CINTERION
WIRELESS MODULES

Hardware Interface Description

MC55i Terminal

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0 Document History

Preceding document: "MC55i Terminal Hardware Interface Description" Version 01.201
New document: "MC55i Terminal Hardware Interface Description" Version **01.201a**

Chapter	What is new
1	Added remark on MC55i Terminal being the successor of the MC35i Terminal.
1.3.1	Revised directives and standards.
2.1	Added temperature and weight information.
3.5	Revised RTC reset timing (see also Table 21). Revised PD_IN characteristics in Table 9.
3.10	Added remarks regarding antenna installation.
4.2	Removed Table 15. Added maximum ambient operating temperatures. Added remark on automatic GPRS multislot class change for MC55i Terminal.
4.6	Added power supply ratings to Table 21.
5	Added temperature and weight information to Table 23.
6.5	New section Compliance with FCC Rules and Regulations.
7	Added ordering information for power supply unit.

New document: "MC55i Terminal Hardware Interface Description" Version 01.201

Chapter	What is new
---	Initial document setup.

1 Introduction

This document[1] describes the hardware of the Cinterion MC55i Terminal as successor of the MC35i Terminal.

The scope of this document includes interface specifications, electrical issues and mechanical characteristics of MC55i Terminal. It specifies standards pertaining to wireless applications and outlines requirements that must be adhered to for successful product design. The MC55i Terminal is a compact GSM modem for the transfer of data, voice, SMS and faxes in GSM networks. Industrial standard interfaces and an integrated SIM card reader allow using MC55i Terminal easily as a quad band GSM/GPRS terminal.

1.1 Related Documents

[1] MC55i Terminal AT Command Set
[2] MC55i Terminal Release Notes
[3] Application Note 16: Upgrading Firmware
[4] Application Note 24: Application Developer's Guide
[5] Multiplexer User's Guide
[6] Multiplex Driver Developer's Guide
[7] Multiplexer Driver Installation Guide

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

You can use the following link to visit the Cinterion Website:
http://www.cinterion.com

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

1.2 Terms and Abbreviations

Table 1: Terms and abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
ARP	Antenna Reference Point
ASIC	Application Specific Integrated Circuit
ATC	AT Cellular
BTS	Base Transceiver Station
CB	Cell Broadcast
CODEC	Coder-Decoder
CPU	Central Processing Unit
DCE	Data Circuit terminating Equipment
DSP	Digital Signal Processor
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
FR	Full rate
G.C.F.	GSM Conformity Forum
GSM	Global Standard for Mobile Communication
HF	Hands-free
HR	Half rate
HW	Hardware
IC	Integrated Circuit
IF	Intermediate Frequency
IMEI	International Mobile Equipment Identifier
I/O	Input/ Output
IGT	Ignition
ISO	International Standards Organization
ITU	International Telecommunications Union
kbps	kbits per second
Li-Ion	Lithium-Ion

Table 1: Terms and abbreviations

Abbreviation	Description
LVD	Low voltage Directive
Mbps	Mbits per second
MMI	Machine Machine Interface
MO	Mobile Originated
MS	Mobile Station
MT	Mobile Terminated
NC	Not Connected
NTC	Negative Temperature Coefficient
PA	Power Amplifier
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PCS	Personal Communication System
PD	Power Down
PDU	Protocol Data Unit
R&TTE	Radio and Telecommunication Terminal Equipment
RAM	Random Access Memory
RF	Radio frequency
RI	Ring Indication
ROM	Read Only Memory
RX	Receive direction
SIM	Subscriber Identification Module
SMS	Short Message Service
SRAM	Static Random Access Memory
SW	Software
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TX	Transmit direction
UART	Universal Asynchronous Receiver and Transmitter
VAD	Voice Activity Detection
ZIF	Zero Insertion Force

1.3 Regulatory and Type Approval Information

1.3.1 Directives and Standards

MC55i Terminal has been designed to comply with the directives and standards listed below.

Table 2: Directives

99/05/EC	Directive of the European Parliament and of the council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (in short referred to as R&TTE Directive 1999/5/EC). The product is labeled with the CE conformity mark CE 0682
2002/95/EC	Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
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)
72/245/EC	Automotive EMC Directive.
2004/104/EC	Automotive EMC Directive.

Table 3: 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
NAPRD.03 V4.1	"Overview of PCS Type certification review board Mobile Equipment Type Certification and IMEI control" PCS Type Certification Review board (PTCRB)
RSS133 (Issue 2)	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 4: Standards of European type approval

3GPP TS 51.010-1	"Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification"
ETSI EN 301 511 V9.0.2	Candidate Harmonized European Standard (Telecommunications series) Global System for Mobile communications (GSM); Harmonized standard for mobile stations in the GSM 900 and DCS 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC) (GSM 13.11 version 7.0.1 Release 1998)
GCF-CC V3.27.1	Global Certification Forum - Certification Criteria

Table 4: Standards of European type approval

ETSI EN 301 489-1 V1.8.1	Candidate Harmonized European Standard (Telecommunications series) Electro Magnetic Compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common Technical Requirements
ETSI EN 301 489-7 V1.3.1	Candidate Harmonized European Standard (Telecommunications series) Electro Magnetic Compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)
EN 62311-2008	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)
EN 60950-1 (2006)	Safety of information technology equipment

Table 5: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

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

SJ/T 11363-2006	"Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products" (2006-06).
SJ/T 11364-2006	"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 7: Toxic or hazardous substances or elements with defined concentration limits

部件名称 Name of the part	有毒有害物质或元素 Hazardous substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
金属部件 (Metal Parts)	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 MC55i Terminal. Manufacturers of the cellular terminal are advised to convey the following safety information to users and operating personnel and incorporate these guidelines into all manuals supplied with the product. Failure to comply with these precautions violates safety standards of design, manufacture and intended use of the product. Cinterion Wireless Modules GmbH assumes no liability for customer's failure to comply with these precautions.

	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.

SOS	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.

2 Product Concept

2.1 Key Features at a Glance

Feature	Implementation
General	
Incorporates MC55i module	The MC55i module handles all processing for audio, signal and data within the MC55i Terminal. Internal software runs the application interface and the whole GSM protocol stack.
Frequency bands	Quad band: GSM 850/900/1800/1900MHz
GSM class	Small MS
Output power (according to Release 99, V5)	Class 4 (+33dBm ±2dB) for EGSM850 Class 4 (+33dBm ±2dB) for EGSM900 Class 1 (+30dBm ±2dB) for GSM1800 Class 1 (+30dBm ±2dB) for GSM1900 The values stated above are maximum limits. According to Release 99, the maximum output power in a multislot configuration may be lower. The nominal reduction of maximum output power varies with the number of uplink timeslots used and amounts to 3.0dB for 2Tx.
Power supply	Single supply voltage 8V to 30V
Ambient operating temperature according to IEC 60068-2	Normal operation: -20°C to +65°C Restricted operation: -30°C to -20°C and +65°C to +75°C
Physical	Dimensions: 65mm x 74mm x 33mm (approx.) Weight: 110g (approx.)
RoHS, WEEE	All hardware components are fully compliant with the EU RoHS and WEEE Directives
GSM / GPRS features	
Data transfer	GPRS: • Multislot Class 10 • Full PBCCH support • Mobile Station Class B • Coding Scheme 1 – 4 CSD: • V.110, RLP, non-transparent • 2.4, 4.8, 9.6, 14.4kbps • USSD PPP-stack for GPRS data transfer
SMS	• Point-to-point MT and MO • Cell broadcast • Text and PDU mode • Storage: SIM card plus 25 SMS locations in mobile equipment • Transmission of SMS alternatively over CSD or GPRS. Preferred mode can be user defined.
Fax	Group 3; Class 2 and Class 1

Feature	Implementation
Audio	Speech codecs: • Half rate HR (ETS 06.20) • Full rate FR (ETS 06.10) • Enhanced full rate EFR (ETS 06.50/06.60/06.80) • Adaptive Multi Rate AMR Echo cancellation, DTMF, 7 ringing tones
Software	
AT commands	Hayes 3GPP TS 27.007, TS 27.005, Cinterion
Firmware update	Upgradeable via serial interface.
Interfaces	
Serial interface	• RS-232 interface, bi-directional bus for AT commands and data. • Multiplex ability according to GSM 07.10 Multiplexer protocol • Baud rates from 300bps to 115200bps • Autobauding supports: 1200, 2400, 4800, 9600, 19200, 38.400, 57600 and 115200bps • Supports RTS/CTS hardware handshake and software XON/XOFF flow control
Audio	Analog (Microphone, Earpiece)
SIM card reader	Supported SIM cards: 3V, 1.8V
Antenna	Connected via antenna FME connector
Power on/off, Reset	
Power on	DTR line at RS232 interface or IGT_IN line at power connector
Power off	• Normal switch-off by AT^SMSO or On/Off push button • Emergency switch-off via EMERGOFF line at power connector • Automatic switch-off in case of critical temperature and voltage conditions
Reset	Orderly shutdown and reset by AT command or power down signal.
Special features	
Real time clock	Timer functions via AT commands
Phonebook	SIM card and phone

3 Interface Description

3.1 Overview

MC55i Terminal provides the following connectors for power supply, interface and antenna:

- 6-pole Western plug (female) for power supply, ignition, power down signal
- 4-pole Western plug (female) for audio accessory, such as a handset
- 9-pole (female) SUB-D plug for RS-232 serial interface
- FME Jack (male) for antenna (Antenna interface)
- SIM card holder
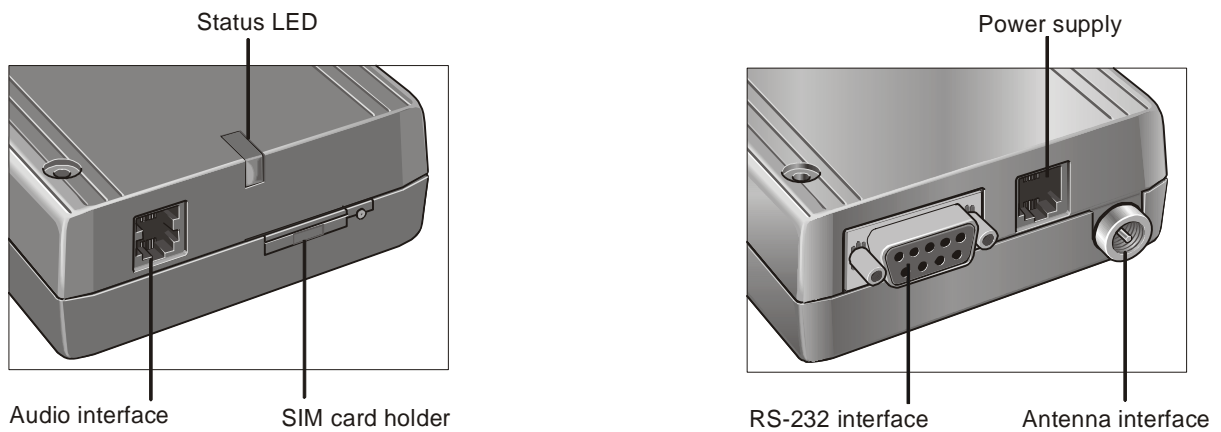
Figure 1: MC55i Terminal rear view

3.2   Block Diagram

Figure 2 shows a block diagram of a sample configuration that incorporates an MC55i Terminal and typical accessories.
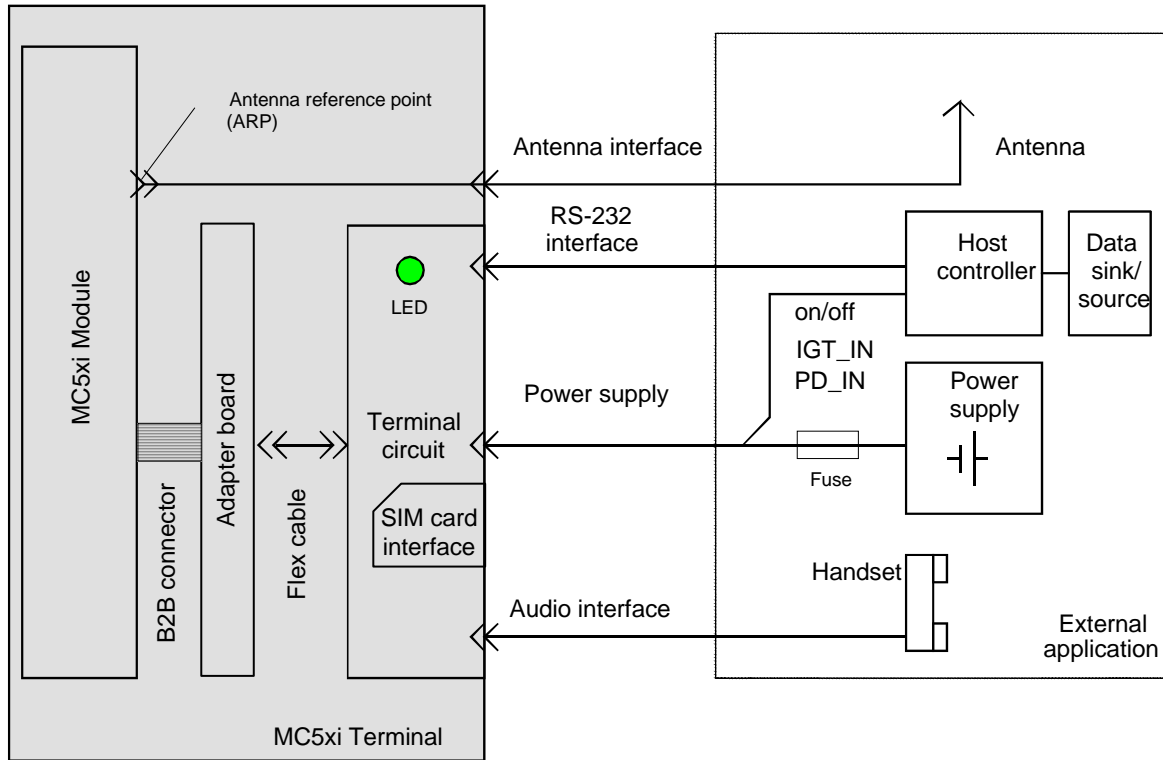
Figure 2: Block diagram

3.3   Operating Modes

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

Table 8: Overview of operating modes

Normal operation	GSM / GPRS SLEEP	Various power save modes set with AT+CFUN command. Software is active to minimum extent. If the Terminal was registered to the GSM network in IDLE mode, it is registered and paging with the BTS in SLEEP mode, too. Power saving can be chosen at different levels: The NON-CYCLIC SLEEP mode (AT+CFUN=0) disables the AT interface. The CYCLIC SLEEP modes AT+CFUN=7 and 9 alternatingly activate and deactivate the AT interfaces to allow permanent access to all AT commands.
	GSM IDLE	Software is active. Once registered to the GSM network paging with BTS is carried out. The Terminal is ready to send and receive.
	GSM TALK	Connection between two subscribers is in progress. Power consumption depends on network coverage individual settings, such as DTX off/on, FR/EFR/HR, hopping sequences, antenna.
	GPRS IDLE	Terminal is ready for GPRS data transfer, but no data is currently sent or received. Power consumption depends on network settings and GPRS configuration (e.g. multislot settings).
	GPRS DATA	GPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates, GPRS configuration (e.g. used multislot settings) and reduction of maximum output power.
POWER DOWN	Normal shutdown after sending the AT^SMSO command or after activation of the PD_IN line. The RTC works continuously, but the software is not active. Interfaces are not accessible.	

3.4 Terminal Circuit
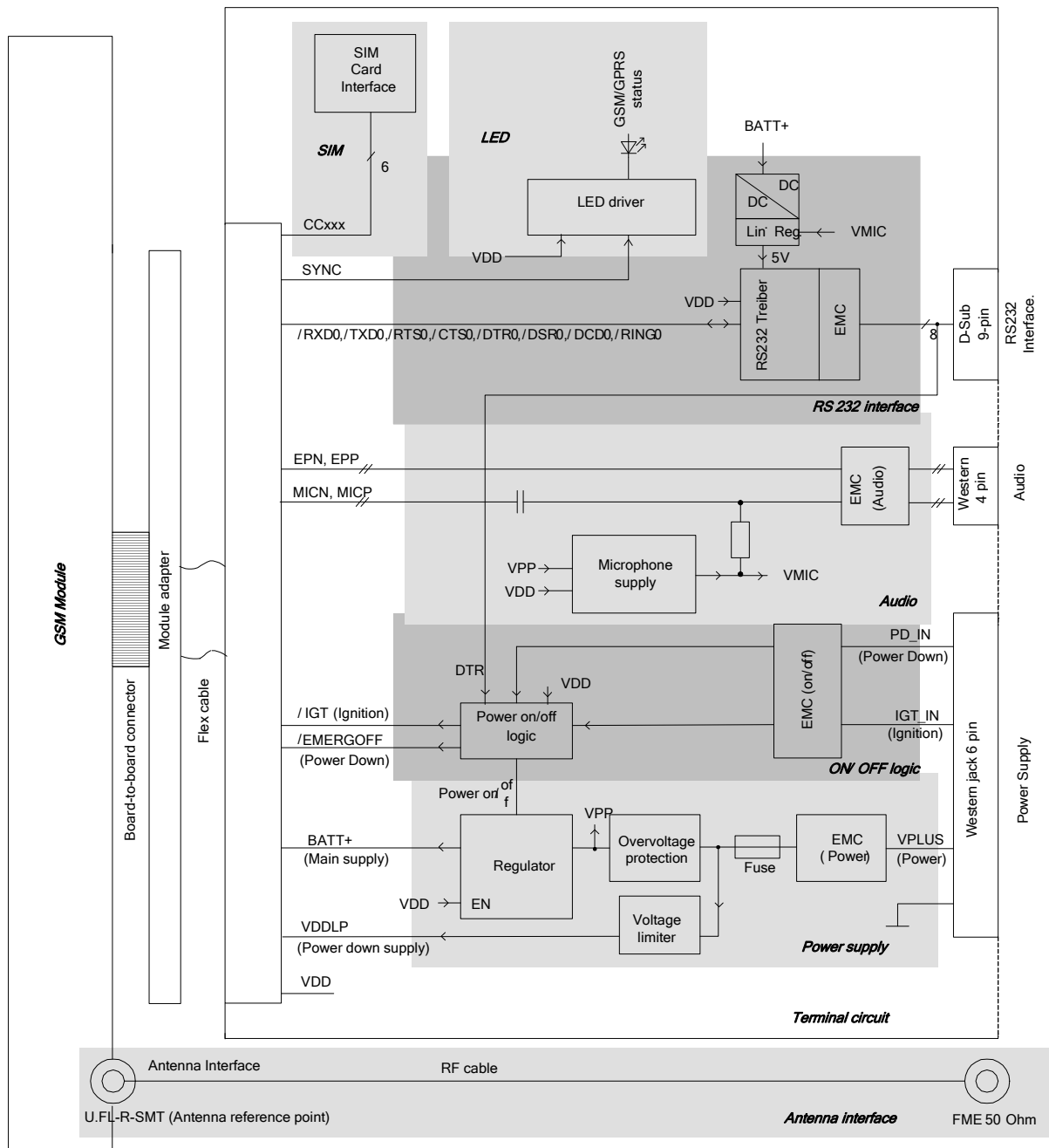
Figure 3: MC55i Terminal circuit block diagram

3.5 Power Supply

The power supply of the MC55i Terminal has to be a single voltage source of V_{PLUS}=8V…30V capable of providing a peak current (pulsed 2x577ms at T=4.615ms) of about 1.2A at 12V during an active transmission. The uplink burst causes strong ripple (drop) on the power lines. The drop voltage should not exceed 1V, but the absolute minimum voltage during drops must be >7.6V.

The MC55i Terminal is protected from supply voltage reversal and overvoltage. An internal fuse that is not removable is intended for electrical safety according to EN60950. An external fast acting fuse $\geq$0.4A with melting integral I^2t (0.15 … 0.25)A^2s is necessary to use the MC55i Terminal at a 12V or 24V power supply system for vehicles.

The power supply must be compliant with the EN60950 guidelines.

A switching regulator regulates the input voltage for the internal supply. In POWER DOWN mode the switching regulator is turned off by the On/Off logic. A separate voltage regulator supplies the real time clock (RTC) in the GSM engine.

When power fails for >1ms, MC55i Terminal resets or switches off. When power fails for >15s the RTC will be reset.

Table 9: Female 6-pole Western plug for power supply, ignition, power down

Pin	Signal name	Use	Parameters
1	PLUS	Power supply	8V – 30V DC, max. 33V for 1 min
2	free	---	---
3	PD_IN	Signal for POWER DOWN mode	$U_{IH} \geq$ 5V for t>100ms turns the terminal off. U_{IL} <2V and low level for normal operation.
4	IGT_IN	Ignition	$U_{IH} \geq$5V Ignition $\geq$5V for more than 200ms switches the MC55i Terminal on. Ignition is activated only by a rising edge. The rise time is <20ms
5	free	---	---
6	GND	Ground	0V

Figure 4: 6-pole Western jack for power supply, ignition, power down
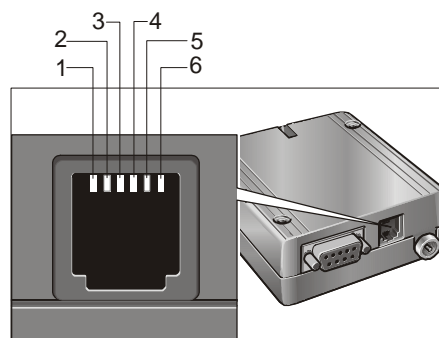
Pin assignment:

1 **+**
2 free
3 **PD_IN**
4 **IGT_IN**
5 free
6 **GND**

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

3.5.1   Turn MC55i Terminal on

The IGT_IN signal (pin 4) switches the MC55i Terminal on. After start-up, the MC55i Terminal enters the net searching state. The IGT_IN signal is activated when an appropriate power supply unit is plugged to the 6-pole Western jack.

While the PD_IN pin (pin3) is not active (voltage <2V) you can start the MC55i Terminal by activating the RS-232 DTR line.

After startup of the MC55i Terminal the RS232 lines are in an undefined state for approx. 900ms. This may cause undefined characters to be transmitted over the RS232 lines during this period.

3.5.2   Reset MC55i Terminal

An easy way to reset the MC55i Terminal is entering the command AT+CFUN=x,1. For details on AT+CFUN please see [1].

As an alternative, you can shut down the MC55i Terminal as described in Section 3.5.3 and then restart it as described in Section 3.5.1.

3.5.3   Turn MC55i Terminal off

Normal shutdown:
*   To turn off the MC55i Terminal use the AT^SMSO command, rather than disconnecting the mains adapter.
    This procedure lets the MC55i Terminal 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 MC55i Terminal returns the following result codes:

        ^SMSO: MS OFF
        OK
        ^SHUTDOWN

    The "^SHUTDOWN" result code indicates that the MC55i Terminal turns off in less than 1 second. After the shutdown procedure is complete the MC55i Terminal enters the POWER DOWN mode. The green status LED stops flashing (see Section 3.9 for a detailed LED description). The RTC is still fed from the voltage regulator in the power supply ASIC.

Emergency shutdown:
*   In the event of software hang-ups etc. the MC55i Terminal can be switched off by applying a voltage >5V to the PD_IN pin (pin 3) for more than 100ms.
    The PD_IN signal switches the MC55i Terminal off. All internal supply voltages are off, except for the power down voltage, which still feeds the real-time clock (RTC).

    Caution: Use the PD_IN pin only when, due to serious problems, the software is not responding for more than 5 seconds. Pulling the /PD 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 MC55i Terminal fails to shut down properly.

When the MC55i Terminal enters the POWER DOWN mode, e.g. after you have issued the AT^SMSO command or activated the PD_IN signal, all RS-232 interface lines are active for a period of 50ms to max. 3.5s. This may cause undefined characters to be transmitted on the RS-232 lines which can be ignored.

3.5.4   Disconnecting power supply

Before disconnecting the power supply from the PLUS pin, make sure that the MC55i Terminal is in a safe condition. The best way is to wait 1s after the "^SHUTDOWN" result code has been indicated.

3.5.5   Automatic thermal shutdown

An on-board NTC measures the temperature of the built-in MC55i module. If over- or under-temperature is detected on the module the MC55i Terminal automatically shuts down to avoid thermal damage to the system. Table 15 specifies the ambient temperature threshold for the MC55i Terminal.

The automatic shutdown procedure is equivalent to the power-down initiated with the AT^SMSO command, i.e. MC55i Terminal logs off from the network and the software enters a secure state avoiding loss of data. In IDLE mode it takes typically one minute to deregister from the network and to switch off.

Alert messages transmitted before the MC55i Terminal switches off are implemented as Unsolicited Result codes (URCs). For details see the description of AT^SCTM command provided in [1].

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

3.5.6   RTC

The internal Real Time Clock (RTC) of the MC55i Terminal retains the time and date and handles the alarm (reminder) function. The AT+CCLK command serves to set the time and date, and AT+CALA specifies a reminder message. See [1] for details.

A dedicated voltage regulator backs up the RTC even in POWER DOWN mode and enables MC55i Terminal to keep track of time and date.

However, please note that the Alarm mode described in [1], Section AT+CALA, is not intended for the MC55i Terminal. The AT+CALA command can only be used to set a reminder message, but not to configure the mobile to wake up from POWER DOWN mode into Alarm mode. Therefore, after setting a timer with AT+CALA be sure not to shut down the MC55i Terminal by AT^SMSO or PD_IN signal.

3.6 RS-232 Interface

Via RS-232 interface, the host controller controls the MC55i Terminal and transports data.
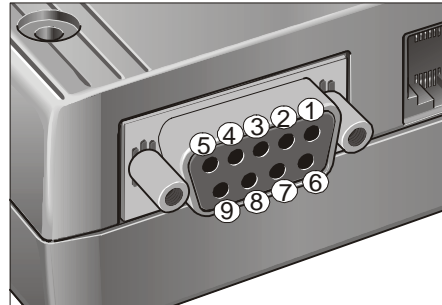
Figure 5: Pin assignment RS-232 (D-Sub 9-pole female)

Table 10: 9-pole D-Sub (female) RS-232

Pin no.	Signal name	I/O	Function
1	/DCD	O	Data Carrier Detected
2	/RXD	O	Receive Data
3	/TXD	I	Transmit Data
4	/DTR	I	Data Terminal Ready Attention: The ignition of MC55i Terminal is activated via a rising edge of high potential (+3 ... +15 V)
5	GND	-	Ground
6	/DSR	O	Data Set Ready
7	/RTS	I	Request To Send
8	/CTS	O	Clear To Send
9	/RING	O	Ring Indication

MC55i Terminal is designed for use as a DCE. Based on the conventions for DCE-DTE connections it communicates with the customer application (DTE) using the following signals:
• Port TxD @ application sends data to TXD of MC55i Terminal
• Port RxD @ application receives data from RXD of MC55i Terminal

The RS-232 interface is implemented as a serial asynchronous transmitter and receiver conforming to ITU-T V.24 Interchange Circuits DCE. It is configured for 8 data bits, no parity and 1 stop bit, and can be operated at bit rates from 300bps to 115kbps. Autobauding supports bit rates from 1.2kbps to 115kbps. Hardware handshake using the /RTS and /CTS signals and XON/XOFF software flow control are supported.

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

Note: The /DTR signal will only be polled once per second from the internal firmware of MC55i.

3.7 Audio Interface

The audio interface provides an analog input for a microphone and an analog output for an ear-piece.

- The microphone input and the earpiece output are balanced.
- For electret microphones a supply source is implemented.
- The microphone supply characteristics are optimized for the recommended Votronic handset. This handset has been used as the reference handset for type approval (see Chapter 6). An extra approval must be obtained for integrating other handsets or amplifiers.

The amplification of sending direction, receiving direction and sidetone depend on the current audio mode.

EMC immunity complies with the vehicular environment requirements according to EN 301 489-7.
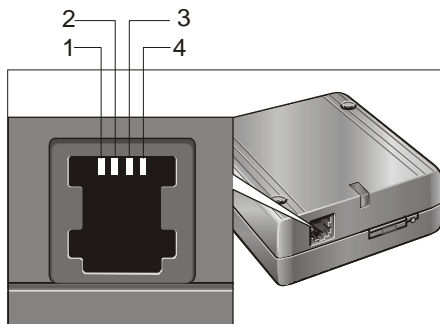
Pin assignment:

1   MICN (Microphone -)
2   EPN (Earpiece)
3   EPP (Earpiece)
4   MICP (Microphone +)

Figure 6: Audio Western plug (4-pole female)
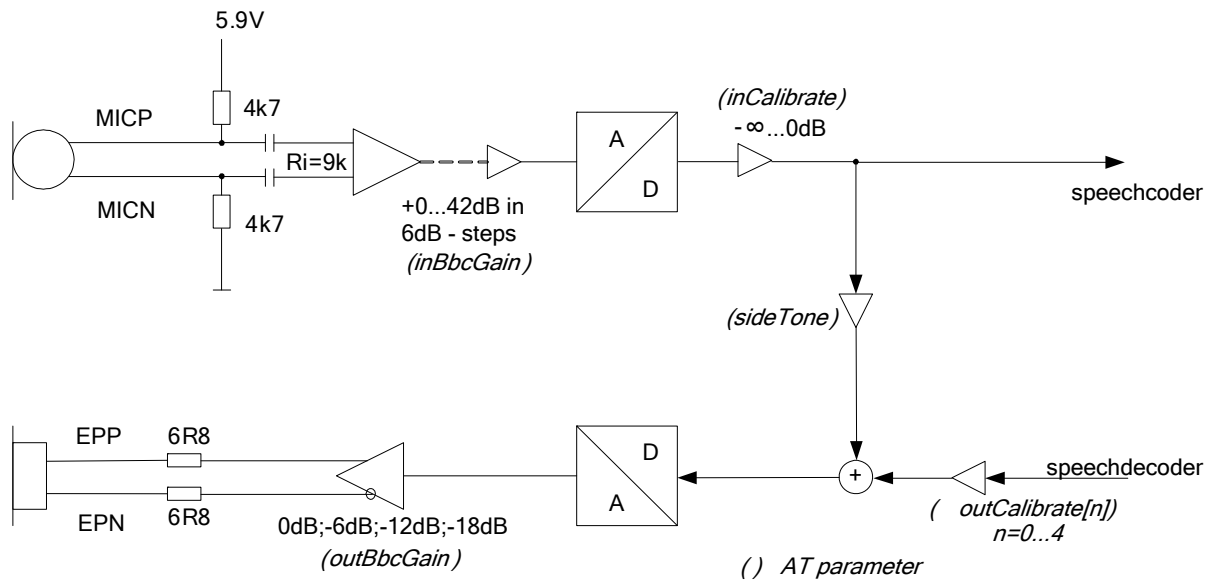
Figure 7: Audio block diagram

3.7.1   Supported Audio Modes

The audio interface can be configured by AT commands. Refer to [1] for details.

The electrical characteristics of the voiceband part vary with the audio mode. Specifications are listed in Table 20. To suit several types of audio equipment, three audio modes given by default can be selected by the AT command AT^SNFS.

Regarding audio performance, compliance with the TS 51010-1 specification and GCF recommendations has been certified for the parameters provided by audio mode 1 and audio interface 1. The settings are optimized for the reference handset (type Votronic) connected to the MC55i Terminal. To ensure that the reference parameters are always within the limits demanded by the standards they cannot be changed by AT command. Furthermore, the reference parameters are set as factory default.

In audio mode 4 and 5, the gain in the microphone, earpiece and the sidetone path can be adjusted from the cellular device application by using further AT commands.

Please note that the 2nd audio interface of the MC55i module is not connected in the MC55i Terminal. Audio modes 2, 3 and 6 can be selected by setting AT^SAIC=2,1,1, for further details refer to [1].

Table 11: Audio modes

Audio mode number: AT^SNFS=	1 (Default settings, not adjustable)	4	5
Audio mode name	Default Handset	User Handset	Plain Codec 1
Purpose	Recommended handset (see Chapter 6)	User provided handset	Direct access to speech coder
Gain programmable via AT command	NO	YES	YES
Sidetone	YES	YES	YES
Volume control	NO	YES	YES
Echo control (send)	Cancellation	Cancellation	NO
MIC input signal for 0dBm0 @ 1024 Hz (at default gain settings)	18mV	18mV	315 mV
Earpiece output signal in mV eff. @ 0dBm0, 1024 Hz, no load (at default gain settings); @ 3.14 dBm0	620mV	620mV default @ max volume	880 mV 3.7 Vpp
Sidetone gain (at default settings)	21.5dB	21.5dB	-∞ dB

3.7.2   Speech processing

The voiceband filter includes a digital interpolation low-pass filter for received voiceband signals with digital noise shaping and a digital decimation low-pass filter for voiceband signals to be transmitted.

After voiceband (interpolation) filtering the resulting 4Mbit/s data stream is digital-to-analog converted and amplified by a programmable gain stage in the voiceband processing part. The output signal can directly be connected to the earpiece of the GSM cellular device or to an external handset earpiece (via I/O connector). In the opposite direction the input signal from the microphone is first amplified by a programmable amplifier. After analog-to-digital conversion a 4Mbit/s data stream is generated and voiceband (decimation) filtering is performed.

The resulting speech samples from the voiceband filters are handled by the DSP of the baseband controller to calculate e.g. amplifications, sidetone, echo cancellation or noise suppression.

Full rate, half rate and enhanced full rate, speech and channel encoding including voice activity detection (VAD) and discontinuous transmission (DTX) and digital GMSK modulation are also performed on the GSM baseband processor.

Note: With regard to acoustic shock, the cellular application must be designed to avoid sending false AT commands that might increase the amplification, e.g. for a high sensitive earpiece.

3.8   SIM Interface

The SIM interface is intended for 1.8V and 3V SIM cards in accordance with GSM 11.12 Phase 2. The card holder is a five wire interface according to GSM 11.11. A sixth pin has been added to detect whether or not a SIM card is inserted.
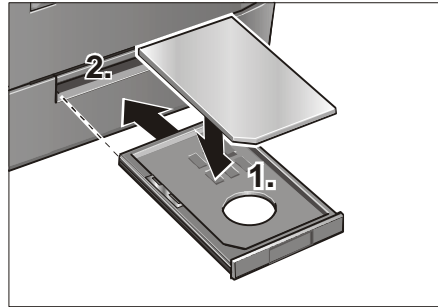
Figure 8: SIM interface

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

Removing and inserting the SIM card during operation requires the software to be reinitialized. Therefore, after reinserting the SIM card it is necessary to restart MC55i Terminal.

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 MC55i Terminal.

3.9 Status LED

A green LED displays the operating status of the terminal:
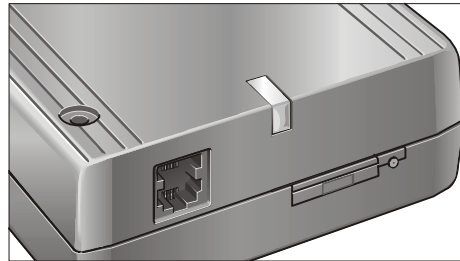
Figure 9: Status LED

The LED is driven by the SYNC line of the integrated MC55i module which can be configured by using the AT^SSYNC command. For the purpose of the MC55i Terminal it is recommended to retain the default setting of AT^SSYNC=1 (AT^SSYNC=0 is not applicable).

The following table lists the possible LED patterns and describes the operating status of the MC55i Terminal indicated by each pattern if AT^SSYNC=1.

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

Table 12: Coding of the green status LED

LED mode	Operating status of MC55i Terminal
Permanently off	MC55i Terminal is in one of the following modes: • POWER DOWN mode • ALARM mode • NON-CYCLIC SLEEP mode • CYCLIC SLEEP mode with no temporary wake-up event[1] in progress.
600 ms on / 600 ms off	Limited Network Service: No SIM card inserted or no PIN entered, or network search in progress, or ongoing user authentication, or network login in progress.
75 ms on / 3 s off	IDLE mode: The mobile is logged to the network (monitoring control channels and user interactions). No call in progress.
75 ms on / 75 ms off / 75 ms on / 3 s off	One or more GPRS contexts activated.
500 ms on / 25 ms off	Packet switched data transfer in progress.
Permanently on	Depending on type of call: *Voice call:* Connected to remote party. *CSD call:* Connected to remote party or exchange of parameters while setting up or disconnecting a call.

[1.] When a temporary wake-up event (for example URC, call, packet switched transfer) occurs in CYCLIC SLEEP mode the LED flashes. See Chapter AT+CFUN provided in [1] for details on the various SLEEP modes and wake-up events.

3.10 Antenna Interface

The external antenna is connected via the terminal's FME jack (male).
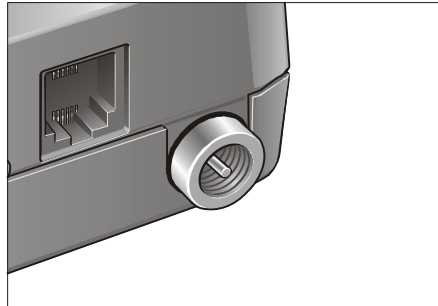
Figure 10: Antenna interface

An internal antenna cable adapts the antenna reference point (antenna connector type U.FL-R-SMT from Hirose) to the FME (male) connector. The position of the antenna reference point can be seen in Figure 2.

- Cable loss of the internal cable
  <0.4dB @ 900MHz
  <0.6dB @ 1800MHz
- The system impedance is 50Ω.
- In every case, for good RF performance the return loss of the customer application's antenna should be better than 10dB (VSWR < 2).
- MC55i Terminal withstands a total mismatch at this connector when transmitting with power control level for maximum RF power.

Inside the MC55i module a 27nH inductor to ground provides additional ESD protection to the antenna connector. For details see Figure 11. To protect the inductor from damage no DC voltage must be applied to the antenna circuit.

U.FL-R-SMT connector (from Hirose)

L (27nH)

TRX In / Output
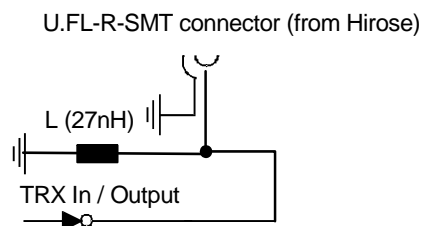
Figure 11: Antenna connector circuit on MC55i module

EMC immunity complies with the vehicular environment requirements according to EN 301 489-7.

For the application it is recommended to use an antenna with the following FME (female) connector:
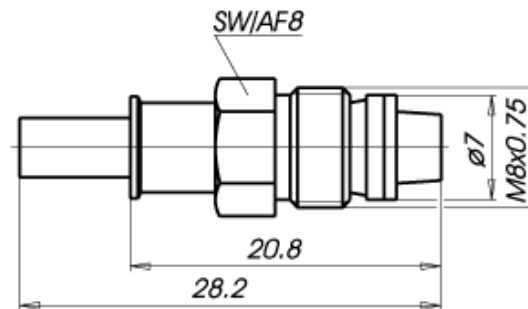
Figure 12: Recommended antenna connector

Please note that the terminal should be installed and operated with a minimum distance of 20cm between the antenna connected to the terminal and any human bodies. Also, the transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. The allowed maximum antenna gain is 4.35dBi.

4 Electrical and Environmental Characteristics

4.1 Absolute Maximum Ratings

Table 13: Absolute maximum ratings

Parameter	Port / Description	Min.	Max.	Unit
Supply voltage	PLUS	-50	30	V
Overvoltage	PLUS / for 1min		33	V
Input voltage for on/off Control lines	/IGT_IN, /PD_IN	-5	30	V
RS-232 input voltage range	/TXD, /DTR, /RTS	-20	+20	V
	/RXD, /CTS, /DSR, /DCD, /RING	-0.3	+5.3	V
Microphone input line voltage	MICP, MICN	-0.3	+10	V
Earpiece input voltage	EPP, EPN	-0.3	+0.3[1]	V
Immunity against discharge of static electricity	all connectors (lines)	-8	+8	kV
Protection Class	IP40 (avoid exposing MC55i Terminal to liquid or moisture, for example do not use it in a shower or bath)		IP 40	
Mechanical vibrations amplitude	@ 5-200Hz		7.5	mm
Mechanical pulse-acceleration	@ 18 ms duration		30	g

[1.] max. 3.0V while MC55i Terminal is switched on.

Table 14: Operating supply voltage for MC55i Terminal

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

4.2　Operating Temperatures

Table 15: Ambient operating temperature of MC55i Terminal according to IEC 60068-2 (w/o forced air circulation)

Parameter	Min	Max	Unit
Normal operation	-20	+65	°C
Restricted operation[1]	-20 to -30	+65 to +75	°C
Automatic thermal shutdown[2] [3]	<-30	>+75	°C

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

[2.] When an emergency call is in progress automatic thermal shutdown is deferred. See also Section 3.5.5.

[3.] Due to temperature measurement uncertainty, a tolerance of ±3°C on these switching thresholds may occur.

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

4.3   Storage Conditions

Table 16: Storage conditions

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

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

4.4 Electrical Specifications of the Application Interface

4.4.1 On/Off Control

Table 17: On/Off control line specifications (requirements)

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V_{high}	Input voltage /IGT_IN, /PD_IN	active high	5			V
V_{low}					2	V
V_{high}	Input voltage /DTR	active high	3		+15	V
V_{low}			-15		1.2	V
R_{IN}	Input resistance of /IGT_IN, /PD_IN		47			kOhm
R_{IN}	Input resistance of /DTR		4	6	8	kOhm
t_{D_IGT}	Duration of active high / IGT_IN, /DTR		200			ms
t_{D_PD}	Duration of active high / PD_IN		100			ms
t_{R_IGT}	Rise time /IGT_IN for power up	0% to 100%			20	ms
t_{R_RTS}	Rise time /DTR for power up	0% to 100%			20	ms
$t_{D\_passive}$	Duration passive (low) of /IGT_IN, /DTR before restart	after power down	500			ms

4.4.2 RS-232 Interface

Table 18: RS-232 interface specifications (requirements)

Parameter	Description	Conditions	Min.	Typ	Max.	Unit
V_{OUT}	Transmitter output voltage for /RXD, /CTS, /DSR, /DCD, /RING	@ 3kOhm load	±5	±6	±7	V
R_{OUT}	Transmitter output resistance /RXD, /CTS, /DSR, /DCD, /RING		300			Ohm
R_{IN}	Resistance /TXD, /RTS, /DTR		3	5	7	kOhm
V_{In}	Receiver input voltage range /TXD, /RTS, /DTR		-15		+15	V
V_{RIHYS}	Input hysteresis		0.2	0.5	1	V
V_{Ilow}	Input threshold low		0.8	1.2		V
V_{Ihigh}	Input threshold high			1.7	2.8	V
Baudrate		Autobauding	1.2		115	kbps
		Fixed range	0.300		115	kbps
LE_{Cable}	Length of RS-232 cable			1.8	2	m

4.4.3   Audio Interface

Table 19: Audio interface specifications (requirements)

Parameter		Min.	Typ.	Max.	Unit
Microphone MICP, MICN	DC (no load) at MICP	5.6	5.9	6.2	
	DC at MICP in POWER DOWN		0		V
	DC (no load) at MICN		0		V
	DC resistance differential MICN, MICP (balanced)	9.3	9.4	9.5	kOhm
	Impedance Z_i (balanced)	4.0	4.3	4.6	kOhm
	Input level U_{imax}			1.03	V_{PP}
	Gain range 6 dB steps	0		42	dB
	Frequency range	300		3400	Hz
Earpiece EPP, EPN	Fine scaling by DSP (inCalibrate)	$-\infty$		0	dB
	Impedance (audio not active)		30		kOhm
	Impedance (balanced)		15		Ohm
	AC output level U_O *Gain* = 0dB @ 3.14 dBm0 no load audio mode = 5, outBbcGain = 0, outCalibrate = 32767	3.3	3.7	4.07	V_{PP}
	Gain range	-18		0	dB
	Gain accuracy			0.8	dB
	Frequency area	300		3400	Hz
	DC Offset (balanced)			100	mV
	Attenuation distortion for 300...3900Hz			1	dB
	Out-of-band discrimination	60			dB

- Unless otherwise stated, all specified values are valid for gain setting (gs) 0dB and 1kHz test signal.
- gs = 0dB means audio mode = 5 for EPP to EPN, inBbcGain= 0, inCalibrate = 32767, out-BbcGain = 0, OutCalibrate = 16384, sideTone = 0.

4.5 Electrical Characteristics of the Voiceband Part

The electrical characteristics of the voiceband part depend on the current audio mode selected by the AT command AT^SNFS. See Table 11: Audio modes.

The audio modes 4 and 5 can be adjusted by parameters. Each audio mode is assigned a separate parameter set.

Table 20: Audio parameters adjustable by AT commands

Parameter	Influence to	Range	Gain range	Calculation
inBbcGain	MICP/MICN analogue amplifier gain of baseband controller before ADC	0...7	0...42dB	6dB steps
inCalibrate	digital attenuation of input signal after ADC	0...32767	-∞...0dB	20 * log (inCalibrate/ 32768)
outBbcGain	EPP/EPN analogue output gain of baseband controller after DAC	0...3	0...-18dB	6dB steps
outCalibrate[n] n = 0...4	digital attenuation of output signal after speech decoder, before summation of sidetone and DAC present for each volume step[n]	0...32767	-∞...+6dB	20 * log (2 * outCalibrate[n]/ 32768)
sideTone	digital attenuation of sidetone is corrected internally by outBbcGain to obtain a constant sidetone independently to output volume	0...32767	-∞...0dB	20 * log (sideTone 32768)

Note: The parameters inCalibrate, outCalibrate and sideTone accept also values from 32768 to 65535. These values are internally truncated to 32767.

4.6 Power Supply Ratings

Table 21: Power supply specifications (to be defined)

Parameter	Description	Conditions		Min.	Typ	Max.	Unit
V_{PLUS}	Allowed voltage ripple (peak-peak), drop during transmit burst peak current	TALK mode, power control level for P_{out} max[1]				1	V
I_{PLUS}[2]	Average supply current (average time 3 min.)	Power Down mode	@8V		480		µA
			@12V		700		
			@30V		1750		
		SLEEP mode (GSM/GPRS)	@8V		45		mA
			@12V		30		
			@30V		17		
		Net searching mode (no net)	@8V		70		mA
			@12V		50		
			@30V		30		
		IDLE mode (GSM/GPRS)	@8V		60		mA
			@12V		45		
			@30V		25		
		GSM TALK mode	@8V		270		mA
			@12V		170		
			@30V		70		
		GPRS DATA mode(1 Tx, 4 Rx)	@8V		290		mA
			@12V		180		
			@30V		75		
		GPRS DATA mode(2 Tx, 3 Rx)	@8V		370		mA
			@12V		230		
			@30V		90		
	Peak supply current (during 577µs transmission slot every 4.6ms)	Power control level for Pout max	@8V		1.7		A
			@12V		1.2		
			@30V		0.7		
$t_{PLUS-Fail}$	Allowed powerfail time without terminal reset or power down	After this time the MC55i Terminal will be reset or switched off				1	ms
	Allowed powerfail time without RTC (real time clock) reset	After this time the RTC will be reset				15	s
t_{R_PLUS}	Allowed rise time of V_{PLUS}	0% to 100%				20	ms

[1.] Lowest voltage (minimum peak) incl. all ripple and drops >7.6V including voltage drop, ripple and spikes, measured at western jack (6-pole) pin (1 to 6).
[2.] Typical values measured with antenna impedance = 50 Ohm (return loss >20dB).

4.7 Antenna Interface

Table 22: Antenna interface characteristics

Parameter		Min	Typ	Max	Unit
Frequency range Uplink (MS → BTS)	GSM 850	824		849	MHz
	E-GSM 900	880		915	MHz
	GSM 1800	1710		1785	MHz
	GSM 1900	1850		1910	MHz
Frequency range Downlink (BTS → MS)	GSM 850	869		894	MHz
	E-GSM 900	925		960	MHz
	GSM 1800	1805		1880	MHz
	GSM 1900	1930		1990	MHz
RF power @ ARP with 50Ω load	GSM 850[1]	31	33	35	dBm
	E-GSM 900[1]	31	33	35	dBm
	GSM 1800[2]	28	30	32	dBm
	GSM 1900[2]	28	30	32	dBm
Number of carriers	GSM 850		124		
	E-GSM 900		174		
	GSM 1800		374		
	GSM 1900		299		
Duplex spacing	GSM 850		45		MHz
	E-GSM 900		45		MHz
	GSM 1800		95		MHz
	GSM 1900		80		MHz
Carrier spacing			200		kHz
Multiplex, Duplex		TDMA / FDMA, FDD			
Time slots per TDMA frame			8		
Frame duration			4.615		ms
Time slot duration			577		µs
Modulation		GMSK			
Receiver input sensitivity @ ARP BER Class II < 2.4% (static input level)	GSM 850	-102[3]	-107[4]		dBm
	E-GSM 900	-102[3]	-107[4]		dBm
	GSM 1800	-102[3]	-107[4]		dBm
	GSM 1900	-102[3]	-107[4]		dBm

[1] Power control level PCL 5
[2] Power control level PCL 0
[3] Under fading conditions
[4] Typical value is at least -107dBm.

5 Mechanical Characteristics

Table 23: Mechanical characteristics

|	
Weight	110g (approx.)
Dimensions (max) LxWxH =	65x74x33mm
Temperature range	Normal operation: -20°C to +65°C Restricted operation: -30°C to -20°C and +65°C to +75°C
Protection class	IP40 (Avoid exposing MC55i Terminal to liquid or moisture, for example do not use it in a shower or bath.)
Mechanical vibrations Amplitude	7.5 mm at 5-200 Hz sinus
Max. pulse acceleration	30g pulse with 18 ms duration time
Air humidity	5...80% (non condensing)
Class of flammability	UL94 HB
Casing material	PC/ABS Cycoloy 1200 HF grey 96444
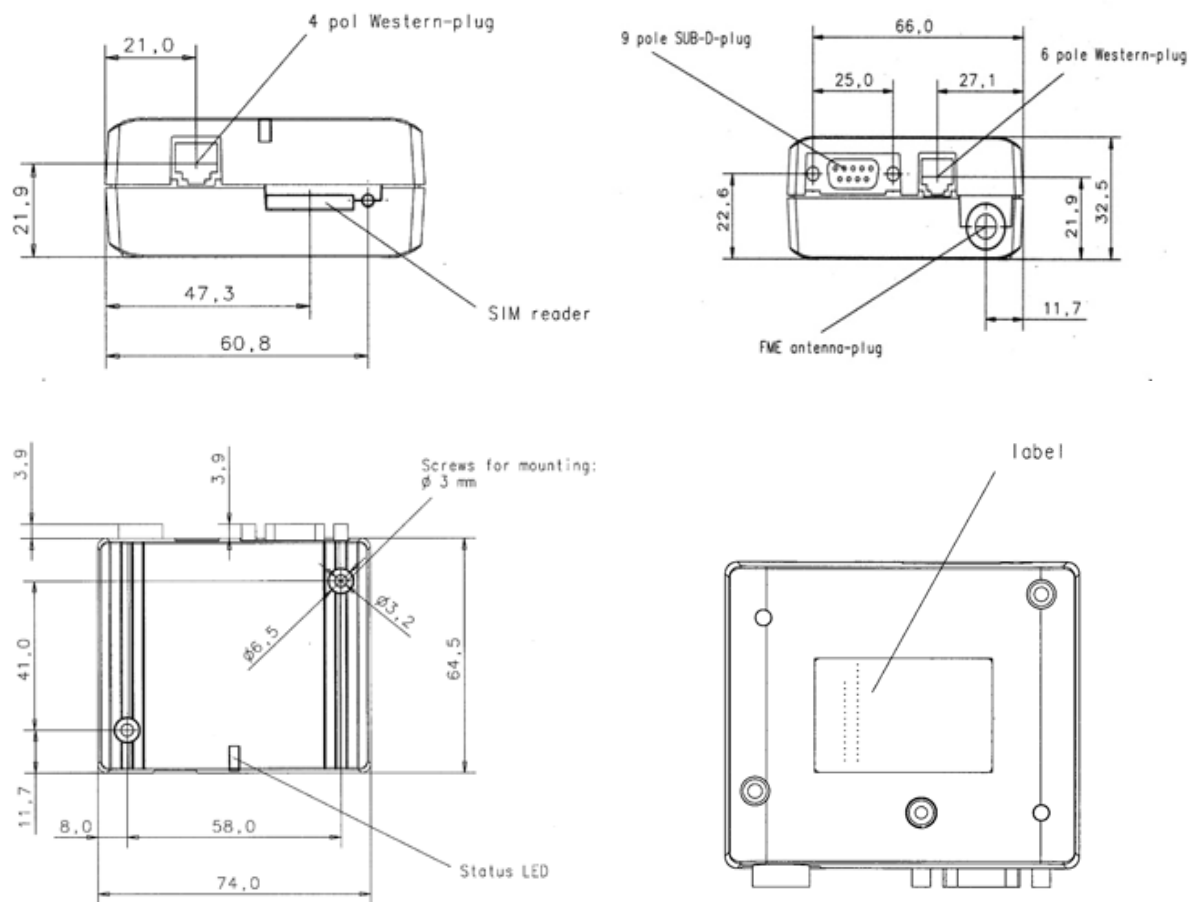
Figure 13: Mechanical dimensions

5.1   Mounting Example

The MC55i Terminal can be attached e.g. to a 35mm top-hat rail installation using two M3 x 50mm screws and an additional fixture element, see Figure 15. In case you wish to order the recommended mounting kit, please refer to Chapter 7 for detailed information.
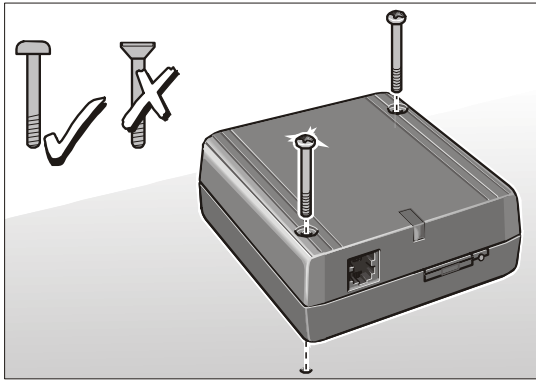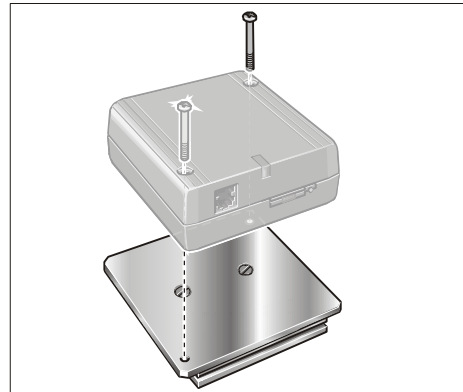
Figure 14: Recommended screws   **Figure 15:** Attaching MC55i Terminal to a top-hat rail

6 Full Type Approval

6.1 Cinterion Reference Setup

The Cinterion reference setup submitted to type approve MC55i Terminal consists of the following components:

• MC55i Terminal with approved GSM module MC55i
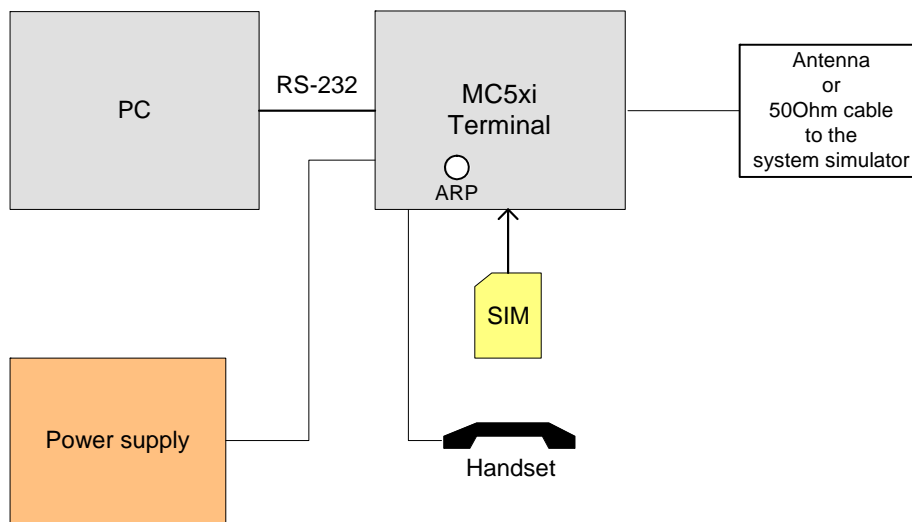• Votronic Handset type
• PC as MMI
• Power Supply

Figure 16: Reference equipment for approval

For ordering information please refer to Chapter 7.

6.2   Restrictions

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

- No further approvals are required for customer applications that comply with the approved MC55i Terminal configuration.
- Extra approval must be obtained for applications using other accessories than those included in the approved MC55i Terminal configuration (handset, power supply, MMI implementation supported by AT commands).

6.3   CE Conformity

The MC55i Terminal meets the requirements of the EU directives listed below.

- R&TTE Directive 1999/5/EC
- Automotive Directive 2004/104/EC

6.4   EMC

The MC55i Terminal meets the EN 301489-7 requirements of equipment for vehicular and fixed use and the 2004/104/EC Directive.

The MC55i Terminal does not resist to test pulse 5 according ISO 7637-2 (load dump at vehicles 12V ($\geq$ level3) and 24V ($\geq$ level2) supply voltage). In case of failure, the internal slow acting unremovable fuse would be damaged. For load dump protection, it is recommended to use an external fast acting fuse $\geq$0.4A with melting integral I^2t (0.15…0.25)A^2s.

Note: V_{PLUS} power fail time >1ms resets the MC55i Terminal.

6.5   Compliance with FCC Rules and Regulations

As an integrated product, the MC55i Terminal is fully compliant with the grant of the FCC Equipment Authorization issued for the built-in MC55i module, and therefore, bears the label "Contains FCC ID QIPMC55I".

The Equipment Authorization Certification for the MC55i module is listed under the following identifiers:

FCC Idenitifier: QIPMC55I
Industry Canada Certification Number: 7830A-MC55I
Granted to Cinterion Wireless Modules GmbH

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

Note: This terminal equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
• Reorient or relocate the receiving antenna.
• Increase the separation between the equipment and receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.

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

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

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

7 List of Parts and Accessories

Table 24: List of parts and accessories

Description	Supplier	Ordering information
MC55i Terminal	Cinterion	Ordering number L36880-N2100-A100
Power supply unit	Cinterion	Terminal Power Supply Ordering number: L36880-N8490-A12 UK adapter for Terminal Power Supply Ordering number: L36880-N8490-A13 US adapter for Terminal Power Supply Ordering number: L36880-N8490-A14 AU adapter for Terminal Power Supply Ordering number: L36880-N8490-A15
Mounting kit for top/hat rail instal-lation	Sphere Design	Ordering number: 20100 Sphere Design Saarpfalz-Park 17 D-66450 Bexbach / Saar Phone: +49-6826-5200-0 Fax: +49-6826-5200-25 E-Mail: info@spheredesign.de http://www.spheredesign.de
Handset	Votronic	Ordering number: HH-SI-30.3/V1.1/0 Votronic GmbH Saarbrücker Str. 8 D-86386 St. Ingbert Phone: +49-6894-9255-44 Fax: +49-6894-9255-88 E-Mail: contact@votronic.com http://www.votronic.com/
Antenna	SMARTEQ	Ordering number: MiniMag 1140.26 (EU, GSM900/1800) MiniMag 1140.27 (US, GSM850/1900) E-Mail: info@smarteq.se http://www.smarteq.com
RS-232 cable (9 pin D-Sub)	Tecline	Ordering number: 300574 Tecline GmbH Behrener Straße 8 D-66117 Saarbrücken Phone: +49-681-926-78-70 Fax: +49-681-926-78-555 http://www.tecline-edv.de/