Globetrotter Module GTM353W
Integration Manual

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About this document

Overview and Purpose

This document is meant for laptop manufacturers and other system integrators, to allow for easy integration into their own product. The bulk of this document describes the functional interfaces of the GlobeTrotter GTM353W Module on hardware, firmware and software levels. At the end, a chapter concerning certification requirements is added, which should be taken into account from the start of the integration.
Please note that this is only a draft version and is subject to change.

Confidentiality

Version History

Date	Release	Version	Author(s)	Revision(s)	Remarks	Phase
June 8, 2005	1	1-Draft	R. Claessens	S. Lodeweyckx	Added general overview diagram, certification content, quickstart guide, general modifications	1.0.0
June 9, 2005	1	2-Draft	R. Claessens		Added revision remarks	1.0.0
June 16, 2005	1	3-Draft	R. Claessens		Added revision remarks	1.0.0
June 22, 2005	1	4-Final	R. Claessens	S. Lodeweyckx, F. Nys, J. Vercruysse	Added antenna guidelines, product pictures	1.0.0
July 8, 2005	2	1-Draft	R. Claessens			1.0.0
September 14, 2005	2	4-Final	R. Claessens	D. Michiels	Added default settings for Option AT commands	1.0.0
November 18, 2005	3	1-Final	Johan De Bisschop		Pinout definition adapted to newly approved PCIExpress Mini Card standard. References to GTM352U removed	
January 16, 2005	4	1-Draft	Johan De Bisschop		Update for GTM353W	
January 18, 2005	4	2-Draft	Johan De Bisschop		Digital PCM interface added	

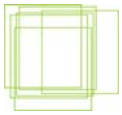
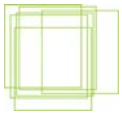


Table of contents



1 INTRODUCTION

1.1 General description

The GTM 35X is a PCIExpress Mini Card providing WWAN (WCDMA & EGPRS) connectivity to laptops or any other device equipped with a PCIExpress Mini Card slot.

Figure 1: Bottom view

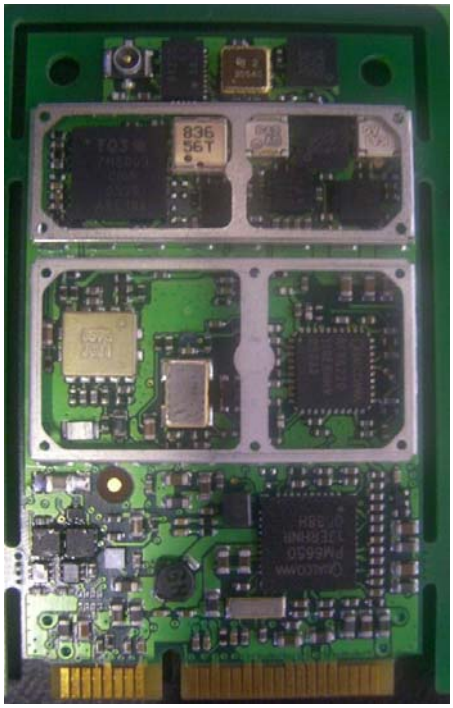
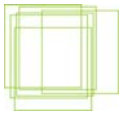


Figure 2: Top view

Based on standard Qualcomm WCDMA and EGPRS technologies, both modules provide quad-band (850/900/1800/1900 MHz) EGPRS connectivity for worldwide operation. The GTM 353W module delivers 850/1900/2100 MHz WCDMA FDD connectivity.



1.2 Features

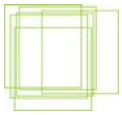
1.2.1 WCDMA

- Model GTM 353W Module (WORLD version)

- FDD 850/1900/2100 MHz
- Power Class 3 (+24dBm)
- 384/128 kbps downlink/uplink modem operation (potentially 384 kbps uplink)
- Supports UL and DL Compressed Modes
- Supports Circuit and Packet-Switched Data
- Upgradeable to HSDPA 1.8Mbps

1.2.2 E-GPRS

- 850/900/1800/1900 MHz
- GSM Power Class 4 (2W) for 850/900 bands, GSM
- Power Class 1 (1W) for 1800/1900 bands
- EDGE class E2 (+27 dBm in 850/900 bands, +26 dBm in 1800/1900 bands)
- GPRS/EGPRS Multislot Class 10 (4 slots Rx, 2 slots Tx, 5 max active)
- GPRS/EGPRS Class B Type 1 MT
- GPRS CS1-CS4; EGPRS MCS1-MCS9
- Circuit Switched Data: 14.4 and 9.6 kbps



1.2.3 Terminal Equipment Interfaces

- Physical interface PCIExpress Mini Card 1.1
- USB 2.0 Full Speed (12Mbits/s) signalling
- NDIS and Modem interface drivers
- AT interface with standard modem emulation
- EAP-SIM / EAP-AKA support
- Operating Systems supported:
  - Windows 2000/XP/XP Pro/Tablet
  - Mac OS X Tiger
  - Linux (on demand)
- Regulatory & Certifications
  - R&TTE, FCC, GCF
  - Mechanical and Environmental testing

1.2.4 Power Requirements

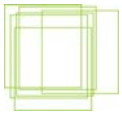
- Vcc 3.3V +/- 9%
- Peak Icc 2750 mA *with max supply droop 50 mV*
- Average Icc 850 mA

1.2.5 Thermal Dissipation and derating

- The maximum thermal dissipation directly from any PCI Express Mini Card add-in card is 2.9 W peak
- See section 7.3 for details on actual thermal dissipation.

1.2.6 LED definition

The module can control one LED via the bus connector.



2 GENERAL OVERVIEW DIAGRAM

Figure 3 gives a high level system overview. Option provides the communication and physical layer. On the physical layer, the bottom interfaces (in dark color) are explicit notations to show the integrator which physical connection capabilities can be used.

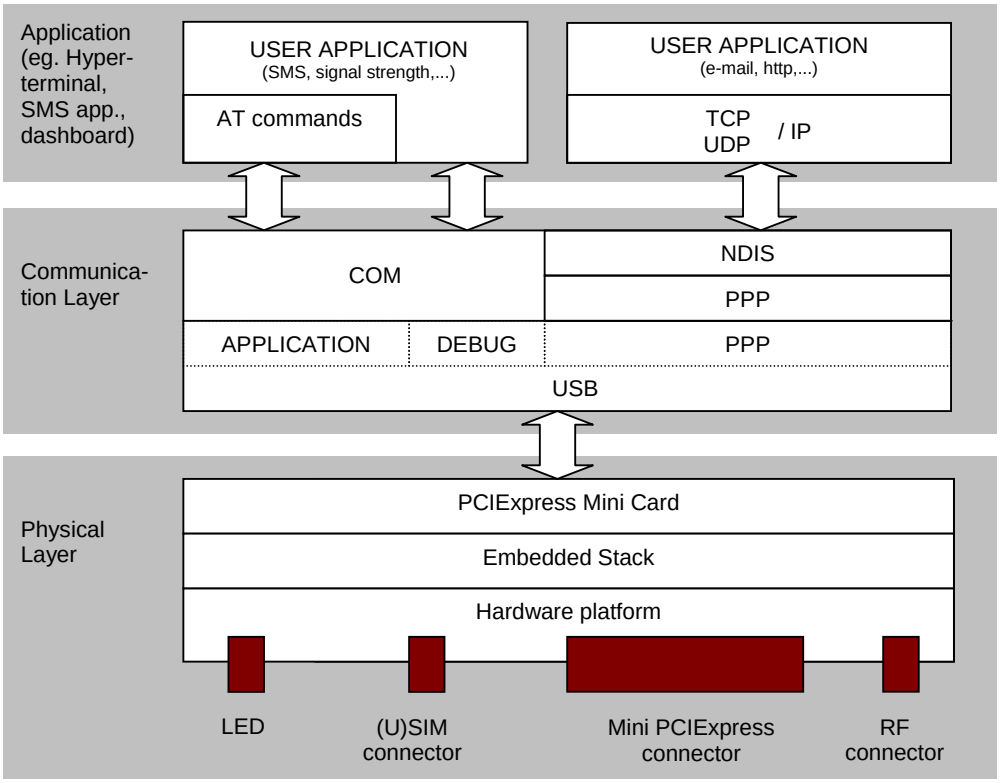


Figure 3: High level system overview

The Communication Layer components are described in chapter 4 and chapter 5. An overview of the supported AT commands is given in chapter 6

3 HARDWARE DESCRIPTION

For abbreviations used in this chapter, please refer to the terms and abbreviations chapter.

3.1 Block diagram GTM353W

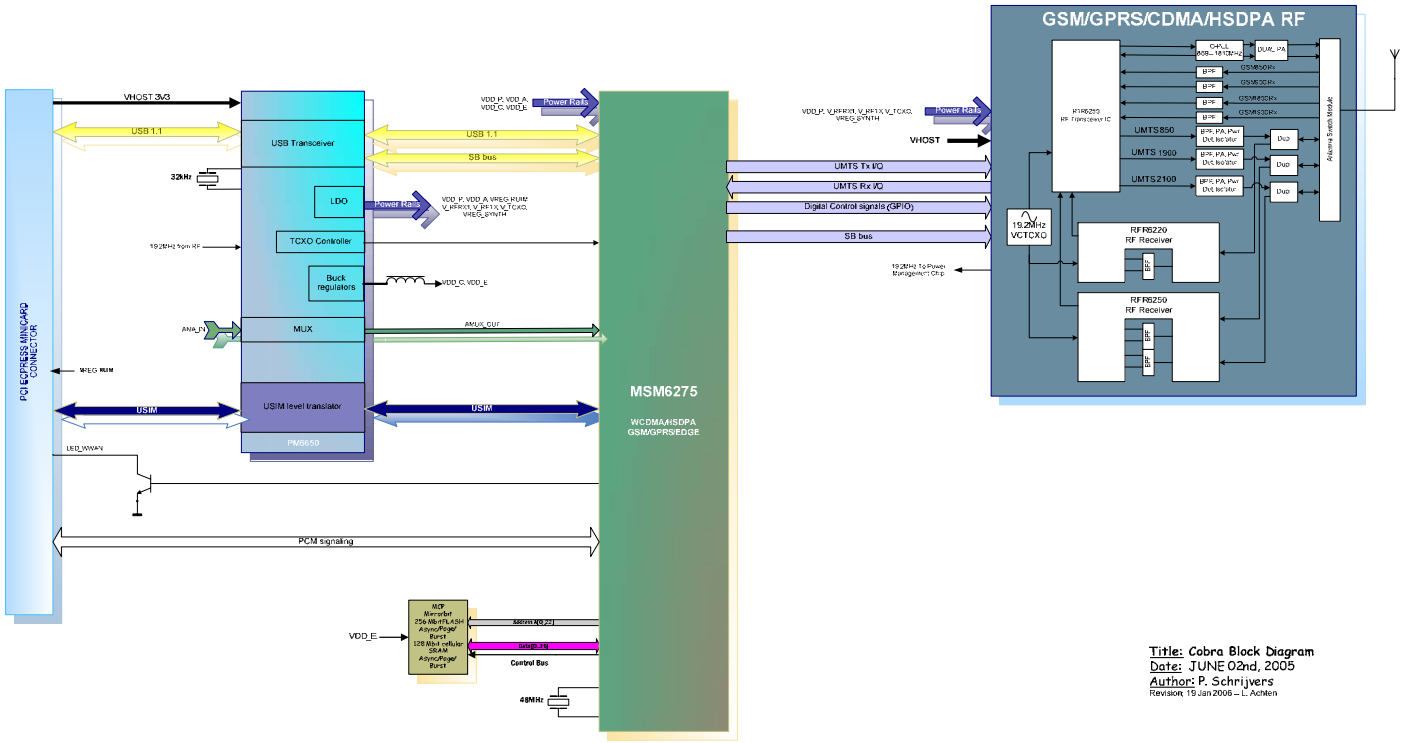
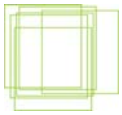


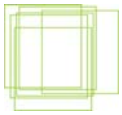
Figure 5: Hardware block diagram GTM353W



3.2 PCIExpress Mini Card interface

While the full PCI Express bus may be routed to the system connector from the host system, the GTM card will only use the USB 2.0 Full Speed (12Mbit/s) interface (See Table 1 - NC is Not Connected).

PIN #	Pin assignment in PCIExpress Mini Card spec	Pin assignment on GTM35x	Additional Description
1	WAKE#	NC	WAKE functionality is NOT supported in USB based Mini Cards per the PCI-SIG specification.
2	3.3Vaux	3.3V	3.3V DC supply rail from the host system. Further description of the sourcing characteristics of this rail is provided in this document.
3	RESERVED	NC	No Connect
4	GND	GND	Mini Card ground.
5	RESERVED	NC	No Connect.
6	1.5V	NC	1.5V DC is not to be used
7	CLKREQ#	NC	As in the MINI Card Specification.
8	UIM_PWR	UICC_PWR	Power source for external UIM/SIM.
9	GND	GND	Mini Card ground.
10	UIM_DATA	UICC_DATA	External UIM/SIM data signal.
11	REFCLK-	NC	No Connect.
12	UIM_CLK	UICC_CLK	External UIM/SIM clock signal.
13	REFCLK+	NC	No Connect.
14	UIM_RESET	UICC_RESET	External UIM/SIM reset signal.
15	GND	GND	Mini Card ground.
16	UIM_Vpp	NC	External UIM/SIM programming voltage.
17	RESERVED	NC	As in the Mini Card Specification.
18	GND	GND	Mini Card ground.
19	RESERVED	NC	As in the Mini Card Specification.
20	W_DISABLE#	HW_RadioXMIT_Disable#	Active low input from the platform to the card to disable all the radios on the MPCI card from transmitting.
21	GND	GND	Mini Card ground.
22	PERST#	NC	No Connect.
23	PERn0	NC	No Connect.
24	3.3Vaux	NC	
25	PERp0	NC	No Connect
26	GND	GND	Mini Card ground.
27	GND	GND	Mini Card ground.
28	1.5V	NC	1.5V DC supply rail is not to be used
29	GND	GND	Mini Card ground.
30	SMB_CLK	NC	SMB support is not required for the WWAN Mini Card module.
31	PETn0	NC	No Connect.
32	SMB_DATA	NC	SMB support is not required for the WWAN Mini Card module.
33	PETp0	NC	No Connect.

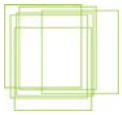


PIN #	Pin assignment in PCIExpress Mini Card spec	Pin assignment on GTM35x	Additional Description
34	GND	GND	Mini Card ground.
35	GND	GND	Mini Card ground.
36	USB_D-	USB_D-	As in the Mini Card specification.
37	GND	GND	Mini Card ground
38	USB_D+	USB_D+	As in the Mini Card Specification.
39	3.3Vaux	3.3V	3.3V rail
40	GND	GND	Mini Card ground.
41	3.3Vaux	3.3V	3.3V rail
42	LED_WWAN#	LED_WWAN_RadioState	Active-low LED drive signal for indicating the state of the WWAN Radio.
43	GND	GND	Mini Card GND
44	LED_WLAN#	NC	No Connect.
45	AUX_PCM_CLK	NC	AUX_PCM_CLK
46	LED_WPAN#	NC	No Connect.
47	AUX_PCM_DIN	NC	AUX_PCM_DIN
48	1.5V	NC	1.5V DC is not to be used
49	AUX_PCM_DOUT	NC	AUX_PCM_DOUT
50	GND	GND	Mini Card Ground
51	AUX_PCM_SYNC	NC	AUX_PCM_SYNC
52	3.3Vaux	3.3V	3.3V DC supply rail from the host system. Further description of the sourcing characteristics of this rail is provided in this document.

Table 1: PCIExpress Mini Card pinout

Remark: Increased electrical power and ground

Initial design reviews show that the current requirements exceed the limits set by the older versions of the PCI Express Mini Card standard v. 1.1. In order to reduce impedances additional pins are needed for power and grounding. Pins are required for supporting the current 1.1A / 2.75A (average / peak) instead of 750mA / 1A. In the new version of the standard, additional supply and grounding pins have been defined for this reason. Those pins are pin 39/41 for additional 3.3V, and 37/43 for additional GND connections



3.3 UICC interface guidelines

3.3.1 Introduction

This section describes how to design the UICC (USIM)-card interface for connection with the GTM.

The baseband processor has an integrated UICC interface compatible with the ISO7816 IC card standard. This is wired to the PCIExpress Mini Card connector (PCIE connector) in order to be connected to an external UICC card holder (see Figure 5: (U)SIM pin assignment). Five pins on the PCIE connector are reserved for the (U)SIM interface (pins 8,10,12, 14 and 15 - see Table 1 and Table 3).

The (U)SIM interface of a GSM/GPRS/EDGE/UMTS/HSDPA module needs some special requirements. The (U)SIM card is connected with the digital part of the module. An RF interference signal picked-up by the (U)SIM card reader can disturb normal operation of the module and result in unexpected errors.

The (U)SIM card is accessible by the customer. In many cases an efficient RF-shielding of the (U)SIM card is not possible. However, with some precautions problems caused by interference signals picked up by the (U)SIM card can be significantly reduced.

3.3.2 UICC Interface

3.3.2.1 UICC Card Holder

The UICC Card interface has got 6 contacts. Officially according to 3GPP there are 8 pads, so you will find eight (8) pads on the PCB-Layout picture (Figure 4) and in the specification of the PCI Express Mini Card, numbered from C1 to C8. Contacting elements in positions C4 and C8 are not used. They shall present high impedance to the UICC. Figure 5 and Table 3 show the pin assignment of a UICC card.
However as a way of an example “how to connect” the company JAE has introduced (http://www.jae-connector.com/) 6 pins UICC connectors. These are numbered JAE-1 through JAE-6. For convenience the JAE numbering is added on the PCB-Layout picture (Figure 4).
All the active circuitry is placed on the GTM. Only passives should be further applied.

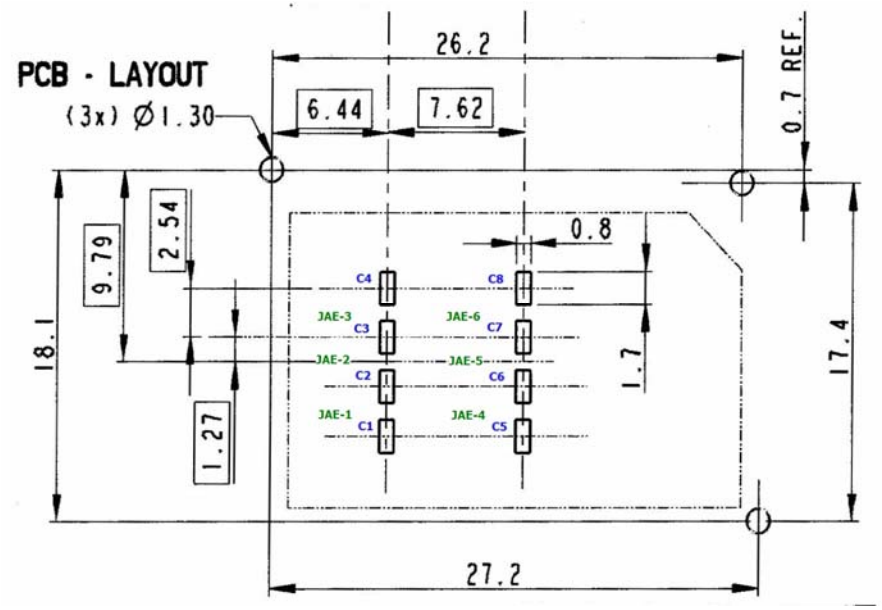


Figure 4: PCB layout pad assignment hosting a UICC

Contact Element	PCIE pin number	PCIE Signal name	Function
C1	Pin#08	UIM_PWR	Power supply of the UICC
C2	Pin#14	UIM_RESET	UICC reset, prompted by the GTM
C3	Pin#12	UIM_CLK	Clock signal, generated by the GTM
C7	Pin#10	UIM_DATA	Bi-directional data signal

Table 2: UICC mapped to B2B pinout

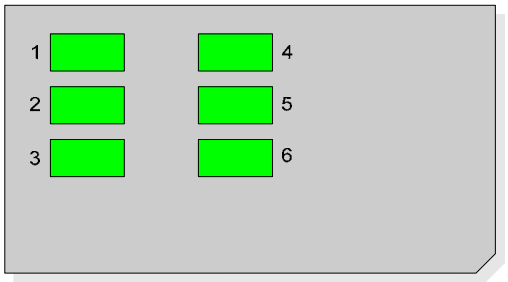
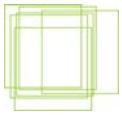


Figure 5: (U)SIM pin assignment



Pin no.	Contact Element	Signal name	(U)SIM I/O	Function
1	C1	VCC	I	Power supply of the SIM, generated by the GTM
2	C2	RST	I	SIM reset, prompted by the GTM
3	C3	CLK	I	clock signal, generated by the GTM
4	C5	GND	I	Ground
5	C6	PROG	-	Not Used
6	C7	I/O	I/O	bi-directional data signal, generated by either GTM or (U)SIM

Table 3: (U)SIM pin description

The 3GPP standard defines 3 operation voltages for the supply voltage of the SIM card: 1.8V, 3V and 5V. The GTM module supports only 2 voltages, 1.8V and 3V. 5V only SIM cards are barely used nowadays.

Note that the GTM does not have a UICC card holder. The UICC signals are connected with the "PCI Express MiniCard" connector (the edge connector).

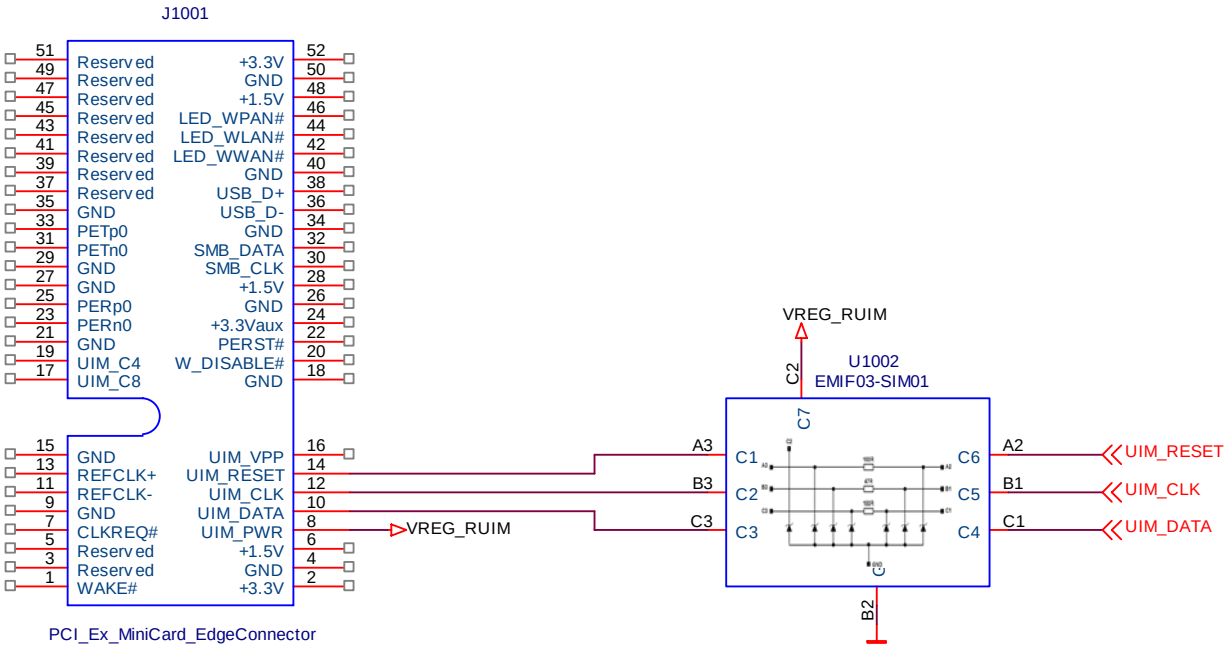
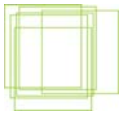


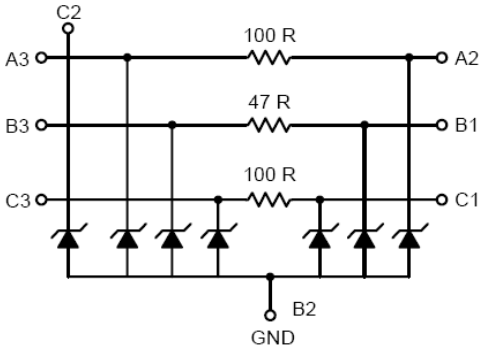
Figure 6: UICC Signal Routing on GTM

3.3.2.2 EMI filtering and ESD protection

The EMIF03-SIM01 (U1002 on Figure 6) is a highly integrated array designed to suppress EMI/RFI noise. Greater than 25dB attenuation is obtained at frequencies from 800MHz to



2.2GHz. Additionally, this filter includes an ESD protection circuitry which prevents the protected device from destruction when subjected to ESD surges up to 8kV (Contact) and 15kV (Air).



· **Figure 7: Schematic of EMIF03-SIM01**

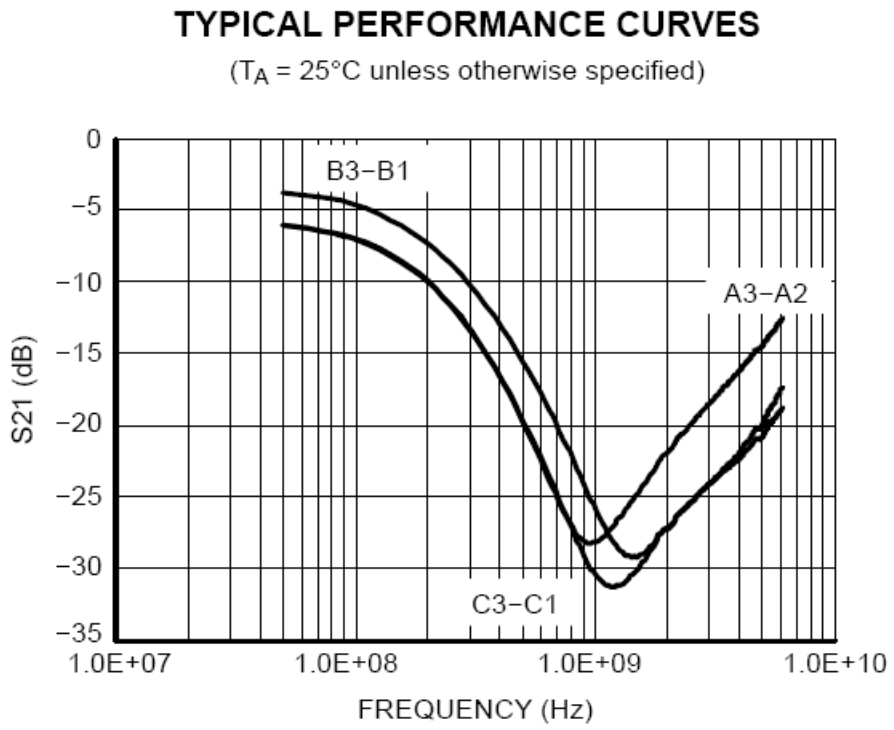
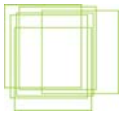


Figure 8: Insertion Loss Characteristic

3.3.3 Electrical specifications of the UICC – Terminal interface

This section is an excerpt from the standards, but it is very important that the integrator takes care in the design phase to comply to these specifications, since they are essential to the final certification of the integrated module (also see chapter 8 on certification).



3.3.3.1 Contact activation and deactivation

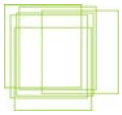
The Terminal shall connect, activate and deactivate the UICC in accordance with the Operating Procedures specified in ISO/IEC 7816-3 [12].
For any voltage level, monitored during the activation sequence, or during the deactivation sequence following normal power-down, the order of the contact activation/deactivation shall be respected.
It is recommended that whenever possible, the deactivation sequence defined in ISO/IEC 7816-3 [12] should be followed by the Terminal on all occasions when the Terminal is powered down.
If the UICC clock is already stopped and is not restarted, the Terminal may deactivate all the contacts in any order, provided that all signals reach low level before Vcc leaves high level. If the UICC clock is already stopped and is restarted before the deactivation sequence, then the deactivation sequence specified in ISO/IEC 7816-3 [12] sub clause 5.4 shall be followed.

3.3.3.2 Inactive contacts

The voltages on contacts C1, C2, C3, C6 and C7 of the Terminal shall be in the range 0 ± 0,4 volts referenced to ground (C5) when the Terminal is switched off with the power source connected to the Terminal. The measurement equipment shall have a resistance of 50 kohms when measuring the voltage on C2, C3, C6 and C7. The resistance shall be 10 kohms when measuring the voltage on C1.

3.3.3.3 Contact pressure

The contact pressure shall be large enough to ensure reliable and continuous contact (e.g. to overcome oxidisation and to prevent interruption caused by vibration). The radius of any curvature of the contacting elements shall be greater than or equal to 0,8 mm over the contact area.
Under no circumstances shall the contact force exceed 0,5 N per contact.
Care shall be taken to avoid undue point pressure to the area of the UICC opposite to the contact area. Such pressure is potentially damaging to the components within the UICC.



3.3.3.4 Power Supply

The supply voltage of power supply is shown in Table 4.

Symbol	Minimum	Maximum	Unit	Voltage Class
Vcc	2,7	3,3	V	B
Vcc	1,62	1,98	V	C

Table 4: Supply Voltage Classes indicated in ATR

- ***Power Consumption of the UICC during ATR***

The maximum power consumption of the UICC during ATR is specified in Table 5 and Table 6. The UICC power consumption during the ATR shall conform to the voltage class indicated in the ATR. If the UICC supports several supply voltage classes, each class shall conform to the corresponding maximum ATR power consumption, as specified in Table 5 and Table 6. This is required because the terminal is not aware of the power consumption of the UICC until the ATR is received and an application is selected.

Symbol	Voltage Class	Maximum	Unit
Icc	B	7.5	mA
Icc	C	5	mA

Table 5: Power Consumption that applies during ATR at max. external clock

Symbol	Voltage Class	Maximum	Unit
Icc	B	6	mA
Icc	C	4	mA

Table 6: Power Consumption that applies during ATR at 4 MHz

3.3.3.5 Specification of the 3V UICC – Terminal Interface

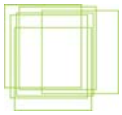
- ***Supply voltage Vcc (contact C1)***

The Terminal shall operate the UICC within the following limits:

Symbol	Minimum	Maximum	Unit
Vcc	2,7	3,3	V

Table 7: Electrical characteristics of Vcc under normal operating conditions

The module is capable of sourcing the maximum current as defined in Table 6. It is also able to counteract spikes in the current consumption of the SIM card up to a maximum charge of 12 nAs with no more than 400 ns duration and an amplitude of at most 60 mA, ensuring that the supply voltage stays in the specified range.



- ***Reset (RST) (contact C2)***

The Terminal shall operate the UICC within the following limits:

Symbol	Conditions	Minimum	Maximum	Unit
V_{OH}	I_{OHmax} = + 20 µA	0,8 x Vcc	Vcc (Note)	V
V_{OL}	I_{OLmax} = -200 µA	0 (Note)	0,2 x Vcc	V
T_R t_F	C_{in} = C_{out} = 30 pF		400	µs
NOTE: To allow for overshoot the voltage on RST should remain between -0,3V and Vcc +0,3V during dynamic operations.				

Table 8: Electrical characteristics of RST under normal operating conditions

- ***Clock CLK (contact C3)***

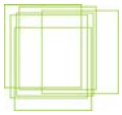
The Terminal shall support 1 to 5 MHz. The Terminal shall supply the clock. No "internal clock" UICC shall be used.
The duty cycle shall be between 40 % and 60 % of the period during stable operation.
The Terminal shall operate the UICC within the following limits:

Symbol	Conditions	Minimum	Maximum	Unit
V_{OH}	I_{OHmax} = + 20 µA	0,7 x Vcc	Vcc (Note)	V
V_{OL}	I_{OLmax} = - 20 µA	0 (Note)	0,2 x Vcc	V
T_R t_F	C_{in} = C_{out} = 30 pF		50	ns
***NOTE**: To allow for overshoot the voltage on CLK should remain between -0,3V and Vcc+0,3V during dynamic operations.*				

Table 9: Electrical characteristics of CLK under normal operating conditions

- ***I/O (contact C7)***

Table 3.6 defines the electrical characteristics of the I/O (contact C7). The values given in the table allow the derivation of the values of the pull-up resistor in the Terminal and the impedance of the drivers and receivers in the Terminal and UICC.



Symbol	Conditions	Minimum	Maximum	Unit
V_{IH}	I_{IHmax} = ± 20 µA (Note 2)	0,7 x Vcc	Vcc+0,3	V
V_{IL}	I_{ILmax} = + 1 mA	- 0,3	0,2 x Vcc	V
V_{OH} (Note 1)	I_{OHmax} = + 20 µA	0,7 x Vcc	Vcc (Note 3)	V
V_{OL}	I_{OLmax} = - 1mA	0 (Note 3)	0,4	V
T_R t_F	C_{in} = C_{out} = 30 pF		1	µs

NOTE 1: *It is assumed that a pull-up resistor is used on the interface device (recommended value: 20 k Ω).*

NOTE 2: *During static conditions (idle state) only the positive value can apply. Under dynamic operating conditions (transmissions) short term voltage spikes on the I/O line may cause* ***a current reversal.***

NOTE 3: *To allow for overshoot the voltage on I/O shall remain between -0,3V and Vcc+0,3V during dynamic operation.*

Table 10: Electrical characteristics of I/O under normal operating conditions

3.3.3.6 Specification of the 1.8V UICC – Terminal Interface

- ***Supply voltage Vcc (contact C1)***

The Terminal shall operate the UICC within the following limits:

Symbol	Minimum	Maximum	Unit
Vcc	1,62	1,98	V

Table 11: Electrical characteristics of Vcc under normal operating conditions

The module is capable of sourcing the maximum current as defined in Table 6. It is also able to counteract spikes in the current consumption of the SIM card up to a maximum charge of 12 nAs with no more than 400 ns duration and an amplitude of at most 60 mA, ensuring that the supply voltage stays in the specified range.

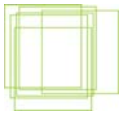
- ***Reset (RST) (contact C2)***

The Terminal shall operate the UICC within the following limits:

Symbol	Conditions	Minimum	Maximum	Unit
V_{OH}	I_{OHmax} = + 20 µA	0,8 x Vcc	Vcc (Note)	V
V_{OL}	I_{OLmax} = -200 µA	0 (Note)	0,2 x Vcc	V
T_R T_f	C_{in} = C_{out} = 30 pF		400	µs

NOTE: *To allow for overshoot the voltage on RST should remain between -0,3V and Vcc +0,3V during dynamic operations.*

Table 12: Electrical characteristics of RST under normal operating conditions



- ***Clock CLK (contact C3)***

The Terminal shall support 1 to 5 MHz. The Terminal shall supply the clock. No "internal clock" UICC shall be used.
The duty cycle shall be between 40 % and 60 % of the period during stable operation.
The Terminal shall operate the UICC within the following limits:

Symbol	Conditions	Minimum	Maximum	Unit
V_{OH}	I_{OHmax} = + 20 µA	0,7 x Vcc	Vcc (Note)	V
V_{OL}	I_{OLmax} = - 20 µA	0 (Note)	0,2 x Vcc	V
T_R T_f	C_{in} = C_{out} = 30 pF		50	ns
NOTE: *To allow for overshoot the voltage on CLK should remain between -0,3V and Vcc+0,3V during dynamic operations.*				

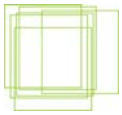
Table 13: Electrical characteristics of CLK under normal operating conditions

- ***I/O (contact C7)***

Table 14 defines the electrical characteristics of the I/O (contact C7). The values given in the table allow the derivation of the values of the pull-up resistor in the Terminal and the impedance of the drivers and receivers in the Terminal and UICC.

Symbol	Conditions	Minimum	Maximum	Unit
V_{IH}	I_{IHmax} = ± 20 µA (Note 2)	0,7 x Vcc	Vcc+0,3	V
V_{IL}	I_{ILmax} = + 1 mA	- 0,3	0,2 x Vcc	V
V_{OH} (Note 1)	I_{OHmax} = + 20 µA	0,7 x Vcc	Vcc (Note 3)	V
V_{OL}	I_{OLmax} = - 1mA	0 (Note 3)	0,4	V
T_R t_F	C_{in} = C_{out} = 30 pF		1	µs
NOTE 1: *It is assumed that a pull-up resistor is used on the interface device (recommended value: 20 k Ω).* ***NOTE 2***: *During static conditions (idle state) only the positive value can apply. Under dynamic operating conditions (transmissions) short term voltage spikes on the I/O line may cause a current reversal.* ***NOTE 3***: *To allow for overshoot the voltage on I/O shall remain between -0,3V and Vcc+0,3V during dynamic operation.*				

Table 14: Electrical characteristics of I/O under normal operating conditions



3.3.4 Electrical interface

The (U)SIM card holder is connected with the module by means of long wires. The (U)SIM card holder and wires are radiated on with different types of noisy signals, e.g. the radiation signals of the module antenna. The SIM interface signals conduct this noise into the module and radiate these signals into the module, with potential disasterous results.

This phenomenon can be significantly reduced by following design rules for EMC interference minimisation:

1. Place noise suppression capacitors on the SIM card holder.
2. Route the SIM card holder signals carefully in relation to other signalling lines and potential noise generation sources.
3. Limit the line length: a maximum length of 200mm is advised.

3.3.4.1 Noise suppression capacitors

On the module suppression capacitor are placed on the signals RTS, CLK and I/O. The value of these suppression capacitors equals 17pF each.

Although the module foresees suppression capacitors it is important to place suppression on the contacts of the SIM card holder. The value of these suppression capacitors must be equal to 10pF. It is important to place the capacitors as short as possible to the SIM card reader. Every mm PCB track (or FFC signalling line) counts. The size of the capacitor also matters. It is advisable to use 0402 type capacitors.

Figure 9 shows the impedance graph of a 10pF capacitor.

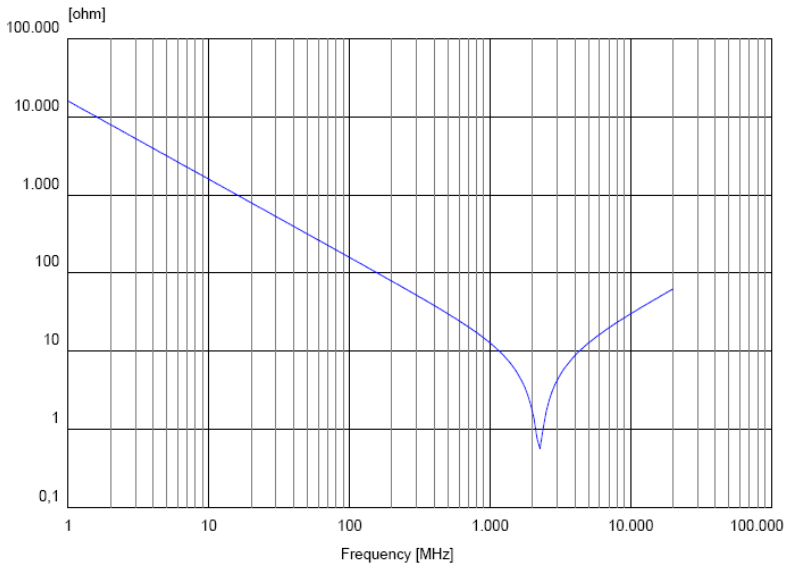


Figure 9: Impedance of 10pF capacitor

3.3.4.2 Maximum Trace Length

The maximum trace length depends on the trace capacitance, but on average it is advisable to limit the length to a maximum of 200mm.

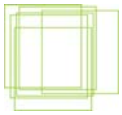
The module controls the signals RST and CLK. A totem-pole output drives these signals high or low. The signal I/O is a bi-directional data line. The I/O interface is shown in Figure 10. The module and the (U)SIM (in the SIM card holder), located on both ends of the lines, control this data line. Either the module or the (U)SIM can pull this line low, through an open-collector. The line is pulled-up by a resistor of 12kΩ.

Figure 10: I/O interface

During certification of the module the SIM interface is tested. A SIM card is simulated by the test equipment. The test conditions are shown in Table 15 and Table 16. The test equipment loads the I/O line with 30pF.

Contacts	Low level	High level	Max. capacitive load
C1 (Vcc)	---	I = 6 mA	
C2 (RST)	I = -200 μA	I = +200 μA	30 pF
C3 (CLK)	I = -20 μA	I = +20 μA	30 pF
C5 (GND)	---	---	
C6 ((Vpp)	---	---	
C7 (I/O) ME input ME output	 V = 0 V I = -1 mA	 I = +20 μA I = +20 μA	30 pF

Table 15: Nominal test conditions on 3V SIM/ME interface



Contacts	Low level	High level	Max. capacitive load
C1 (Vcc)	---	I = 4 mA	
C2 (RST)	I = -200 μA	I = +200 μA	30 pF
C3 (CLK)	I = -20 μA	I = +20 μA	30 pF
C5 (GND)	---	---	
C6 ((Vpp)	---	---	
C7 (I/O) ME input ME output	 V = 0 V I = -1 mA	 I = +20 μA I = +20 μA	30 pF

Table 16: Nominal test conditions on 1V8 SIM/ME interface

The maximum rise-time of I/O equals 1μs. This result in a maximum capacitive load of 70pF on the I/O line. The maximum capacitance is the sum of all capacitors:

- Suppression capacitor on GTM, typical 17pF
- SIM driver logic on GTM, typical 5pF
- Suppression capacitor on SIM card holder, 10pF.
- Test equipment, maximum 30pF load.
- Connectors

The sum of al these capacitors, without the trace capacitance, equals 62pF. The trace capacitance is 70pF minus all other capacitance. The maximum trace capacitance equals 70 – 62 = 8pF. This capacitance typically gives lead to a maximum length of 200mm in the worst case.

3.3.5 Practical implementation

The (U)SIM signals on the GTM are connected to the PCI Express MiniCard edge connector. The method of routing the signals to the SIM card holder depends on which connecter is used.

Note that only one of the two connectors can be used at once, the other needs to be left floating.

3.3.5.1 PCI Express MiniCard edge connector Signal Routing

When using this connector the SIM signals are routed throughout the PCB. In this environment it is possible to shield the signals in an efficient way. An example of possible PCB stackup is shown in Figure 11: PCB Stackup.

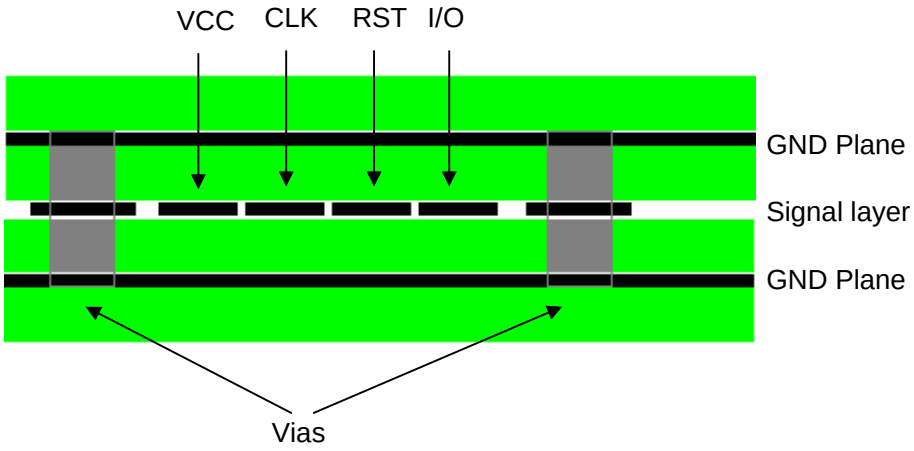


Figure 11: PCB Stackup

Note: Ground vias are placed every 2 – 3 mm along the signal traces.

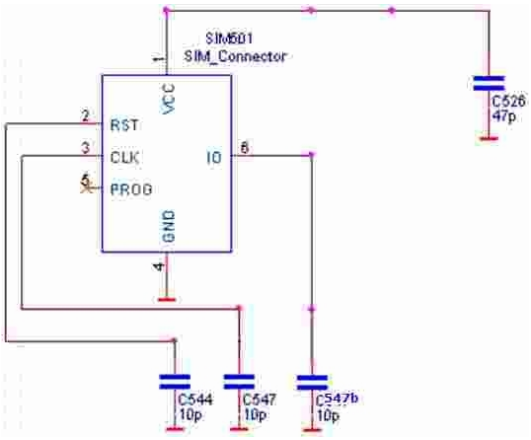
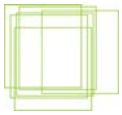


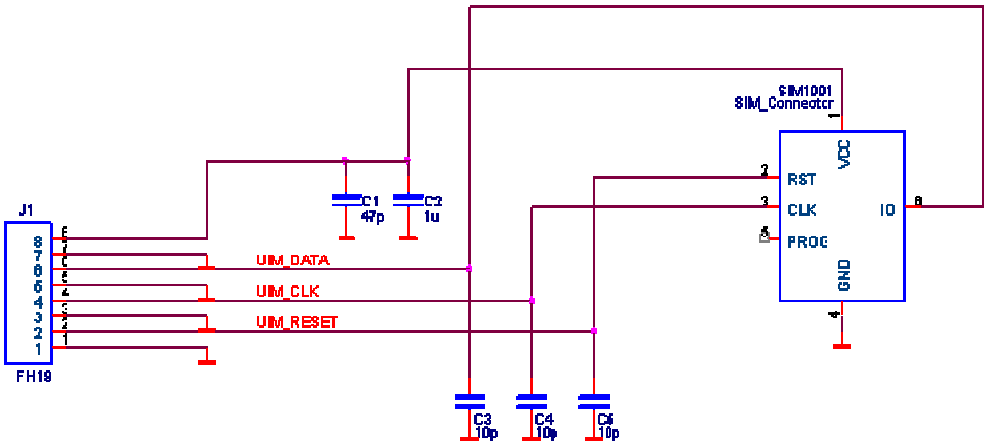
Figure 12: Possible Schematic of a UICC cardholder

Note the 47pF suppression capacitor near contact C1 of the UICC cardholder.



3.3.5.2 FH19 Signal Routing

The connection between the GTM and UICC cardholder is made by an FFC (flexible flat cable). Shielding in this environment is much more problematic. In many cases the signals are not shielded at all. However, the ground wires between every active signal grants certain immunity against noise.
However an additional PCB board should be designed to host cardholder and some decoupling capacitors.. The 8-contacts connector from Hirose's FH19 Series is the same as on the GTM module. Keep in mind the flat cable has a symmetrical usage.
Figures below show an example for an UICC card holder PCB board and interface. The schematic and a layout are shown in these pictures.



· **Figure 13: Possible Schematic of a UICC card holder PCB board**

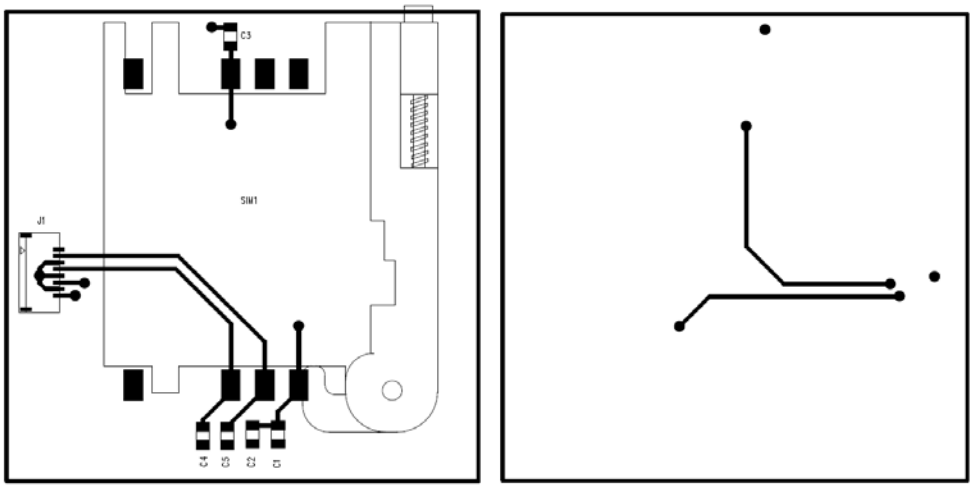


Figure 14: Example of a (U)SIM card holder layout

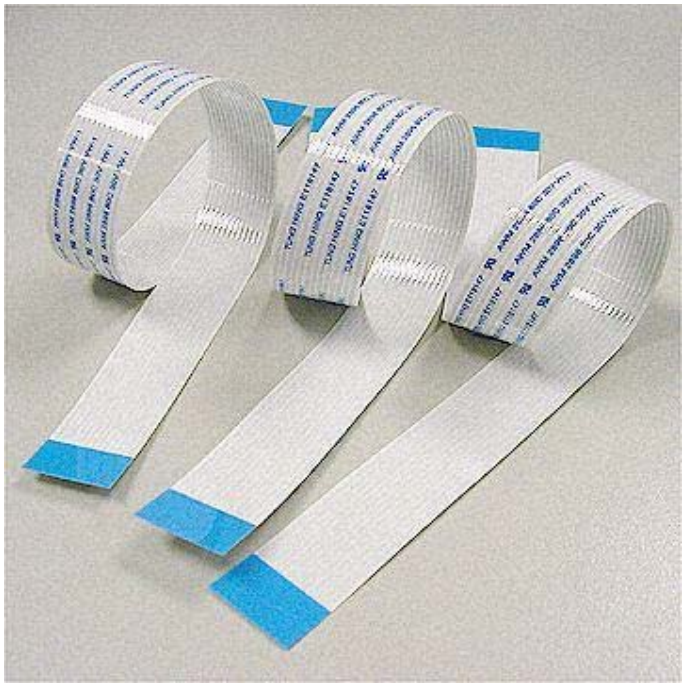
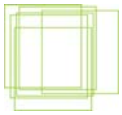


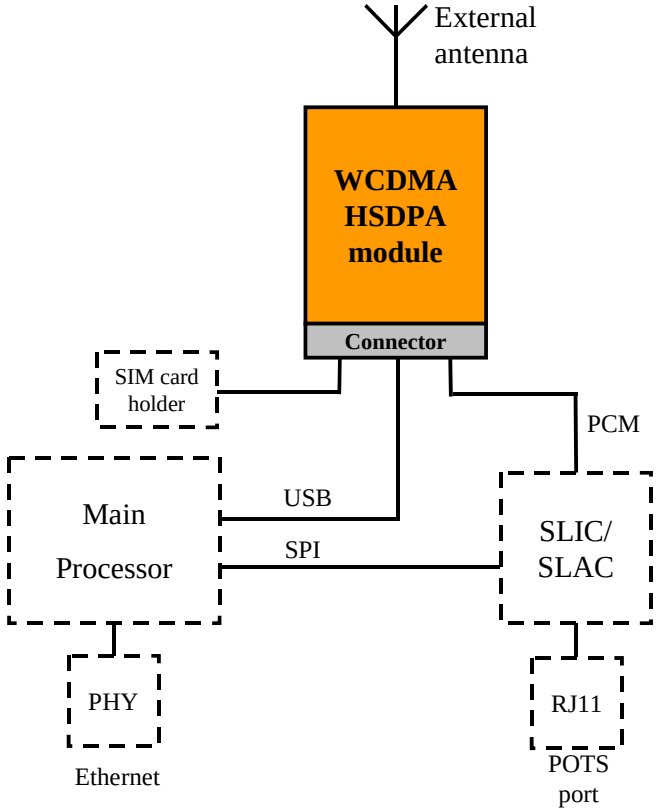
Figure 15: Example of a FFC

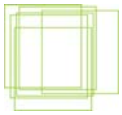


3.4 Digital PCM interface

3.4.1 Background

The module shall interface towards the main processor through the USB interface and it shall also have an audio interface (PCM) towards the SLIC/SLAC device. Although some signalling can de done in band over the PCM interface, the application AT-command interface over the USB is to be used for settings, dialling out, accepting voice calls and reply messages as RING, BUSY and DISCONNECT.





3.4.1.1 Mechanical form factor for data and voice module

PRELIMINARY PINOUT :

The PCM interface (for voice) will be set on pin 45, 47, 49 and 51 of the PCIe Express MiniCEM IO interface.

There are 4 pins defined PCM_CLK, for uplink voice PCM_UPLINK, downlink voice PCM_DOWNLINK and PCM_SYNC. The PCM_CLK and PCM_SYNC are generated by the module and therefore it act as MASTER. The CODEC port supports 2.048MHz PCM clock and 8KHz sync timing for linear, companded (A-law and µ-law) CODEC's that match the sync timing.

3.4.2 Interfaces, Features & Functions

3.4.2.1 Telephony features

It is possible to originate and terminate calls via AT commands.

The module drives the PCM clock and sync (MASTER). When the module goes to sleep, clock is lost and the PCM interface becomes inactive. Leaving the PCM interface active on at all times would force standby time to be close to talk time.

The AT-commands ATD and ATA will connect the PCM interface and makes the PCM_DOWNLINK data-pin active by reversing the pin's tri-state. The ATH command disconnects the remote user: all calls are released (active, on-hold and waiting calls).

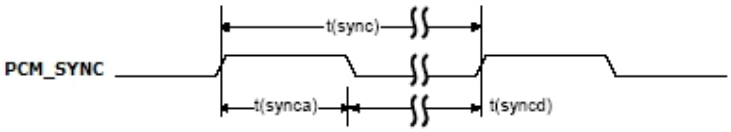
3.4.2.1.1 PCM/Audio interface

The module has a PCM interface for a direct connection to an external SLAC/SLIC that provides a single POTS port.

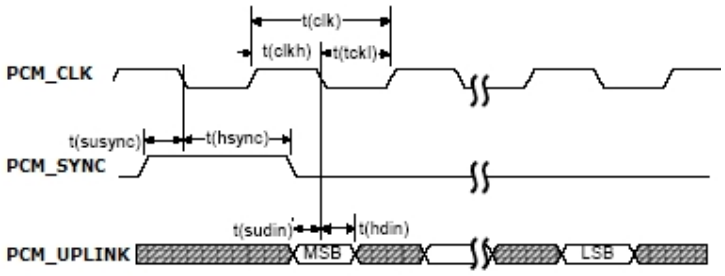
A 16-bit linear or 8-bit A-law or µ-law with padding can be selected for the primary PCM interface. (See AT commands doc subsection 'Voice')

For all three, the format of the 16 bits on the PCM_UPLINK hardware line is 0xSDDD DDDD DDDD DDVV, where S is the signed bit, D is data, and V is for volume padding. Also, for PCM_DOWNLINK, PCM has the 16-bit format of 0xSDDD DDDD DDDD DVVV, where S is the signed bit, D is data, and V is for volume padding.

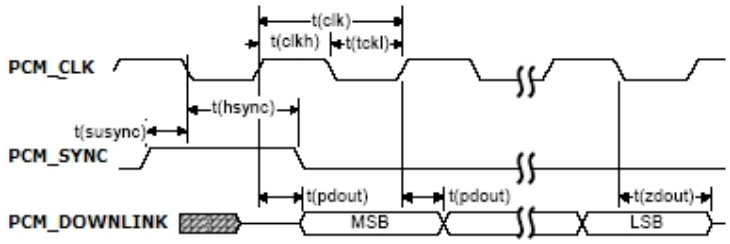
Each interface path always accepts/outputs data in 20 millisecond frames.
This translates to 320 bytes per frame
(8 k samples/second * 16 bits/sample * 20 ms).



· Figure 16 PCM_SYNC timing



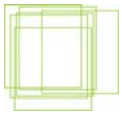
· Figure 17 PCM_UPLINK, Codec to Module timing



· Figure 18 PCM_DOWNLINK, Module to Codec timing

Parameter	Description	Min	Typical	Max	Units
t(sync)	PCM_SYNC cycle time	--	125	--	µs
t(synca)	PCM_SYNC asserted time	62.4	62.5	--	µs
t(syncd)	PCM_SYNC deasserted time	62.4	62.5	--	µs
t(clk)	PCM_CLK cycle time	--	7.8	--	µs
t(clkh)	PCM_CLK high time	3.8	3.9	--	µs
t(clkl)	PCM_CLK low time	3.8	3.9	--	µs
t(susync)	PCM_SYNC setup time to PCM_CLK rising				ns
t(hsync)	PCM_SYNC hold time after PCM_CLK rising				ns
t(sudin)	PCM_UPLINK setup time to PCM_CLK falling				ns
t(hdin)	PCM_UPLINK hold time after PCM_CLK falling				ns
t(pdout)	Delay from PCM_CLK rising to PCM_DOWNLINK valid				ns
t(zdout	Delay from PCM_CLK falling to PCM_DOWNLINK HIGH-Z				ns

· Table 17 PCM Codec timing parameters



3.4.2.1.2 Voice codecs

The module supports 1. Full Rate (FR), 2. Enhanced Full Rate (EFR), 3. Half Rate (HR) and 4. Adaptive Multi-Rate (AMR) voice codecs.

3.4.2.1.3 Handling of Emergency Calls

It is possible to place an emergency call (i.e. 112 or 911) without having to enter a PIN-code. SO the call should be set-up by the AT-command interface either PCM interface.

3.4.2.1.4 Voice quality

The module will fulfil terminal acoustics according to 3GPP TS 26.131 Rel 5 and TS 26.132 Rel 5 (headset) if relevant.

Comment: The overall requirement for the module, is that it shall be possible to achieve typical MOS 3.5 between a phone connected to the unit and a phone connected to the PSTN (running AMR codec).

Algorithm	Bit Rate (kbits/s)	MOS (good network conditions)	Framesize (ms)
PCM G.711	64	4.3	0
GSM FR RPE-LTP	13	3.7 (average)	20
GSM EFR	13	4	20
GSM HR VSELP	6.3	~3.4	20
GSM AMR CELP	adaptive		20

3.4.2.1.5 Message based DTMF transmission on the radio interface

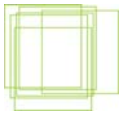
The module is capable of transmitting DTMF on the radio interface as received on the POTS interface using message based signalling on Layer 3 out of 'Voice' band.

The module detects and suppresses DTMF tones generated on the POTS interface according to applicable standards (when the voice service is being used). (See AT commands doc subsection 'Voice')

3.4.2.1.6 Tones

The following tones are provided by the module over the POTS interface.

- ✓ Call waiting tone:
  A call waiting tone that is used to advise a subscriber who is engaged in



a call that another subscriber is attempting to call. (The reader shouldn't get confused with the reply message over the AT-command channel 'BUSY'.)

- ✓ Cost warning tone:
  During an advice of charge charging call the user can be informed about the remaining credit during a call. This cost warning is a tone advising the user that a limited credit (number of units) is left.

3.4.2.1.7 Ringing signals

The module indicates to the AT-command interface two (2) different call types:
voice and voice line 2 (ALS).

3.4.2.1.8 CLI service

The module provides Caller Line Id (CLI) information to the main processor via AT commands.

3.4.2.1.9 Alternate line service (ALS)

The module supports Alternate Line Service (ALS). This function is available when a (U)SIM application providing this service is installed.

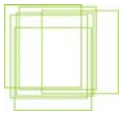
3.4.2.1.10 Fixed number dialling

The module supports Fixed Number Dialling. If enabled, this function allows only calls to fixed numbers stored in (U)SIM. This function is available when a (U)SIM providing this service is installed.

3.4.2.1.11 Supplementary services

The module supports below supplementary services in both GSM and UMTS network as specified in applicable standards.

Supplementary service
Calling Line Identification Presentation (CLIP)
Calling Line Identification Restriction (CLIR)
Connected Line Identification Presentation (COLP)
Connected Line Identification Restriction (COLR)
Call Forwarding Unconditional
Call Forwarding on Mobile Subscriber Busy
Call Forwarding on No Reply
Call Forwarding on Mobile Subscriber Not Reachable
Call Waiting
Call Hold
Multi Party Service



Supplementary service
Advice of Charge (Information)
Advice of Charge (Charging)
Barring of All Outgoing Calls
Barring of Outgoing International Calls
Barring of Outgoing International Calls except thos directed to the Home PLMN Country
Barring of All Incoming Calls
Barring of Incoming Calls when Roaming Outside the Hom PLMN Country
Explicit Call Transfer
Unstructured SS Data

3.5 Antenna guidelines

This section describes general guidelines for the design of multi-band antenna required for the GTM module.

3.5.1 Antenna specifications

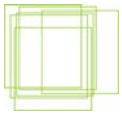
- **Frequency range:**
  - GSM850 (824-894 MHz)
  - EGSM900 (880-960 MHz)
  - DCS1800 (1710-1880 MHz)
  - PCS1900 (1850-1990 MHz)
  - W UMTS 850/1900/2100 (830-885 / 1850-1990 / 1920-2170 MHz)

- **Gain**:
  - Radiation pattern: omni-directional
  - Gain averaged in space in all frequencies: > -3dBm
- **Maximum VSWR**: < 2.5:1 with 50Ω reference impedance
- **Polarization**: linear

3.5.2 WLAN Antenna Isolation

Based upon the known isolation and the lineair gain of the WLAN receiver there is a minimum requirement for the out of band isolation in the GSM and UMTS bands. The isolation is depending upon the antenna isolation WLAN and mobile standard, the output power of the mobile, the linearity of the WLAN receiver IIP3 and the front-end filter (blocking filter). Therefore it is preferred to use WLAN modules with blocking filter.

	frequency	PWR dBm	Ant ISOL (dB)	Attn front end filter (dB)

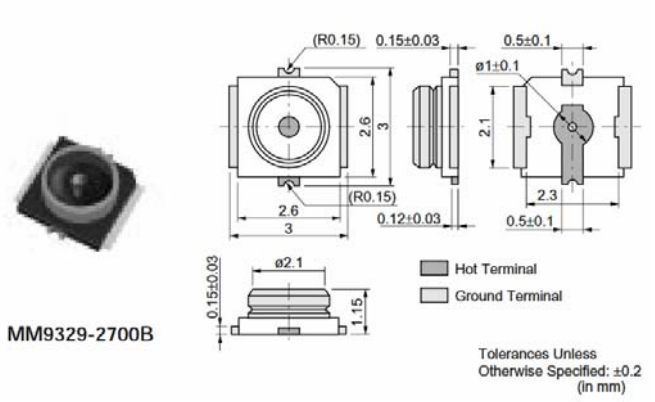


WLAN IIP3	2400-2500MHz	-8		
GSM PWR	880-915MHz	33	20	34
DCS PWR	1710-1785MHz	30	15	36
PCS PWR	1850-1910MHz	30	15	36
UMTS PWR	1920-1980MHz	24	12	33

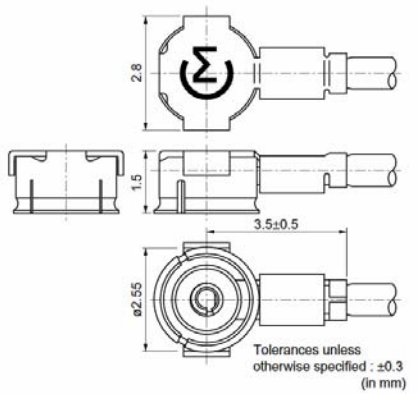
Table 18: Antenna isolation example

3.5.3 Antenna connector

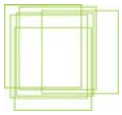
The connector type used is a muRata MM9329-2700B miniature microwave coaxial connector.



· **Figure 19: PCB connector (on GTM module)**



· **Figure 20: Jack connector**



4 HOST CONTROL INTERFACES

Figure 14 shows the NDIS interface via the TCP/IP stack as well as the COM interface via the custom IOCTL interface. More details on the driver interface can be found in the following chapter (Device Driver Interface)

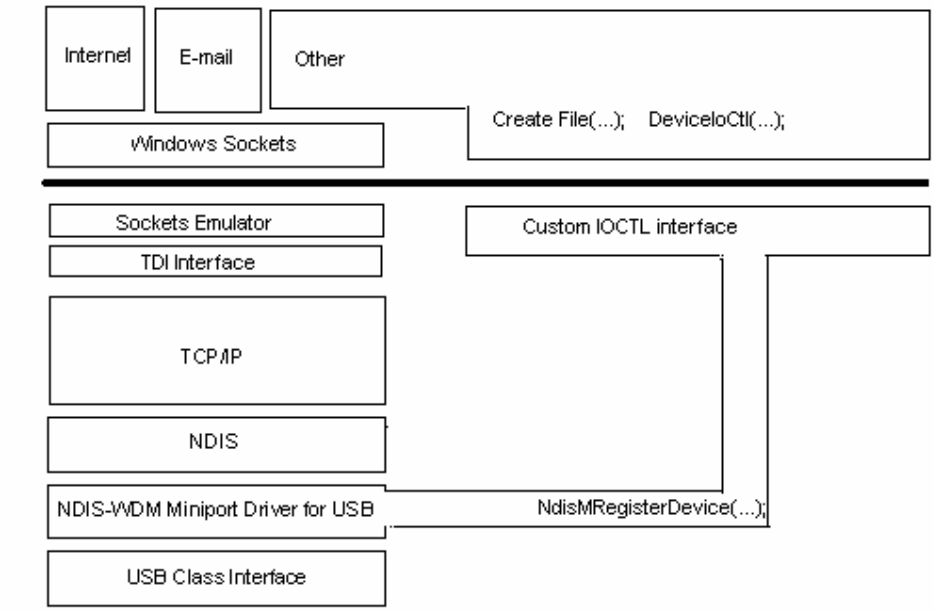


Figure 21: Host interface components

4.1 USB interface

The hardware USB interface is USB 2.0 compatible, USB 2.0 Full Speed (12Mbi/s) signalling will be used.

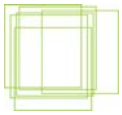
4.2 COM interface

Three com ports are defined:

- *application*: This interface can be used for SMS and AT control commands and event reporting
- *modem*: a second COM port provides the interface for the data channel and supports dial up networking
-*diagnostic*: A third port is used for layer 1-3 stack tracing and debugging messages.

4.3 NDIS interface

The NDIS interface for the data channel provides an "auto start", "no click" way to get online for a user. To the operating system, the card is represents itself as a network interface card, hiding dial-up networking and AT commands.
One NDIS driver could also run the SMS and signal strength port. This data can be shipped to an application via a custom IOCTL interface.



5 DEVICE DRIVER INTERFACE

The figure below gives an overview of the driver structure which will be provided with the GTM. Basically the module will manifest itself as a composite USB device which creates stubs which the other higher level drivers hook into and provide their respective function. The version number in gtmndisXXusb.sys denotes the operating system (XX= 50 for windows 2000, 51 for XP and 60 for Longhorn).

The “gtffbus.sys” driver is in fact a flip flop driver (type of mux) which chooses the interface to use for data traffic: either the modem or the NDIS interface can be used.
For informational point of view it is illustrated that the mdm.exe service in fact controls the “modem.sys” driver and the “tcpip.sys” is used for the TCP/IP stack interface towards the application. These 2 drivers are default OS drivers.

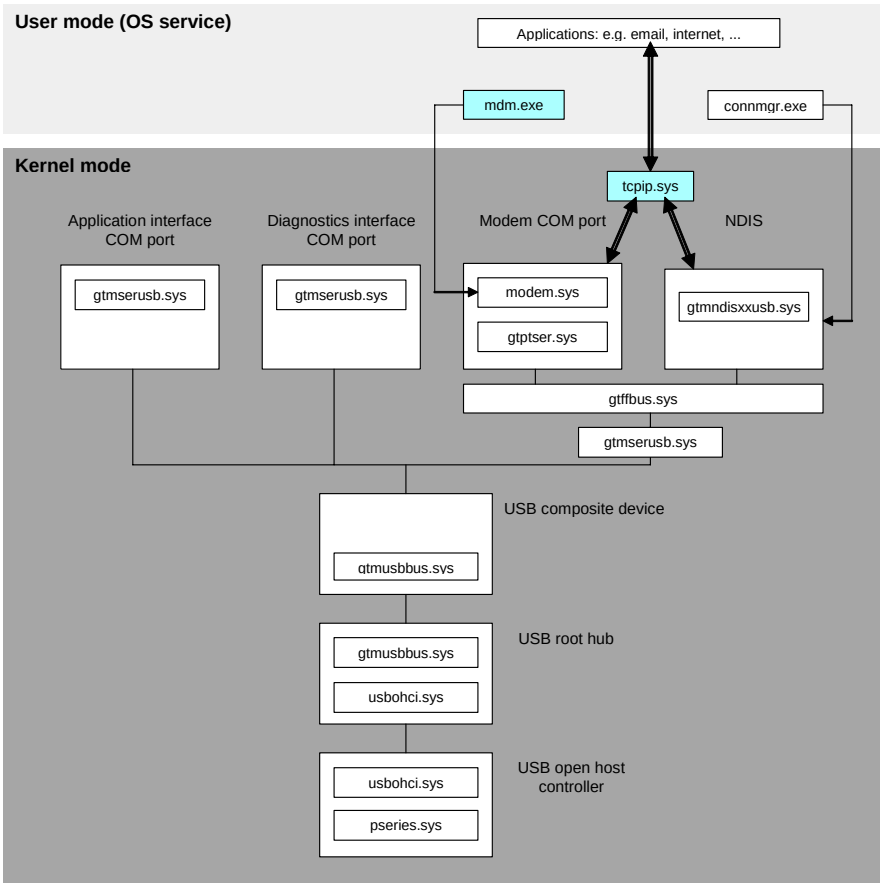
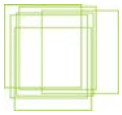


Figure 22: Driver structure

The “connmgr.exe” is a service proposed by Option to control the functionality of the NDIS driver (e.g. other PIN code, APN, …). The user space API will be available to aplication developers.



6 AT COMMAND SET REFERENCE

This section lists the AT commands available on the GTM module. Most of the AT commands supported are specified in 3GPP TS 27.007 and 3GPP TS 27.005. Details of these commands can be found in those 3GPP specifications.
Only Option and/or Qualcomm proprietary AT commands are fully described in this section .

Please note that this section is subject to change. Support for some commands still needs to be defined and will be updated in future versions of this document.

6.1 DTE-TA/DCE Interface Commands

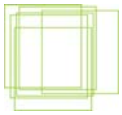
All these commands are specified in 3GPP TS27.007 [1] and or ITU-T V.25ter.
Some of these commands may become meaningless on GTM because of the specific hardware design. For example, since GTM internally uses a USB interface towards the host commands to set the baud rate are no longer applicable. Where possible, this shall be indicated.

Command	Description	Used
S3	Command line termination character (S-parameter)	Yes
S4	Response formatting character (S-parameter)	Yes
S5	Command line editing character (S-parameter)	Yes
E	Command Echo	Yes
Q	Result code suppression	Yes
V	DCE Response format	Yes
&C	Circuit 109 behavior	Yes
&D	Circuit 108 behavior	Yes
+IPR	Fixed DTE rate	Not applicable
+ICF	DTE-DEC character framing	Not applicable
+IFC	DTE-DCE local flow control	Yes
&V	Dump configuration parameters	Yes

6.2 General commands

All these commands are specified in 3GPP TS27.007 [1].

Command	Description	Used
+CGMI	Request manufacturer identification	Yes
+CGMM	Request model identification	Yes
+CGMR	Request revision identification	Yes
+CGSN	Request product serial number identification	Yes

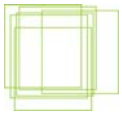


+CSCS	Select TE character set	Yes – but support for IRA character set only
+CIMI	Request international mobile subscriber identity	Yes
Z	Reset to default configuration	Yes
&F	Set to factory defined configuration	Yes
I	Request identification information	Yes
+GMI	Request manufacturer identification	Yes
+GMM	Request manufacturer identification	Yes
+GMR	Request revision identification	Yes
+GSN	Request revision identification	Yes
+GCAP	Request complete capabilities list	Yes

6.3 Call control commands

All these commands are specified in 3GPP TS27.007 [1].

Command	Description	Used
+CSTA	Select type of address	TBD
D	Dial (using new dial modifiers, ">", "**I/i**", "**G/g**", and "**;**" applicable to UMTS only) **>** = direct dial from phone book **I/i** = override CLIR supplementary service default **G/g** = control CUG supplementary service for call **;** = initiate voice call	Yes
+CHUP	Hang up	Yes – for voice call hangup
+CBST	Select bearer service type	Yes
+CRLP	Radio link protocol	Yes
+CR	Service reporting control	Yes
+CRC	Cellular result codes	Yes
T	Select tone dialing	Yes – but does nothing
P	Select pulse dialing	Yes – but does nothing
A	Answer	Yes
H	Hook control	Yes
O	Return to online data state	Yes
S0	Automatic answer	Yes
S6	Pause before blind dialing	Yes – but does nothing
S7	Connection completion timeout	Yes – but does nothing
S8	Comma dial modifier time	Yes – but does nothing
S10	Automatic connect delay	Yes – but does nothing
L	Monitor speaker loudness	Yes – but does nothing
M	Monitor speaker mode	Yes – but does nothing
+DS	Data compression	Yes
+DR	Data compression reporting	Yes



6.4 Network service related commands

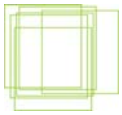
All these commands are specified in 3GPP TS27.007 [1].

Command	Description	Used
+CREG	Network registration	Yes
+COPS	Operator selection	Yes
+CLCK	Facility lock	Yes
+CPWD	Change password	Yes
+CLIP	Calling line identification presentation	TBD
+CLIR	Calling line identification restriction	TBD
+COLP	Connected line identification presentation	TBD
+CCUG	Closed user group	TBD
+CCFC	Call Forwarding Number and Conditions	TBD
+CCWA	Call waiting	TBD
+CHLD	Call related supplementary services	TBD
+CTFR	Call deflection	TBD
+CUSD	Unstructured supplementary service data	TBD
+CAOC	Advice of charge	TBD
+CSSN	Supplementary service notifications	TBD
+CLCC	List current calls	TBD
+CPOL	Preferred operator list	TBD
+CAEMLPP	eMLPP priority registration and Interrogation	TBD

6.5 Mobile equipment commands

All these commands are specified in 3GPP TS27.007 [1].

Command	Description	Used
+CPAS	Phone activity status	Yes
+CFUN	Set phone functionality	Yes
+CPIN	Enter PIN	Yes
+CBC	Battery charge	Yes – but not applicable
+CSQ	Signal quality	Yes
+CPBS	Select phone book memory storage	Yes
+CPBR	Read phone book entries	Yes
+CPBF	Find phone book entries	Yes
+CPBW	Write phone book entry	Yes
+CLVL	Loudspeaker volume level	Yes - but not applicable
+CMEE	Report mobile equipment error	Yes



6.6 UMTS packet domain commands

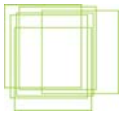
All these commands are specified in 3GPP TS27.007 [1].

Command	Description	Used
+CGDCONT	Define PDP context	Yes
+CGQREQ	Requested quality of service profile	Yes
+CGQMIN	Minimum acceptable quality of service profile	Yes – Accepted but does nothing
+CGEQREQ	Requested 3G quality of service profile	Yes
+CGEQMIN	Minimum acceptable 3G quality of service profile	Yes – Accepted but does nothing
+CGATT	PS attach or detach	Yes
+CGACT	PDP context activate or deactivate	Yes
+CGCLASS	GPRS mobile station class (GPRS only)	Yes
+CGEREP	Packet domain event reporting	Yes – Accepted but does nothing
+CGREG	GPRS network registration status	Yes
+CGSMS	Select service for MO SMS messages	Yes

6.7 SMS Commands

All these commands are specified in 3GPP TS27.005 [2].

Command	Description	Used
+CSMS	Select message service	Yes
+CPMS	Preferred message storage	Yes
+CMGF	Message format	Yes
+CSCA	Service center address	Yes
+CSMP	Set text mode parameters	Yes
+CSDH	Show text mode parameters	Yes
+CNMI	New message indications to TE	Yes
+CMGL	List message	Yes
+CMGR	Read message	Yes
+CNMA	New message acknowledge to ME/TA	Yes
+CMGS	Send message	Yes
+CMSS	Send message from storage	Yes
+CMGW	Write message to memory	Yes
+CMGD	Delete message	Yes



6.8 Synchronous data mode commands

These commands are specified in ITU-T V.80ter.

Command	Description	Used
+ES	Enables the synchronous mode	Yes
+ESA	Preferred message storage	Yes

These commands are not tested and probably will not work over the USB interface.

6.9 SIM Toolkit commands

There are no standard AT commands available in the GSM/GPRS/UMTS specifications to manipulate the SIM Toolkit interface. See proprietary commands for SIM Toolkit in section 6.10.7.

6.10 Option proprietary commands

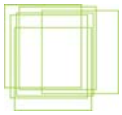
These are commands added by Option to accomplish things that cannot be done via the standard AT commands available in the GSM/GPRS/UMTS specifications. This list of proprietary commands will grow during the development of the module.

Command	Description	Used
_OHWV	Read hardware version	Yes
_OPSYS	Preferred system	Yes
_OSEC	RRC Security	Yes
_OSSYS	Selected system	Yes
_OAIR	Aircraft mode	Yes
_OCHAP	enable/disable CHAP	Yes
+STPD	SIM toolkit profile download	Yes

6.10.1 Read hardware version _OHWV

Command	Possible Response(s)
_OHWV	_OHWV: <version>

Description
This command returns the version of the PCB and the version of the BOM (Bill Of Materials).
Defined Values
<version> :
String type, indicates the PCB and BOM revision.



6.10.2 Preferred SYStem AT_OPSYS

Command	Possible Response(s)
_OPSYS=[<mode>[,<domain>]]	OK
_OPSYS?	_OPSYS: <mode>,<domain>
_OPSYS=?	_OPSYS: (0-5),(0-6)

Description
This command changes the preferred system, GSM/WCDMA, the acquisition order and the service domain preference PS/CS.

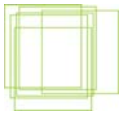
Defined values
<mode>:
0 GSM only
1 WCDMA only
2 GSM first
3 WCDMA first (default)
4 No change
5 Auto

<domain>:
0 Acquire only circuit-switched systems
1 Acquire only packet-switched systems
2 Acquire circuit-and/or packet-switched systems (default)
3 Any domain will do; no preference
4 To be used by clients who do not want to change the service domain
5 PS attach on demand; note that this value of service domain preference is not saved in NV
6 PS detach on demand; note that this value of service domain preference is not saved in NV

6.10.3 Security "AT_OSEC"

Command	Possible Response(s)
_OSEC=[<sec>]	OK
_ OSEC?	_ OSEC: < sec >
_ OSEC =?	_ OSEC: (list of supported <sec>s)

Description
This command sets the RRC security setting.
Please note that a hard reset of the GTM is required before the setting will take effect.
Defined values
<sec>:
0 None
1 Integrity
2 Ciphering
3 Fake Security
4 Integrity and Ciphering (default)



6.10.4 Selected System "AT_OSSYS"

Command	Possible Response(s)
_OSSYS=[<n>]	OK
_OSSYS?	_OSSYS: <n>,<AcT>
_OSSYS=?	_OSSYS: (0-1),(0,2)

Description
This command enables/disables the unsolicited result code _OSSYSI: <mode>.

Defined values
<n>:
0 Turns off unsolicited result code _OSSYSI: <mode> (default)
1 Turns on unsolicited result code _OSSYSI: <mode>

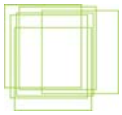
<AcT>:
0 GSM
2 UTRAN
3 No service

6.10.5 Aircraft Mode "AT_OAIR"

Command	Possible response(s)
_OAIR= < aircraft mode>	OK
_OAIR?	_OAIR: < aircraft mode>
_OAIR=?	_OAIR: (list of supported <mode>'s)

Description
Allows the user to change the startup RF of the gsm/wcdma part (protocol stack) at power up setting or query its current state.

Defined Values
<Aircraft mode>
0 Off, the unit will startup protocol stack at power up (gsm/wcdma part). (default)
1 On, the unit will NOT startup the protocol stack at power up (gsm/wcdma part).



6.10.6 Enable/Disable CHAP "AT_OCHAP"

Command	Possible Response(s)
_OCHAP=[<sec>]	OK
_ OCHAP?	_ OCHAP: < sec >
_ OCHAP =?	_ OCHAP: (0-1)

Description
This command enables or disables CHAP Protocol security setting during activation of a PDP context.

Value is stored in NVRAM. The default state is enabled.

Defined values
<sec>:
0 Disabled
1 Enabled (default)

6.10.7 SIM toolkit profile download "AT+STPD"

Command	Possible Response(s)
+STPD=<length>, <profile>	OK, ERROR
+STPD?	ERROR
+STPD=?	ERROR

Description
This command will send the given profile to SIM toolkit.

Parameters
<Length> = a number representing the length of the binary profile.
<Profile> = the SIM toolkit profile in hexadecimal format (see 3GPP 11.14 [Structure and coding of TERMINAL PROFILE])

Example
AT+STPD=1,03
Indicates that profile download and SMS-PP data download are supported by the ME (GTM in this case)

7 PHYSICAL CHARACTERISTICS

7.1 Dimensions

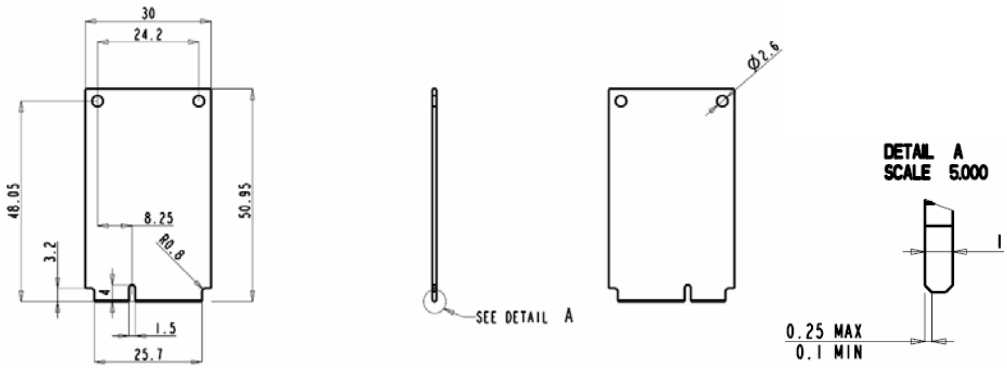


Figure 23: card dimensions (in mm - not to scale)

7.2 Power consumption

(preliminary)

Vcc	3.3V +/- 9%
Peak Icc	2750 mA
with max supply droop 50mV	
Average Icc	850mA

7.3 Thermal dissipation requirements

The GTM power dissipation in idle mode (slow clocking mode) is 80mW, under the condition that the USB defined selective suspend is fully supported for USB Host Controllers (UHCI). The maximum thermal dissipation directly from any PCI Express Mini Card add-in card is 2.9 W peak

- Total estimated power consumption (based on calculations; worst case: highest Tx):

	GPRS (2TX+4RX) 850	UMTS 2100	UMTS US 850	UMTS US 1900
Total power (mW)	**1800**	**2750**	**2800**	**2900**

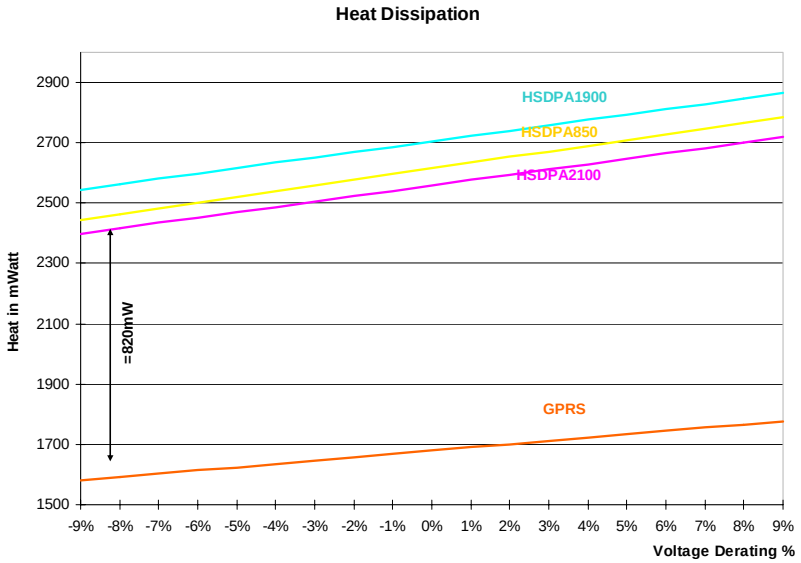
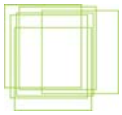


Figure 24: Thermal Design Profile (TDP) Worst Case

Figure 24 shows the (calculated) power consumtion versus voltage derating characteristic.

- Measured power consumption: to be determined.



7.4 Operating and Storage Environment

These values should be considered preliminary and are to be investigated later.

7.4.1 Shock

Operating 15 G, 18 ms
Non-operating 30 G, 11 ms

7.4.2 Vibration

Operating Linear: 20-300 Hz, 0.75 G (0 to peak)
Random: 10-300 Hz, 0.004 g^2/Hz
Non-operating 5-20 Hz, 0.195 inches (double amplitude)
20-500 Hz, 4.0 G (0 to peak) Sweep Rate 0.5 octave/minute minimum

7.4.3 Operating Temperature and Humidity

Temperature -10°C to 55°C (14°F to 131°F)
Humidity 5-95% RH non-condensing
33°C (maximum wet bulb)
Thermal Gradient 20°C/hour (maximum)
Humidity Gradient 20%/hour (maximum)

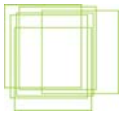
7.4.4 Non-Operating Temperature and Humidity

Temperature -40°C to 65°C (-40°F to 149°F)
Humidity 5-95% RH non-condensing
35°C (maximum wet bulb)
Thermal Gradient 30°C/hour (maximum)
Humidity Gradient 20%/hour (maximum)

7.4.5 Altitude

Operating -1000 feet to 10,000 feet (-305M to 3,050M)
Non-Operating -1000 feet to 40,000 feet (-305M to 12,200M)

These figures are valid in open air (not valid in e.g. planes since this is a pressurised room)



8 CERTIFICATION

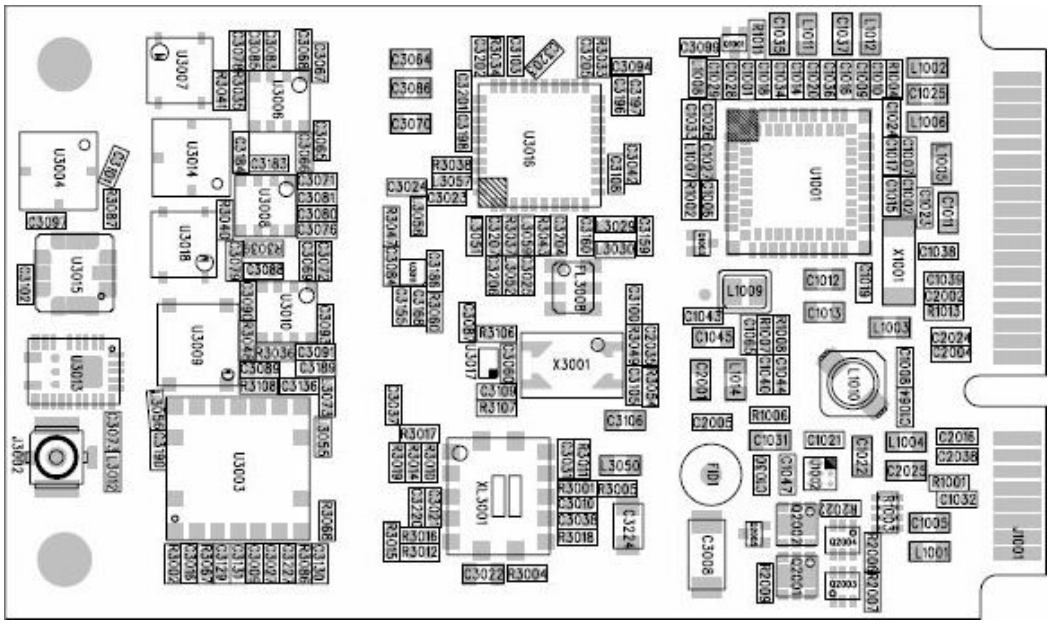
FCC certification:
If the FCC ID is not visible when this card is installed inside another device, then the outside of the device into which this device is installed must also display a label referring to the enclosed device. This exterior label can use wording such as the following: "Contains FCC ID: NCMOGTM353-W". Any similar wording that expresses the same meaning may be used. Other certification statements are to be added in a next revision of this document.

FCC Radiation Exposure Statement:
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 20cm between the radiator and your body.

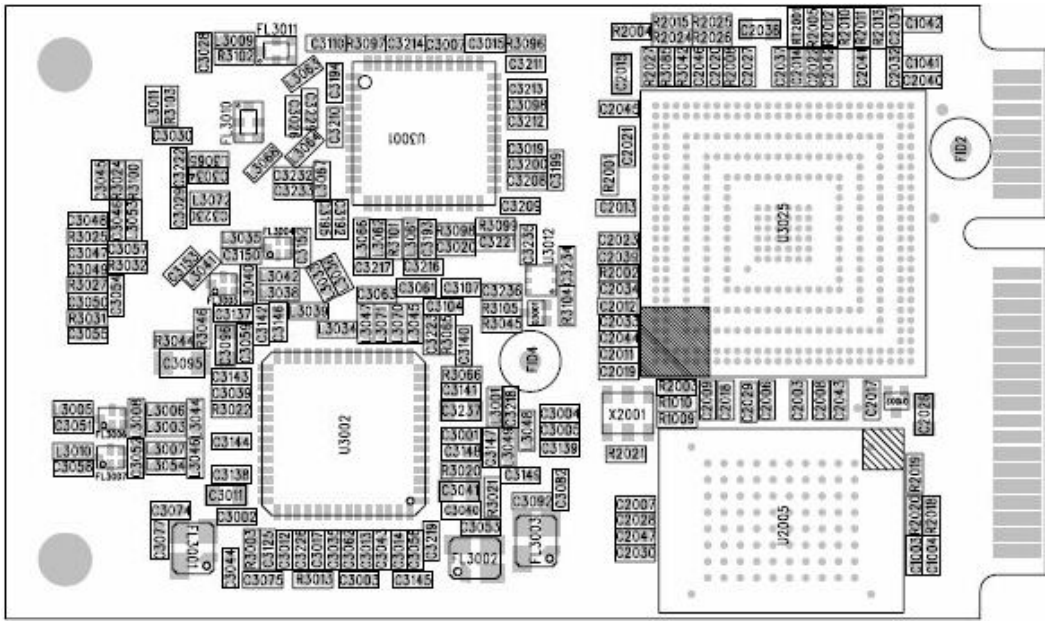
This device is intended only for OEM integrators under the following conditions:
OEM integrator is still responsible for testing their end product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

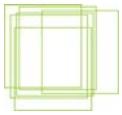
9 BOARD ASSEMBLY

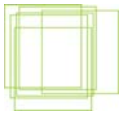


· **Figure 25: Top view**



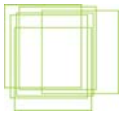
· **Figure 26: Bottom view**





10 ABBREVIATIONS

Abbreviation	Description
B2B	Board-to-board connector
EDGE	Enhanced Data Rates for Global Evolution
FFC	Flexible Flat Cable
GND	Ground
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HSDPA	High Speed Data Packet Access
IEC	International Electrotechnical Commission
ISO	International Standards Organization
I/O	Input/Output
ME	Mobile Equipment
NDIS	Network Driver Interface Specification
NVRAM	Non volatile RAM
SIM	Subscriber Identification Module
UICC	UMTS Integrated Circuit Card
UMTS	Universal Mobile Telephone Service
USB	Universal Serial Bus
(U)SIM	Universal Subscriber Identity Module



11 REFERENCES

Ref	Document
[1]	3GPP TS 27.007 V3.7.0 (2000-12) AT Command set for User Equipment (UE) (Release 1999)
[2]	3GPP TS 27.005 V3.1.0 (2000-01) Equipment (DTE-DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)