RADIOMETRIX

Hartcran House, 231 Kenton Lane, Harrow, Middlesex, HA3 8RP, England
Tel: +44 (0) 20 8909 9595, Fax: +44 (0) 20 8909 2233, www.radiometrix.com

GTC01 PRELIMINARY Issue 2, 18 November 2010

GSM Telemetry Controller

GTC01 is a self contained GSM / GPRS platform supporting the Cinterion M2M Evolution range of GSM modems.

GTC01 includes a watchdog, SIM holder and user interfaces. It can be directly added to any application requiring GSM connectivity.

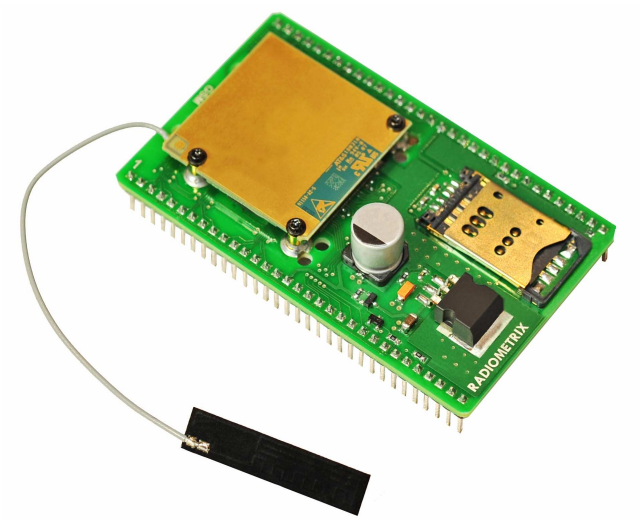

Figure 1: GTC01

Features

- Supports Cinterion MC75i, TC65i, or TC63i GSM modules
- Java platform using TC65i
- Worldwide communication potential
- Programmable Watchdog function
- SIM holder
- RS232 compliant serial interfaces
- On-board supply regulation
- DIL module form factor

Applications

- GSM communications interface for any product
- Remote management and instrumentation
- Remote imaging
- Emails
- SMS
- TCP/IP
- Remote web-site

PRELIMINARY

General Description

GTC01 is a complete GSM / GPRS modem communications processor solution in an easy to use plug-in module form factor. Essential references for the developer are the hardware and software documents for the GSM module to be used. Useful third-party documents and the contact details for Cinterion are listed at the end of this datasheet under **References**.

This document:

1. States the physical dimensions and pin-arrangement
2. Details the hardware connection of the Cinterion GSM device
3. Specifies the power supply requirements
4. Describes how the watchdog controller is typically used in a system

Figures 2 and 3 illustrate the outline shape and physical connections to the GTC01 PCB.

The antenna connection is 50 Ohms impedance and is via a Hirose U.FL connection directly to the GSM unit rather than to the GTC board. Typically the part number of the connector will be U.FL-LP-0xx, where "xx" varies according to the type of coaxial cable used. Extremely thin cable is commonly used (1.2 – 1.4mm diameter) and as both the connectors and cable require specialist tools it is often convenient to source a pre-assembled loom or loom and antenna combined.

It is easier to connect the RF loom to the GSM unit before mating the GSM unit to the rest of the module since the RF connection becomes inverted once the GSM unit is installed. The very small size of U.FL connectors means that care must be taken when handling the RF connection.

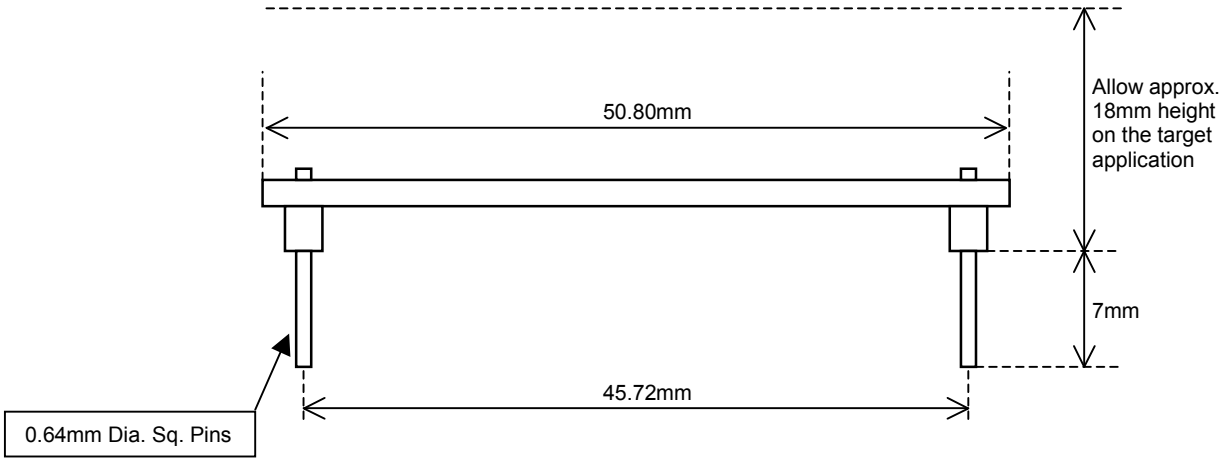

Figure 2: GTC01 Dimensions – end view

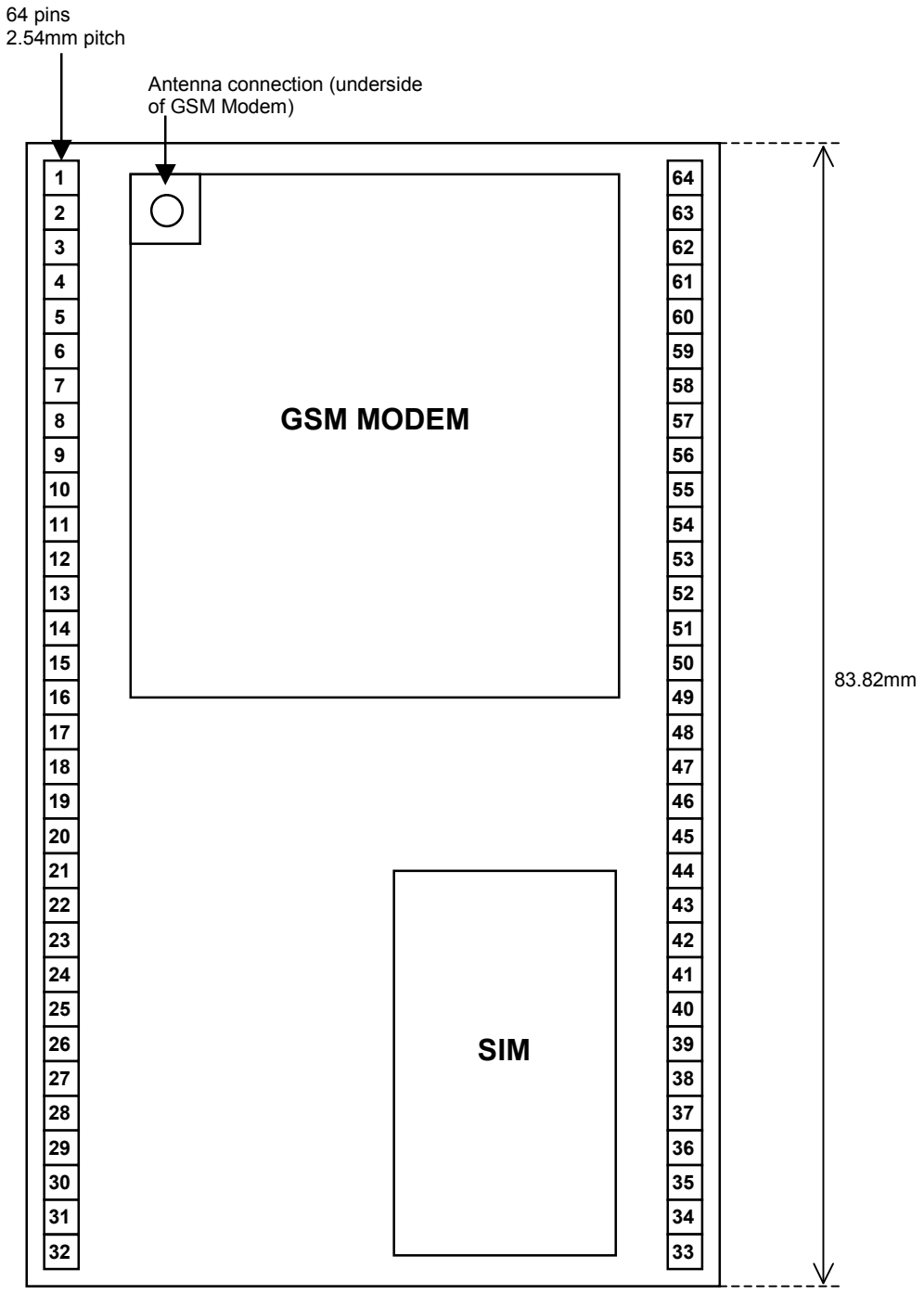

Figure 3: GTC01 Dimensions – plan view

GTC01 PIN DESCRIPTION

Pin	Name	GSM unit Pin No. or PIC Pin descriptor	Function and Notes - where "GSM" is referenced please refer to the Hardware Interface Description document pertaining to the GSM unit installed
1	ENable		Enables the on-board regulator when taken high. Typically this pin is tied to one of the +V supply pins.
2	ASC0-RI		RS232 Ring Indicator output from GSM ASC0
3	ASC0-DSR		RS232 Data Set Ready output from GSM ASC0
4	ASC0-CTS		RS232 Clear To Send output from GSM ASC0
5	ASC0-RTS		RS232 Request To Send input to GSM ASC0
6	ASC0-DTR		RS232 Data Terminal Ready input to GSM ASC0
7	ASC0-DCD		RS232 Data Carrier Detect output from GSM ASC0
8	ASC0-TD		RS232 Data input to GSM ASC0
9	ASC0-RD		RS232 Data output from GSM ASC0
10	SPIDI	GSM: 7	GSM SPI Digital Input
11	GPIO8	GSM: 6	GSM General Purpose Input/Output
12	GPIO10	GSM: 5	GSM General Purpose Input/Output and Pulse Counter
13	ADC2_IN	GSM: 3	GSM Analogue to Digital conversion input. +2.4V FS. Do not drive beyond 0.3V when GSM unit is shut down.
14	ADC1_IN	GSM: 2	GSM Analogue to Digital conversion input. +2.4V FS. Do not drive beyond 0.3V when GSM unit is shut down
15	+V Supply		+5.00 to +13.8V supply to the module: typically 6V – see specifications for more information Connected to pins 15, 16, 47, 48
16	+V Supply		
17	GND	GSM: 1, 4, 36-40, 80 PIC: VSS	Ground (0V) of the module Connected to pins 17, 18, 33, 49, 50
18	GND		
19	DAC_OUT	GSM: 79	GSM Pulse-Width Modulator output (use an external filter to achieve an analogue output)
20	GPIO9	GSM: 76	GSM General Purpose Input/Output
21	SPICS	GSM: 75	GSM SPI Chip Select (output)
22	GPIO4	GSM: 74	GSM General Purpose Input/Output
23	GPIO3	GSM: 73	GSM General Purpose Input/Output
24	GPIO7	GSM: 8	GSM General Purpose Input/Output
25	GPIO6	GSM: 9	GSM General Purpose Input/Output
26	GPIO5	GSM: 10	GSM General Purpose Input/Output
27	I2CCLK_SPICLK	GSM: 11	GSM I2C or SPI Clock Output
28	DAI5	GSM: 13	GSM: PCM Audio input – 100k pull-down on board
29	I2CDAT_SPIDO	GSM: 70	GSM: I2C Data in/out or SPI Data output
30	VMIC	GSM: 66	GSM: external microphone supply 2.5V output, 2mA max current capability.
31	EPN2	GSM: 65	GSM: external speaker connection (32 ohm)
32	EPP2	GSM: 64	GSM: external speaker connection (32 ohm)
33	GND		Connected to pins 17, 18, 33, 49, 50
34	DAI4	GSM: 22	GSM: PCM Audio input – 100k pull-down on board
35	DAI3	GSM: 23	GSM: PCM Audio output
36	EPP1	GSM: 63	GSM: external speaker connection (8 ohm)
37	EPN1	GSM: 62	GSM: external speaker connection (8 ohm)
38	MICP1	GSM: 59	GSM: external microphone input
39	MICN1	GSM: 58	GSM: external microphone input
40	AGND	GSM: 57	GSM: analogue ground
41	DAI2	GSM: 24	GSM: PCM Audio output
42	DAI1	GSM: 25	GSM: PCM Audio input – 100k pull-down on board
43	DAI0	GSM: 26	GSM: PCM Audio output
44	SYNC	GSM: 28	GSM: Synchronization Signal – useful indicator for monitoring GSM activity (500uA max output)

45	VRTC		GSM Real Time Clock backup supply input: connected to VDDLP (GSM: 33) via a schottky diode – the diode may be bypassed with a solder link in order to use a capacitor as the RTC backup supply but should be left untouched when using a battery. Vin: 2.7V - 3.6V (max)
46	ASC1-CTS		RS232 Clear To Send output from GSM ASC1
47	+V Supply		Connected to pins 15, 16, 47, 48
48	+V Supply		
49	GND		Connected to pins 17, 18, 33, 49, 50
50	GND		
51	ASC1-TD		RS232 Data input to GSM ASC1
52	ASC1-RTS		RS232 Request To Send input to GSM ASC1
53	ASC1-RD		RS232 Data output from GSM ASC1
54	ASC0-SHDN	PIC: RB4	Output: goes high to indicate that ASC0 RS232 traffic is inhibited: if the PIC is required to make a call for some reason it needs to take over the ASC0 interface to the GSM unit. It achieves this by making the on-board RS232 drivers for ASC0 high impedance.
55	PIC-RB5	PIC: RB5	PIC General Purpose Input / Output
56	PIC-PGC	PIC: RB6	PIC General Purpose Input / Output – also used for In-Circuit Serial Programming (ICSP) of the PIC
57	PIC-PGD	PIC: RB7	PIC General Purpose Input / Output – also used for ICSP
58	PIC-Vdd-2V7	PIC: VDD	PIC +V supply: Supplied from the on-board +3V regulator via a schottky diode. This can be used as a general low current supply (<50mA). Example: connect to pull-up resistors for use with GSM GPIO inputs.
59	PIC-RA0	PIC: RA0/AN0	PIC General Purpose Input / Output
60	PIC-RA1	PIC: RA1/AN1	PIC General Purpose Input / Output
61	ON-OFF	PIC: RB0/INT	PIC General Purpose Input / Output but suggested use is to provide an ON/OFF input function for the GSM unit.
62	PIC-RA2	PIC: RA2/AN2	PIC General Purpose Input / Output
63	PWR_IND	GSM: 78 PIC: RA3	PWR_IND (Power Indicator): the GSM unit on/off status – open collector pulled up via 10k to PIC-Vdd-2V7 so logic '0' indicates that the GSM unit is 'on'.
64	PIC-Vpp	PIC: /MCLR	PIC /MCLR is pulled up via 10k to PIC-Vdd-2V7. This pin is used during ICSP. Holding low will keep the PIC in reset.

Notes on the Module Pin description table

Not all of the GSM pins are "brought out" and some of the PIC pins are similarly unavailable. Please refer to the next table for a description of the on-board permanent connections between the PIC watchdog and the GSM unit. The PIC will normally be programmed – even if its only function is to turn the GSM unit on or off.

In all cases of interfacing peripherals to the GSM device please refer to the relevant Hardware description documents for the type of GSM device being used.

CAUTION!

Take care that inputs to GSM GPIO lines never exceed 3.00V – it is recommended to use the PIC-Vdd-2V7 (pin 58) as a Logic '1' reference for all digital inputs to the GTC01. Standard RS232 bus transceivers can be used for serial interfacing. Analogue inputs to the GSM unit should not be present whilst the unit is shut down (PWR_IND = high) and should not exceed 2.4V in any case.

PIC Watchdog

The on-board 16LF628A PIC is able to provide support for the GTC01 in the following ways:

- Control of IGT and EMERG_OFF on the GSM unit – turn GSM unit on/off
- Initiate software shutdown (e.g. of a Java application) via GPIO
- AT commands via the ASC0 interface (e.g. make calls)
- Inform peripheral devices of GTC01 status

PIC pin description is given in the table below – pre-determined functions are highlighted:

GTC Pin	PIC Name	GSM unit Pin No.	Function and Notes
59	RA0/AN0		Digital I/O or analogue input
60	RA1/AN1		Digital I/O or analogue input
62	RA2/AN2/VREF		Digital I/O or analogue input
63	RA3	78	PWR_IND (Power Indicator – input to the PIC): the GSM unit on/off status is open collector pulled up via 100k to PIC-Vdd-2V7, so logic '0' indicates that the GSM unit is 'on'.
	RA4	71	Connected directly to GPIO1 on the GSM unit, RA4 is an open-drain pulled up via 10k to PIC-Vdd-2V7. Intended for use as a control output from the PIC to the GSM unit.
64	/MCLR /VPP		PIC /MCLR is pulled up via 10k to PIC-Vdd-2V7. This pin is used during **ICSP**. Pull low to reset.
	RA6	(56)	Connected to GSM IGT (pin 56) via a transistor (open collector). This is able to turn the GSM unit on/off.
	RA7	(55)	Connected to GSM EMERG_OFF (pin 55) via a transistor (open collector). This is able to turn the GSM unit off.
58	VDD		PIC-Vdd-2V7: supply to the PIC is from the +3V supply on-board the GTC01 via schottky diode. Note that the +3V supply is not available externally but the PIC supply can be used as a general-purpose low-current source for interfacing with the rest of the module. This pin can be driven to +5V during **ICSP** (whilst main module supply is disconnected).
17 18 33 49 50	VSS		Connected to the GND (0V) pins of GTC01. Also used during **ICSP**.
61	RB0/INT		Intended for use as the ON/OFF request user input. Normally pulled high within the PIC by software (PORT B "weak pull-up" should be enabled in the program code).
	RB1/RX	30	Connected to RXD0 on the GSM unit: serial data from GSM unit to PIC using ASC0. Never make RB1 an output.
	RB2/TX	32	Connected to TXD0 on the GSM unit: serial data from PIC to GSM unit using ASC0. Note that the PIC program should ensure that that RB2 is always configured as an input and that the TXEN bit of the TXSTA register is '0' whenever RB4 is low (i.e. when ASC0 is available for external use).
	RB3	72	Connected directly to GPIO2 on the GSM unit, RB3 is intended for use as a status / response signal input from the GSM unit. Use PORT B "weak pull-up enable".
54	RB4		ASC0-SHDN: set High to inhibit external ASC0 RS232 traffic: if the PIC is required to communicate serially with the GSM unit it should have control over the ASC0 interface. This is achieved by making the GTC01 RS232 drivers for ASC0 high impedance (tri-state). RB4 should always be configured as an output in the PIC program and driven low or high as required by the application.
55	RB5		Digital I/O. See notes for a suggested use of RB5.
56	RB6/PGC		PIC-PGC: General Purpose Input/Output. Also used as programming clock during **ICSP** of the PIC.
57	RB7/PGD		PIC-PGD: General Purpose Input/Output. Also used as the data input during **ICSP** of the PIC.

PIC Watchdog notes

The on-board PIC uses the 4MHz oscillator contained within the PIC.

The on-board PIC of the GTC01 as supplied will contain a short program allowing a GSM unit to be turned on/off. When power is first applied (EN = High) the PIC will attempt to start the GSM unit via the IGT line. After this, taking the GTC ON/OFF pin low for approx. 500ms will cause the PIC to attempt switching the GSM unit off using the IGT line – the success of this action will depend upon how the GSM unit is set-up. Taking the ON/OFF pin low for >2s then releasing it will cause the PIC to force the GSM unit off via the EMERG_OFF line.

If the GSM unit is turned off it can be turned on again by taking the ON/OFF pin low for approx. 500ms, causing the PIC activate the IGT line again.

Because the PIC has direct control over the GSM unit it is also possible to write applications for the PIC and use the GSM unit as a straightforward modem. However as the GSM device contains a far more powerful processor (32-bit) and has more resources and capabilities it is anticipated that the PIC will normally be used in a supporting role with some useful additional I/O capability.

Note: if the GSM unit were set to auto-start then it would be possible to operate the GSM unit with no program contained within the PIC. The watchdog function may be temporarily disabled by taking pin 64 low.

A PIC Watchdog example

The application within the GSM unit would regularly signal its status via GPIO2 (active low). Short activation of GPIO2 could refresh a watchdog timer. Long activation could signal a request to the PIC to make a standard telephone call using ASC0 (for example: to maintain the network acceptance of a PAYG SIM in an application that rarely uses a GSM connection e.g. alarms).

The PIC is able to restart a “hung” application, having control of both IGT and EMERG_OFF lines. It could also request an action of the GSM unit via GPIO1 – e.g. halt a Java application.

Recommended use of RB5

In using Cinterion modules it has been found that during startup-shutdown momentary logic ‘1’ outputs can appear on some of the GPIO lines. This behaviour could be a problem in some situations. Therefore the PIC on GTC01 could be programmed so that RB5 is a “CINTERION_INVALID” indication that is high whenever PWR_IND is high but is also held high during initialisation (e.g. up to 1s post IGT) and driven high just *before* driving RA6 IGT or RA7 EMERG_OFF.

PIC programming

The PIC may be programmed using a suitable in-circuit programming device. A Microchip™ programmer is recommended. Note that both the Low-Voltage Programming Enable bit (LVP) and the Brown-out Reset Enable bit (BOREN) of the configuration word should be disabled (set to ‘0’). Oscillator Selection bits (FOSC<2:0>) should be set to ‘100’ corresponding to selection of the internal oscillator with RA6 and RA7 available for use as general purpose I/O.

CAUTION!

Due to the possibility for damage to be done to the GSM unit whilst in-circuit programming the PIC device with an external supply Radiometrix does not recommend in-circuit programming of the PIC with a GSM unit fitted to the board.

In-circuit programming can be achieved using the GTC01 on-board PIC supply (PIC-Vdd-2V7) but if code protection is enabled in the configuration word you may find that re-programming cannot be achieved without an external +5V supply to the PIC. For this reason it is recommended not to enable code protection during development of PIC programs for GTC01. If it is necessary to program the PIC using an external supply please bear in mind that several PIC port pins are connected directly to GSM I/O pins. Either disconnect the power supply or inhibit the supply by connecting pin 1 to 0V.

When programming with a +5V supply the in-circuit programming device default configuration should be set to hold the PIC in reset whilst connected, so that the PIC program is never run whilst the +5V supply is connected. With the main module supply either disconnected or inhibited as described above, the PIC may be programmed with a +5V supply connected to pin 58.

Operating Specifications

Compatible GSM units:	Cinterion MC75i, TC65i and TC63i
Operating temperature[1]	-25°C to +65°C
Storage temperature	-40°C to +85°C
DC supply (pins 15, 16, 47, 48)[2]	+5.00V to +13.8V
Supply current	
(typical quiescent – GSM PA not active)	30 – 40mA
(typical average allowance during GPRS activity)[3]	600mA
ENable pin (enables module supply)[4]	+1V to 13.8V (0V = module off)
Digital I/O logic '1' level[5]	+2.5V to +2.9V
Analogue inputs (GSM)[6]	+2.4V max.
Analogue inputs (PIC)	(up to) PIC VDD
Maximum data rate for serial interfaces	230400 bps

Notes:

1) GSM devices can become hot during periods of GSM activity. When intending to use in applications involving long periods of GSM data transfer consideration should be given to extra heat-sinking of the GSM unit and / or extra ventilation. Please refer to the GSM device datasheet.

2) 5.00V is the absolute minimum and is measured at the supply pins of the module – no dip from this voltage is permissible during use. Because of the relatively high peak currents involved careful consideration should be given to the supply. It is recommended to use all the supply pins.

With regard to higher supply voltages 13.8V is a nominal figure and the on-board regulator will handle up to 20V for very short periods of GSM activity but when used in an application requiring long periods of GSM activity the supply voltage should be maintained at approx. 5.5V maximum otherwise the module may overheat and will shut down. However, many applications use GSM for short periods only.

In electrically noisy environments it is recommended to use transient voltage suppression (e.g. TVS clamp diode). The module is not reverse polarity protected.

3) For specific supply currents pertaining to the GSM device being used please refer to the datasheet of the device. Peak current during GSM activity can exceed 2A. Therefore a generic 5V 1A supply is not sufficient, whereas a 6V 1A supply with a 10,000uF bulk storage capacitor would be acceptable. Wide PCB traces to the module supply pins are recommended.

4) ENable is a logic-level input to a switch for the main power supply: do not apply voltages between +0.2V and +1V to the ENable pin as this may result in damage to the module. The upper value of 13.8V is a nominal figure (see Note 2 above).

5) +3.00V is the absolute maximum. No voltage should be present with the GSM device (or PIC) un-powered. Please refer to the datasheet for the GSM unit to be used.

6) Make sure that no analogue input is present when the GSM unit is shutdown. MIC inputs should not be present when VMIC is not enabled. Please refer to the GSM datasheet.

Installing a GSM modem

There are three options when attaching a GSM unit to GTC01:

- Plastic clip
- Soldered pillars (threaded) and screws
- Plain spacers with screws, washers and nuts

Whichever method is chosen a 4mm stack height is required. When using pillars / spacers note that the GSM unit uses a three-point mounting. Please state your preferred choice of fitting kit when ordering or use the part numbers and supplier references given below.

PLASTIC CLIP

Manufacturer:	GTT Europe
Website:	http://www.gtteurope.co.uk/ http://www.gtteurope.co.uk/cinterionwirelessmodule/integrationclips.php
Distribution:	Farnell
Manufacturer Part:	GT-MC75I-CLIP-F

A datasheet is available illustrating how to use the mounting clip.

SOLDERABLE PILLAR and LOCKING SCREW

Manufacturer:	GTT Europe
Website:	http://www.gtteurope.co.uk/ http://www.gtteurope.co.uk/cinterionwirelessmodule/pillars.php
Distribution:	Farnell
Manufacturer Part:	R-15-0075-F (pillar) R-14-0067-F (screw)

PLAIN SPACER

Manufacturer:	RICHCO International Co Ltd
Website:	http://www.richco-inc.com/
Part number:	RRSB-2240-04

Note that M2 x 10mm screws with nuts and washers are also required when using plain spacers.

Ordering information

Radiometrix part number:

GTC01

GSM Modems can be supplied with the GTC01. Please ask for details. To start using GSM a SIM card is also required (not supplied by Radiometrix).

Carrier Boards

The GTC01 can be evaluated on common 0.1” stripboard or incorporated straight into the design of the customer but Radiometrix also offer a complete system with ready-to use interfaces etc.
There are two types available:

GTC-DEV

Offers a ready to use development and evaluation platform: the GTC-DEV has a Power supply socket, DB9 serial connectors, USB - UART bridge, DIP switch, buttons, LED’s and ICSP connectors. All GTC01 connections are made available via breakout through-hole solder pads. Additionally, a NBEK style RF module carrier board can be fitted. This board can also be supplied in a “bare bones” configuration where only the Power supply connection and GTC01 socket is fitted.

GTC-APP

Aimed at a light industrial / control environment: screw terminal connections for serial data interfaces, relay outputs, isolated digital inputs and analogue inputs. As with GTC-DEV there is breakout connection via through-hole solder pads for all of the GTC01 pins.

References

For Cinterion GSM products:

Cinterion Wireless Modules GmbH
St.-Martin-Str. 53
81669 Munich
GERMANY

Switchboard: +49 89 21029 9000
Web: http://www.cinterion.com/
http://www.cinterion.com/m2m-evolution.html

Documentation (the documents listed here are not necessarily the latest versions):

TC63i

TC63i Hardware Interface Description:	TC63i_HD_v01.100a
TC63i AT Command Set:	TC63i_ATC_V01.100

TC65i

TC65i Hardware Interface Description:	TC65i_HD_v01.100b
TC65i AT Command Set:	TC65i_ATC_V01.000
Java User's Guide:	wm_java_usersguide_v14

MC75i

MC75i Hardware Interface Description:	MC75i_HD_v01.100a
MC75i AT Command Set:	MC75i_ATC_V01.100

PIC16LF628A

PIC16F627A/628A/648A Data Sheet:	DS40044G

Radiometrix Ltd

Hartcran House
231 Kenton Lane
Harrow, Middlesex
HA3 8RP
ENGLAND
Tel: +44 (0) 20 8909 9595
Fax: +44 (0) 20 8909 2233
sales@radiometrix.com
www.radiometrix.com

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The Intrastat commodity code for all our modules is: 8542 6000

R&TTE Directive

After 7 April 2001 the manufacturer can only place finished product on the market under the provisions of the R&TTE Directive. Equipment within the scope of the R&TTE Directive may demonstrate compliance to the essential requirements specified in Article 3 of the Directive, as appropriate to the particular equipment.

Further details are available on The Office of Communications (Ofcom) web site:

http://www.ofcom.org.uk/

Information Requests
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
Tel: +44 (0)300 123 3333 or 020 7981 3040
Fax: +44 (0)20 7981 3333
information.requests@ofcom.org.uk

European Communications Office (ECO)
Peblingehus
Nansensgade 19
DK 1366 Copenhagen
Tel. +45 33896300
Fax +45 33896330
ero@ero.dk
www.ero.dk