terminals are marked with the CE conformity mark (without a notified body number):

Conformity mark
CE

6.4 EMC

The Java Terminals comply with the equipment requirements specified in EN 301489-1, and -52 are covered by the RED Directive. For details see Section 1.3.

6.5 Compliance with FCC and IC Rules and Regulations

As an integrated product, the Java Terminals EHS5T-US RS485, EHS6T USB, EHS6T LAN and BGS5T USB 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“ or “Contains FCC ID: QIPE-HS5-US“.

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

FCC Idenitifier: QIPEHS6 or QIPBGS5 or QIPEHS5-US
Industry Canada Certification Number: 7830A-EHS6 or 7830A-BGS5 or 7830A-EHS5US
Granted to THALES DIS AIS Deutschland 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 Thales 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 3.16 and Section 4.5.

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 device 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 28: List of parts and accessories

Description	Supplier	Ordering information
Java Terminals	Thales	Ordering number EHS5T RS485: L30960-N2730-A100 EHS5T-US RS485: L30960-N2760-A100 EHS6T USB: L30960-N2740-A100 EHS6T LAN: L30960-N2750-A100 BGS5T USB: L30960-N2720-A100
Power supply unit Input: 100-240V / 50/60Hz / 500mA Output: 12V / 1,25A 	Thales	Power supply including 4 exchangeable AC plugs (EU, UK, US and AUS) Ordering number: L36880-N8490-A82
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: info@bopla.de Web: http://www.bopla.de
GSM/UMTS Broadband Antenna fitting to the used frequency bands, 50 Ohm, SMA connector (male)		
RS-232 cable with 9-pin D-sub connector (male)	Tecline	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 GPIO connector (female plug) for GPIO interface Type: 8-pin: B2CF 3.50/08/180 SN BK BX 12-pin: B2CF 3.50/12/180 SN BK BX 	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: info@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 level shifter's GPIO directions and DSR0/ADC1_IN availability at the GPIO connector

The complete watchdog functionality can be configured by means of special watchdog configuration commands (i.e., WD commands) that are passed to the watchdog via the serial TXD0 line. For details on how to configure the complete watchdog functionality see Section 8.3.

A qualified set of configuration commands - level shifter's GPIO directions, DSR0/ADC1_IN usage, trigger delay and firmware infos - can be specified by means of a special write/read protocol handled by the watchdog's I^2C interface. For details on how to configure the watchdog via I^2C interface see Section 8.4.

The below Figure 23 illustrates the various ways the watchdog may be accessed and configured.

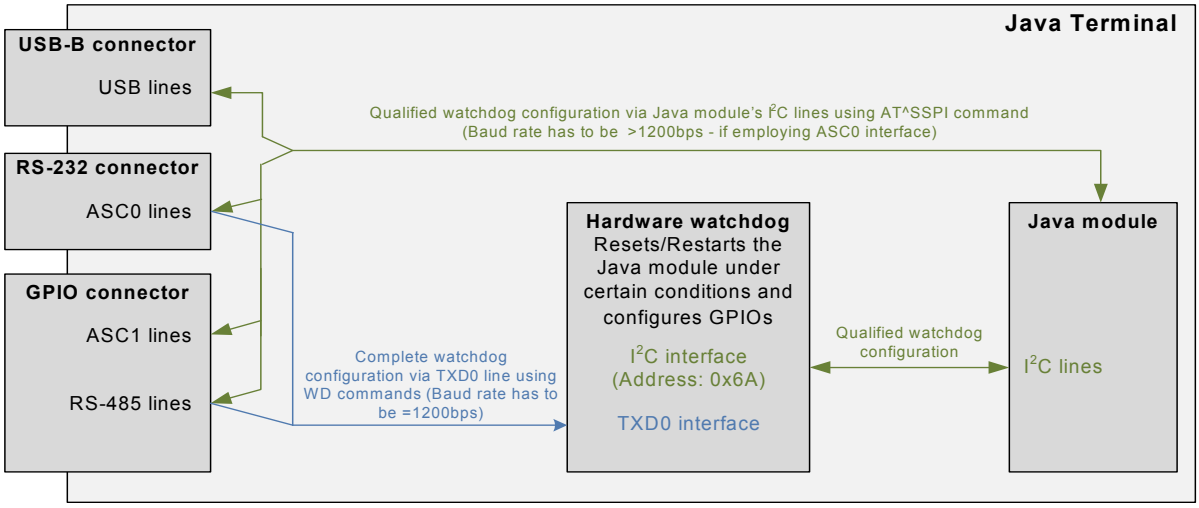


Figure 23: Hardware watchdog configuration

Note: Unless the complete configuration scope is required, the qualified watchdog configuration via I^2C interface should be used.

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 can be 24h or longer. This feature can be configured via the RST_REP timeout.
- UART activity: The watchdog can be used to reset the module, when no response from the module on AT commands 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 as well as the Java module status, depending on timeout parameter settings and perform frequent resets, if it is configured to do so.

8.1.1 Reset stages

Basically, there are up to two 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 signaling has gone low, the module is regularly restarted.
- Second stage (emergency restart): If the module can for some reasons not be switched off successfully during the first stage, the watchdog resets the module via an internal EMERG_RST signal. The emergency restart procedure includes disconnecting the power supply lines, and causes the loss of all information stored in the Java module‘s volatile memory.

During the first stage the watchdog waits for up to three seconds for the internal signaling to go low. If the internal signaling does not change, the watchdog escalates to the second stage in order to switch off and restart the module.

The watchdog can also be configured to automatically switch on resp. power up the module following a shutdown and a configured delay time (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. The reset delay mechanism may be useful for software updates.

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 is 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 Complete Watchdog Configuration

The complete hardware watchdog functionality can be configured via the TXD0 line of the serial interface ASC0 as described in this section.

The watchdog listens on the TXD0 line exclusively at the low baudrate 1200bps. 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). Note that in this case the watchdog gives no feedback via an output line. Commands are acknowledged by green ON LED - see Section 8.3.1.

So, to control and configure the watchdog, a terminal program MUST be set to 1200bps, before a command can be sent to the watchdog. See Section 8.3.1 for the watchdog‘s configuration command specification. Once completed, the terminal program should be changed to higher baud rates again to enable proper communication with the module. Note that the Java module has to be up and running for this type of configuration.

Please note that a qualified set of configuration commands can also be configured via I^2C interface. See Section 8.4 for details.

8.3.1 Watchdog (WD) 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
- I^2C reset - see Section 8.3.1.6
- Restart delay - see Section 8.3.1.7
- Always on - see Section 8.3.1.8
- Load default values - see Section 8.3.1.9
- Change the Watchdogs I^2C Address - see Section 8.3.1.10
- Set GPIO Direction - see Section 8.3.1.11
- Configure ADC1_IN/DSR0/SPI_CLK Line - see Section 8.3.1.12

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, some use cases may even require a setting > 24h.

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_GPIO,600000,6 // Resets the module if there was no activity on the WD_RETRIG line for 10 minutes

This command configures a module reset, if no activity from the module was observed on the signal WD_RETRIG for the specified amount of time (see Figure 4 for WD_RETRIG (GPIO8) line). The module has activate the WD_RETRIG signal by toggling the GPIO8 module output within the specified time period. Otherwise the watchdog will reset the module. If enabled, each GPIO8 toggling resets the timer to its configured value. Note that for this feature to work, GPIO8 has to be available and enabled, and its direction must be set to output. Please refer to Section 8.3.1.11, Section 8.4 and Section 8.5 for details on how to configure GPIO directions. If configured as WD_RETRIG signal, GPIO8 cannot be used for any other purpose.

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 I²C Reset

Command	RST_I2C	
Parameter	<timeout>	
Type	Milliseconds	
Range	0 .. 2^{32}-1	
Default	0: Feature is disabled	
Non-volatile	Yes	
Example	WD=RST_I2C,600000,6	// Resets the module if there was no keep alive signal received at the I²C bus address 0x09 for 10 minutes.

This command configures an Ethernet sub-system reset, if no activity from the Ethernet sub-system or a possible external application also connected to the I²C bus was observed for the specified amount of time (see Figure 4 and Section 3.7 for I²C lines). If enabled, the Ethernet sub-system or an external application will have to send keep alive signals to the I²C bus address 0x09 within the specified time period. If the keep alive signals are not regularly received at this address, the watchdog will reset the Ethernet sub-system.

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).

8.3.1.7 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 Java module firmware or userware update right after startup should be taken into account which may take up to 15 min.

8.3.1.8 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 signalling. 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.

8.3.1.9 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.

8.3.1.10 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 Terminals.

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

8.3.1.11 Set GPIO Direction

Command	GPIO_DIR
Parameter	<pin-config>
Type	Number
Range	0-1023
Default	0 (0x000, 0000000000b)
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 GPIO connectors 8-pin and 12-pin:

10-Bit number	GPIO	8-pin connector	12-pin connector	Default
0	GPIO6	1	-	Input
1	GPIO7	2	-	Input
2	GPIO8	3	-	Input
3	GPIO11	4	-	Input
4	GPIO12	5	-	Input
5	GPIO13	6	-	Input
6	GPIO22	7	-	Input
7	GPIO23	8	-	Input
8	GPIO21	-	12	Input
9	GPIO20	-	11	Input

Changing the directions of the level-shifters must be executed with great care. They may only be set in accordance with the Java modules‘ GPIO 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 should be set first, followed by the module output configuration. Configuring an input, the module input should be set first, followed by the level shifter input. Please refer to Section 8.5 for more information on how to configure GPIO directions.

Please note that the GPIO direction can also be configured via I^2C interface (see Section 8.4). 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.

8.3.1.12 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 GPIO 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 Qualified Watchdog Configuration

While the complete watchdog functionality may be configured via TXD0 line of the ASC0 interface (for details see Section 8.3), a qualified set of configuration commands can also be specified via the watchdog's I²C interface as described in this section. The Java module has to be up and running for this type of configuration.

The watchdogs's I²C interface is accessible by means of the Java module's I²C lines, and either via the Java module's AT command interface, or through a Java MIDlet during runtime (see Figure 23). **Note:** When using a Java MIDlet to set GPIO directions using the I²C interface, please allow for a guard time of at least 500ms between two I²C commands.

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 8.3.1.10).

8.4.1 I²C Interface 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 30). 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 29). 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 29: 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 30
0x09	W	RST_I2C		Yes	0	
0x10	W	GPIO6	GPIOxR	Yes	0	Level shifter‘s GPIO direction: 0: Input 1: Output
0x11	W	GPIO7		Yes	0	
0x12	W	GPIO8		Yes	0	
0x13	W	GPIO11		Yes	0	
0x14	W	GPIO12		Yes	0	
0x15	W	GPIO13		Yes	0	
0x16	W	GPIO22		Yes	0	
0x17	W	GPIO23		Yes	0	
0x18	W	GPIO21		Yes	0	
0x19	W	GPIO20		Yes	0	
0x30	R	GPIO direction Low Byte: Read out 8 bits for the GPIOs [15,14,13,12,11,8,7,6]	GPIOLBR	-		[0..0xFF]

Table 29: Address register for I²C commands

Register address	Read/ Write	Description	Name	Non-volatile	Default	Value range
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]
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 29):

Table 30: 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	

Note: When using Java to set GPIO directions over the I²C interface, please allow for a guard time of at least 500ms between I²C commands.

Examples

The following two samples show how the watchdog can be configured by means of the watchdog's I²C interface and using the AT^SSPI command over 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 Java module's I²C interface.

The above Table 29 specifies the address register that can be used in I²C configuration commands.

The **first** example sets the level shifter's GPIO12 direction to "output". It therefore configures a write register marked as "W" in Table 29. For more information on the configuration of GPIO directions see Section 8.5.

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 30.
{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.

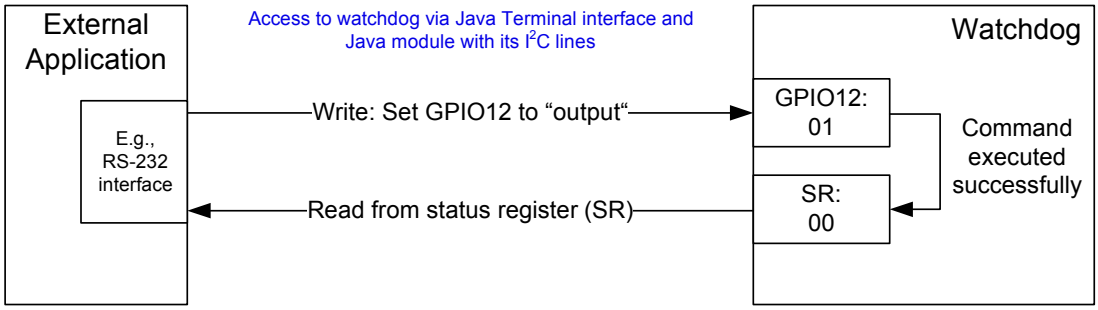


Figure 24: Write data to address register

The **second** example listed below reads out the hardware watchdog‘s firmware version, it therefore uses a read register marked as “R“ in Table 29.

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 hardware watchdog‘s 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.

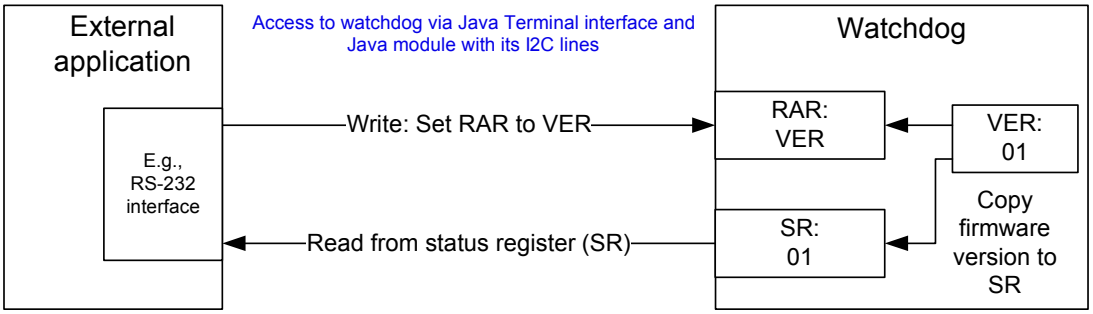


Figure 25: Read data from address register

8.5 Configuring GPIO Directions

As already shown in Figure 4 and mentioned in Section 8.3.1.11 the GPIO pins at the Java Terminals‘ GPIO connector are not electrically identical to the GPIO lines at the integrated Java module. A built-in level shifter needs to ensure that the voltage level is correctly converted.

Because of that it is necessary to not only configure the Java modules‘ GPIO settings by AT command, but to also configure the the built-in level shifter‘s GPIO directions by means of the watchdog.

As described in Section 8.3, Section 8.4 and shown in Figure 23 there are various ways to configure the watchdog and therefore the level shifter‘s GPIO directions:

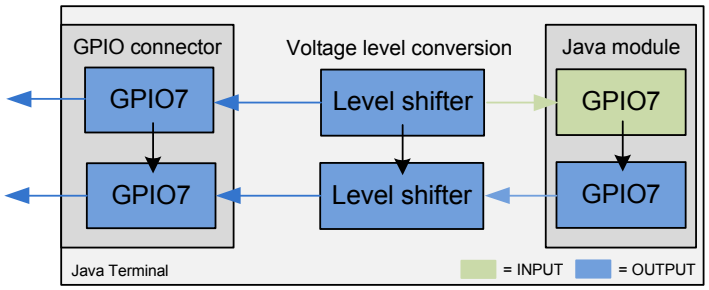
- A qualified configuration including GPIO directions can be done using the watchdog‘s I^2C interface. For details see Section 8.5.1. This is the recommended method to set the level shifter‘s GPIO direction.
- A complete configuration can be done using the TXD0 line of the ASC0 interface. For details see Section 8.5.2.

Notes: The VCCref signal at the Java Terminals‘s GPIO connector needs to be connected - for instance to the +5Vout signal - for the level shifters to be active. Also note that in order to have a defined level for GPIOs configured as inputs, external pull-ups or pull-downs will have to be implemented at the GPIO lines.

8.5.1 Configuration using I²C Interface

Please refer to Section 8.4 for more information on how to configure the watchdog via I²C interface.

Figure 26 explains the configuration steps required to set the Java Terminals's GPIO7 signal direction to OUTPUT (default direction is INPUT):



Steps:

Set level shifter to OUTPUT using AT^SSPI and a specific read/write protocol over I²C interface *

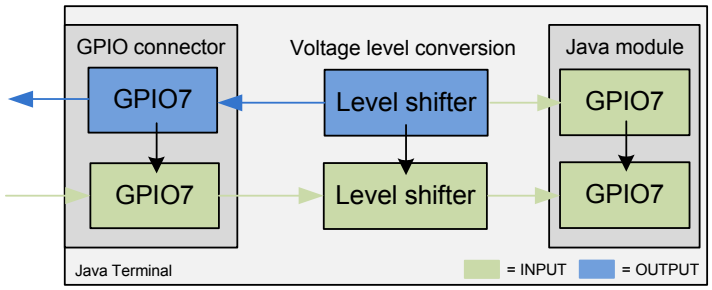
Set GPIO7 at Java module to OUTPUT with GPIO command AT^SCPIN=1,6,1

Now, IO state can be set with AT^SSIO=6,0

* See Section 8.4.1.4 for configuration details.

Figure 26: Setting GPIO direction to OUTPUT via I²C interface

Figure 27 shows the configuration steps required to re-set the Java Terminals's GPIO7 signal direction to INPUT:



Steps:

Set GPIO7 at Java module to INPUT with GPIO command AT^SCPIN=1,6,0

Set level shifter to INPUT using AT^SSPI and a specific read/write protocol over I²C interface *

Now, GPIO7 can be read out with AT^SGIO=6

* See Section 8.4.1.4 for configuration details.

Figure 27: Setting GPIO direction to INPUT via I²C interface

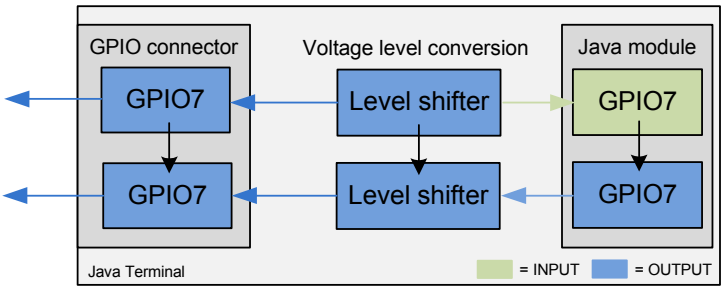
For more information on the AT commands mentioned in the above figures see also [1].

Note: When using a Java MIDlet to set GPIO directions using the I²C interface, please allow for a guard time of at least 500ms between two I²C commands.

8.5.2 Configuration using TXD0 Line of ASC0 Interface

Please refer to Section 8.3 for more information on how to configure the watchdog via TXD0 line of ASC0 interface.

Figure 26 explains the configuration steps required to set the Java Terminals's GPIO7 signal direction to OUTPUT (default direction is INPUT):



Steps:

Set level shifter to OUTPUT with watchdog command WD=GPIO_DIR,527,14 *

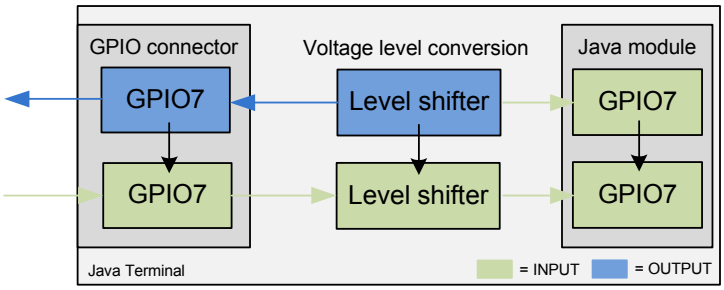
Set GPIO7 at Java module to OUTPUT with GPIO command AT^SCPIN=1,6,1

Now, IO state can be set with AT^SSIO=6,0

* See Section 8.3.1.11 for configuration details.

Figure 28: Setting GPIO direction to OUTPUT via TXD0 line (at 1200bps)

Figure 26 shows the configuration steps required to re-set the Java Terminals's GPIO7 signal direction to INPUT:



Steps:

Set GPIO7 at Java module to INPUT with GPIO command AT^SCPIN=1,6,0

Set level shifter to INPUT with watchdog command WD=GPIO_DIR,525,12 *

Now, GPIO7 can be read out with AT^SGIO=6

* See Section 8.3.1.11 for configuration details.

Figure 29: Setting GPIO direction to INPUT via TXD0 line (at 1200bps)

For more information on the AT commands mentioned in the above figures see also [1].

9 Appendix B: Ethernet Setup and Usage

Once EHS6T LAN is connected and set up as described in Section 9.1, the Ethernet connection can be used to transparently exchange data.

Via Ethernet link it is also possible to access the Java module's AT command interface, to update the Java module's firmware, and to update the Ethernet sub-system's software.

Section 9.2 describes how to use the EHS6T LAN Ethernet link.

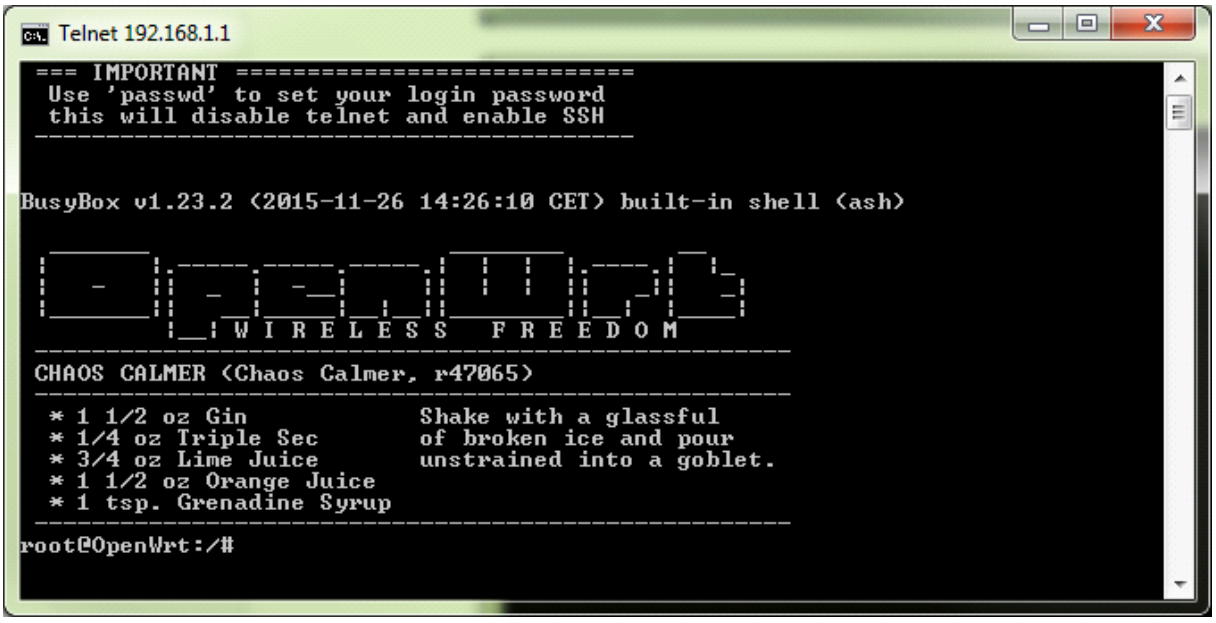
9.1 Connection Setup

Please complete the following steps to set up the Ethernet connection:

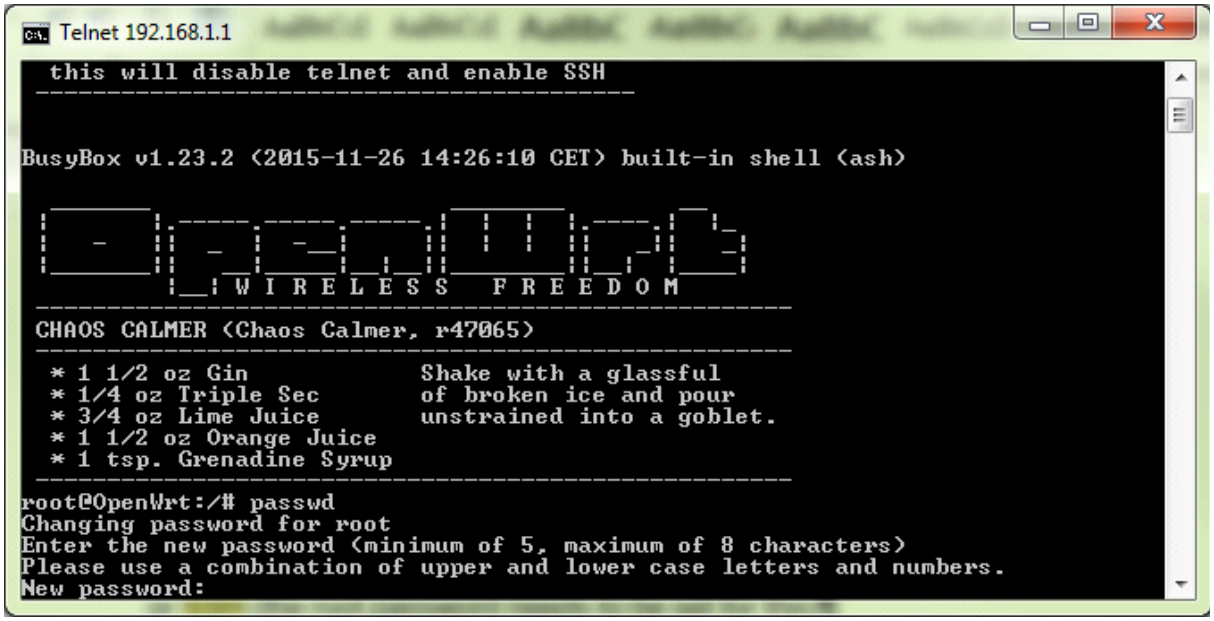
1. Connect the SMA RF antenna to the EHS6T LAN.
2. Connect the power supply, e.g., the mains adapter mentioned in Chapter 7. A green LED indicates the connected power supply, and the EHS6T LAN including EHS6 module is started up. As an alternative it is possible to employ PoE (see Section 3.8).
3. Plug the Ethernet cable between an external application such as a PC and the EHS6T LAN. EHS6T LAN as DHCP server is able to provide a valid IP address to the PC.
4. Insert the SIM card. If required to for instance connect to a network provider's Internet gateway, a SIM pin should be entered as described in Section 9.2.6 before inserting the card.
5. Test the Ethernet connection by opening an initial Telnet connection from the PC to the EHS6T LAN. The default IP address of EHS6T LAN is "192.168.1.1".

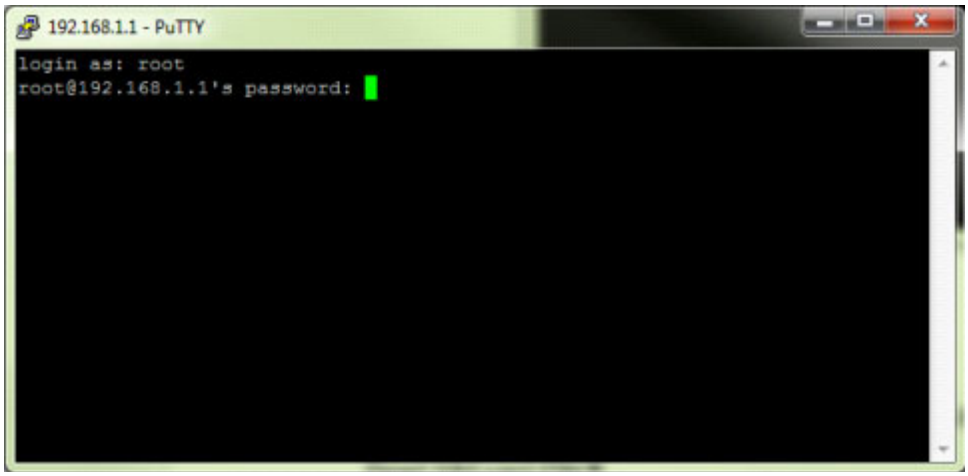


If the connection setup is successful, the login shell of the EHS6T LAN's embedded Linux system is started, providing root access to the system, and allowing you to for instance change the IP address of EHS6T LAN or to edit the default APN list (see Section 9.2 for more information).



Note: The Telnet connection can be opened only if no root login password is configured. In case a root login password exists, access to the embedded Linux system is only possible via SSH (using e.g., PuTTY for Windows).





6. Having set up the Ethernet connection, the link can now be used to exchange data as well as for administration purposes - see Section 9.2 for details.

A Telnet (or SSH) connection can be terminated by simply closing the PC's command shell.

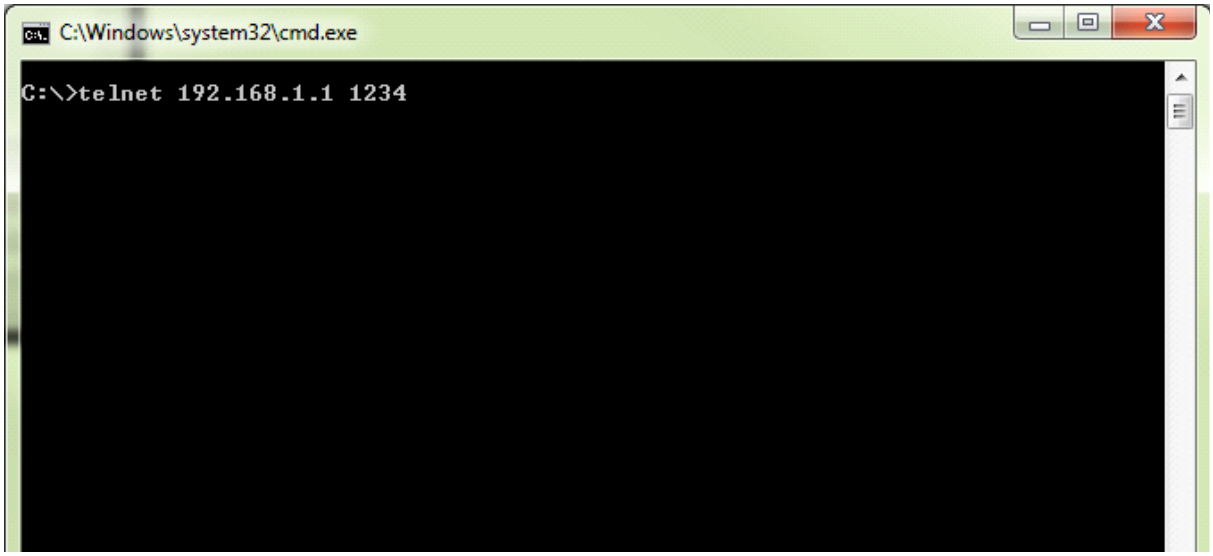
9.2 Connection Usage

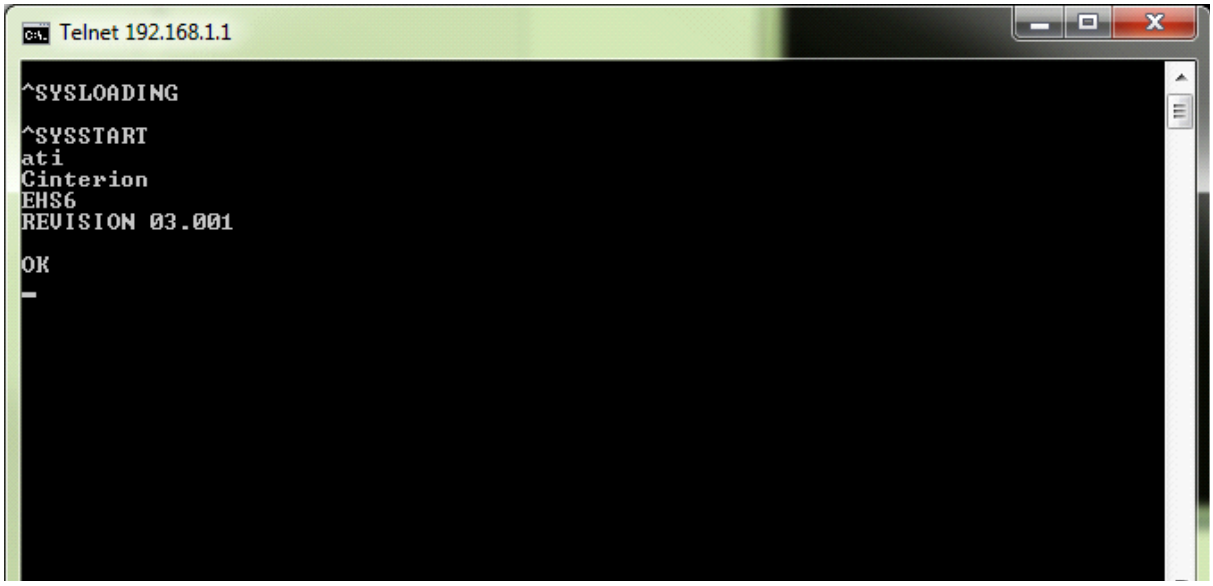
Once the Ethernet connection has been set up successfully, it is possible to transparently exchange data with a remote application, or to administer the EHS6T LAN. Possible usages are described in more detail in the following sections.

9.2.1 Access EHS6T LAN via Telnet (or SSH)

EHS6T LAN can be accessed from a PC via Telnet (or SSH) for administrative purposes, and there are two types of connection:

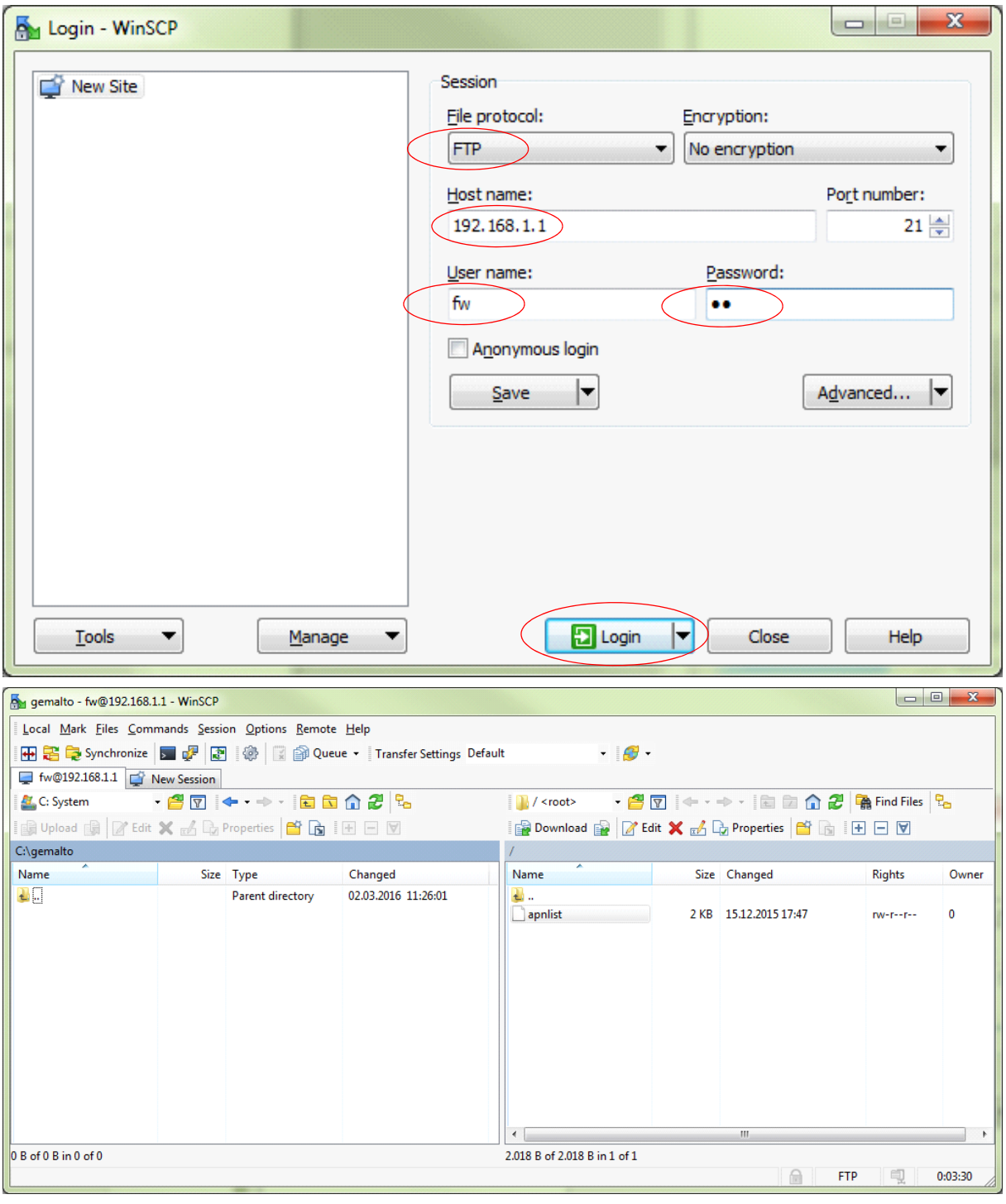
- Calling Telnet (or SSH) as described above in Section 9.1 connects to the EHS6T LAN's embedded Linux system. The Linux shell provides access to files containing the network configuration (see Section 9.2.4) as well as the wireless APN configuration (see Section 9.2.5).
- Calling Telnet with a dedicated port - "1234" - opens a direct link to the EHS6 module's COM port and with that to the EHS6 Java platform. Over this interface it is possible to control the Java module, to for instance receive URCs, or query the current firmware version.





9.2.2 Access EHS6T LAN via FTP

In addition to Telnet, it is also possible to access the EHS6T LAN via FTP, i.e., build a connection to an FTP server on the EHS6T LAN that gives access to a defined directory for FTP services. The FTP server's root directory in the embedded Linux file system is "/tmp/fw", the default user name to access FTP services is "fw", and default password is also "fw" If accessing the EHS6T LAN's FTP server from a Windows PC, the FTP client should support passive FTP (PASV). The default Windows FTP client does not support passive FTP. However, the FTP client from WinSCP for instance supports this feature. The following figure shows how to use WinSCP to link to the EHS6T LAN'S FTP server - allowing access to the file "apnlist".



9.2.3 Security Notes

Please note that by delivery default it is possible to open a Telnet connection to EHS6T LAN's embedded Linux system without being asked for a password. A root login password should therefore be defined to restrict this type of access. If a root login password exists, access to the embedded Linux system is only possible via SSH root login (using e.g., PuTTY for Windows).

9.2.4 Configure IP Address

To change the default IP address for EHS6T LAN, it is necessary to access EHS6T LAN's embedded Linux system as root user. This connection can be accomplished by Telnet (or SSH) as described in Section 9.1.

Once connected, the IP address may be configured as follows:

- Open the file "/etc/config/network". This file can be opened either on the embedded Linux system by using the vi editor, or on an external PC by copying the file to the FTP directory, transferring the file from the FTP directory to the PC, changing it using a text editor, transferring it back to the FTP directory and finally from there to its original directory. For more information on FTP access see Section 9.2.2.
- Edit the file and adapt the line "option ipaddr 192.168.1.1" to for instance "option ipaddr 192.168.**2**.1".
- Commit the new IP address by entering "/etc/init.d/network restart". After the restart, the system can be reached via the new IP address.

9.2.5 Edit APN List

Using the APN list, EHS6T LAN determines the applicable APN for the inserted SIM card. The APN list matches the unique mobile country and mobile network codes read from the SIM card to the available APNs. By default, the APN list already comprises a comprehensive number of the most commonly used APNs.

However, it may become necessary to add a particular APN, or to remove unnecessary APNs. To do so, please complete the following steps:

- Open the file "/etc/apnlist". This file can be opened either on the embedded Linux system by using the vi editor, or on an external PC by copying the file to an FTP directory, transferring the file from the FTP directory to the PC, changing it using a text editor, transferring it back to the FTP directory and finally from there to its original directory. For more information on FTP access see Section 9.2.2.
  The file "apnlist" contains one APN per line using the syntax:
  <3-digit MCC><2-digit MNC> <access point name>
- Edit the file by adding, changing or removing APNs.
- Save the file. The adapted APN list is available as soon as it is saved.

9.2.6 Enter SIM Pin

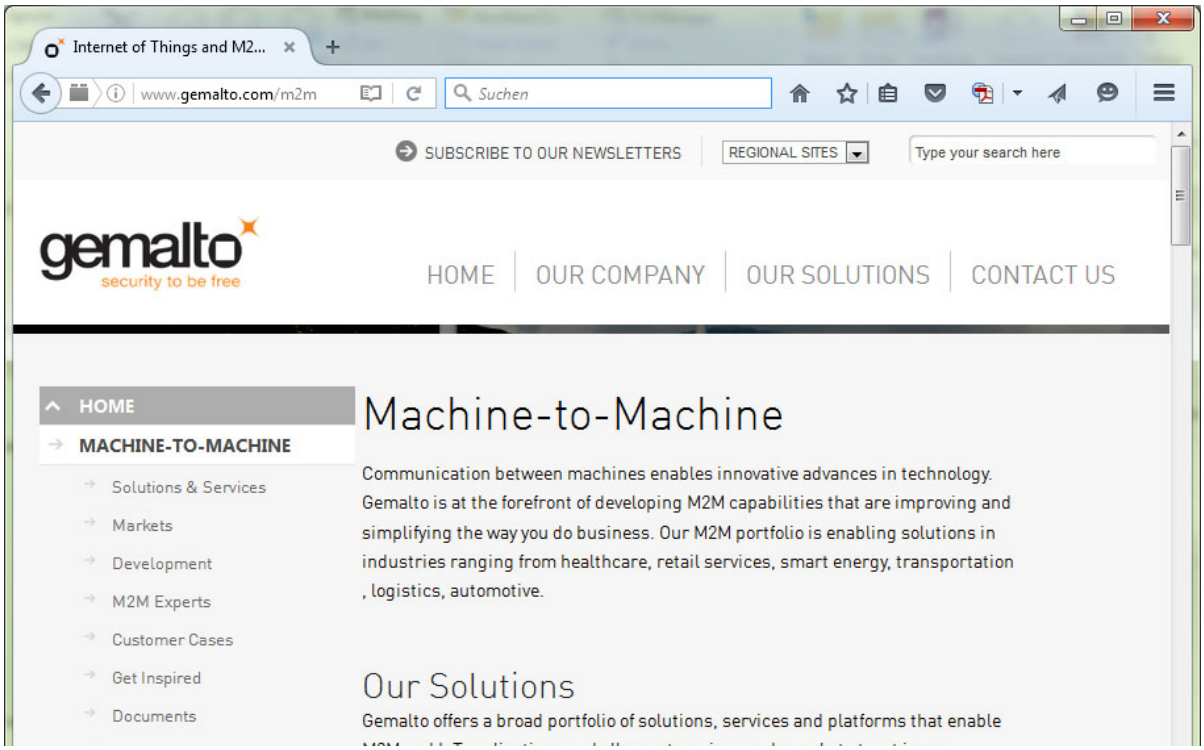
Normally, EHS6T LAN requires a SIM pin before being able to automatically connect to the APN (Internet). **Note:** The SIM pin should be made available permanently to EHS6T LAN before the SIM is actually required, i.e., usually before the SIM is inserted, and a wireless connection is built up. Also, remember to renew the SIM pin before inserting another SIM card.

Please complete the following steps to set the pin for the SIM card to be inserted:
- Connect to EHS6T LAN using Telnet (or SSH). For more information see Section 9.2.1.
- Change to directory “/etc” and call the command to enter the <pin code>:
  root@OpenWrt:/etc# uci set network.3gwan.pincode='<pin code>'
- Save the SIM pin to the flash file system, and activate the pin it through a reboot:
  root@OpenWrt:/etc# uci commit
  root@OpenWrt:/etc# reboot

To read the currently used SIM pin please enter the command:
root@OpenWrt:/etc# uci show network.3gwan.pincode

9.2.7 Transparent Data Exchange

To transparently exchange data please complete the following steps:
1. Set up an Ethernet connection as described in Section 9.1, and enter a SIM pin as described in Section 9.2.6.
2. Start an Internet browser on the connected device (e.g., a PC) and call a URL. The PC must be connected to EHS6T LAN via Ethernet, and needs to be set up in the same IP sub-network, or has to be able to receive a valid IP address from EHS6T LAN’s DHCP server.
   By means of EHS6T LAN, it is now possible to open up an IP connection to a remote host using a wireless network provider’s data gateway.
3. If the Website does not open, the correct APN may not be available in the APN list. The appropriate APN should then be added to the list as described in Section 9.2.5.



9.2.8 Update EHS6 Module Firmware

To update the firmware of the Java terminal's EHS6 module, please complete the following steps:

- Connect to the EHS6T LAN using FTP as described in Section 9.2.2.
- Transfer the firmware download files from the PC to the EHS6T LAN's FTP directory. The firmware update files have the extensions "*.usf", "*.jad", and "*.jar", e.g., "ehsx-_rev03.001_arn0000007.usf".
- Connect to the EHS6T LAN using Telnet (or SSH) as described in Section 9.2.1.
- Call the firmware update shell script: "./etc/gmup.sh". After a successful update the Java terminal restarts automatically.

9.2.9 Update Ethernet Sub-System Software

To update the software of the Java terminal's Ethernet sub-system, please complete the following steps:

- Connect to the EHS6T LAN using FTP as described in Section 9.2.2.
- Transfer the software download file from the PC to the EHS6T LAN's FTP directory. The software update file has the extension "*.bin", e.g., "xxx_yyy_zzz.bin".
- Connect to the EHS6T LAN using Telnet (or SSH) as described in Section 9.2.1.
- Call the software update shell script: "./etc/ewup.sh". After a successful update the Java terminal restarts automatically.



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