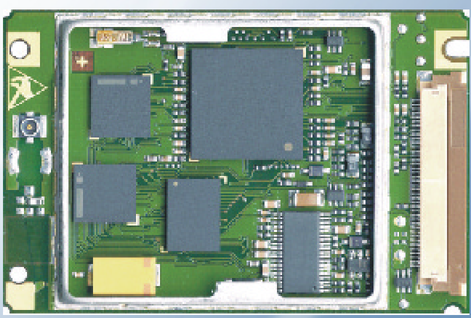
SIEMENS

MC35

Siemens Cellular Engine



Hardware Interface Description

Version: 00.20
DocID: MC35-HD-01-V00.20

Wireless Modules

Document Name:	**MC35 Hardware Interface Description**
Version:	**00.20**
Date:	**07.08.2001**
Technical Support:	**wm.support@mch.siemens.de**
DocId:	**MC35-HD-01-V00.20**
Status:	**Preliminary**

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Furthermore, all safety instructions regarding the use of mobile technical systems, including GSM products, which also apply to cellular phones must be followed.

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0 Version History

This chapter reports modifications and improvements over previous versions of the document.
Preceding document: "MC35 Hardware Interface Description" Version **00.10**
New document: "MC35 Hardware Interface Description" Version **00.20**

Chapter	Page	What is new
1.1	9	Abbreviations updated
2.1	14	Power consumption in SLEEP mode added (3.5mA) SIM Application Toolkit added Weight of module: 17g instead of 18g
3.1	20	Overview of operating modes added
3.2.2	23	Pin 30 (VDDLP): now U_{IN} = 2.0 V...5.5 V instead of U_{IN} = 2.0 V...4.8 V
3.2.4.3	27	Description of Charge-only mode added
3.3	28	Power up / Power down scenarios described in more detail, figures added
3.3.1.4	30	Description of Alarm mode added
3.3.2	31	Summary of wake-up events added
3.3.4	33	Summary of state transitions revised
3.4	34	Figure 10 (RTC backup from rechargeable battery): Schematic modified - battery now connects to VDDLP
3.6	36	Description of audio interface revised
3.9	43	Pin 13 (VDD): C_{load} max,extern = 1µF. Pin 30 (VDDLP): U_{IN} = 2.0 V...5.5 V instead of U_{IN} = 2.0 V...4.8 V. Pin 14 (ACCU_TEMP): NTC can be placed *inside or near* battery. Pin 31 (PD): Pin is only for use in case of emergency. Frequency of watchdog signals modified. Pin 32 (SYNC): Pin can be used to control a status LED. Pin 34, 36 (EPPN): Parameters specified for outCalibrate = 16384.
4.1 / 5.5 / 6.7	47 / 54 / 66	Antenna connector: 27nH inductor for ESD protection added (figure and note)
6.1	59	Supply voltage now V_{BATT+} = 5.5 instead of 6.0V
6.4	60	Power consumption in SLEEP mode added (3.5mA)
6.6	65	Receiver input sensitivity: values slightly changed
7	67	MC35 specific requirements for DSB35 Support Box
8	70	Information on Reference Approval added
9	71	Ordering information of BB35 Bootbox and DSB35 Support Box and Siemens Car Kit added

1 Introduction

This document describes the hardware interface of the Siemens MC35 module that connects to the cellular device application and the air interface. As MC35 is intended to integrate with a wide range of application platforms, all functional components are described in great detail.

So this guide covers all information you need to design and set up cellular applications incorporating the MC35 module. It helps you quickly retrieve interface specifications, electrical and mechanical details and, last but not least, information on the requirements to be considered for integrating further components.

1.1 Terms and abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AF	Audio Frequency
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
ARP	Antenna Reference Point
ASIC	Application Specific Integrated Circuit
BB	Baseband
BTS	Base Transceiver Station
CB or CBM	Cell Broadcast Message
CS	Coding Scheme
CSD	Circuit Switched Data
CPU	Central Processing Unit
CTR	Common Technical Regulation
DAI	Digital Analog Interface
dBm0	digital level, 3.14dBm0 corresponds to full scale, see ITU G.711, A-law
DCE	Data Communication Equipment, Data Circuit-terminating Equipment
DSB	Development Support Box
DSP	Digital Signal Processor
DSR	Data Set Ready
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
E-GAIM	Enhanced GSM Analog Interface Module
EGSM	Enhanced GSM
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FDMA	Frequency Division Multiple Access
FFC	Flat Flexible Cable
FR	Full Rate
GAIM	GSM Analog Interface Module
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications

Abbreviation	Description
HR	Half rate
HW	Hardware
IC	Integrated Circuit
IF	Intermediate Frequency
IMEI	International Mobile Equipment Identity
I/O	Input/Output
ISO	International Standards Organization
ITU	International Telecommunications Union
kbps	kbits per second
Li-Ion	Lithium-Ion
LNA	Low Noise Amplifier
LO	Local Oscillator
Mbps	Mbits per second
MMI	Man Machine Interface
MO	Mobile Originated
MT	Mobile Terminated
MTBF	Mean Time Between Failures
NTC	Negative Temperature Coefficient
n.a.	Not available
PA	Power Amplifier
PCB	Printed Circuit Board
PCL	Power Control Level
PDU	Protocol Data Unit
PGC	Programmable Gain-Controlled Amplifier
PLL	Phase Locked Loop
PPP	Point-to-point protocol
PSU	Power Supply Unit
R&TTE	Radio and Telecommunication Terminal Equipment
RAM	Random Access Memory
RF	Radio Frequency
RI	Ring Indication
ROM	Read-only Memory
RMS	Root Mean Square (value)
RTC	Real Time Clock
Rx	Receive Direction
SAW	Surface Acoustical Wave Filter

Abbreviation	Description
SELV	Safety Extra Low Voltage
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
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
VSWR	Voltage Standing Wave Ratio
ZIF	Zero Insertion Force

1.2 Standards

This product has been approved to comply with the following directives and standards.

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
89/336/EC	Directive on electromagnetic compatibility
73/23/EC	Directive on electrical equipment designed for use within certain voltage limits (Low Voltage Directive)

Standards of type approval

ETS 300 607-1	Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification; (equal GSM 11.10-1=>equal 3GPP51.010-1)
EN 301 419-1	v.4.1.1 (4-2000) Global System for Mobile communications (GSM); Harmonized standard for mobile stations in the GSM 900 and 1800 Bands covering essential requirements under article 3.2 of the R&TTE Directive (1999/5EC)(GSM 13.11)
ETS 300 342-1	Radio Equipment and Systems(RES); Electro Magnetic Compatibility (EMC) for European digital cellular telecommunications system (GSM 900 MHz and DCS 1800 MHz) Part 1: Mobile and portable radio and ancillary equipment (for equipment for fixed and vehicular use)
EN 60 950	Safety of information technology equipment
ES 59005/ANSI C95.1	Considerations for evaluation of human exposure to Electromagnetic Fields (EMFs) from Mobile Telecommunication Equipment (MTE) in the frequency range 30MHz-6GHz (relevant for applications)

Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

2 Functions

MC35 is a product variant of the well-proven TC35 dual band GSM engine. It supports all the features of TC35 and, on top, offers the advantages of the fast GPRS technology. Designed to easily provide radio connection for voice and data transmission it integrates seamlessly with a wide range of GSM/GPRS application platforms and is ideally suited to design and set up innovative cellular solutions with minimum effort.

MC35 supports GPRS multislot class 8 (4 Rx, 1 Tx time slot) and GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. It operates in the frequency bands GSM 900 MHz and GSM 1800 MHz.

The complete RF part is incorporated and the GSM protocol runs autonomously on a GSM baseband processor. MC35 uses a single 40-pin ZIF connector that connects to the cellular device application. The ZIF connector establishes the application interface for control data, audio signals and power supply lines.

The cellular device application forms the Man-Machine Interface (MMI). Access to the MC35 is enabled by a serial interface (RS232).

2.1 MC35 key features at a glance

Table 1: MC35 key features

Feature	Implementation
Transmission	Voice, Data, SMS, Fax
Power supply	Single supply voltage 3.3V – 4.8V Please refer to Chapter 6.4 for more detailed information
Frequency bands	Dual Band EGSM900 and GSM1800 (GSM Phase 2+)
GSM class	Small MS
Transmit power	Class 4 (2W) for EGSM900 Class 1 (1W) for GSM1800
GPRS connectivity	GPRS multi-slot class 8 GPRS mobile station class B
SIM card reader	External – connected via interface connector Note: The SIM card reader is not part of the MC35
External antenna	Connected via 50 Ohm antenna connector
Temperature range	Normal operation: -20°C to +55°C Restricted operation: -20°C to -25°C and +55°C to +70°C Storage: -40°C to +85°C
Current consumption (typical)	Depending on operating mode • TALK mode (during TX burst) at EGSM 900/1800: 2A • TALK mode (average) at EGSM 900/1800: 300mA / 270mA • IDLE mode at EGSM 900/1800: 10mA / 10mA • IDLE GPRS mode: 10mA • DATA GPRS mode at EGSM 900, multi-slot class 8, PCL 5: 360mA • SLEEP mode: 3.5mA • Power Down mode: 50µA
Speech codec	Triple rate codec: • Half Rate (ETS 06.20) • Full Rate (ETS 06.10) • Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80)
SMS	MT, MO, CB, Text and PDU mode
DATA	Transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent GPRS: max. 85.6 kbps (downlink) USSD Coding scheme: CS 1, 2, 3, 4 PPP-stack

Feature	Implementation
FAX	Group 3: Class 1, Class 2
Audio interface	Analog voice: • Microphone • Earpiece • Handsfree (supports echo cancellation and noise reduction)
Interfaces	RS232 (CMOS level) bi-directional bus for commands / data using AT commands
Supported SIM card	3V/1.8V (Please note that 1.8V support requires to be separately tested and validated according to GSM 11.10)
Phonebooks	Implemented via SIM
SIM Application Toolkit	Enables the SIM card to be programmed and to run additional applications such as value added services, online banking, information services etc.
Reset of MC35	Reset via AT command or Power Down Signal
Selectable baud rate	300bps ... 115kbps (AT interface)
Autobauding range	1.2kbps ... 115kbps (AT interface)
Firmware download	Optionally via RS232 interface or SIM interface
Real time clock	Implemented (clock frequency 32.768kHz)
Timer function	Programmable via AT command
Physical dimensions	Size: 54.5 x 36 x 6.7mm Weight: 17g

2.2 Block diagram of a GSM/GPRS application

MC35 connects to the application platform over the host interface, which takes the form of a ZIF connector. This is a data, control, audio and power supply interface. In addition, power can be supplied via contact pads located on the RF part of the MC35 PCB.

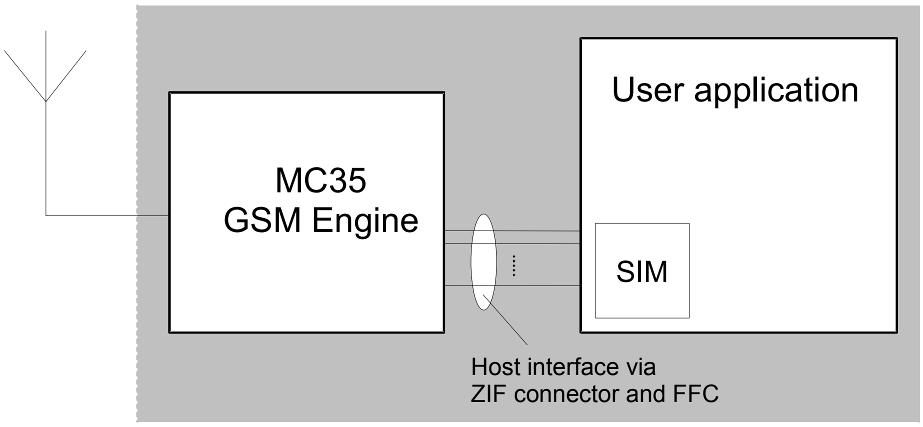
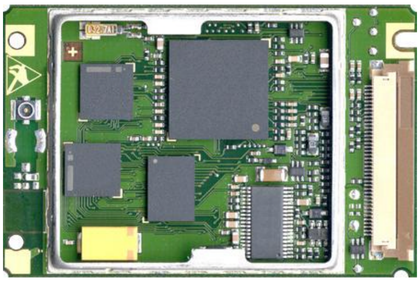


Figure 1: Overview of product concept

2.3 Block diagram of MC35

Figure 2 shows a block diagram of the MC35 module and illustrates the major functional components:

- GSM baseband processor
- GSM radio
- Power supply (ASIC)
- Flash
- SRAM
- ZIF connector
- Antenna connector



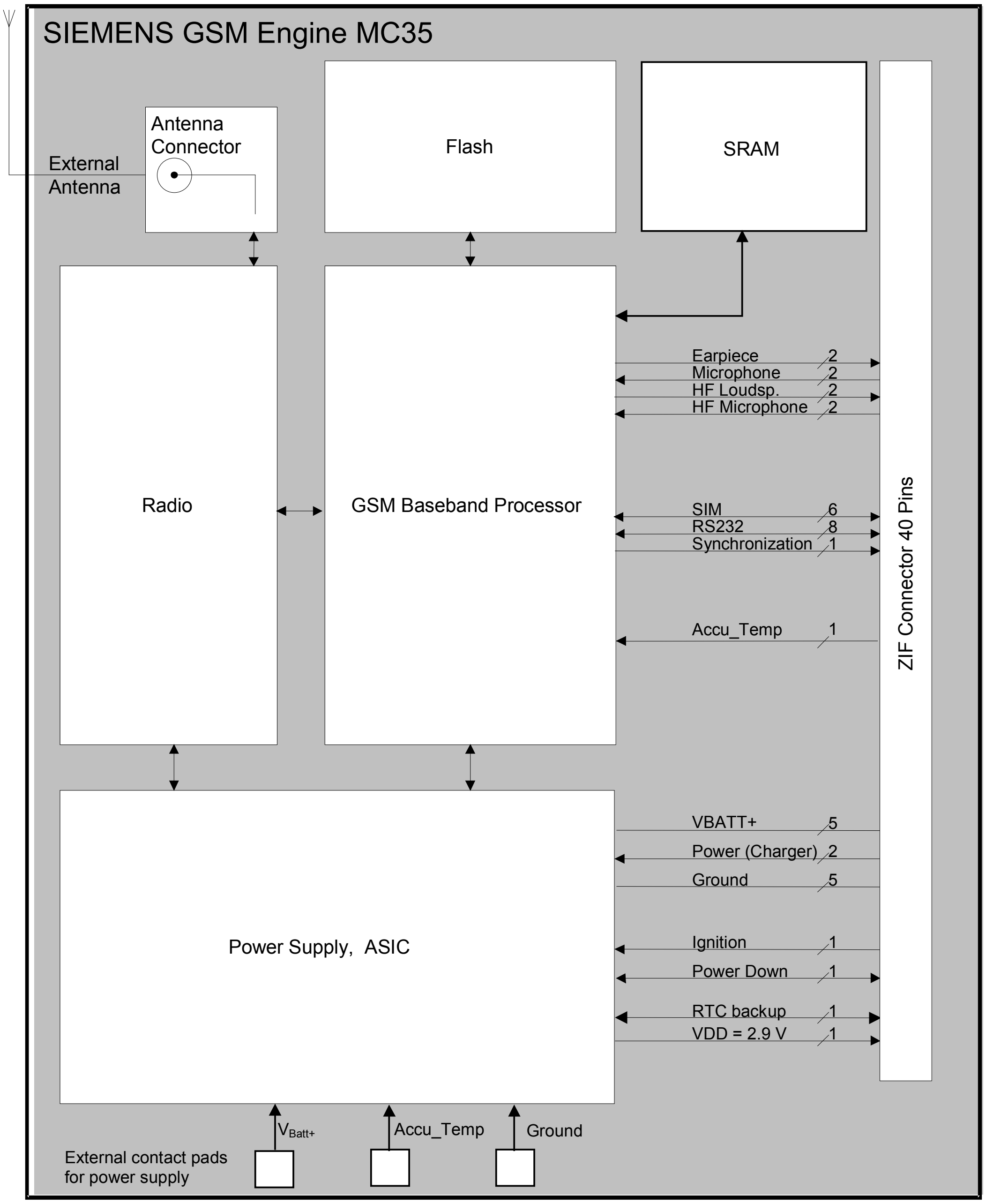


Figure 2: Block diagram of MC35

2.4 GSM baseband processor

The GSM baseband processor handles all the processing for audio, signal and data within a GSM cellular device. Internal software runs the application interface and the whole GSM protocol stack. A UART forms the interface to the cellular device application.

The GSM baseband processor is a single chip mixed signal baseband IC, containing all analog and digital functionality of a cellular radio. Designed to meet the increasing demands of the GSM/PCS cellular subscriber market, it supports FR, HR and EFR speech and channel coding without the need for external hardware.

Its high level of integration reduces system complexity, board dimensions and the number of components. In combination with the RF solution a complete two-chip GSM system solution is achieved, which results in extremely compact implementation, very low power consumption and cost effective system performance. Due to its very flexible interfaces the baseband controller can easily be set up to control a wide variety of RF architectures. The baseband processor is powered by a C166 CPU and a DSP processor core. Integrating these high performance processor cores with on-chip memory, a TDMA timer module and GSM specific peripherals provides a compelling single chip cellular baseband processor.

2.4.1 Features of the GSM baseband processor

The baseband processor includes the following major features:

- C166 MCU processor core
- Digital Signal Processing core
- On-chip MCU Program ROM / SRAM flexibly configurable as program or data RAM
- DSP Program ROM / RAM
- DSP Data ROM / RAM
- Programmable PLL for system clock generation
- GSM Timer Module that off-loads the MCU from radio channel timing
- MCU and DSP Timers
- Pulse Carry Modulation output for Automatic Frequency Correction (AFC)
- Serial RF Control Interface
- ISO 7816 compatible SIM card interface
- Digital and analog voiceband and baseband filters including digital-to-analog and analog-to-digital converters
- RF power ramping functions
- Measurement of battery voltage, battery and environment temperature
- GMSK Modulator
- Viterbi Hardware Accelerator
- A51/A52 Cipher Unit
- Comprehensive static and dynamic power management

3 Application Interface

MC35 is equipped with a 40-pin 0.5mm pitch ZIF connector that connects to the cellular application platform. The host interface incorporates several sub-interfaces described in the following chapters:

- Power supply and charging
- Serial interface
- Two audio interfaces
- SIM interface

Electrical and mechanical characteristics of the ZIF connector are provided in Chapter 5.4. Ordering information for the ZIF connector and the required cables are listed in Chapter 9.

3.1 Operating modes

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

Table 2: Overview of operating modes

Mode	Function	
Power Down	Operating voltage applied. Only a voltage regulator in the Power Supply ASIC is active for powering the RTC. Software is not active. The RS-232 interface is not accessible.	
Normal operation	GSM / GPRS SLEEP	Power saving mode set by AT+CFUN command. Software is active to minimum extent. If the module was registered to the GSM network in IDLE mode, it is registered and paging in SLEEP mode, too. AT commands cannot be used.
	GSM IDLE	Software is active. Once registered to the GSM network, paging with BTS is carried out. The module 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	Module 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 and GPRS configuration (e.g. used multislot settings).
Alarm mode	Restricted operation launched by RTC alert function while the module is in Power Down mode. Module will not be registered to GSM network. Limited number of AT commands is accessible.	
Charge-only	Limited operation for battery powered applications. Enables charging while module is detached from GSM network. Limited number of AT commands is accessible. There are several ways to launch Charge-only mode: • From Power Down mode: Connect charger to POWER lines when engine was powered down by AT^SMSO. • From Normal mode: Connect charger to POWER lines, then enter AT^SMSO.	
Charge mode during normal operation	Normal operation (SLEEP, IDLE, TALK) and charging running in parallel. Charge mode changes to Charge-only mode when the module is powered down before charging is completed.	

See also Table 7 and Table 8 for the various options of waking up MC35 and proceeding from one mode to another.

3.2 Power supply

The power supply of the GSM Engine MC35 has to be a single voltage source of V_{BATT+}= 3.3V...4.8V. It must be able to provide a peak current of about 2A during the uplink transmission and account for drops on the VBATT+ line that may be caused in transmit bursts.

All the key functions for supplying power to the device are handled by an ASIC power supply. The ASIC provides the following features:

- Stabilizes the supply voltages for the GSM baseband using linear voltage regulators.
- Controls the module's power up and power down procedures.
  A watchdog logic implemented in the baseband processor periodically sends signals to the ASIC, allowing it to maintain the supply voltage for all MC35 components. Whenever the watchdog pulses fail to arrive constantly, the module is turned off.
- Delivers, across the VDD pin, a regulated voltage of 2.9V/70mA for the external application.

The RF power amplifier is driven directly from VBATT+.

MC35 offers two options of connecting the power supply to your application platform:

- the ZIF connector (see Chapter 3.2.2)
- or the contact pads located on the MC35 PCB (see Chapter 3.2.3).

Both options can be used in parallel.

3.2.1 Minimizing power losses

When designing the power supply for your application please pay specific attention to power losses. Ensure that the input voltage V_{BATT+} never drops below 3.3 V on the MC35 board, not even during transmit bursts. Also, make sure that any voltage drops that may occur during transmit bursts never exceed 400mV. It should be noted that MC35 will be switched off in the event of exceeding these limits. For further details see Chapter 6.4.

Note: In order to minimize power losses, use a FFC cable as short as possible. The resistance of the power supply lines on the host board and a battery pack should also be considered.

Example: The ZIF-FFC-ZIF connection causes a resistance of 50mΩ in the VBATT+ line and 50mΩ in the GND line, if the FFC cable reaches the maximum length of 200mm. As a result, a 2A transmit burst would add up to a total voltage drop of 200mV. Plus, if a battery pack is involved, further losses may occur due to the resistance across the battery lines and the internal resistance of the battery.

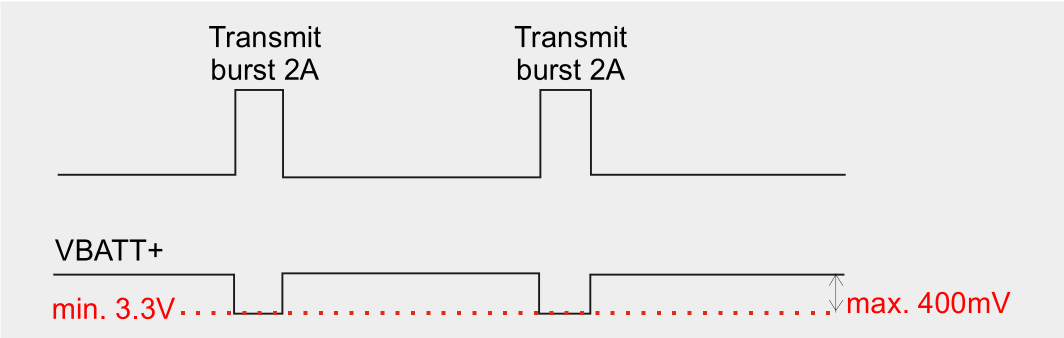


Figure 3: Power supply limits during transmit burst

3.2.2 Power supply across ZIF connector

10 pins of the ZIF connector are dedicated to connect the supply voltage (VBATT+) and ground (GND).

Table 3: Power supply pins of ZIF connector

Signal name	Pin	I/O	Description	Parameter
VBATT+	1-5	-	Positive operating voltage	3.3 V...4.8 V, $I_{max} \leq 2$ A @ antenna return loss ≥ 6 dB The minimum operating voltage must not fall below 3.3 V, not even in case of voltage drop.
GND	6-10	-	Ground	0 V
POWER	11-12	I	Positive charging voltage	I_{max} = 500 mA U = 5.5...8 V internal Pull Down R=100kΩ
VDDLP	30	I/O	Buffering of RTC (see Chapter 3.4)	$U_{OUT,max} < V_{BATT+}$ U_{IN} = 2.0 V...5.5 V R_i = 1kΩ $I_{in,max}$ = 30µA

3.2.3 Power supply across contact pads

In addition, MC35 can be powered from the contact pads located on the RF part of the PCB.

In order to connect the contact pads to your application platform it is recommended to use contact springs. A soldering connection to any of the contact pads VBATT+, GND or ACCU_TEMP may damage MC35 and is not permitted. The position of the power pads is shown in Figure 22 and Figure 30.

Table 4: Parameters of power supply contact pads

Signal name	I/O	Description	Parameter
VBATT+	-	Positive operating voltage	3.3 V...4.8 V, $I_{max} \leq 2$ A @ antenna return loss ≥ 6 dB The minimum operating voltage must not fall below 3.3 V, not even in case of voltage ripple.
GND	-	Ground	0 V
ACCU_ TEMP	I	Input for temperature measurement with NTC 10 kΩ @ 25 C to GND, B = 3370 Kelvin ± 3%	U_{out} = 2.65 V $R_i \approx 8.4$ kΩ

3.2.4 Battery pack

For some applications the use of a battery pack may be required. MC35 can be powered from a Li-Ion battery pack which must be specified for 3.8V, 0.85Ah and a final charge voltage of 4.2V.

To ensure reliable operation and proper charging take care that the battery pack you want to integrate into your MC35 application meets the following requirements:

- Ensure that the battery pack incorporates a protection circuit. Since charging and discharging largely depend on the battery temperature, the battery pack should include an NTC resistor. If the NTC is not inside the battery pack it must be placed nearby. The NTC resistor must be connected between ACCU_TEMP and GND. Required NTC characteristics are: *10kΩ @ 25°C, B=3370 Kelvin ±3%*. Please note that the NTC is indispensable for proper charging, i.e. the charging process will not start if no NTC is present.
- Furthermore, the protection circuit must be capable of detecting overvoltage (against overcharging), undervoltage (against deep discharging) and overcurrent. The circuit must be insensitive to pulse loading (see Chapter 3.2.4.1).
- On the MC35 module, a built-in measuring circuit constantly monitors the charging voltage. In the event of undervoltage, it causes MC35 to power down and automatically starts up trickle charging to protect the cell from damage. Undervoltage thresholds during the SLEEP mode are specific to the battery pack and must be evaluated for the intended model. When you evaluate undervoltage thresholds, consider both the current consumption of the MC35 and of the application circuit.
- The battery cell must be insensitive to rupture, fire and gasing under extreme conditions of temperature and charging (voltage, current).

Figure 4 shows the circuit diagram of a typical battery pack design that includes the protection elements described above.

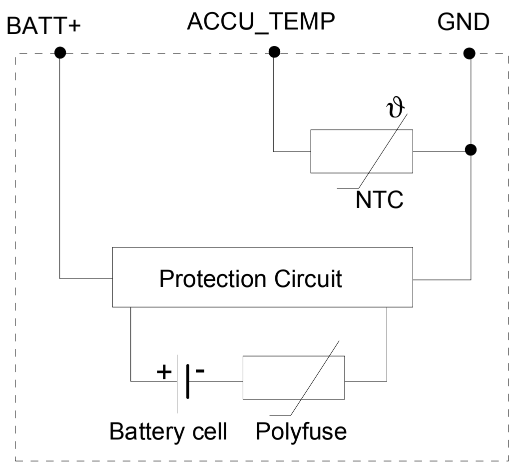


Figure 4: Battery pack

3.2.4.1 Supported charging technique

Charging can be accomplished only in a temperature range from 0°C to +45°C. The charging process supports trickle charging and processor controlled fast charging. In trickle mode, the battery is charged at a rate of less than 10mA. The fast charging rate provided by the charger or any other external source must be limited to 500mA. See also Table 23.

Of course, the battery can be charged regardless of the engine's operating mode. When the GSM engine is in SLEEP, IDLE or TALK mode, it remains operational while charging is in progress (provided that sufficient voltage is applied). If the charger is connected in Power Down mode (caused by AT^SMSO), the GSM engine goes into Charge-only mode.

The charge cycle begins once the charger is tied to the two POWER pins of the ZIF connector. First, the charging process goes into trickle charge mode, no matter whether the battery was deeply or partially discharged. When the battery voltage reaches 3.2V within 60 minutes, the Power ASIC turns on and wakes up the baseband processor.

Once activated, the baseband processor enables fast charging, in parallel to trickle charging. Fast charging delivers a constant current until the battery voltage reaches 4.2V and then proceeds with varying charge pulses. As shown in Figure 5, the pulse duty cycle is reduced to adjust the charging procedure and prevent the voltage from overshooting beyond 4.2V. Once the pulse width reaches the minimum of 100ms and the duty cycle does not change for 2 minutes, fast charging is completed.

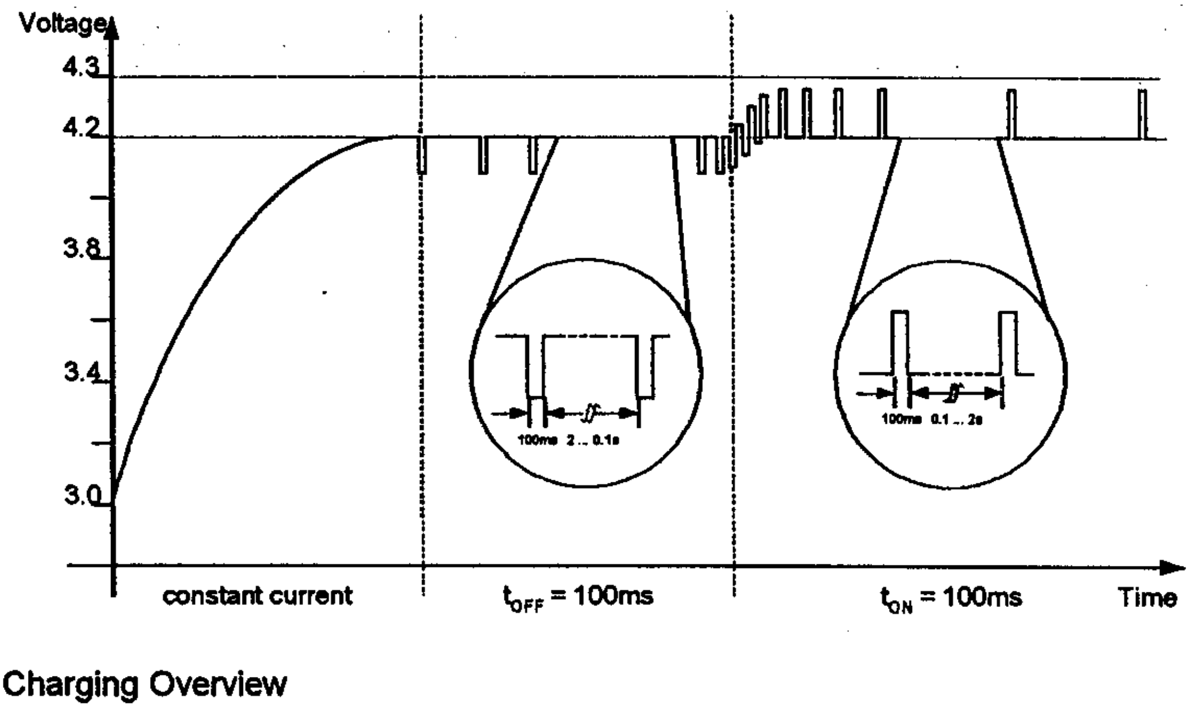


Figure 5: Fast charging process

If the battery voltage fails to pass the 3.2V level within 60 minutes ±10%, and consequently, processor controlled charging does not start up automatically, you have the following options:

a) You can activate the IGT line by pulling it to ground. If the voltage is, meanwhile, above 3.0V the GSM engine proceeds to fast charging controlled by software.
b) Driving the IGT line to ground while the voltage is still below 3.0V has no effect at all. Only trickle charging would continue. Since trickle charging may take much time (more than 60 minutes), it is recommended to manually activate software controlled charging. To do so, shortly disconnect and reconnect the charger.
c) If no action is taken trickle charging goes on.

Note: Do not connect the charger to the VBATT+ lines. Only the POWER lines are intended as input for charging!
The battery manufacturer must guarantee that the battery complies with the described charging technique. Please refer to the Application notes "Battery Pack" and "Charging the Battery Pack" for a detailed description of the charging characteristics.

3.2.4.2 Charger requirements

The charger must be designed to meet the following requirements:

a) Simple transformer power plug
- Output voltage: 5.5V...8V (under load)
- The charge current must be limited to 500mA
- At an output voltage of 2.8V the current must never exceed 1A.
- Voltage spikes that may occur while you connect or disconnect the charger must be limited to a maximum of 25V and must not exceed 1ms.
- There must not be any capacitor on the secondary side of the power plug (avoidance of current spikes at the beginning of charging)

b) Supplementary requirements for a) to ensure a regulated power supply
- Output voltage: 5.5V...8V
- Current limit: 500mA
- When current is switched off a voltage peak of 10V is allowed for a maximum 1ms
- When current is switched on a spike of 1.6A for 1ms is allowed

Note: To detect extreme thermal conditions while charging is in progress, connect a NTC (10kΩ @ 25°C, B=3370 Kelvin ±3%) from ACCU_TEMP to GND.

3.2.4.3 Operating modes during charging

While charging is in progress, the GSM engine can adopt two modes referred to as Charge mode or Charge-only mode.

	How to activate mode	Advantages
Charge mode	Connecting charger to the POWER lines while • GSM engine is operating, e.g. in IDLE or TALK mode • is in SLEEP mode	• Battery can be charged while GSM engine remains operational and registered to the GSM network. • In IDLE and TALK mode, the RS-232 interface is accessible. AT command set can be used to full extent. • In SLEEP mode, the RS-232 interface is not accessible at all.
Charge-only mode	Connecting charger to the POWER lines while GSM engine is • in Power Down mode (powered down by AT^SMSO) • in Normal mode: Connect charger to POWER lines, then enter AT^SMSO.	• Battery can be charged while GSM engine is deregistered from GSM network. • Charging runs smoothly due to constant current consumption. • The AT interface is accessible and allows to use the commands listed below.

Once the GSM engine enters the Charge-only mode, the AT command interface presents an Unsolicited Result Code (URC) which reads:
^SYSSTART CHARGE-ONLY MODE

Note that this URC will not appear when autobauding was activated (due to the missing synchronization between DTE and DCE upon start-up). Therefore, it is recommended to select a fixed baudrate before using the Charge-only mode.

While the Charge-only mode is in progress, you can take advantage of the AT commands listed in Table 5. For further instructions refer to the AT Command Set.

Table 5: AT commands available in Charge-only mode

AT command	Use
AT+CALA	Set alarm time
AT+CCLK	Set date and time of RTC
AT^SBC	Monitor charging process Note: While charging is in progress, no battery parameters are available. To query the battery capacity disconnect the charger. If the charger connects *externally* to the host device no charging parameters are transferred to the module. In this case, the command cannot be used.
AT^SCTM	Query temperature range, enable/disable URCs to report critical temperature ranges
AT^SMSO	Power down GSM engine

To proceed from Charge-only mode to normal operation, it is necessary to drive the ignition line to ground. This must be implemented in your host application as described in Chapter 3.3.1.1.

If your host application uses the SYNC pin to control a status LED as described in Chapter 3.8.2.2, please note that the LED is off while the GSM engine is in Charge-only mode.

3.3 Power up / down scenarios

3.3.1 Turn on the GSM engine

MC35 can be activated in a variety of ways which are described in the following chapters:

- via ignition line IGT: starts normal operating state
- via POWER lines: starts charging algorithm
- via RTC interrupt: starts Alarm mode

3.3.1.1 Turn on GSM engine using the ignition line IGT (Power on)

To switch on MC35 the IGT (Ignition) signal needs to be driven to ground level for at least 100ms. This must be accomplished with an open drain/collector driver to avoid current flowing into this pin.

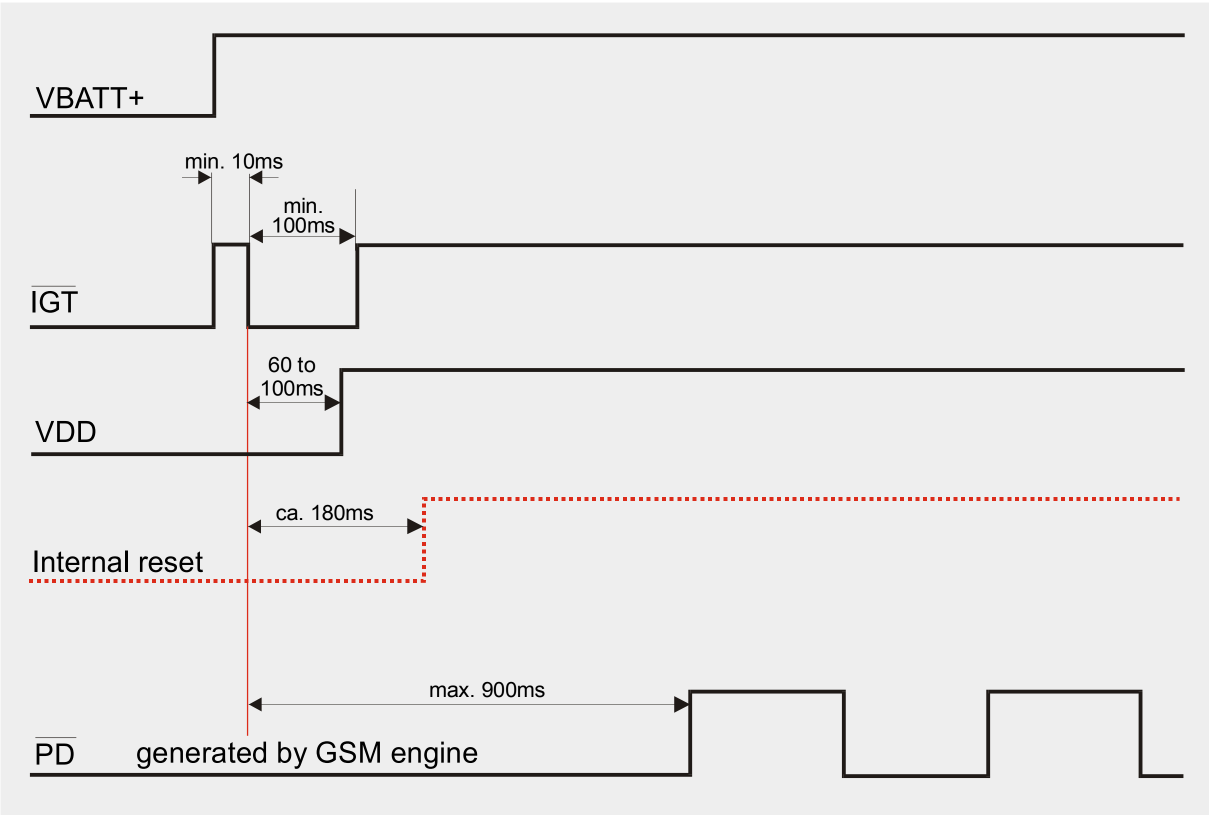


Figure 6: Power-on by ignition signal

Note: If a charger and a battery connect to the GSM engine the duration of the IGT signal must be 1s minimum.

3.3.1.2 Timing of the ignition process

When designing your application platform take into account that powering up MC35 requires the following steps.

- The ignition line cannot be operated until V_{BATT+} passes the level of 3.0V.
- 10ms after V_{BATT+} has reached 3.0V the ignition line can be switched low. The duration of the falling edge must not exceed 1ms.
- Another 100ms are required to power up the module.
- Ensure that V_{BATT+} does not fall below 3.0V while the ignition line is driven. Otherwise the module cannot be activated.

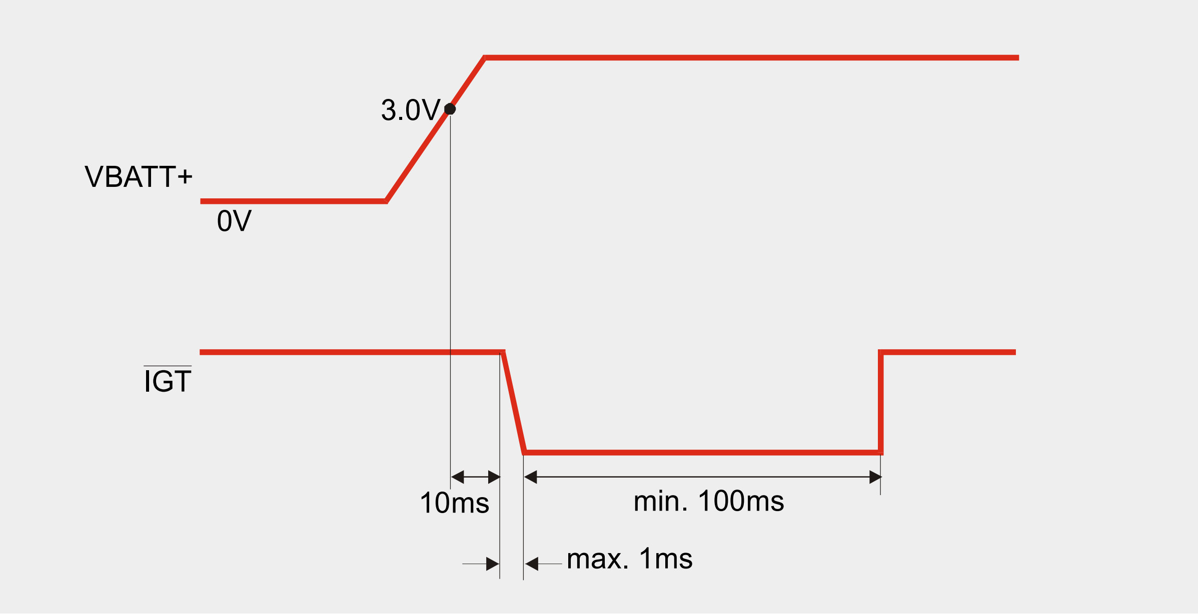


Figure 7: Timing of power-on process

3.3.1.3 Turn on GSM engine using the POWER lines

As detailed in Chapters 3.2.4.1 and 3.2.4.3, the charging adapter can be connected regardless of the GSM engine's operating mode. If the charger is connected to the POWER lines while the GSM engine is off, only the charging algorithm will be launched. The GSM engine runs in a restricted mode, referred to as Charge-only mode.

During the Charge-only mode the GSM engine is neither logged on to the GSM network nor is the RS-232 interface fully accessible. When the minimum voltage of 3.2V is achieved within 60 minutes and the charging process changes from trickle charging to software controlled charging. To switch to normal software mode and log on to the GSM network, the IGT line needs to be activated.

See Chapter 3.2.4.1 for a detailed description of the charge-only mode.

3.3.1.4 Turn on GSM engine using RTC (Alarm mode)

Another power-on approach is to use the RTC, which is constantly supplied with power from a separate voltage regulator in the power supply ASIC. The RTC provides an alert function which allows to wake up the GSM engine while power is off. To prevent the engine from unintentionally logging into the GSM network, this procedure only enables restricted operation, referred to as Alarm mode. It must not be confused with a wake-up or alarm call that can be activated by using the same AT command, but without switching off power.

Use the *AT+CALA* command to set the alarm time. The RTC retains the alarm time if the GSM engine was powered down by AT^SMSO. Once the alarm is timed out and executed, the GSM engine enters into the Alarm mode. This is indicated by an Unsolicited Result Code (URC) which reads:

    ^SYSSTART ALARM MODE

In Alarm mode only a limited number of AT commands is available. For further instructions refer to the AT Command Set.

Table 6: AT commands available in Alarm mode

AT command	Use
AT+CALA	Set alarm time
AT+CCLK	Set date and time of RTC
AT^SBC	Monitor charging process. Note: In Alarm mode, the command lets you only check whether or not a charger is connected. The battery capacity is returned as 0, regardless of the actual voltage (since the values measured directly on the cell are not delivered to the module).
AT^SCTM	Query temperature range, enable/disable URCs to report critical temperature ranges
AT^SMSO	Power down GSM engine

For the GSM engine to change from the Alarm mode to full operation (normal operating mode) it is necessary to drive the ignition line to ground. This must be implemented in your host application as described in Chapter 3.3.1.1.

If your host application uses the SYNC pin to control a status LED as described in Chapter 3.8.2.2, please note that the LED is off while the GSM engine is in Alarm mode.

3.3.2 Wake up GSM engine

The following table summarizes the options of waking up the GSM engine from SLEEP or Power Down mode. See also Table 8 for further information.

Table 7: Wake-up events

GSM engine is registered to GSM network	
How to wake up	From SLEEP mode
Ignition line	Not relevant
RTS (falling edge)	Yes
Unsolicited Result Code (URC)	Yes
Incoming call	Yes
Incoming SMS depending on mode selected by AT+CNMI: AT+CNMI=0,0 (= default, no indication upon receipt of SMS) AT+CNMI=1,1 (= displays URC upon receipt of SMS)	 No Yes
RTC alarm	Yes
GSM engine is detached from GSM network	
How to wake up	From Power Down mode
Ignition line	Yes (see Chapter 3.3.1.1)
RTS (falling edge)	No
Unsolicited Result Code	No
Incoming call	No
RTC alarm	Yes, but only wake-up into Alarm mode (see Chapter 3.3.1.4)
Charger to POWER lines	Yes, but only wake-up into Charge-only mode (see Chapter 3.2.4.3)

3.3.3 Turn off GSM engine

To switch the module off you can use one of the two options:

- *Normal procedure*: Software controlled by sending an AT command over the RS232 application interface. See Chapter 3.3.3.1.
- *Emergency shutdown*: Hardware driven by switching the PD (Power Down) line of the ZIF connector to ground = immediate shutdown of supply voltages, only applicable if the software controlled procedure fails! See Chapter 3.3.3.2.

3.3.3.1 Turn off GSM engine using AT command

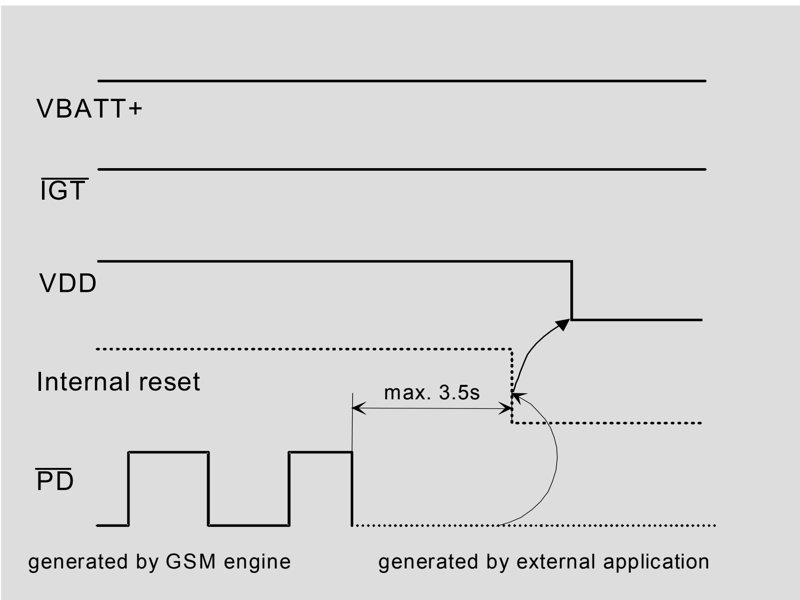
The best and safest approach to powering down MC35 is to issue the *AT^SMSO* command. This procedure lets MC35 log off from the network and allows the software to enter into a secure state and to save data before disconnecting the power supply.

If the module is in Charge Only mode (not logged into the GSM network), it switches off when the voltage is disconnected from the POWER inputs.

3.3.3.2 Emergency shutdown (using PD pin)

Caution: Use the PD 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 MC35 fails to shut down properly.

The PD signal is available on the ZIF connector. To control the PD line it is recommended to use an open drain / collector driver. To actually turn the GSM engine off, the PD line has to be driven to ground for ≥ 3.5 s.



How does it work:

- Voltage VBATT+ is permanently applied to the module.
- The module is active while the internal reset signal is kept at high potential.
- The module turns off once the PD signal is grounded, the baseband processor stops sending watchdog pulses to the ASIC and the VDD line goes low.

Figure 8: Deactivating GSM engine by Power Down signal

3.3.4 Summary of state transitions

Table 8: State transitions of MC35

The table shows how to proceed from one mode to another (gray column = present mode, white columns = intended modes)

Further mode →→→ Present mode	Power Down	Normal mode**)	Charge-only mode*)	Charging in normal mode*)**)	Alarm mode
Power Down mode without charger	---	IGT >100 ms at low level	Connect charger to POWER (high level at POWER)	No direct transition, but via "Charge-only mode" or "Normal mode"	Wake-up from Power Down mode (if activated with AT+CALA)
Power Down mode with charger (high level at POWER pin)	---	IGT (if supply voltage is above 3.0V). No automatic transition, but via Power Down mode without charger	100ms < IGT < 500ms at low level	IGT >1 s at low level	Wake-up from Power Down mode (if activated with AT+CALA)
Normal mode**)	AT^SMSO or exceptionally PD pin > 3.5 s at low level	---	No automatic transition, but via "Power Down"	Connect charger to POWER (high level at POWER)	AT+CALA followed by AT^SMSO
Charge-only mode *)	Disconnect charger (POWER at low level) or AT^SMS0 or exceptionally PD pin >3.5 s at low level	No automatic transition, but via "Charge in Normal mode"	---	IGT >1 s at low level	No direct transition
Charging in normal mode*) **)	Via "Charge-only mode" or exceptionally PD pin > 3.5 s at low level	Disconnect charger from POWER	AT^SMSO	---	No direct transition
Alarm mode	AT^SMSO or exceptionally PD pin > 3.5 s at low level	IGT >100 ms at low level	Connect charger to POWER (high level at POWER)	No direct transition, but via "Charge-only mode" or "Normal mode"	---

*) See Chapter 3.2.4.1 for details on the charging mode

**) Normal mode covers TALK, IDLE and SLEEP modes

3.4 RTC backup

The internal Real Time Clock of MC35 is supplied from a voltage regulator of the power supply ASIC which is also active when MC35 is powered down. An alarm function is provided for activating and deactivating MC35.

In addition, you can use the VDDLP pin on the ZIF connector (pin no. 30) to backup the RTC from an external capacitor or a battery (rechargeable or non-chargeable). The capacitor is charged by the VBATT+ line of MC35. If the voltage supply at VBATT+ is disconnected the RTC can be powered by the capacitor. The size of the capacitor determines the duration of buffering when no voltage is applied to MC35, i.e. the greater capacitor the longer MC35 will save the date and time.

A serial resistor placed on the board next to VDDLP limits the input current of an empty capacitor. This eliminates the need of adding a resistor as required on TC35 or TC37 applications.

The following figures show various sample configurations. The voltage applied at VDDLP can be in the range from 2 to 5.5V. Please refer to Table 14 for the parameters required.

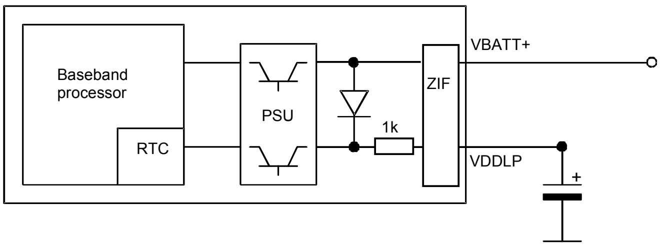


Figure 9: RTC supply from capacitor

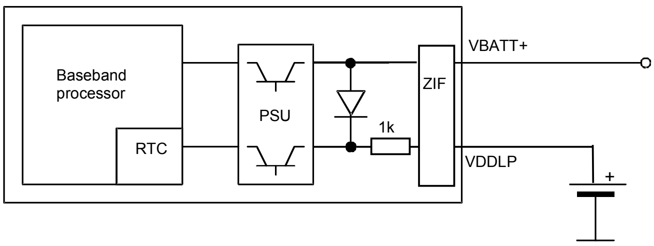


Figure 10: RTC supply from rechargeable battery (accumulator)

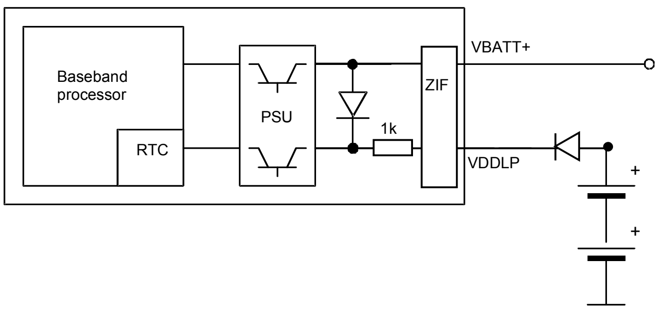


Figure 11: RTC supply from non-chargeable battery

3.5 Serial interface

This chapter describes the data interface of the MC35 GSM Engine. The data interface operates at CMOS level (2.65V).

Note: The MC35 GSM engine is connected like a DCE:

TxD MC35	*receives data from*	*TxD Application*
RxD MC35	*sends data to*	*RxD Application*

All RS232 signals on the ZIF connector are low active!

An overview of the data interface signals is given in *Figure 12.*

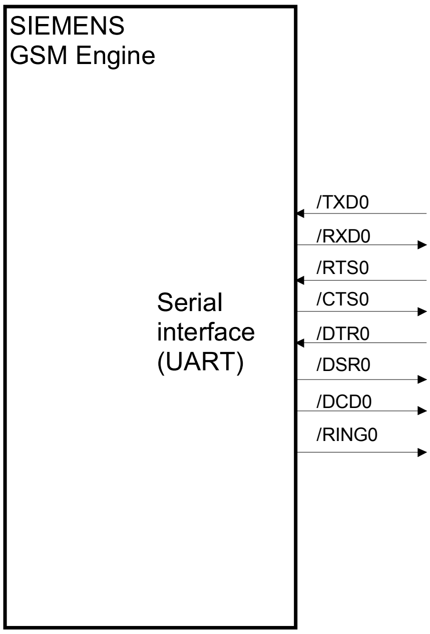


Figure 12: RS232 interface

The data interface is implemented as a serial asynchronous transmitter and receiver conforming to ITU-T RS232 Interchange Circuits DCE. It has fixed parameters of 8 data bits, no parity and 1 stop bit, and can be selected in the range of 1.2kbps up to 115kbps for autobauding and in the range of 300baud to 115kbps for manual settings. Hardware handshake using signals RTS0 / CTS0 and software flow control via XON/XOFF are supported.

In addition, the modem control signals DTR0*), DSR0, DCD0 and RING0 are available. The modem control signal RING0 (Ring Indication) is supported to indicate an incoming call to the cellular device application. There are different modes of operation, which are software-selectable (AT commands).

*) **The DTR0 signal will only be polled once per second from the internal firmware of MC35 !**

3.6 Audio interface

MC35 comprises two audio interfaces, each with an analog microphone input and an analog earpiece output (see block diagram below).

To suit several types of equipment, there are six audio modes available which can be selected with the AT^SNFS command. The electrical characteristics of the voiceband part vary with the audio mode. For example, sending and receiving amplification, sidetone paths, noise suppression etc. depend on the selected mode and can be set with AT commands (except for mode 1).

Please refer to Chapter 6.5 for specifications of the audio interface and an overview of the audio parameters. Detailed instructions on using AT commands are presented in the "MC35 AT Command Set". Table 25 on page 62 summarizes the characteristics of the various audio modes and shows what parameters are supported in each mode.

The first audio interface can be set to the audio modes 1 (default), 4 and 5. The default configuration is optimized for the Votronic HH-SI-30.3/V1.1/0 handset and used for type approving the Siemens reference configuration. Audio mode 1 has fix parameters which cannot be modified. In audio mode 4, you can avail of AT commands to adjust the Votronic handset as well as any individual handset.

The second audio interface is especially intended for headsets and can be configured to the audio modes 2, 3 or 6. In order to integrate a handsfree application you can take advantage of the Siemens Car Kit Portable and connect it to the second interface.

All microphone inputs and the earpiece / headset outputs are balanced. A power supply for electret microphones is implemented and can be used with in audio modes 1 to 4. If not needed, it has to be decoupled with capacitors.

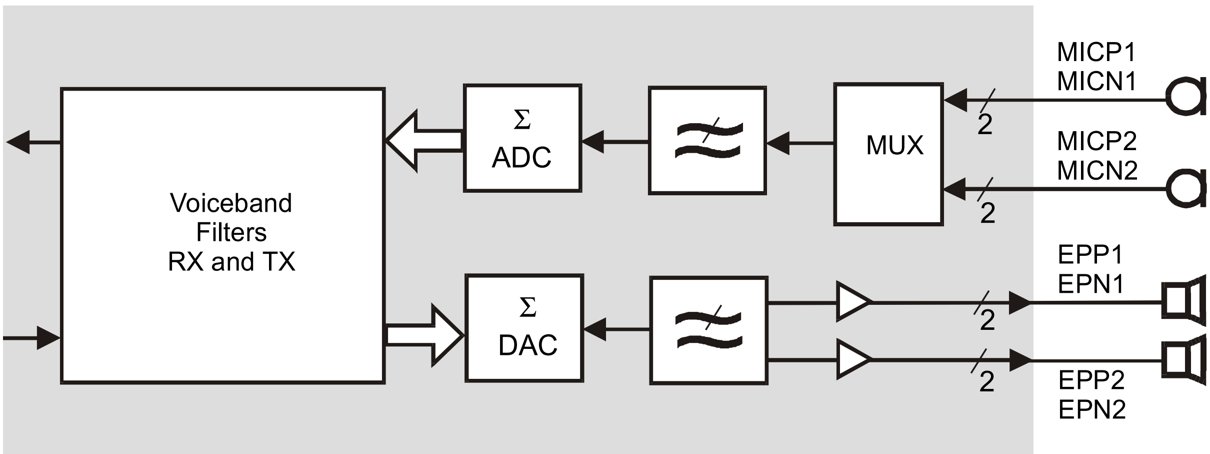


Figure 13: Audio block diagram

3.6.1 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 2Mbit/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 headset 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 2Mbit/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.

3.7 SIM interface

The baseband processor has an integrated SIM interface compatible with the ISO 7816-3 IC Card standard. This is wired to the host interface (ZIF connector) in order to be adapted to an external SIM card holder.

Six pins on the ZIF connector are reserved for the SIM interface. Further to the five wire SIM interface according to GSM 11.11, the CCIN pin has been added. The CCIN pin serves to detect mechanically whether or not a card is inserted into the card holder. The default level of CCIN is low (internal pull down resistor, no card inserted). It must go high when the card is inserted.

To take advantage of this feature, an appropriate contact is required on the card holder. For example, this is true for the model supplied by Molex Deutschland GmbH, which was tested within the Siemens reference configuration (Molex ordering number 91228-0001). Ensure that the card holder on your application platform be wired to output a high signal when the SIM card is present.

Note: Before removing the SIM card or inserting a new one be sure that the GSM engine has been powered down as described in Chapter 3.3.

Table 9: Signal of the SIM interface

Signal	Description
CCRST	Chipcard reset, provided by baseband processor
CCCLK	Chipcard clock, various clock rates can be set in the baseband processor
CCIO	Serial data line, input and output.
CCIN	Input on the baseband processor for detecting the SIM in the holder; if the SIM is removed during operation the interface is shut down immediately to prevent destruction of the SIM.
CCVCC	SIM supply voltage.
CCGND	Separate ground connection for SIM card to improve EMC

3.7.1 Updating firmware over SIM interface

MC35 offers two different solutions for updating firmware. To download the software onto the module, you can either use the SIM interface or, if available on your application platform, the RS232 interface of the ZIF connector. To avail of the SIM option, you will need to purchase a special adapter named BB35 BootBox. Click http://www.siemens.com/wm for further details and ordering information.

3.8 Control signals

The following control signals are available (2.65V CMOS level).

3.8.1 Inputs

Table 10: Input control signals of the MC35 module

Function	Pin	Status	Description
Ignition	$\overline{\text{IGT}}$	= falling edge	Power on MC35
		= 1	No operation
	Active low ≥ 100ms (Open drain/collector driver required in cellular device application) Note: If a charger and a battery is connected to the customer application the IGT signal must not be less than 1s.		
Power down	$\overline{\text{PD}}$	= 0	Power down GSM Engine MC35
		= 1	No operation
	Active low ≥ 3.5s (Open drain/collector driver required in cellular device application). At the PD signal the watchdog signal of the GSM Engine can be traced (see description in Table 14).		

3.8.2 Outputs

3.8.2.1 Synchronization signal

The synchronization signal serves to indicate growing power consumption during the transmit burst. The signal is generated by the SYNC pin (pin number 32). Please note that this pin can adopt two different operating modes which you can select by using the AT^SSYNC command (mode 0 and 1). For details refer to the "AT Command Set".

To generate the synchronization signal the pin needs to be configured to mode 0 (= default). This setting is recommended if you want your application to use the synchronization signal for better power supply control. Your platform design must be such that the incoming signal accomodates sufficient power supply to the MC35 module if required. This can be achieved by lowering the current drawn from other components installed in your application. The characteristics of the synchronization signal are explained below.

Table 11: MC35 synchronization signal (if SYNC pin is set to mode 0 via AT^SSYNC)

Function	Pin	Status	Description
Synchronization	SYNC	= 0	No operation
		= 1	Indicates increased power consumption during transmission.

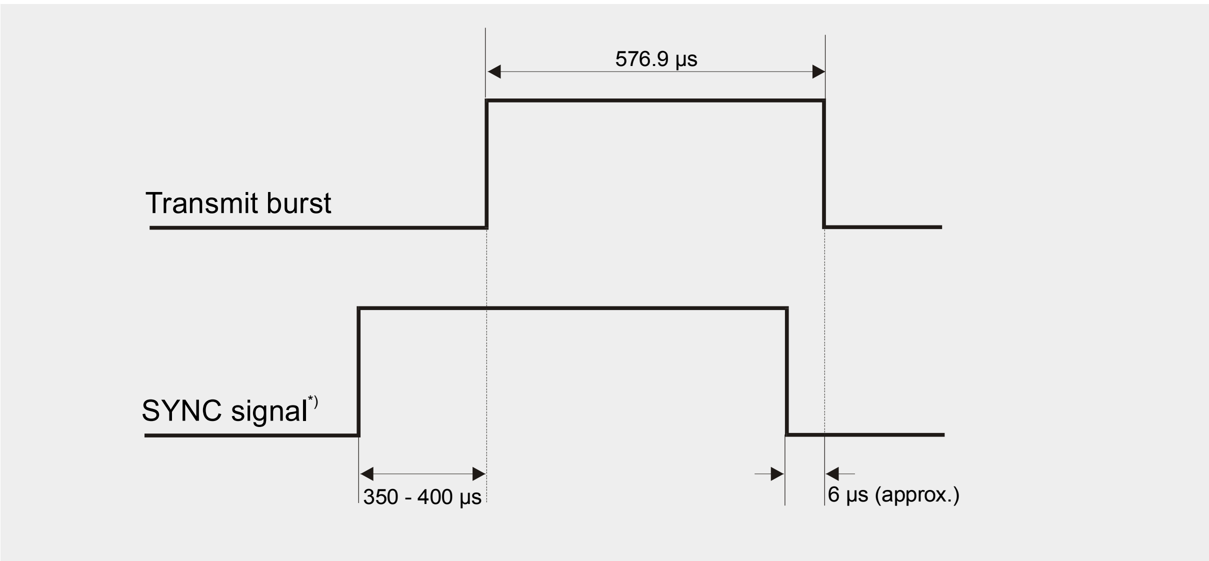


Figure 14: MC35 output control signals

*) The duration of the SYNC signal is always equal, no matter whether the traffic or the access burst are active.

3.8.2.2 Using the SYNC pin to control a status LED

As an alternative to generating the synchronization signal, the SYNC pin can be used to control a status LED on your application platform.

To avail of this feature you need to set the SYNC pin to mode 1 by using the AT^SSYNC command. For details see the "AT Command Set".

When controlled from the SYNC pin the LED can display the following functions:

Table 12: Modes of the LED and associated functions

LED mode	Function
Off *)	MC35 is off or in Sleep mode
600 ms On / 600ms Off *)	No SIM card inserted or no PIN entered, or network search in progress, or ongoing user authentication, or network login in progress.
75ms On / 3s Off *)	Logged to network (monitoring control channels and user interactions). No call in progress.
On	Depending on type of call: *Voice call:* Connected to remote party. *Data call:* Connected to remote party or exchange of parameters while setting up or disconnecting a call.

*) LED Off = SYNC pin low. LED On = SYNC pin high

To operate the LED a buffer, e.g. a transistor or gate, must be included in your application. A sample configuration can be gathered from Figure 15. Power consumption in the LED mode is the same as for the synchronization signal mode. For details see Table 14, pin number 32.

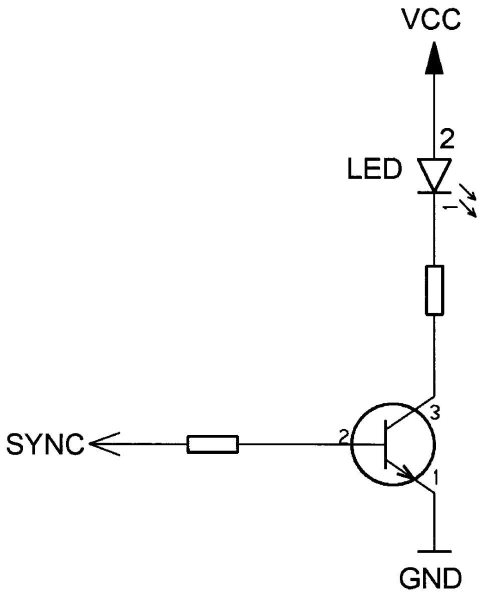


Figure 15: LED Circuit (Example)

3.8.2.3 Behavior of the RING0 line

The behavior of the RING0 line depends on the type of the call received.

- When a *voice call* comes in the RING0 line goes low for 1s and high for another 4s. Every 5 seconds the ring string is generated and sent over the RXD0 line.
  If there is a call in progress and call waiting is activated for a connected handset or handsfree device, the RING0 pin switches to ground in order to generate acoustic signals that indicate the waiting call.

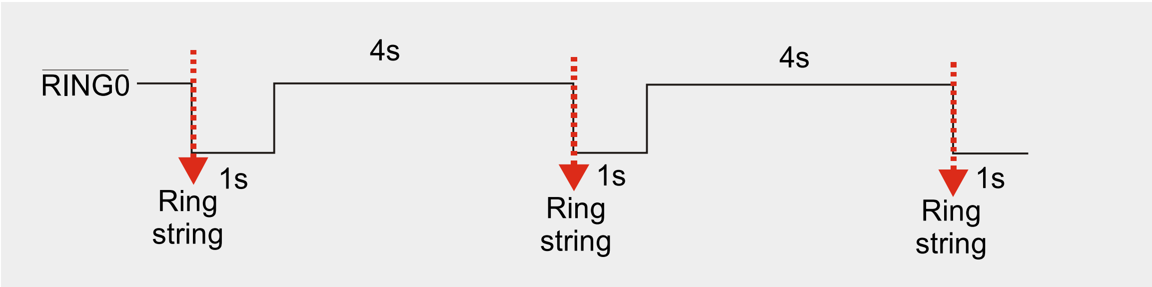


Figure 16: Incoming voice call

- Likewise, when a *Fax* or *data call* is received, RING0 goes low. However, in contrast to voice calls, the line remains low. Every 5 seconds the ring string is generated and sent over the RXD0 line.

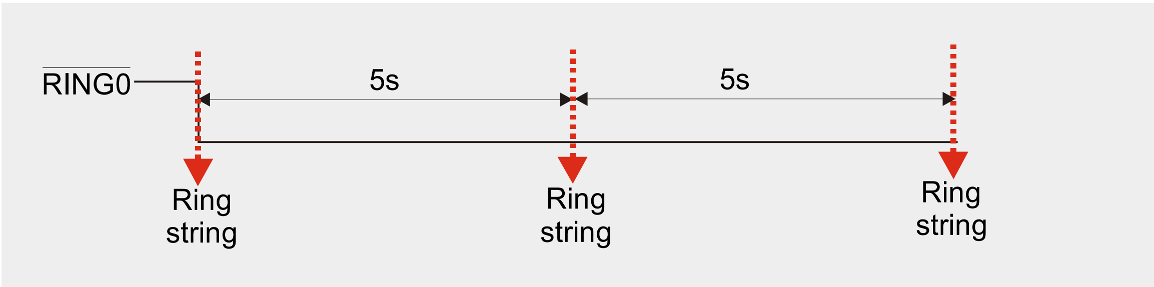


Figure 17: Incoming data call

- An incoming *SMS* can be indicated by an Unsolicited Result Code (URC) which causes the RING line to go low for 1 second only. Using the AT+CNMI command you can configure MC35 whether or not to send URCs upon the receipt of SMS. For instance, enter *AT+CNMI=1,1* to activate URCs for incoming short messages. For more details please refer the "MC35 AT Command Set".

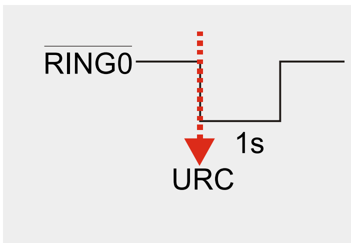


Table 13: MC35 ring signal

Function	Pin	Status	Description
Ring indication	RING0	= 0	Indicates an incoming call. Wakeup of cellular device application.
		= 1	No operation

3.9 Pin assignment

Please note that the reference voltages listed below are the values measured directly on the MC35 module. They do not apply to the accessories connected.

Table 14: Pin assignment

Function	Signal Name	Pin No.	I/O	Signal Level	Comment
Power supply	VBATT+	1 2 3 4 5	I/O	Input: V_{in} = 3.3V...4.8V $I_{max} \leq$ 2A I_{max} is valid only during uplink transmission timeslot (e.g. TALK mode: I_{max} for 577µs every 4.616ms) Output*:* only valid when charging	Usage is mandatory Five power supply pins have to be connected in parallel due to peak current up to 2A Voltage must stay within the min/max values, including voltage drop, ripple, spikes. See also Table 23.
	GND	6 7 8 9 10	-	Ground (0V)	
Charger	POWER	11 12	I	V_{in} = 5.5V...8V I_{max} = 500mA Internal Pull Down (100kΩ)	If unused keep pin open
Supply voltage for external application	VDD	13	O	IDLE / TALK mode: V_{out} = 2.9V ±3% @ 70mA I_{max} = 70mA Power Down mode: V_{out} = 0V C_{load} max,extern = 1µF	If unused keep pin open Voltage is applied 60ms – 100ms after IGT was driven low.
Battery temperature	ACCU_ TEMP	14	I/O	External NTC: R_{NTC} = 10kΩ @ 25°C ±3% connected to GND IDLE / TALK mode: $V_{out,MEAS}(R_{NTC}$=10kΩ)=1.15V Power Down mode: V_{out} = 0V (internal Pull Down)	If unused keep pin open. If used: external NTC should be installed inside or near battery pack enables the charging algorithm and delivers temperature values
Ignition	$\overline{IGT}$	15	I	IDLE / TALK / Power Down mode: $V_{in,\ high,\ min}$ = 2.0V R_{pullup} = 200kΩ $V_{low,max}$ = 0.45V @ I_{out} = 10µA $t_{low} \geq$ 100ms *(see Chapter 3.3!)* Signal: falling edge and hold for t_{low}	Usage is mandatory Open drain/collector driver or a simple switch is required to pull down this pin to power on MC35. Signal is low active.

Function	Signal Name	Pin No.	I/O	Signal Level	Comment
RS232	DSR0	16	O	IDLE / TALK mode: Output: R_i = 1kΩ (serial resistor) $V_{out,low,max}$ = 0.2V @ I = 0.1mA $V_{out,high,min}$ = 2.25V @ I = -0.1mA $V_{out,high,max}$ = 2.76V Input: $R_i \geq$ 1MΩ $V_{in,low,min}$ = -0.3V, $V_{i,l,max}$ = 0.5V $V_{in,high,min}$ = 1.95V, $V_{i,h,max}$=3.3V Power Down mode: • Signals are low active. • Be aware of backward supply effects at the *inputs* and *outputs*	Application interface to control MC35 via AT commands If unused keep output pins open and connect input pins to GND via 10kΩ. When a voice call comes in RING0 goes active low for 1s and inactive high for another 4s (alternating). An incoming data call also causes RING0 to go active low, but without changing to inactive high. See Chapter 3.8.2.3. DCD0 and DTR0 lines are connected via internal clamp diodes to 2.65V and GND
	$\overline{\text{RING0}}$	17	O		
	RxD0	18	O		
	TxD0	19	I		
	CTS0	20	O		
	RTS0	21	I		
	DTR0	22	I		
	DCD0	23	O		
SIM	CCIN	24	I	IDLE / TALK mode: SIM contact (active high) R_{PD} = 100kΩ (internal Pull Down resistor to GND) R_i = 10kΩ (serial resistor) $V_{in,low,max}$ = 0.4V $V_{in,high,min}$ = 2.15V, $V_{i,h,max}$ = 3.3V Power Down mode: Be aware of backward supply	All signals of the SIM interface are protected from electrostatic discharge with spark gaps to GND and clamp diodes to 2.9V and GND If a card is inserted CCIN has to be at high level If not used connect to CCVCC
	CCRST	25	O	R_i ~ 47 Ω External C = 1nF to CCGND required. This capacitor must be located close to the SIM card reader.	Usage is mandatory Signal levels according to GSM Rec. (2) FFC must not exceed 200mm to meet the timing requirements of GSM Rec. 11.10
	CCIO	26	I/O	Output: R_i ~ 220 Ω (serial resistor) V_{OL}max = 0.2 V at I = 0.1 mA V_{OH}min = 2.25 V at I = -0.1 mA V_{OH} = 2.76 V Input: R_i ~ 10 kΩ V_{IL}min=-0.3 V, V_{IL}max = 0.5 V V_{IH}min = 1.95 V, V_{IH}max=3.3 V	

Function	Signal Name	Pin No.	I/O	Signal Level	Comment
SIM	CCLK	27	O	Output: R_i ~ 220 Ω (serial resistor) V_{OL}max = 0.2 V at I = 0.1 mA V_{OH}min = 2.25 V at I = -0.1 mA V_{OH} = 2.76 V	
	CCVCC	28	O	$CCVCC_{min}$ = 2.84V $CCVCC_{max}$ = 2.96V I_{max} = 20mA External C ≥ 200nF to CCGND is required. This capacitor must be located close to the SIM card reader.	Usage is mandatory
	CCGND	29	O	Ground (0V)	Usage is mandatory. See Application note SIM Interface for details on grounding.
RTC backup	VDDLP	30	I/O I	IDLE/TALK/Power Down mode if VBATT+ connected: $V_{out} < V_{BATT+}$ R_i = 1kΩ (serial resistor) PD mode if VBATT+ disconnected: V_{in} = 2.0V...5.5V $I_{in,max}$ = 30µA	If unused keep pin open (see chapter 3.4)
Power down (only for emer-gency)	$\overline{PD}$	31	I/O	IDLE/ TALK mode input: $V_{in,low,max}$ = 0.45V @ I = 0.1mA input signal low ≥ 3.5s ~~~|_______|~~~ active Watchdog output: $V_{out,low}$ = 0.35V @ 0.01mA $V_{out,high}$ = 2.30V @ -0.01mA $f_{out,\ min\ =}$ = 0.16 Hz $f_{out,\ typ\ =}$ = 0.236 Hz $f_{out,\ max\ =}$ = 1.53 Hz	If unused keep pin open Open drain/collector driver or simple switch to GND required. PD switches MC35 off. A low pulse at pin IGT resets MC35 and restarts the system. The PD also indicates the internal watchdog function.
Synchroni-zation	SYNC	32	O	IDLE/ TALK mode: R_i = 1kΩ (serial resistor) $V_{out,low,max}$ = 0.2V @ 0.1mA $V_{out,high,min}$ = 2.25V @ -0.1mA $V_{out,high,max}$ = 2.76V Power Down mode: be aware of backward supply	If unused keep pin open Indication of in-creased current con-sumption during uplink transmission burst. Alternatively used to control status LED.

Function	Signal Name	Pin No.	I/O	Signal Level	Comment
Audio Interface	EPP2	33	O	R_i = 15Ω, (30kΩ if not active) V_{omax} = 3.7V_{pp}, no load, @ 3.14 dBm0: f = 1024Hz, audio mode = 6, outBbcGain = 0, outCalibrate = 16384	If unused keep pin open Differential output, e.g. for external loud-speaker amplifier for handsfree operation
	EPN2	34	O		
	EPP1	35	O	R_i = 15Ω, (30kΩ if not active) V_{omax} = 3.7V_{pp}, no load, @ 3.14 dBm0: f = 1024Hz, audio mode = 5, outBbcGain = 0, outCalibrate = 16384	If unused keep pin open Differential output, e.g. for internal ear-piece
	EPN1	36	O		
	MICP1	37	I	Z_i = 2kΩ V_{imax} = 1.03V_{pp} V_{supply} = 2.65V (0V if off), R_{DC} = 4kΩ	Keep unused inter-face open Balanced input with switchable micro-phone supply source, e.g. for internal micro-phone
	MICN1	38	I		
	MICP2	39	I	Z_i = 2kΩ V_{imax} = 1.03V_{pp} V_{supply} = 2.65V (0V if off), R_{DC} = 4kΩ	Keep unused inter-face open Balanced input with switchable micro-phone supply source, e.g. for external microphone for handsfree operation
	MICN2	40	I		

Explanation of signal names:
P = positive
N = negative

4 Radio interface

In transmit mode, the radio frequency part converts the I/Q baseband signals supplied by the baseband into a RF signal with characteristics as described by the GSM recommendation and which are then radiated by the antenna. In case of the receiving mode the radio part converts the RF signals supplied by the antenna into I/Q baseband signals which can then be further processed by the baseband.

The radio part is designed for dual band operation and can therefore serve the frequency bands GSM900 (including EGSM) and GSM1800. The following definitions have been made:

- The radio part can never transmit in both bands simultaneously.
- The radio part can never receive in both bands simultaneously.
- The monitor time slot can be selected independently of the frequency band.
- The transmitter and receiver never operate simultaneously.

4.1 Antenna interface (antenna reference point – ARP)

In order to connect the antenna MC35 uses a GSC connector. The interface is specified for an impedance of 50Ω with an SWR ≤ 2. MC35 is capable of withstanding a total mismatch at the antenna connector when transmitting at maximum RF power.

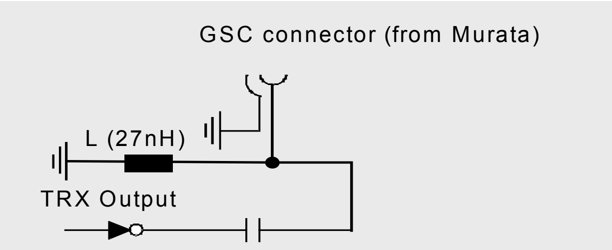


Figure 18: GSC connector circuit

To help you choose an appropriate antenna, Chapters 5.5 and 9 provide technical specifications and ordering information.

Table 15: Return loss

State of the module	Return loss of the module	Required return loss of application
receive	8dB min	10dB min
transmit	Not applicable	10dB min
idle	5dB max	Not applicable

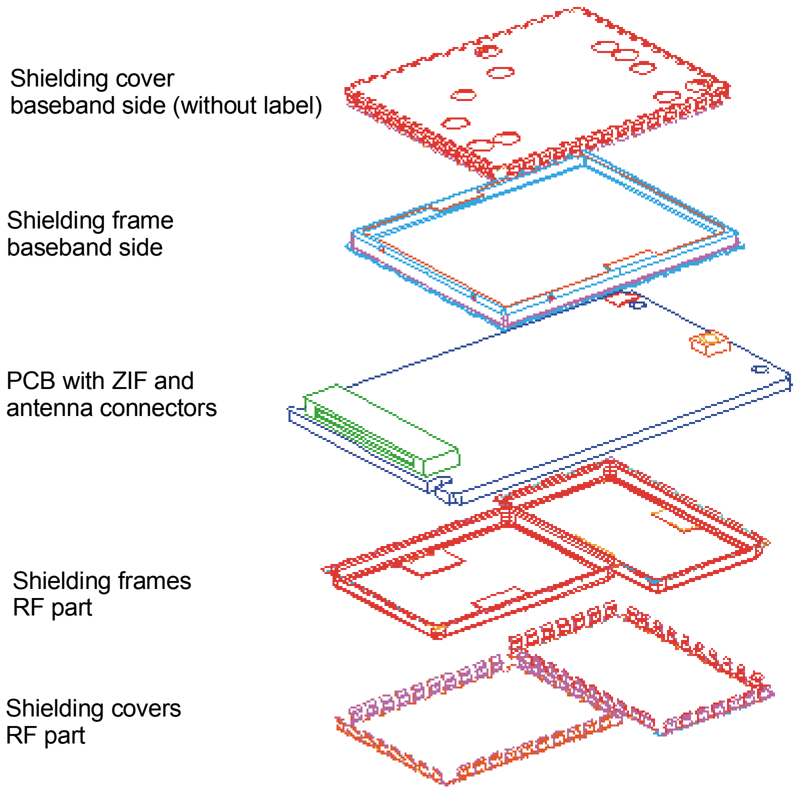
Table 16: Signals of GSC RF jack

Signal name	Pin	I/O	Description	Parameter
RF	Internal	I/O	RF input and output	Z = 50 Ω
GND	External	X	Ground connection	

5 Physical characteristics

5.1 Exploded diagram

Figure 19 shows an exploded assembly drawing of the MC35 module.



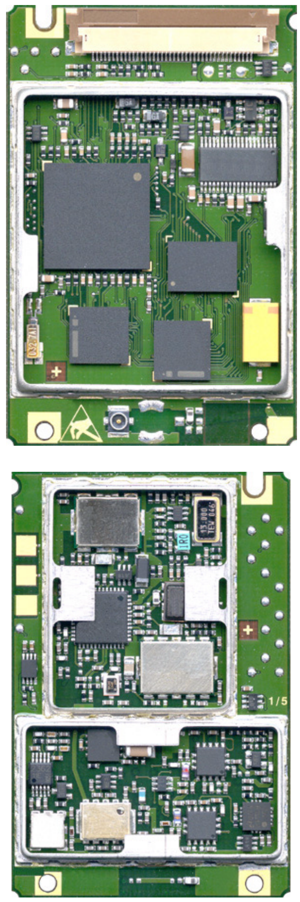


Figure 19: Exploded diagram of MC35

Figure 20: PCB of MC35 (top - baseband side, bottom - RF side)

5.2 Mechanical dimensions of MC35

Figure 21 shows the RF part of MC35 and provides an overview of the mechanical dimensions of the board. For further details see Figure 22.

Size: 54.5±0.2 x 36±0.2 x 6.70±0.35 mm

Weight: 17g

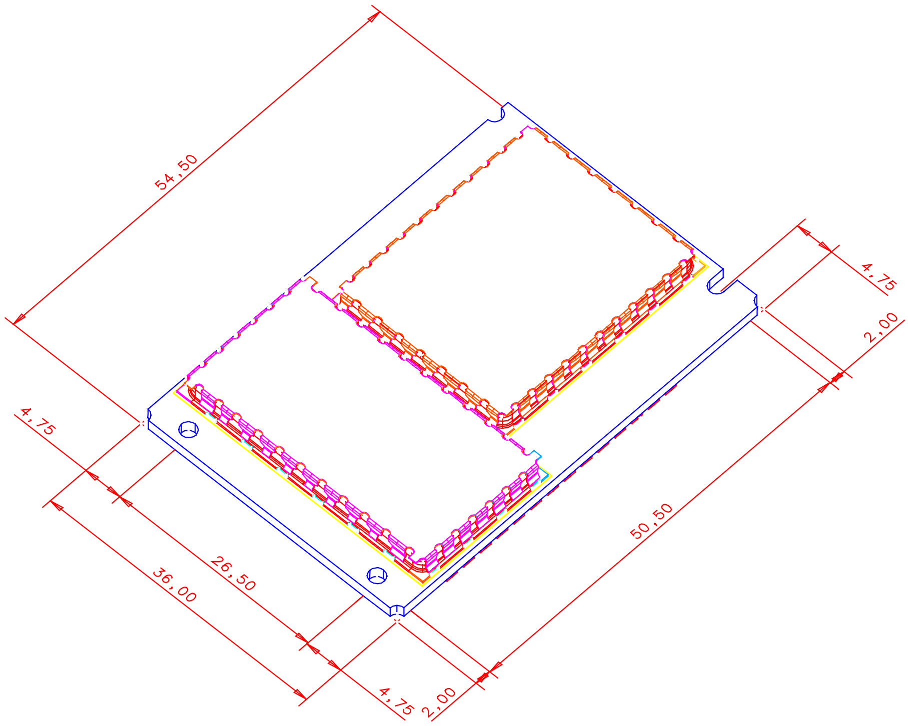
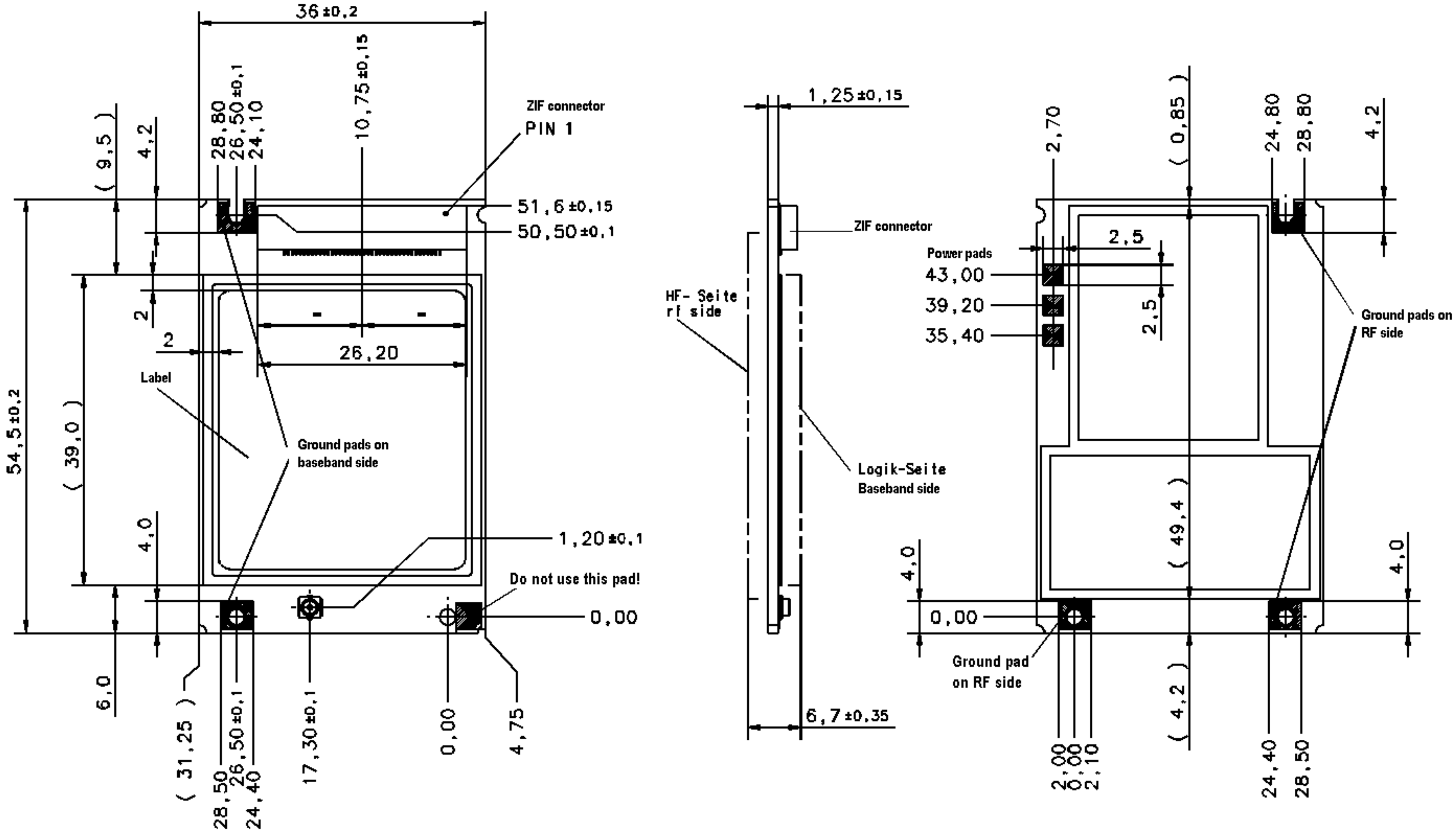


Figure 21: MC35 – view of RF side



0,00 = Reference point All dimensions in millimeter

Figure 22: Mechanical dimensions of MC35

5.3 Mounting MC35 onto the application platform

For the cellular application to operate reliably it is essential that the MC35 module is securely attached to the host housing.

The MC35 board provides three mounting holes. To properly mount it to the host device you can use M1.6 or M1.8 screws plus suitable washers. The maximum diameter of the screw head incl. the washer must not exceed 4 mm.

Avoid placing the MC35 board tightly to the host device. Instead, it is recommended to set spacers between the MC35 module and the host device. If your design approach does not allow for spacers make sure the host device provides an opening for the RF part.

For ease of migration from TC35 or TC37 GSM engines, MC35 features the same dimensions. The ZIF connector, the RF connector and the mounting holes are located at the same coordinates.

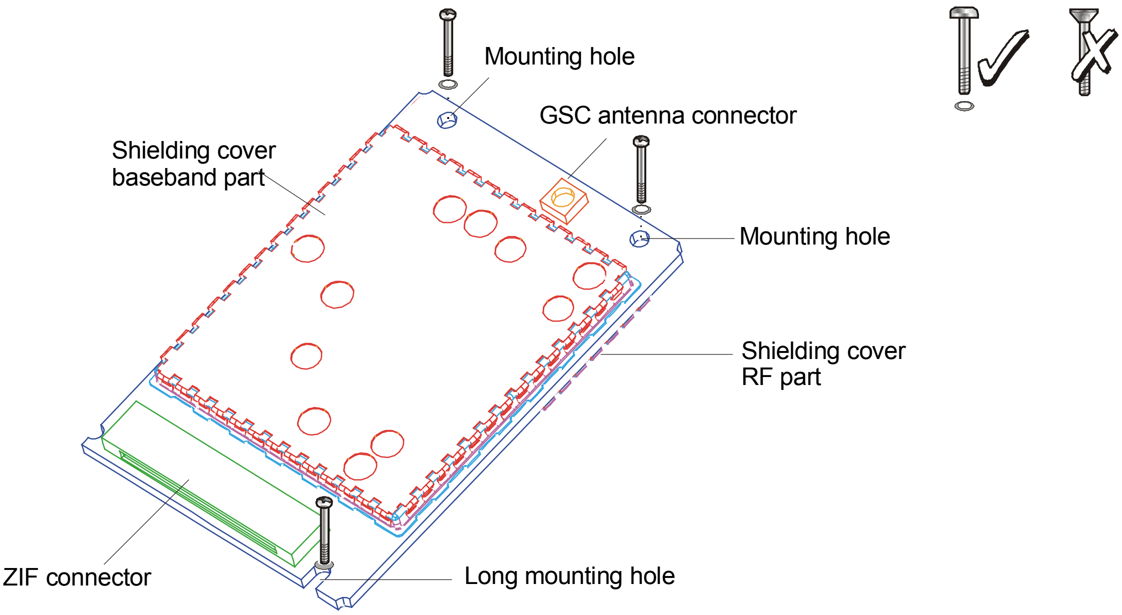


Figure 23: Mounting MC35 – view on baseband side

5.4 ZIF connector

This chapter provides specifications and handling instructions for the 40-pin ZIF connector and the Flat Flexible Cable (FFC) used to connect the GSM engine to the host application.

The ZIF (zero insertion force) design allows to easily fasten or remove the cable without the need for special tools. Simply insert the FFC cable into the open socket without using any pressure. Then carefully close the socket lid until the contacts of the socket grip the cable contacts.

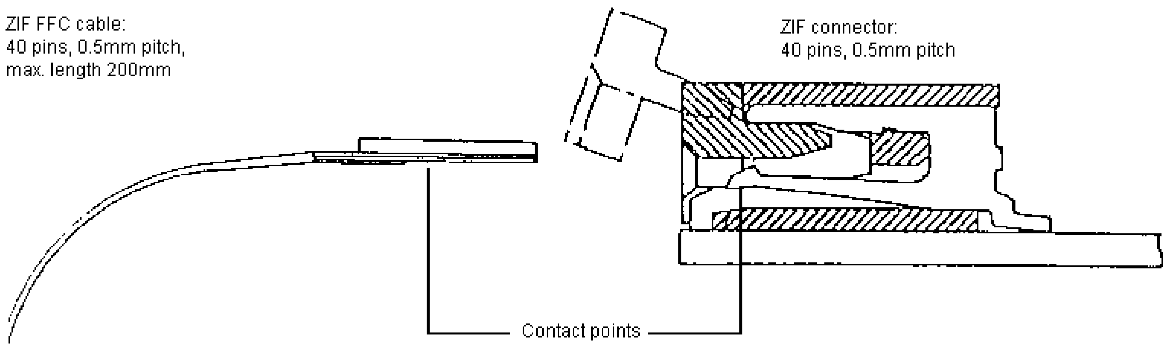


Figure 24: Connecting FFC cable to ZIF connector

Table 17: Electrical and mechanical characteristics of the ZIF connector

Parameter	Specification (40 pin ZIF connector)
Number of Contacts	40
Quantity delivered	2000 Connectors per Tape & Reel
Voltage	50V
Current Rating	0.4A max per contact
Resistance	0.05 Ohm per contact
Dielectric Withstanding Voltage	200V RMS min
Operating Temperature	-40°C...+85°C
Contact Material	Phosphor bronze (tin-lead plated)
Insulator Material	PPS, natural color
Slider Material	PPS, natural color
FFC/FPC Thickness	0.3mm ±0.05mm (0.012" ±0.002")
Profile Height	2.00mm
Dimension A	24
Dimension B	19.5
Dimension C	26.2
Maximum connection cycles	50
Cable	FFC (Flat Flexible Cable), max. length 200mm from SIM interface

5.4.1 Mechanical dimensions of the ZIF connector

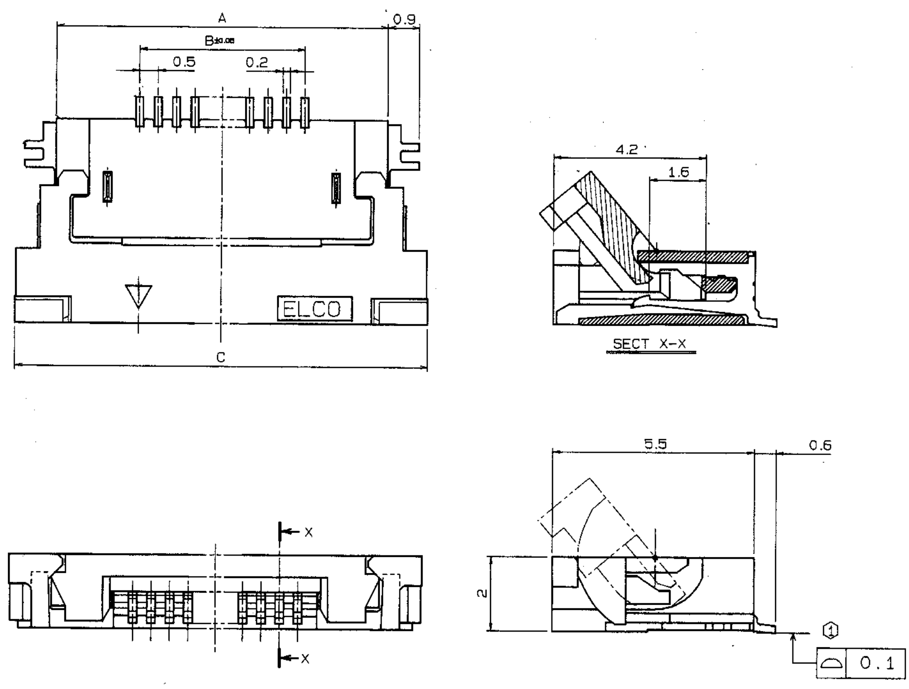


Figure 25:Mechanical dimensions of ZIF connector

Pad-Layout

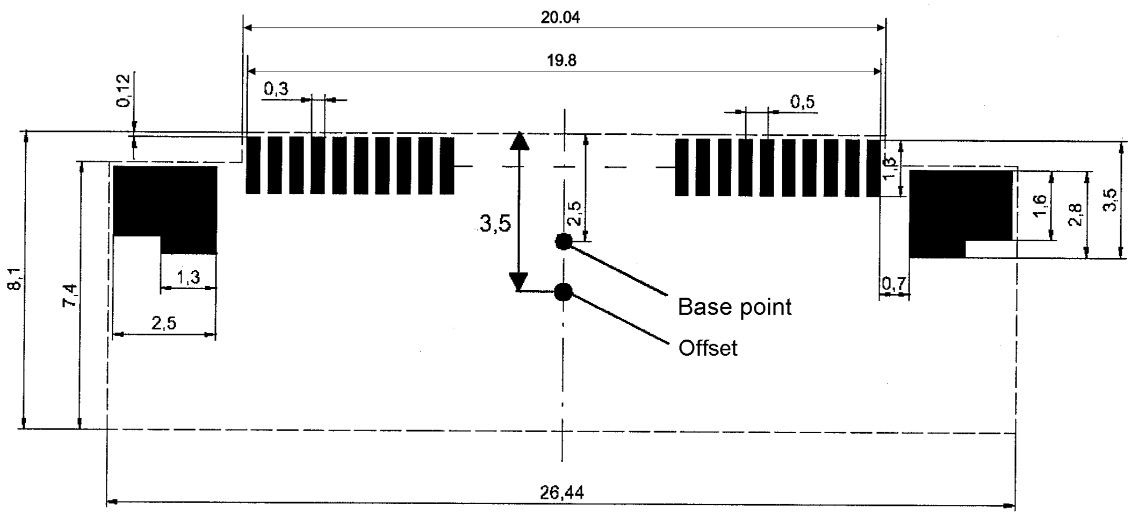


Figure 26: PCB ZIF connector

5.5 GSC antenna connector

MC35 uses a GSC antenna connector. Below please find brief ordering information to help you retrieve further details from the manufacturer MuRata, e.g. under http://www.murata.com.

Description	MuRata part number
Male connector mounted on TC35	MM9329-2700
Matching female connectors suited for individual cable assembly • Right-angle flexible cable • Right-angle flexible cable • Right-angle semirigid cable	 MXTK88xxxx MXTK92xxxx MXTK91xxxx

The physical dimensions and maximum mechanical stress limits can be gathered from the table and the figures below. To securely fasten or remove the antenna cable MuRata recommends to use a special engagement/disengagement tool.

Table 18: Ratings and characteristics of the GSC antenna connector

Item	Specification	
Frequency range	DC to 6GHz	
VSWR	1.2 max. (DC to 3 GHz), 1.3 max. 3GHz to 6GHz)	
Nominal impedance	50Ω	
Temperature range	-40°C to +90°C	
Contact resistance	15mΩ max.	
Insulation resistance	500MΩ min.	
Material and finish • Center contact: • Outer contact: • Insulator:	Material: Copper alloy Copper alloy Engineering plastic	Finish: Gold plated Silver plated None

Note: A 27nH inductor to ground provides additional ESD protection for the antenna connector. To protect the inductor from damage no DC voltage must be applied to the antenna circuit.

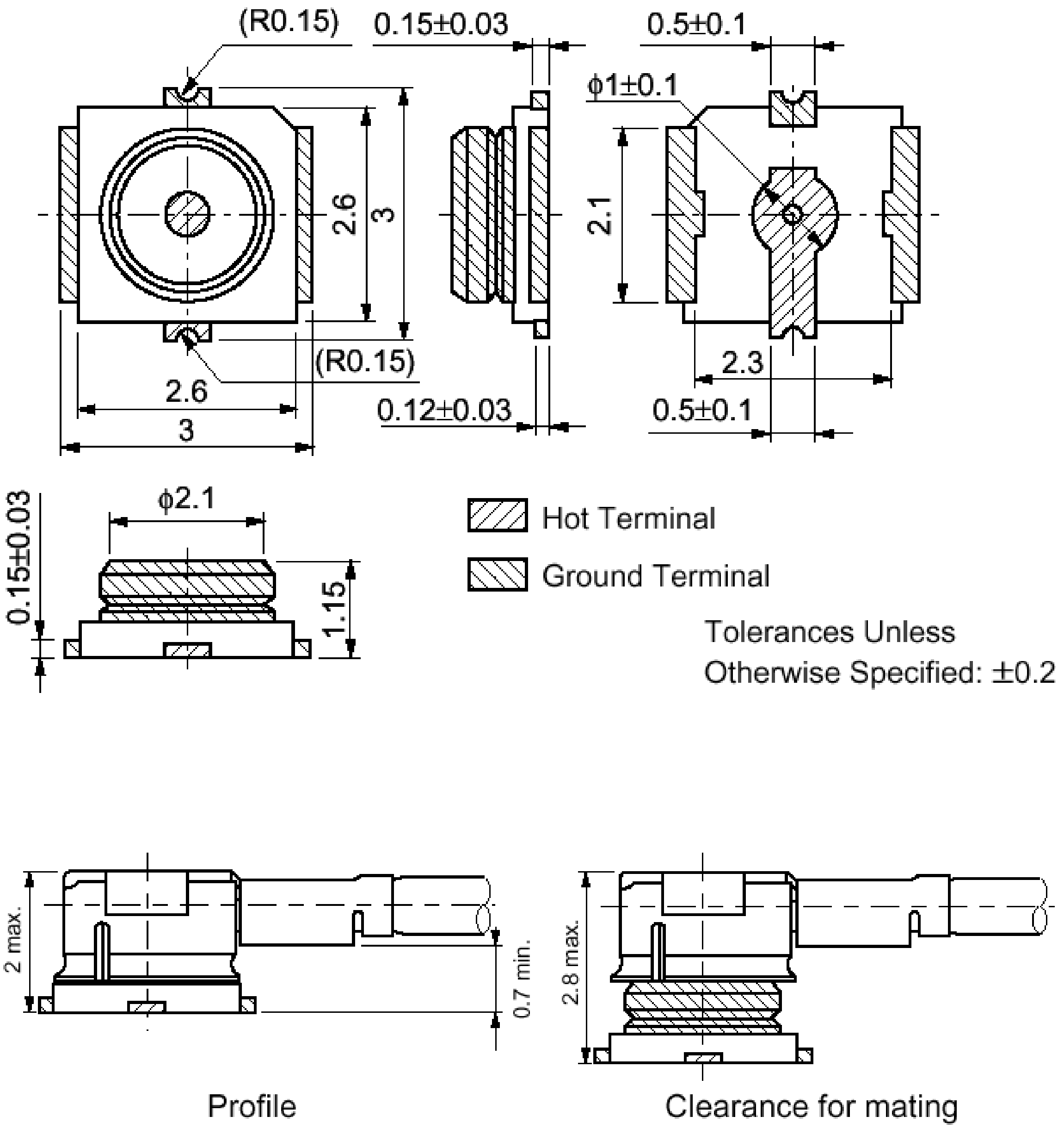


Figure 27: Mechanical dimensions of MuRata GSC connector (in mm)

Table 19: Stress characteristics of the GSC antenna connector

Parameter	Specification
Connector durability	100 cycles of mating and withdrawal with a jig at 12 cycles/minute maximum
Engage force	30N max
Disengage force	3N min, 30N max
Angle of engagement	15 degree max
Mechanical stress to connector • Stress to the housing: • Stress to outer sleeve: • Cable pull strength:	See Figure 28 for details A and B: 4.9N max. C: 2.94N max and D: 1.96N max E: 4.9N max

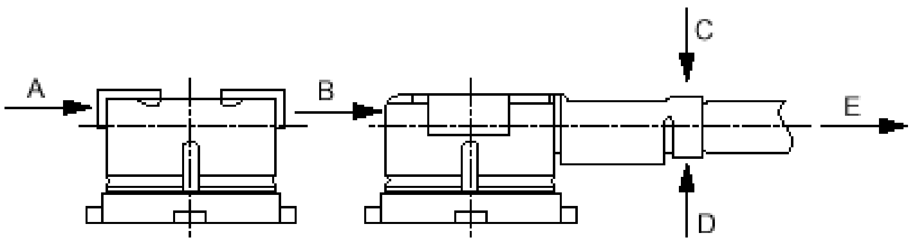


Figure 28: Maximum mechanical stress to the connector

The following figure illustrates the engagement/disengagement tool recommended by MuRata and provides instructions for proper use.

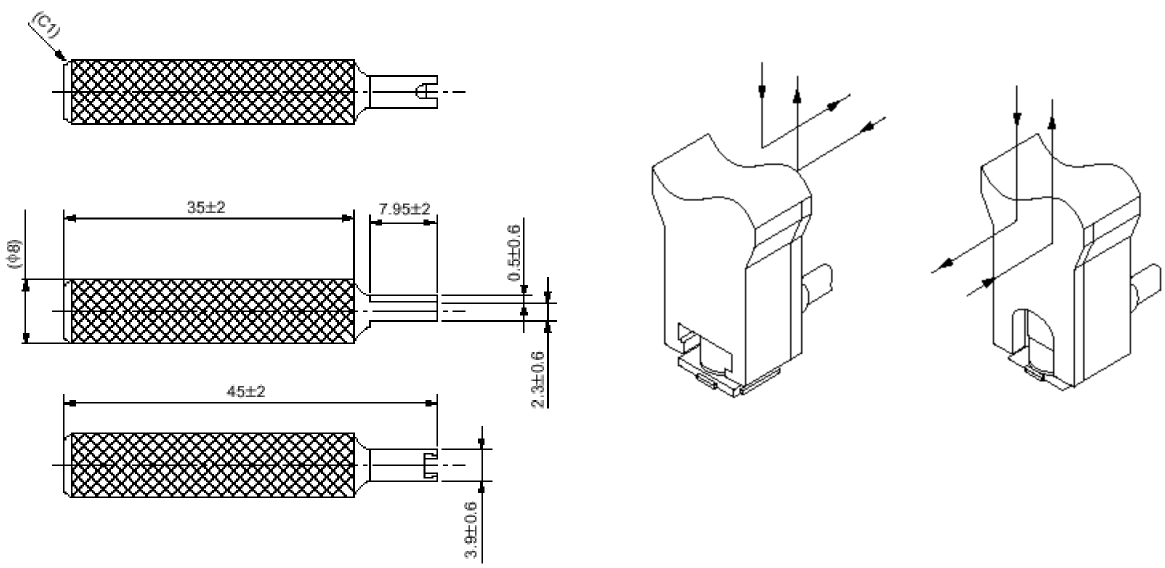


Figure 29: How to use MuRata tool

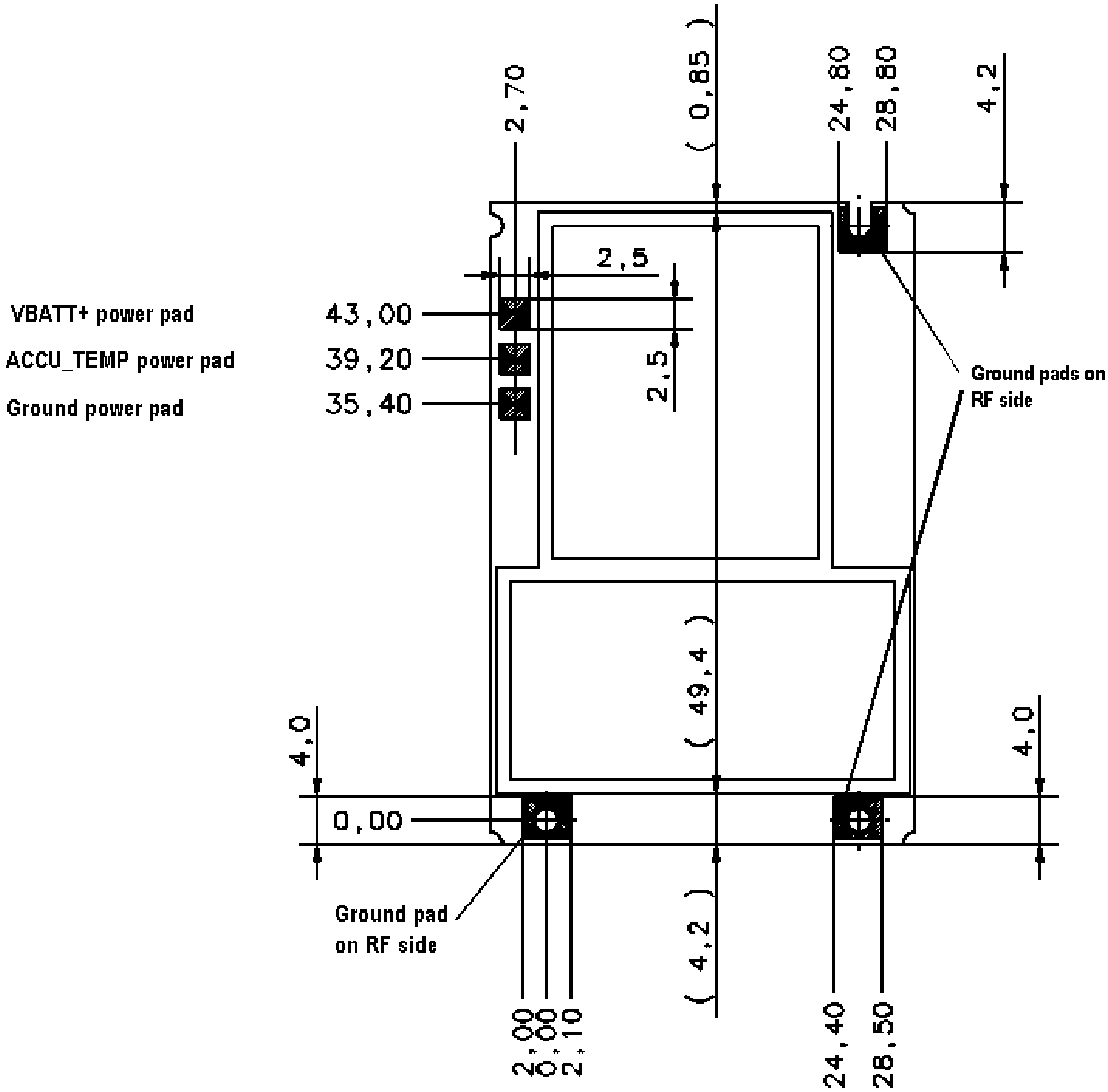
5.5.1 Using antenna cable from other manufacturers

For your product to meet individual design or technical requirements, you may decide to choose antenna equipment from suppliers other than MuRata.

When selecting a suitable antenna your considerations should also include the requirements of electromechanical valence. To achieve best performance it is essential to minimize the valence potential delta levels of dissimilar metal mating surfaces. Therefore the material of the antenna cable plug must be compatible with the material of the GSC receptacle on the GSM engine, i.e. it should belong to the same group in the electromechanical series. The material of the GSC connector on MC35 in specified in Table 18.

5.6 Position and dimension of power pads

As described in Chapter 3.2.3, MC35 can be powered across the ZIF connector and, in addition, from three contact pads. The power contact pads are placed on the RF part of the MC35 PCB. The position and the dimensions are shown in Figure 30.



0,00 = Reference point on MC35

Figure 30: Power pads on the RF part of the MC35 PCB

6 Electrical, temperature and radio characteristics

6.1 Absolute maximum ratings

Absolute maximum ratings for supply voltage and voltages on digital and analog pins of GSM Engine MC35 are listed in Table 20. Exceeding these values will cause permanent damage to the GSM Engine MC35.
The safety status of the power supply has to be SELV (as defined by EN60950). The supply current must be limited according to Table 20.

Table 20: Absolute maximum ratings

Parameter	Min	Max	Unit
Supply voltage V_{BATT+}	0	5.5	V
Peak current of power supply	0	4.0	A
RMS current of power supply (during one TDMA-frame)	0	0.7	A
Voltage on digital pins *)	-0.3	3.3	V
Voltage on analog pins *)	-0.3	3.0	V
Storage temperature	-40	+85	°C

*)Valid only in IDLE and TALK mode, if in Power Down mode absolute maximum ratings are ± 0.25 V.

6.2 Operating conditions

Table 21: Operating conditions

Parameter	Min	Typ	Max	Unit
Ambient temperature	-20	25	55	°C
Supply voltage V_{BATT+}	3.3	4.2	4.8	V

6.3 Temperature conditions

Table 22: Temperature conditions

Parameter	Min	Typ	Max	Unit
Ambient temperature (regarding GSM 11.10)	-20	25	55	°C
Restricted operation *)	-25 to -20		55 to 70	°C
Automatic switch off			>=70**)	°C
Storage temperature	-40		+85	°C

*) MC35 works, but deviations from the GSM specification may occur.
**) Limited performance if $V_{BATT+\ max} \leq 4.0V$ and PCL5 is required at $T_{amb\ max}$ = 70°

6.4 Power supply ratings

Table 23: Power supply ratings

Parameter	Description	Conditions	Min	Typ	Max	Unit
V_{BATT+}	Supply voltage	Reference point on VBATT+ contact pad Voltage must stay within the min/max values, including voltage drop, ripple, spikes.	3.3	4.2	4.8	V
	Voltage drop during transmit burst	Normal condition, power control level for $P_{out\ max}$			400	mV
I_{BATT+}	Average supply current	Power Down mode		50	100	µA
		SLEEP mode		3.5		mA
		IDLE mode GSM		10	20	mA
		TALK mode GSM		300	400	mA
		IDLE mode GPRS		10	20	mA
		DATA mode GPRS		360	480	mA
	Peak supply current (during 577µs trans-mission slot every 4.6ms)	Power control level for $P_{out\ max}$ I_{max} @ antenna return loss =6dB		2		A
I_{CHARGE}	Charging current	Li-Ion battery pack	350		500	mA
	Trickle charging	$U_{battery}$ 0...3.6V			9.0	mA

6.4.1 Drop definition

During the transmission burst the supply voltage of MC35 can drop considerably, depending on the internal resistance of the external power supply. As specified, the supply voltage V_{BATT+} must not fall below 3.3 V at any time, thus requiring an appropriate higher open-circuit voltage at MC35.

The drop of the supply voltage, generated by the serial resistance of the supply voltage connection, is not negligible. Peak currents of I = 2 A during the GSM transmission burst cause a supply voltage drop.

If your application incorporates a battery pack it is recommended to use the ZIF connector and the power contact pads in parallel. By connecting the battery power lines to the contact pads you can significantly reduce the total voltage drop caused across the ZIF-FFC-ZIF connection during transmit bursts. Note that the minimum supply voltage measured at the VBATT+ contact pad during TX bursts must not fall below 3.3 V, while the voltage drop must not exceed 400 mV. The power pads are located on the RF part of the PCB. See Chapters 3.2.1 and 5.6 for further details.

Note: In order to reduce voltage drops during transmission choose cables (FFC) as short as possible and apply a low impedance power supply. The use of the ground pads further minimizes power losses.

6.5 Electrical characteristics of the voiceband part

6.5.1 Setting audio parameters by AT commands

The audio modes 2 to 6 can be adjusted according to the parameters listed below. Each audio mode is assigned a separate set of parameters.

Table 24: Audio parameters adjustable by AT command

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 independent of output volume	0...32767	-∞...0dB	20 * log (sideTone/ 32768)

The following figure illustrates how the signal path can be influenced by varying the AT command parameters.

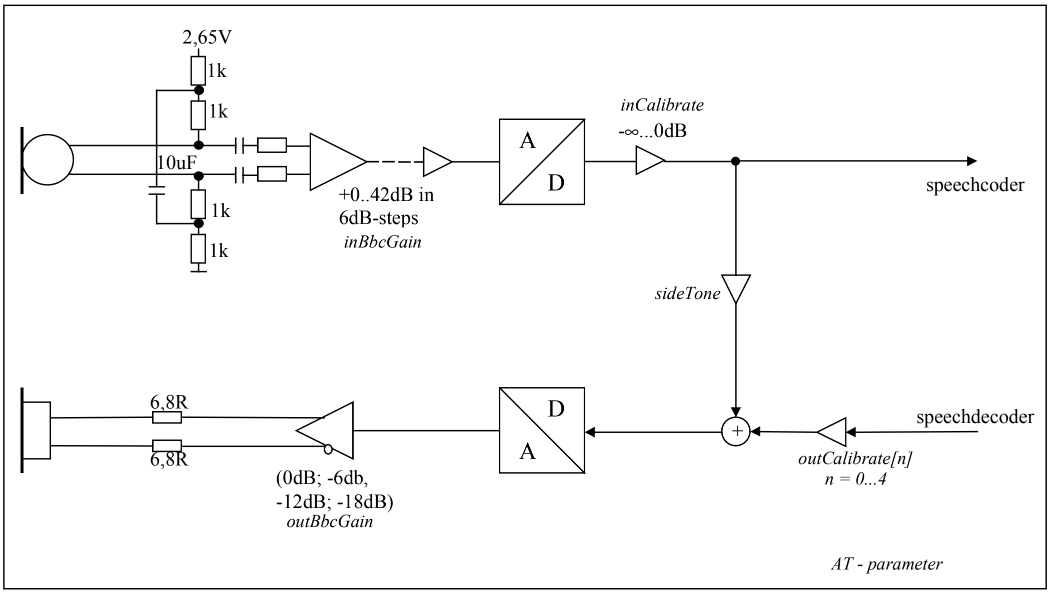


Figure 31: AT audio programming model

6.5.2 Characteristics of audio modes

The electrical characteristics of the voiceband part depend on the current audio mode set by the AT^SNFS command.

Table 25: Voiceband characteristics

Audio mode no. AT^SNFS=	1	2	3	4	5	6
Name	Default Handset	Basic Handsfree	Headset	User Handset	Plain Codec 1	Plain Codec 2
Purpose	DSB with M20T handset	Siemens Car Kit Portable	Siemens Headset	DSB with handset from customer	direct access to speech coder	direct access to speech coder
Gain setting via AT command	NO	YES	YES	YES	YES	YES
MICPn/MICNn EPPn/EPNn	n=1	n=2	n=2	n=1	n=1	n=2
Supply	ON	ON	ON	ON	OFF	OFF
Sidetone	YES	NO	YES	YES	YES	YES
Volume control	NO	YES	YES	YES	YES	YES
Limiter (receive)	YES	YES	YES	YES	NO	NO
Compressor (receive)	NO	YES *)	NO	NO	NO	NO
AGC (send)	NO	NO	YES	NO	NO	NO
Echo control (send)	Suppression	Cancellation + Suppression	NO	Suppression	NO	NO
Noise suppression	YES	YES	YES	YES	NO	NO
MIC input signal for 0dBm0 @ 1024 Hz (default gain)	11.54 mV	91.9 mV	n.a. due to AGC	11.54 mV	308.5 mV	308.5 mV
EP output signal in mV eff. @ 0dBm0, 1024 Hz, no load (default gain); @ 3.14 dBm0	397.5 mV	561.4 mV default @ max volume	288 mV default @ max volume	397.5 mV default @ max volume	931.8 mV 3.7 Vpp	931.8 mV 3.7 Vpp
Sidetone gain at default settings	22 dB	-∞ dB	n.a. due to AGC	22 dB	-∞ dB	-∞ dB

All values are preliminary.
*) Adaptive, receive volume increases with higher ambient noise level.

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

6.5.3 Voiceband receive path

The values specified below were tested to 1kHz and 0dB gain stage, unless otherwise stated.

gs = 0dB means audio mode = 5 for EPP1 to EPN1 and 6 for EPP2 to EPN2, inBbcGain= 0, inCalibrate = 32767, outBbcGain = 0, OutCalibrate = 16384, sideTone = 0.

Table 26: Voiceband receive path

Parameter	Min	Typ	Max	Unit	Test condition / remark
Differential output voltage (peak to peak)	3.33	3.7	4.07	V	from EPPx to EPNx *gs* = 0dB @ 3.14 dBm0 no load
Differential output gain settings (*gs*) at 6dB stages (outBbcGain)	-18		0	dB	
fine scaling by DSP (outCalibrate)	-∞		0	dB	
Output differential DC offset			100	mV	*gs* = 0dB, outBbcGain = 0 and -6dB
Differential output resistance	13	15		Ω	from EPPx to EPNx
Absolute gain accuracy			0.8	dB	Variation due to change in temperature and life time
Attenuation distortion			1	dB	for 300...3900Hz, @ EPPx/EPNx (333Hz) / @ EPPx/EPNx (3.66kHz)
Out-of-band discrimination	60			dB	for *f* > 4kHz with in-band test signal@ 1kHz and 1kHz RBW

gs = gain setting

6.5.4 Voiceband transmit path

The values specified below were tested to 1kHz and 0dB gain stage, unless otherwise stated.

Audio mode = 5 for MICP1 to MICN1 and 6 for MICP2 to MICN2, inBbcGain= 0, inCalibrate = 32767, outBbcGain = 0, OutCalibrate = 16384, sideTone = 0

Table 27: Voiceband transmit path

Parameter	Min	Typ	Max	Unit	Test condition/Remark
Input voltage (peak to peak) MICP1 to MICN1, MICP2 to MICN2			1.03	V	
Input amplifier gain in 6dB steps (inBbcGain)	0		42	dB	
fine scaling by DSP (inCalibrate)	-∞		0	dB	
Input impedance		2.0		kΩ	
Microphone supply voltage ON Ri = 4kΩ	2.57 2.17 1.77	2.65 2.25 1.85	2.73 2.33 1.93	V V V	no supply current @ 100µA @ 200µA
Microphone supply voltage OFF ; Ri = 4kΩ		0		V	
Microphone supply in power down mode					see Figure 32

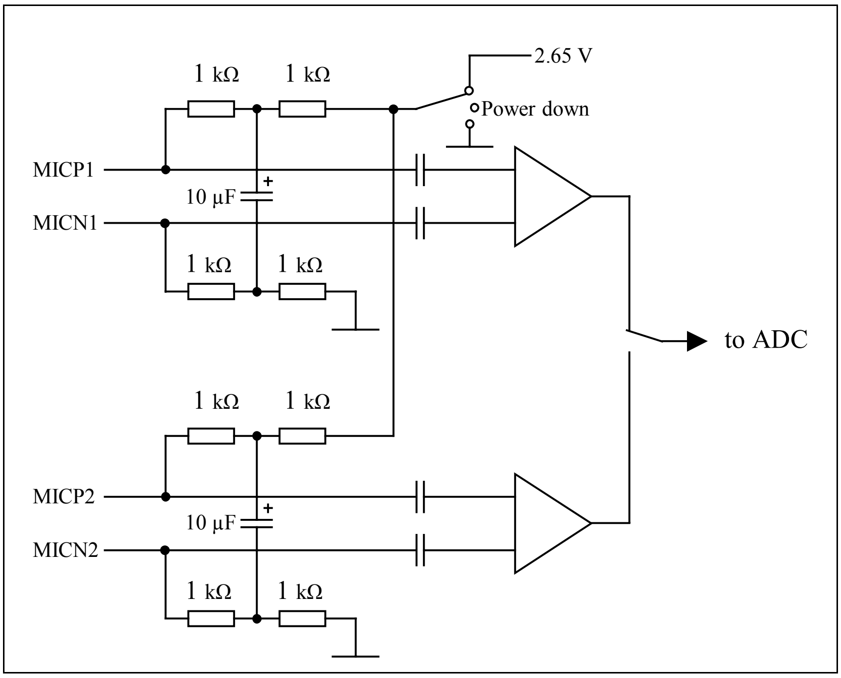


Figure 32: Structure of audio inputs

6.6 Air interface

Table 28: Air Interface

Parameter		Min	Typ	Max	Unit
Frequency range	E-GSM 900	880		915	MHz
Uplink (MS → BTS)	GSM 1800	1710		1785	MHz
Frequency range	E-GSM 900	925		960	MHz
Downlink (BTS → MS)	GSM 1800	1805		1880	MHz
RF power @ ARP with 50Ω load	E-GSM 900	31	33		dBm
	GSM 1800	28	30		dBm
Number of carriers	E-GSM 900		174		
	GSM 1800		374		
Duplex spacing	E-GSM 900		45		MHz
	GSM 1800		95		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	E-GSM 900		-105	-102	dBm
BER Class II < 2.4%	GSM 1800		-105	-102	dBm

6.7 Electrostatic discharge

The GSM engine is not protected against Electrostatic Discharge (ESD) in general. Consequently, it is subject to ESD handling precautions that typically apply to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates a MC35 module.

Despite of this, the antenna port, the SIM interface, the ACCU_TEMP port, the POWER port and the battery lines are equipped with spark gaps and clamp diodes to protect these lines from overvoltage. For all the other ports, ESD protection must be implemented on the application platform that incorporates the GSM engine.

MC35 has been tested and found to comply with the EN 61000-4-2 directive. The measured values can be gathered from the following table.

Table 29: Measured electrostatic values

Pin No.	Signal name	Contact discharge (environment)	Air discharge (directly to MC35)
1 - 5	VBATT+	>4kV	8kV
6 - 10	GND	>4kV	8kV
11 - 12	POWER	>4kV	8kV
13	VDD	>4kV	1kV
14	ACCU_TEMP	>4kV	8kV
15	$\overline{\text{IGT}}$	>4kV	1kV
16 - 23	RS232 signals	>4kV	1kV
24 - 29	SIM signals	>4kV	8kV
30	VDDLP	>4kV	1kV
31	$\overline{\text{PD}}$	>4kV	1kV
32	SYNC	>4kV	1kV
33 - 40	Audio	>4kV	1kV
Antenna	RF GND	>4kV	8kV

Note: Please note that the values may vary with the individual application design. For example, it matters whether or not the application platform is grounded over external devices like a computer or other equipment, such as the Siemens reference application described in Chapter 8.

The antenna connector is ESD protected by a 27nH inductor to ground. Therefore, no DC voltage must be applied to the antenna circuit in order to protect the inductor from damage (see Chapters 4.1 and 5.5).

7 Using MC35 in conjunction with the DSB35 Support Box

The DSB35 Support Box is an evaluation kit designed to test and type approve Siemens cellular engines and provide a sample configuration for application engineering.

To take advantage of the evaluation kit please consider the following requirements specific to MC35. For further operating instructions and a detailed hardware interface description refer to the manual supplied with the DSB35 Support Box.

If you would like to purchase the DSB35 Support Box contact your local Siemens dealer. See Chapter 9 for ordering information.

7.1 Type approval requirements

Old versions of the DSB35 Support Box (e.g. supplied for TC35 evaluation) can be used to test and evaluate MC35 applications, but are not suited for type approval.

Note:

If a configuration submitted for type approval includes a DSB35 Support Box, ensure that you use a model as per the new serial number. The number is printed on a label on the back of the DSB35 Support Box casing.

Old DSB35 version (not for MC35 type approval)	S30880-S8101-A10-1 S30880-S8101-A10-2
New DSB35 version (suited for MC35 type approval)	S30880-S8101-A10-3

7.2 Power supply requirements

7.2.1 Power supply sources

Applications that incorporate MC35 and a DSB35 Support Box must be powered from a *laboratory power supply*, regardless of the operating mode. The laboratory PSU is specified in the DSB35 manual (supply voltage 10V ±1V, maximum current 1A, compliant with EN 60950). The *plug-in PSU* delivered with DSB35 is intended only to test and evaluate the charging procedures of the battery pack. See also Chapter 7.3.

Note:
The laboratory PSU connects to the 4mm X1404 and X1405 jacks illustrated in Figure 33.

- *To ensure that DSB35 and MC35 are powered from the laboratory PSU (normal operation, i.e. no battery charge and discharge test) set the X1300 toggle switch to "down" position.*
- *To evaluate charging and discharging characteristics turn the X1300 toggle switch "up". In this case the laboratory PSU supplies only the DSB35 board.*

The length of the DC connection wires between DSB35 and your power supply sources must not exceed 3m.

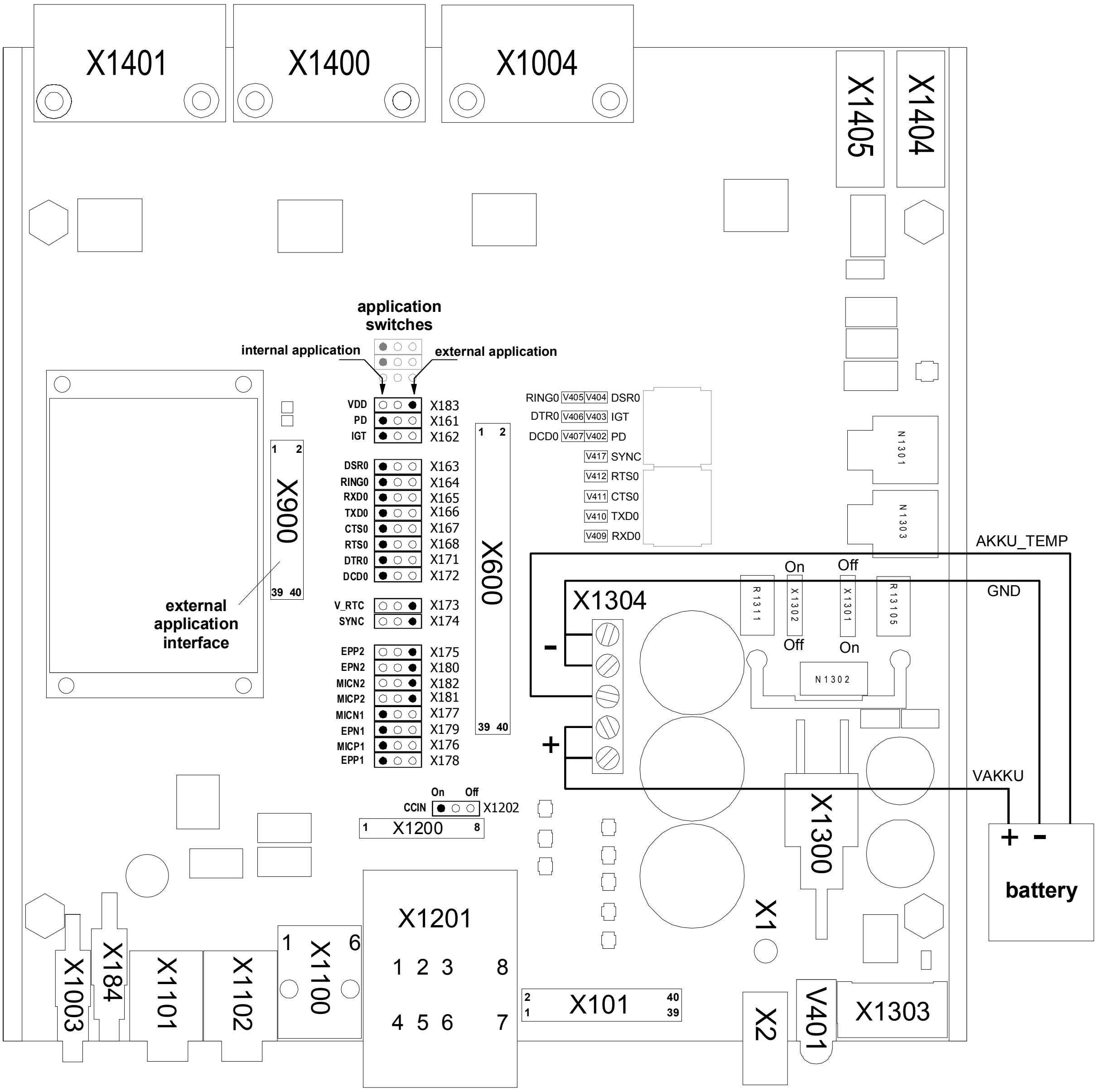


Figure 33: DSB35 board interfaces

7.2.2 Adjusting supply voltage

The DSB35 Support Box supplies a voltage (V_{BATT+}) of up to 5.75V. To operate MC35 the voltage generated by the DSB board must be limited to 4.8V.

To vary the supply voltage the DSB board uses the two R1311 and R1305 potentiometers. Both can be easily adjusted with the X1301 and X1302 slide switches and a screw on each potentiometer. The position of the switches and the potentiometers can be gathered from Figure 33. For further details on the slide switches and the generated supply voltage please refer to the DSB35 manual.
Factory setting of the slide switches is 4.2V: X1301 = OFF and X1302 = ON.

Note:

Follow these steps to adjust the supply voltage required for MC35.

1. *Set the slide switches: X1301 = OFF and X1302 = OFF. This is equivalent to V_{BATT+} 5.5V.*
2. *To reduce the supply voltage from 5.5V to 4.8V use a screw driver and turn the screw of R1311 until the supply voltage is 4.8V. Use the test points of the X600 connector to measure the generated voltage.*

7.3 Verifying charge and discharge time

The plug-in PSU supplied with the DSB35 board can be used to charge lithium-ion batteries.

Note:

The internal electronic of the DSB35 Board affects the duration of charging and discharging. Your most effective approach to testing and verifying the charge and discharge time is, therefore, to make the measurements directly on your application platform, excluding the DSB35 board.

8 Reference Approval

8.1 Reference Equipment

MC35 has been approved to satisfy all the requirements of GSM Phase 2/2.

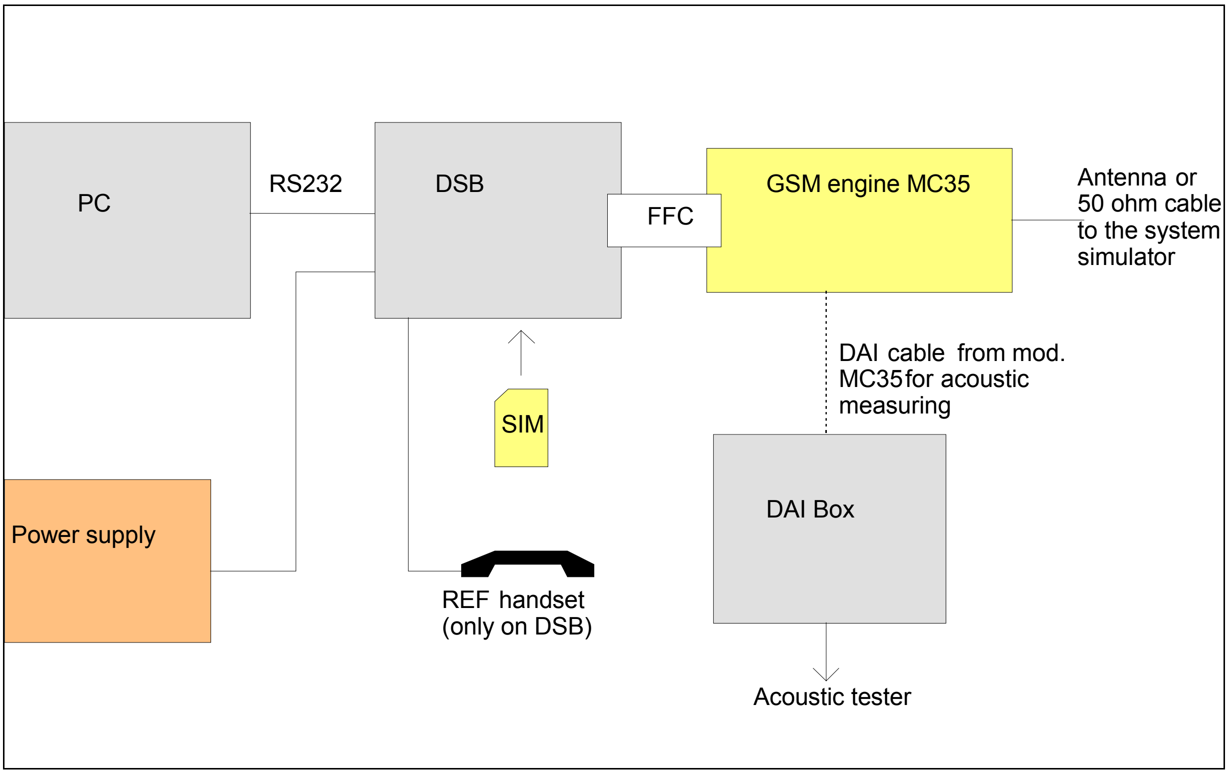


Figure 34: Reference Equipment for Approval

Referred to as "GSM terminal equipment" the reference configuration consists of the following components:
- Siemens MC35 cellular engine
- Development Support Box (DSB)
- SIM card reader integrated on the DSB
- Handset Votronic standard handset type HH-V0-30.1
- PC as MMI

For Siemens MC35, an IMEI number contingent has been reserved for the basic approval of the reference configuration. It will also apply to later approvals of customer configurations incorporating MC35 modules.

Approved Siemens MC35 configurations are recorded in the approval documentation. 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. The relevant test applications for supplementary approvals should be agreed upon with Siemens.

9 Accessory list for MC35

Table 30: List of accessories

Description	Supplier	Parts number (supplier)
Card holder SIM **Ejector Type SIM**	Molex	91228 91236
ZIF connector	AVX	04 6240 040 003 800
Flat cable for ZIF connector (cable 160 mm) (cable 80 mm)	Axon	 FFC 0.50 A 40 / 0160 K4.0-4.0-08.0-08.0SABB FFC 0.50 A 40 / 0080 K4.0-4.0-08.0-08.0SABB
RF cable GSC-GSC (cable 50 mm) (cable 100 mm)	Murata	 MXTK 88 TK 0500 MXTK 88 TK 1000
GSC connector	Murata	MM9329-2700 TB2
Handset	Votronic	HH-SI-30.3/V1.1/0
Siemens Car Kit Portable	Siemens	Siemens ordering number L36880-N3015-A117
DSB35 Support Box	Siemens	Siemens ordering number L36880-N8101-A100-3
BB35 Bootbox	Siemens	Siemens ordering number L36880-N8102-A100-1