
MultiConnect™ OCG-E Open Communications Gateways

Developer Guide

MultiConnect™ OCG-E Developer Guide

MT100EOCG -G2, -H5, -EV2, and radioless model

S000516C, Revision D

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Revision History

Revision	Date	Description
A	11/21/2011	Initial Release
B	02/16/2012	Added MT100EOCG model. Fixed various issues with original version.
C	01/23/2013	Added USB power and enumeration information, H5 information, troubleshooting information about restoring bootstrap and u-boot memory, RoHS and pacemaker statement.
D	10/06/2015	For H5, added powering down your device section. Caution to avoid corruption of device file system.

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Chapter 1 – Developer’s Kit and Developer’s Board Overview

Welcome

Thank you for using the MultiConnect open communications gateway embedded (MultiConnect™ OCG-E) developer’s kit. This guide describes how to use the kit to design, develop and test custom applications for your business.

This chapter describes the gateway product, the developer board, and other kit contents. It also includes safety notices that you can include in your product’s documentation, if desired.

Product Overview

The MultiConnect™ OCG-E helps you quickly create custom applications. The gateway is made up of an open Linux development environment and fully certified hardware. The gateway includes multiple interfaces (serial, USB, Ethernet and SD card) and internal peripherals (including a cellular modem and a GPS receiver) in one, application-ready end user solution. This gateway is ideal for companies with hardware and software competencies and provides maximum design flexibility.

Applications that require device networking capability can now reside directly on select Multi-Tech gateways. This product brings together a cellular hardware development kit, Multi-Tech’s CoreCDP Linux distribution and a complete Linux build environment, allowing you to quickly create custom applications. The MultiConnect OCG-E gateway provides a flexible, quick and cost-effective way to bring your solution to market.

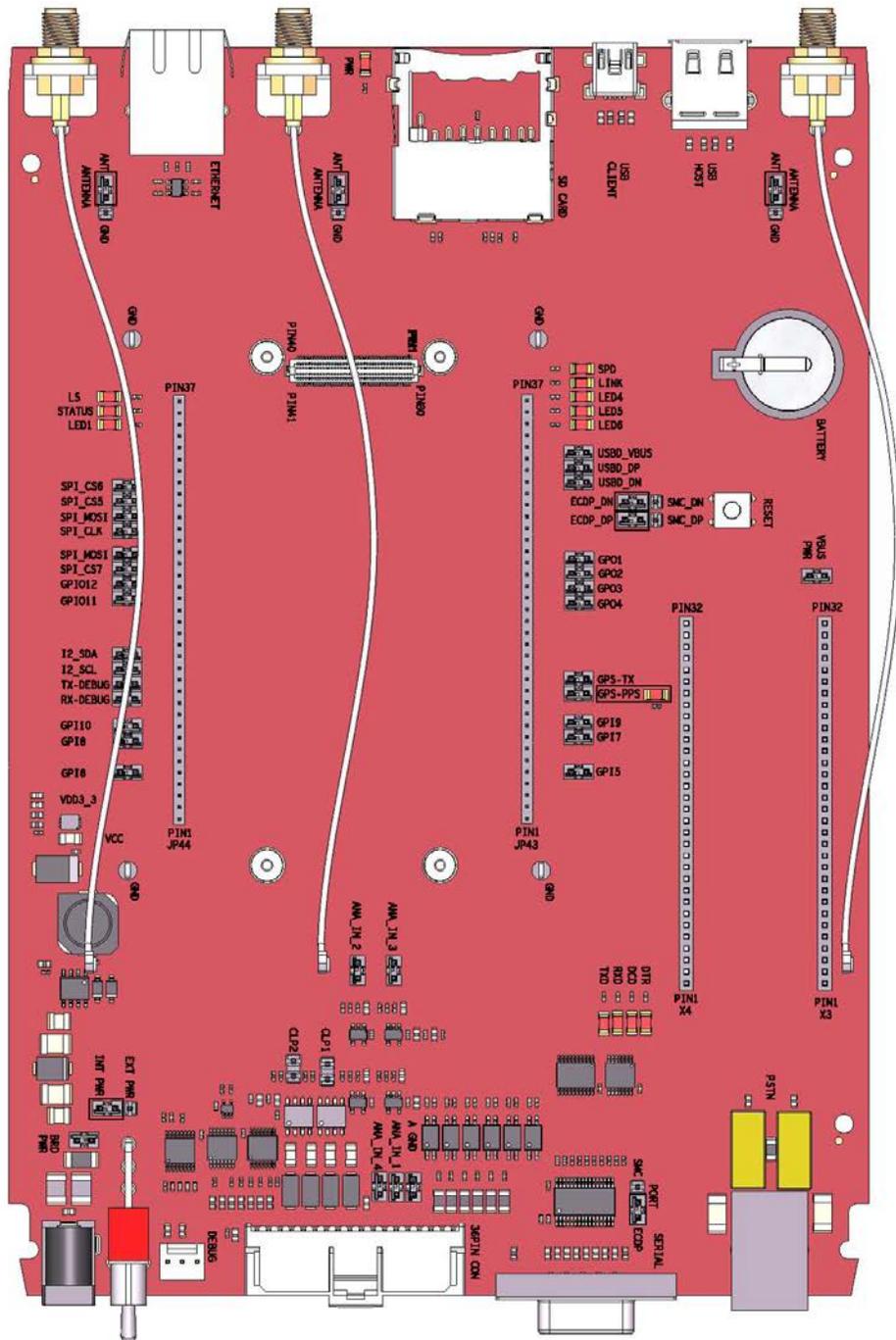
For detailed information about the CoreCDP Development Platform, please visit the Multi-Tech website at: <http://www.multitech.net/>

Product Features

- CoreCDP™
- Uses OpenEmbedded framework
- Linux Kernel 2.6.35.14
- Drivers to support all peripherals included on the platform hardware
- Programming languages: Python, Java (JamVM, Open JDK), Perl, Ruby, C/C++, PHP
- Networking: PPP, iptables
- Web Server: lighttpd
- Remote shell: SSH
- Network file system: samba
- Security: OpenSSL
- UFL antenna connector
- SIM socket for G2 and H5 models
- AT command compatible
- Carrier approved

- Two-year warranty

An illustration of the developer board follows.



The developer's board is available without a cellular modem.

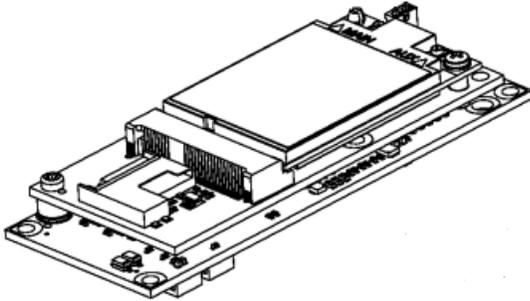
You can also develop your solution by choosing an MT100EOCG model that uses the standard you desire:

- GPRS, by selecting the MT100EOCG-G2 model

- HSPA or HSDPA, by selecting the MT100EOCG-H5 model
- EV-DO Rev A, by selecting the MT100EOCG-EV2 model

For complete ordering details, see the section “Product Ordering Options” in this manual.

An illustration of an MT100EOCG gateway follows. Your gateway may look slightly different, depending on the type of model you select (-G2, -H5, -EV2, or gateway without cellular modem).



Product Ordering Options

Product	Description	Region
MT100EOCG-G2	2G, GPRS Embedded Open Communications Gateway (OCG)	Global
MT100EOCG -G2-GP	2G, GPRS Embedded OCG with GPS	Global
MT100EOCG-H5	3G, HSPA Embedded OCG	Global
MT100EOCG -H5-GP	3G, HSPA Embedded OCG with GPS, Telus	Global
MT100EOCG -EV2-N2	3G, EV-DO Embedded OCG, Sprint	US
MT100EOCG -EV2-GP-N2	3G, EV-DO Embedded OCG with GPS, Sprint	US
MT100EOCG -EV2-N3	3G, EV-DO Embedded OCG, Verizon	US
MT100EOCG -EV2-GP-N3	3G, EV-DO Embedded OCG with GPS, Verizon	US
MT100EOCG -EV2-N16	3G, EV-DO Embedded OCG, Aeris	US
MT100EOCG -EV2-GP-N16	3G, EV-DO Embedded OCG with GPS, Aeris	US
MT100EOCG	Open Communications Gateway without cellular modem	Global
MT100EOCG - GP	Open Communications Gateway without cellular modem, with GPS	Global
MT100EOCG -DK	Embedded OCG Developer Kit – Includes all cables and Core CDP DVD	Global

Developer’s Kit Contents

Use the MultiConnect OCG-E Developer’s Kit MT100EOCG-DK and the models described in this guide to develop and evaluate your products and applications. This kit contains:

- One MT100EOCG-DK developer board
- Universal power supply:
 - 100-240V 9V-1.7A changeable blade power supply
 - Three removable blades (US, EURO and UK)
- Cables
 - One DB9 serial cable
 - One 3-pin serial cable (debug)
 - One USB host cable
 - One USB device cable
 - One 36-pin GPIO cable
 - One RJ-45 Ethernet cable
 - One RJ-11 phone cable
- Antennas
 - Two hepta-band cellular antennas. One GPS antenna.
 - One Wi-Fi/Bluetooth antenna
- Antenna cables
 - Two SMA-to-UFL antenna cables
 - One RSMA-to-UFL antenna cable
 - One RSMA-to-MMCX antenna cable
- One 2GB SD memory card
- One CoreCDP DVD
- Four screws for mounting gateway to developer’s board.
- One Multi-Tech screwdriver
- Generic activation card

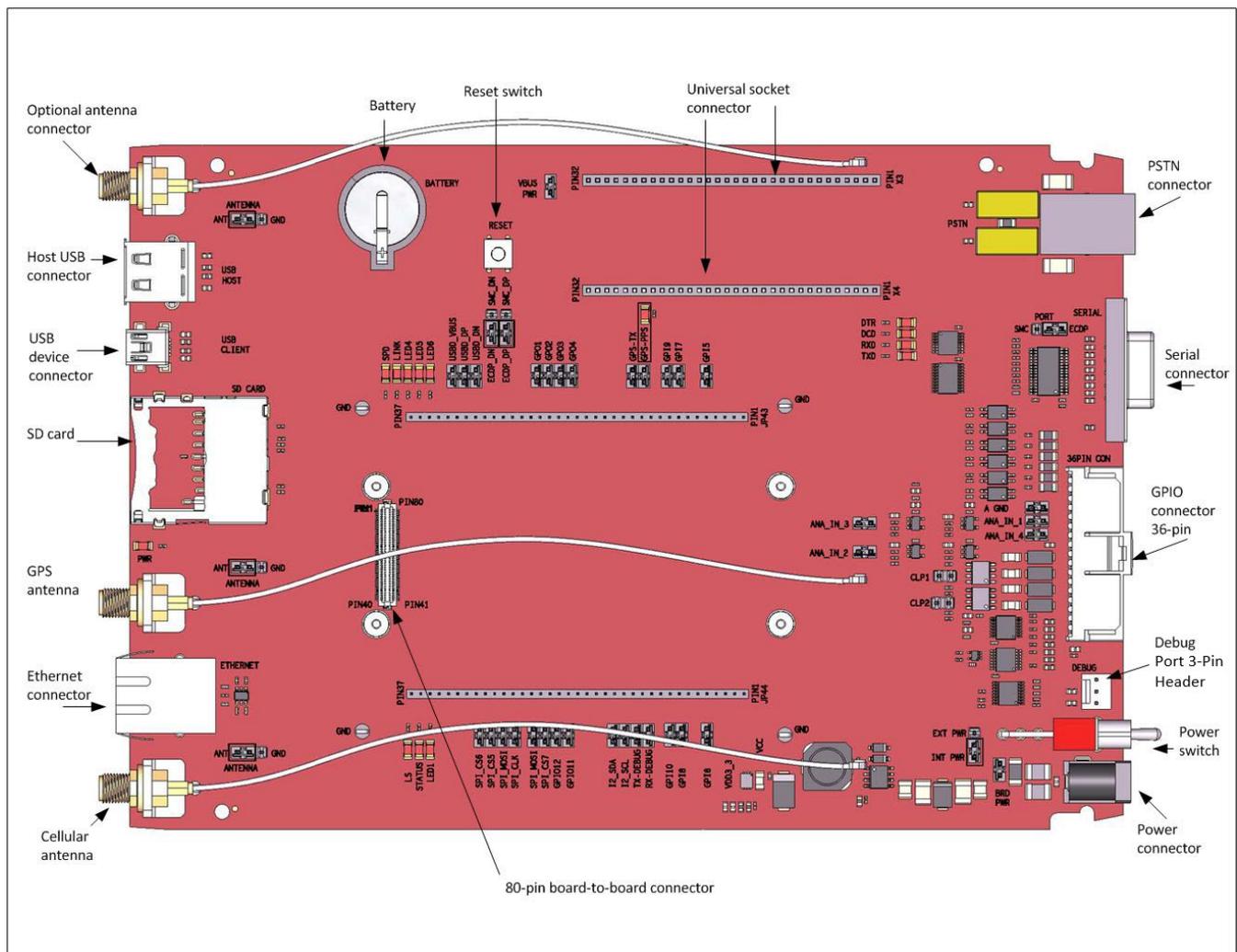
Developer’s Board Components

The developer board is an auxiliary board that helps you develop and debug products that use an embedded MT100EOCG gateway. Using the developer board, you can connect the embedded MT100EOCG gateway to your device.

The developer board provides multiple interfaces, such as USB, serial, Ethernet and SD card. The test points of key signals are led out on the developer board. In addition, the board is designed with switches or pins of commonly used signals such as the reset signal and the enable signal for converting the working state of the gateway.

You can use the board to test the performance of the gateway. You can implement both the wired connection test and the wireless connection test (connect the gateway model to the antennas). You can also test the signal points when you maintain and repair the gateway.

The board provides two, universal socket connectors that give you the option to develop and test your solutions that might include Wi-Fi or other types of technologies.



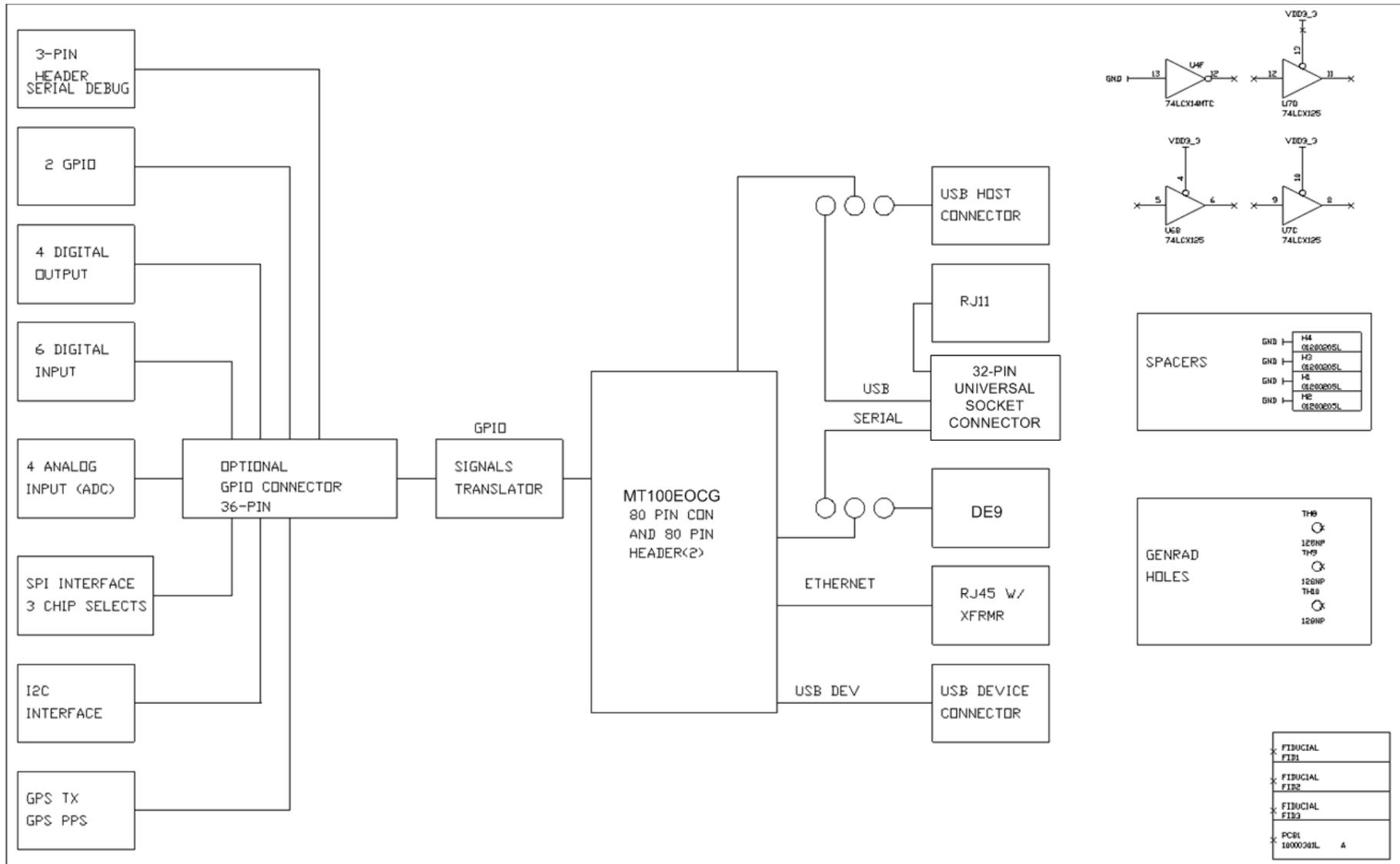
Pin Descriptions of Board to Board Connector

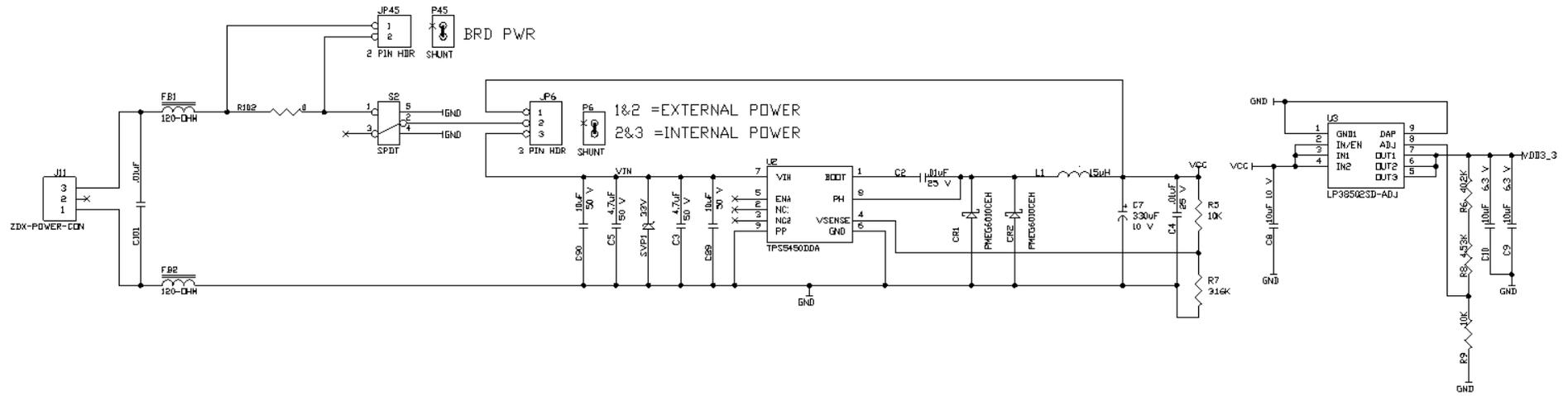
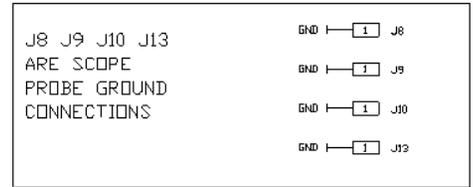
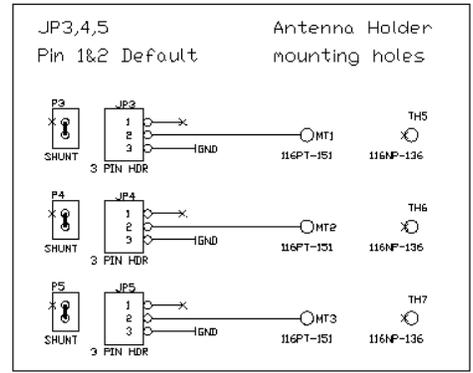
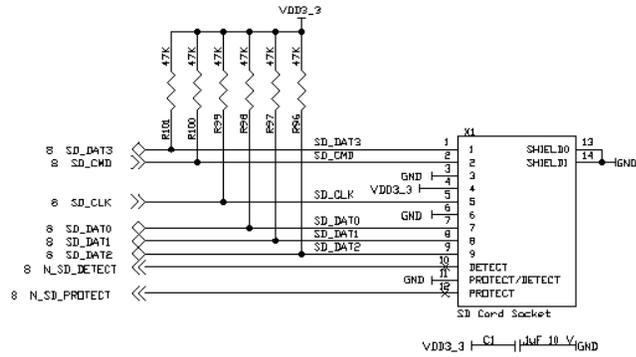
The MultiConnect OCG-E gateway connects to the developer board using an 80-pin board to board connector. This section describes the connector’s pins.

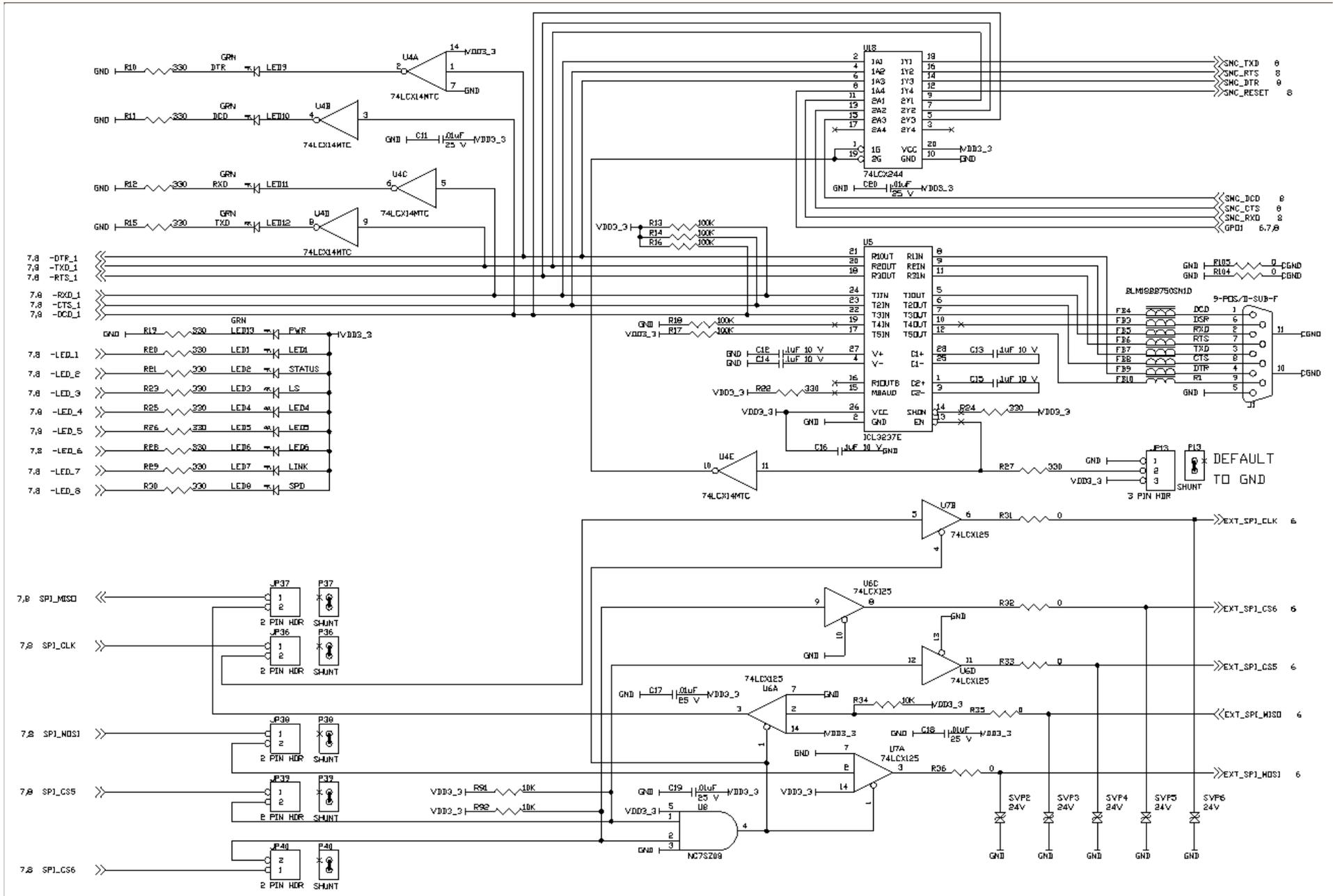
Pin	Signal Name	In/Out	Description
1	VCC	I	DC Input Power. 5V DC power
2	VCC	I	DC Input Power. 5V DC power
3	VCC	I	DC Input Power. 5V DC power
4	GND		Logic Ground.
5	SD_CLK	O	SDIO Clock
6	SD_CMD	O	SDIO command
7	SD_DAT0	I/O	SDIO Data0
8	GPI5	I	General-Purpose Input.
9	ADC0	I	Analog-to-Digital converter Input. (0 to 3v)
10	ADC2	I	Analog-to-Digital converter Input. (0 to 3v)
11	GPI7	I	General-Purpose Input.
12	GPI9	I	General-Purpose Input.
13	TDO	O	JTAG Data Output
14	NTRST	I/O	JTAG Reset (Active Low)
15	GPS-PPS	O	GPS PPS - Pulse Per Second
16	GPS-TX	O	GPS - Transmit Data
17	-DTR_1	I	Data Terminal ready. The DTE uses the -DTR_1 line to signal to the module that it is ready to accept communication . The signal is also used to signal to the module to terminate communication (Hang-up).
18	-RXD_1	O	Received Data. The gateway uses the RXD1 line to send data to the DTE and to send gateway responses to the DTE. In command mode, -RXD1 data presents the gateway responses to the DTE.
19	-TXD_1	I	Transmitted Data. The DTE uses the -TXD1 line to send data to the gateway for transmission or to transmit commands to the gateway. The DTE holds this circuit in mark state when no data is being transmitted or during intervals between characters.
20	-RTS_1	I	"Request to Sent (Active Low). -RTS1 signal is used for hardware flow control. -RTS1 input ON (low) indicates that the DTE is ready to send data to the device. In the command state, the device ignores -RTS1.
21	-DCD_1	O	Data Carrier Detect (Active Low). DCD is controlled by processor. You can program how DCD is set.
22	-CTS_1	O	Clear to Send (Active Low). -CTS_1 is controlled by the gateway to indicate whether or not the gateway is ready to receive data from the DTE on the -TXD_1 input signal.
23	GPO4	O	General-Purpose Output.
24	GPO3	O	General-Purpose Output.
25	GPO2	O	General-Purpose Output.
26	GPO1	O	General-Purpose Output.
27	GND		Logic Ground.
28	-RESET	I	Device Reset (with pull-up). The active low -RESET input resets the device logic. -RESET is tied to VCC through a time-constant circuit for proper reset of the device if -RESET is not being externally driven.
29	BATT-IN	I	Battery Backup Input 3V
30	USBH_DP	I/O	USB Host Data Positive. Positive pin of USB data pair.
31	USBH_DN	I/O	USB Host Data Negative. Negative pin of USB data pair.
32	GND		Logic Ground.
33	USBD_DN	I/O	USB Device Data Negative. Negative pin of USB data pair.
34	USBD_DP	I/O	USB Device Data Positive. Positive pin of USB data pair.
35	USBD_VBUS	I	USB Device Voltage Sense. Senses the voltage level of the USB to determine if the bus is available.
36	-LED_6	O	General Purpose LED6 output (signal strength.)
37	-LED_5	O	General Purpose LED5 output (signal strength.)

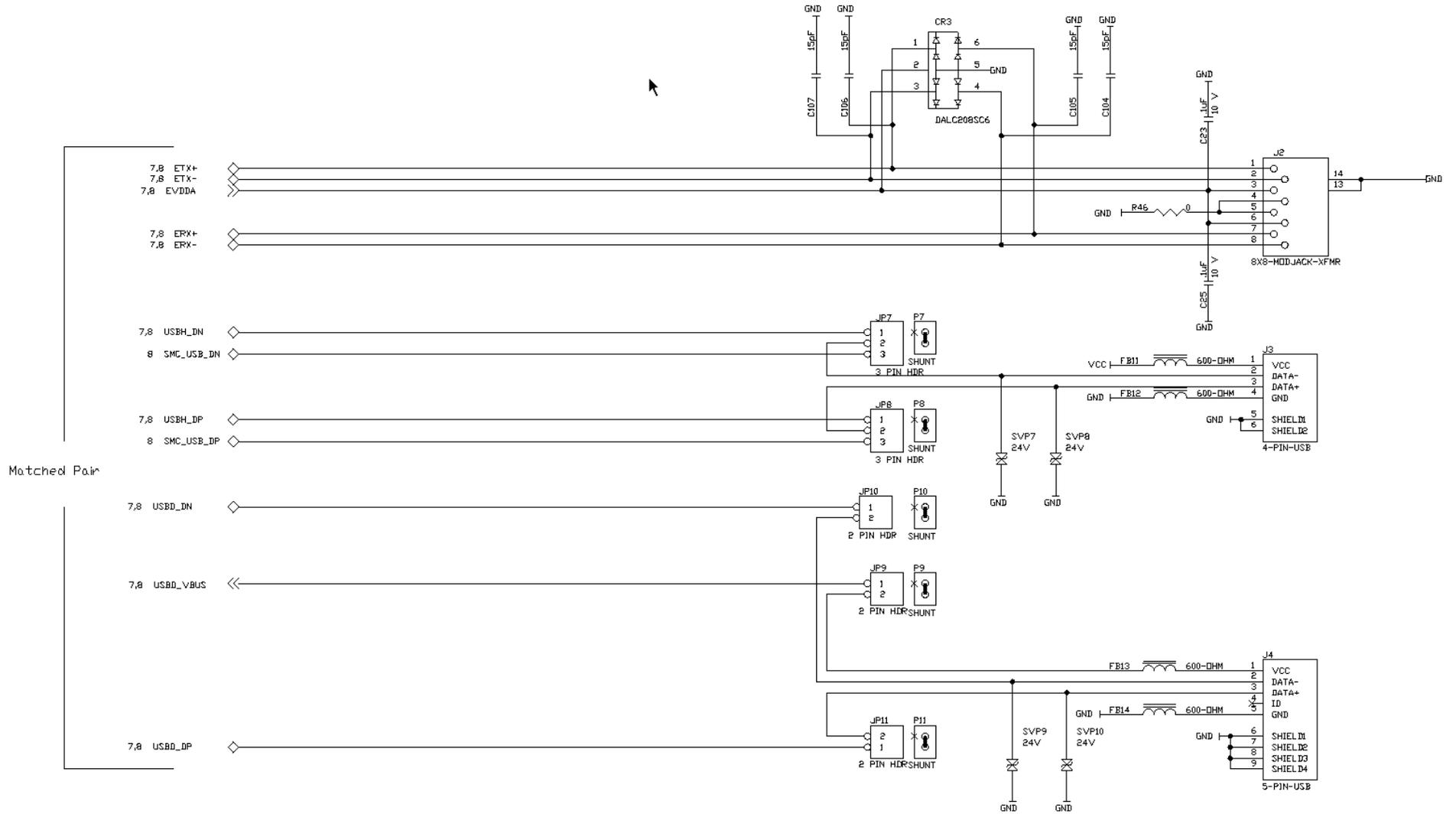
Pin	Signal Name	In/Out	Description
38	-LED_4	O	General Purpose LED4 output (signal strength.)
39	-LED_7	O	Ethernet link.
40	-LED_8	O	Ethernet speed.
41	EVDDA	O	3.3V analog supply for Ethernet transformer.
42	ERX-	I	Receive Input Negative. Differential receive input pin for Ethernet
43	ERX+	I	Receive Input Positive. Differential receive input pin for Ethernet
44	ETX-	O	Transmit Output (negative). Differential transmit output for Ethernet
45	ETX+	O	Transmit Output (positive). Differential transmit output for Ethernet
46	GND		Logic Ground.
47	N_SD_PROTECT	I	SD Card Detection input
48	TMS	I	JTAG Test Mode Select
49	SPI_CS6	O	SPI Chip Select 6
50	SPI_CS5	O	SPI Chip Select 5
51	SPI_MOSI	O	SPI Master-Out
52	SPI_CLK	O	SPI Clock
53	GND		Logic Ground.
54	SPI_MISO	I	SPI Master-In
55	SPI_CS7	O	SPI Chip Select 7
56	N_SD_DETECT	I	SD Card Detection input
57	GPIO12	I/O	General-Purpose Input/Output. User-configurable input or output pin.
58	GPIO11	I/O	General-Purpose Input/Output. User-configurable input or output pin.
59	RTCK	O	JTAG Returned JTAG Clock
60	-LED_3	O	General Purpose LED3 output (Link staus output.)
61	-LED_2	O	General Purpose LED2 output. (status)
62	-LED_1	O	General Purpose LED1 output.
63	SDA	I/O	I2C Data.
64	SCL	O	I2C Clock.
65	-TXD-Debug	I	Transmitted Data. The DTE uses the -TXD3 line to send data to the gateway for transmission of Debug information.
66	-RXD-Debug	O	Received Data. The gateway uses the RXD=debug line to send data to a DTE for debug purposes.
67	TCK	I	JTAG Clock
68	TDI	I	JTAG Data Input
69	GPI10	I	General-Purpose Input.
70	GPI8	I	General-Purpose Input.
71	ADC3	I	Analog-to-Digital converter Input. (0 to 3v)
72	ADC1	I	Analog-to-Digital converter Input. (0 to 3v)
73	GPI6	I	General-Purpose Input.
74	SD_DAT3	I/O	SDIO Data3
75	SD_DAT2	I/O	SDIO Data2
76	SD_DAT1	I/O	SDIO Data1
77	GND		Logic Ground.
78	VCC	I	DC Input Power. 5V DC power
79	VCC	I	DC Input Power. 5V DC power
80	VCC	I	DC Input Power. 5V DC power

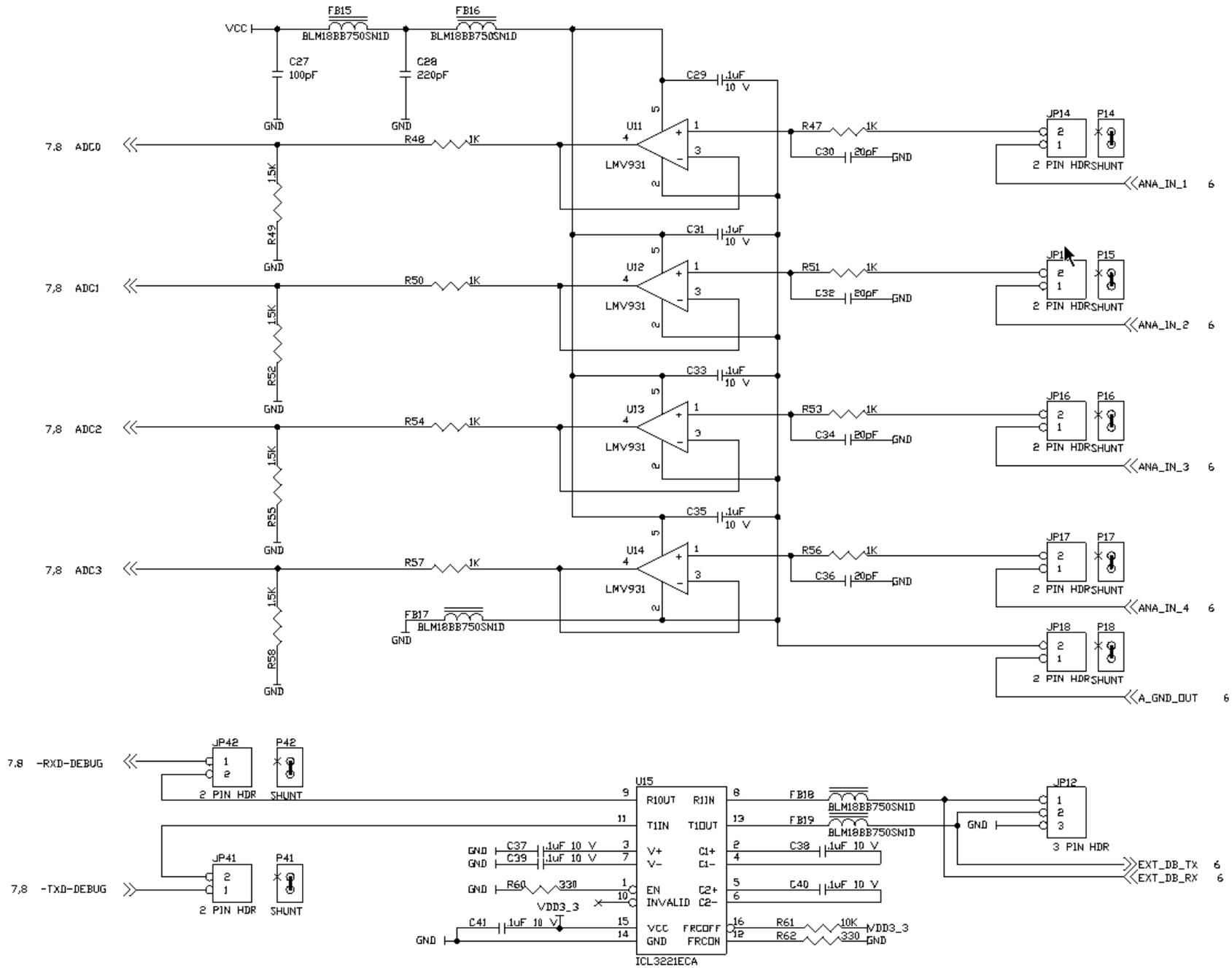
Developer’s Board Block Diagram and Schematics

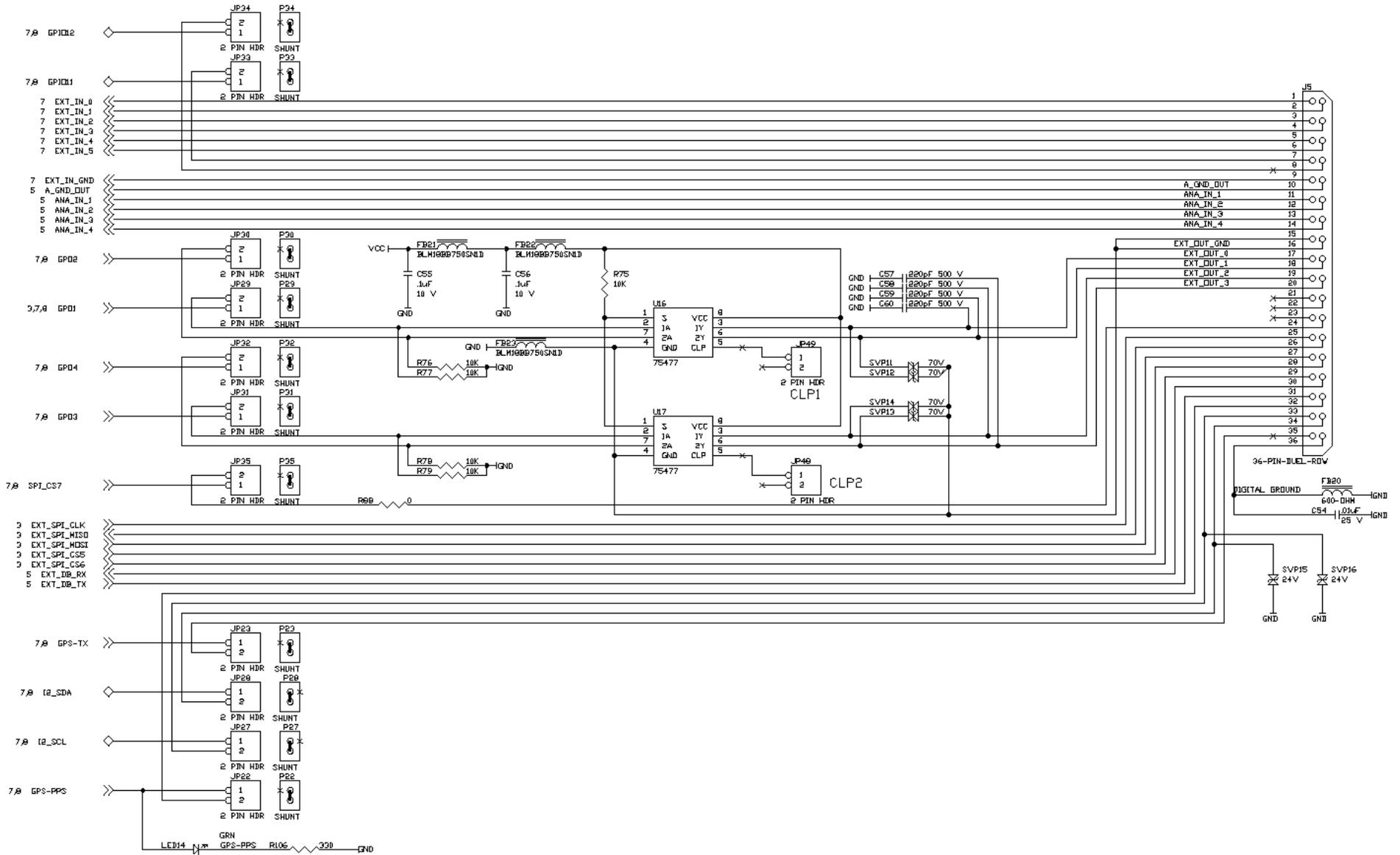


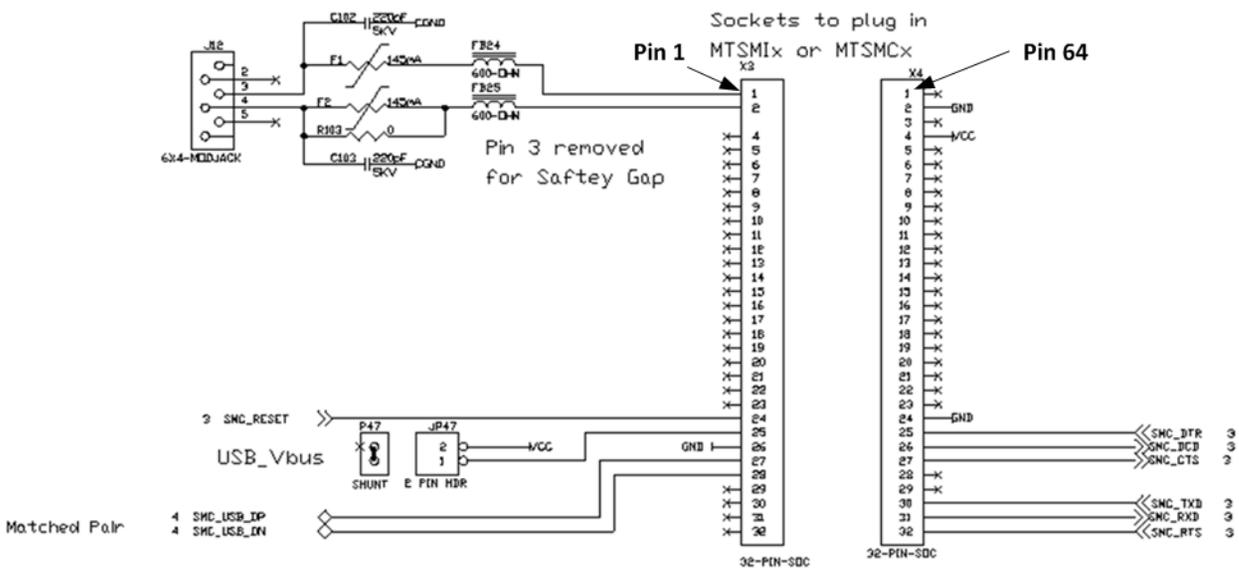
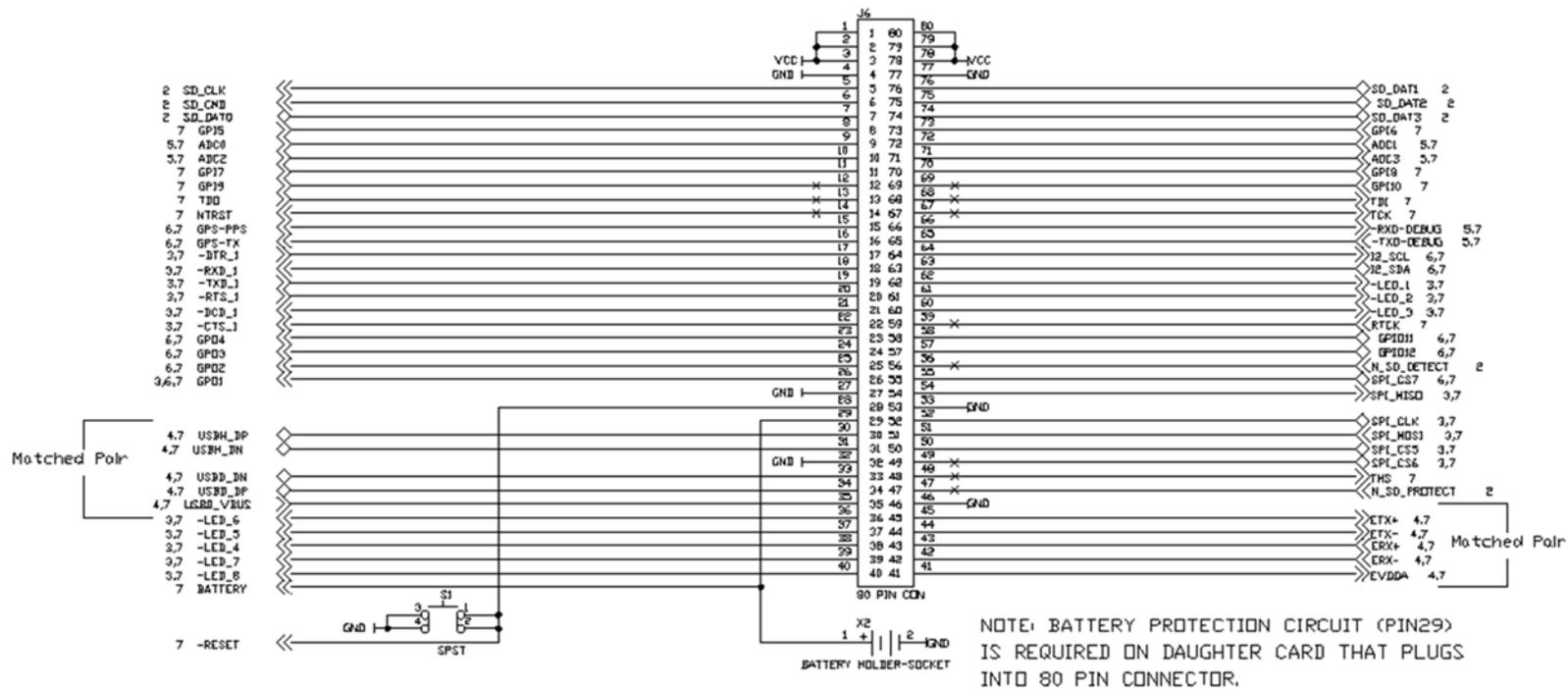












Technical Specifications

All models of the MultiConnect OCG-E gateway share the following specifications. Specifications that are unique to a particular model (-G2, -H5, and -EV2) are documented in the chapter dedicated to the model.

Category	Description
Operating Voltage	5VDC \pm 10%
Dimensions	3.650" x 1.375" (92 mm x 34.925 mm)
Storage Environment	-40° to +85° C
Humidity	20% to 90% non-condensing
Warranty	2 years

MT100EOCG-DK LEDs Description

LED 1	General Purpose LED1 output.
LED 2	General Purpose LED2 output. (status)
LED 3	General Purpose LED3 output. (Link status)
LED 4	General Purpose LED4 output.
LED 5	General Purpose LED5 output.
LED 6	General Purpose LED6 output.
LED 7	Ethernet link.
LED 8	Ethernet speed.
LED 9	DTR.
LED 10	DCD.
LED 11	RXD.
LED 12	TXD.
LED 13	POWER.

Logging into the MultiConnect OCG-E Gateway

To log into the MultiConnect OCG-E gateway and open the modem port, use SSH or the debug serial port.

- To use SSH to log into the gateway:
 - The default IP address is 192.168.2.1
 - The default username and password are: **root** and **root**
- To use the debug serial port:
 - The debug port serial settings are 115200 baud, 8N1, with no flow control.
 - The default username and password are: **root** and **root**.

Safety Notices and Warnings

This section describes safety statements that OEMs can use in their product documentation.

RF Safety

Remote modems are cellular devices. It is important to follow any special regulations regarding the use of radio equipment due in particular to the possibility of Radio Frequency (RF) interference.

Caution: A separation distance of at least 20 cm must be maintained between the modem transmitter’s antenna and the body of the user or nearby persons. The modem is not designed for or intended to be used in portable applications within 20 cm of the body of the user.

Check your local standards regarding safe distances and so on.

- Operating a cellular modem close to other electronic equipment may cause interference if the equipment is inadequately protected. Observe any warning signs and manufacturers’ recommendations.
- Different industries and businesses have their own restrictions governing the use of cellular devices. Please observe local restrictions of the environment where you intend to operate the cell modem.
- Under no circumstances should the antenna be placed outdoors.

Vehicle Safety

- Do not use your cellular device while driving.
- Respect national regulations on the use of cellular telephones in vehicles. Road safety always comes first.
- If the cellular device is incorrectly installed in a vehicle, the device’s operation can interfere with the correct functioning of vehicle electronics. To avoid such problems, ensure that only qualified personnel install the device. The installation process must verify that vehicle electronics are protected from interference.
- Using an alert device to operate a vehicle’s lights or horn is not permitted on public roads.
- UL has evaluated this device for use in ordinary locations only. UL did not evaluate installation in a vehicle or other outdoor locations. UL Certification does not apply or extend to use in vehicles or outdoor applications or in ambient temperatures above 40° C.

Maintaining the Cellular Device

Your cellular device is the product of advanced engineering, design, and craftsmanship. Treat it with care. The suggestions that follow can help you enjoy this product for many years.

- Do not attempt to disassemble the cellular device. There are no user serviceable parts inside.
- Do not expose the cellular device to water, rain, or spilled beverages. It is not waterproof.
- Do not place the cellular device alongside computer discs, credit or travel cards, or other magnetic media. The phone may affect the information contained on discs or cards.
- Using accessories not authorized by Multi-Tech or not compliant with Multi-Tech's accessory specifications may invalidate the warranty of the cellular device.
- In the unlikely event of a fault in the cellular device, contact Multi-Tech Tech Support.

Handling Precautions

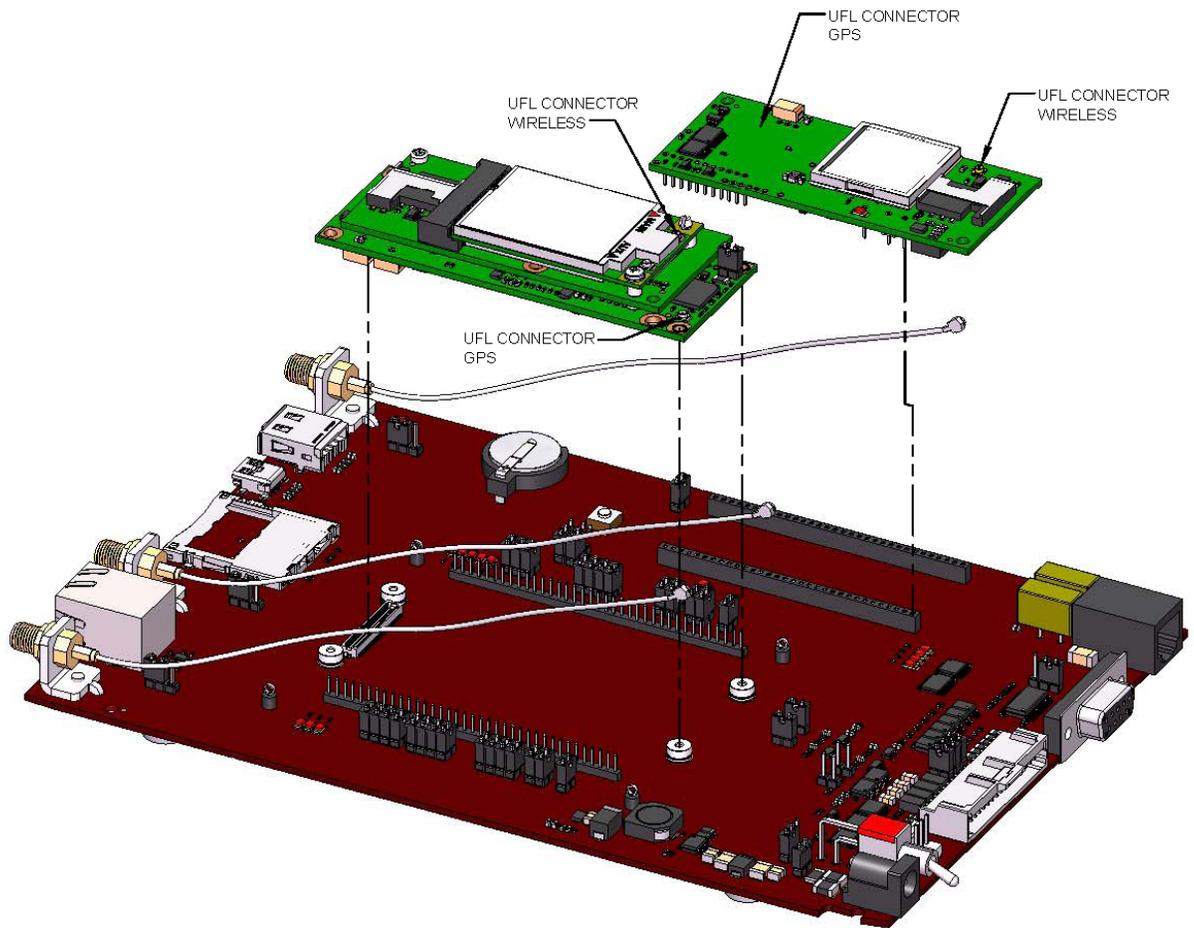
To avoid damage due to the accumulation of static charge, use proper precautions when handling any cellular device. Although input protection circuitry has been incorporated into the devices to minimize the effect of static build-up, use proper precautions to avoid exposure to electronic discharge during handling and mounting the device.

Securing Your Device

Respect all local regulations. Become familiar with and use the security features to block unauthorized use and theft.

Chapter 2 – Installing Gateways on the Developer Board

This chapter describes how to install gateways on the developer board. You can install a Multi-Connect OCG-E gateway or, optionally, a universal socket communications device.



Installing a MultiConnect OCG-E Gateway onto the Board

To install a MultiConnect OCG-E gateway:

1. Align the 80-pin connector on the bottom of the gateway with the 80-pin connector on the developer board.
2. Press the 80-pin connector of the gateway firmly into the 80-pin connector on the developer board. Ensure that the mounting holes on the ends of the gateway align with the four standoffs on the developer board.
3. If you are installing a MultiConnect OCG-E gateway with a cellular wireless network, connect the cellular antenna lead to the antenna connector on the MultiConnect OCG-E gateway.

4. If you are installing a MultiConnect OCG-E gateway with a GPS receiver, first connect the cellular antenna lead to the cellular antenna connector on the gateway, then connect the GPS antenna lead to the GPS antenna connector on the gateway.

Installing a Universal Socket Communications Device onto the Board

To install a SMI/SMC modem:

1. Align the pin of the universal socket communications device with pin 1 of the universal socket connector on the board and press firmly. For details about the location of pin 1, see the illustration on page 20.
2. Use the optional antenna lead to connect to the antenna connector on the modem.

Installing a SIM Card onto the Board

To install a SIM card:

1. Install the SIM card into the SIM card holder on the board.

Making Other Board Connections

1. If your application needs a power supply, connect the power supply lead to the power connector on the developer board.
2. If you need to connect the debug cable for your application, connect the 3-pin connector of the debug cable to the debug jumper next to the power switch.

If you need the GPIO cable in your application, connect the J1 connector on the GPIO cable to the 36-pin connector on the developer board.

General Purpose Input Output (GPIO) Cable Overview

RoHS Compliant

The drawing shows a cable assembly with a P1 connector on the left and a 36-pin connector on the right. Dimensions include a total length of 305.0 ± 20.0 mm, a 25.0 mm reference length for the connector, and a 30.0 mm reference length for the cable body. The cable body is 35.0 mm wide and 10.0 mm high. The right connector has a 5.0 ± 1.0 mm pitch. The cable is labeled with P/N: 45000030L REV. A and MGF LOT: XXXXXXXX.

38	LIGHT GREEN/RED
35	LIGHT BLUE/RED
34	PINK/RED
33	WHITE/RED
32	GRAY/RED
31	PURPLE/RED
30	BLUE/RED
29	GREEN/RED
28	YELLOW/RED
27	ORANGE/RED
26	BROWN/RED
25	BLACK
24	LIGHT GREEN/BLACK
23	LIGHT BLUE/BLACK
22	PINK/BLACK
21	WHITE/BLACK
20	GRAY/BLACK
19	PURPLE/BLACK
18	BLUE/BLACK
17	GREEN/BLACK
16	YELLOW/BLACK
15	ORANGE/BLACK
14	RED/BLACK
13	BROWN/BLACK
12	LIGHT GREEN
11	LIGHT BLUE
10	PINK
9	WHITE
8	GRAY
7	PURPLE
6	BLUE
5	GREEN
4	YELLOW
3	ORANGE
2	RED
1	BROWN

UL2576 #22, 36C+AE, BLACK
L=300±15.0/-0mm

ITEM	PART NUMBER	VENDOR	DESCRIPTION	QTY
4	LAB-MUL-00101	OVIS	TEXT "P/N : 45000030L", "MGF LOT :", "XXXXXXXX"	1
3	C39036CSA3001	OVIS	UL2576 #22, 36C+AE, BLACK, L=300mm	1
2	501847-1000	MOLEX	2.00mm W/B DUAL CONN DIP RCPT TERM	36
1	501846-3600	MOLEX	2.00mm W/B DUAL CONN DIP RCPT HSG, 36P	1

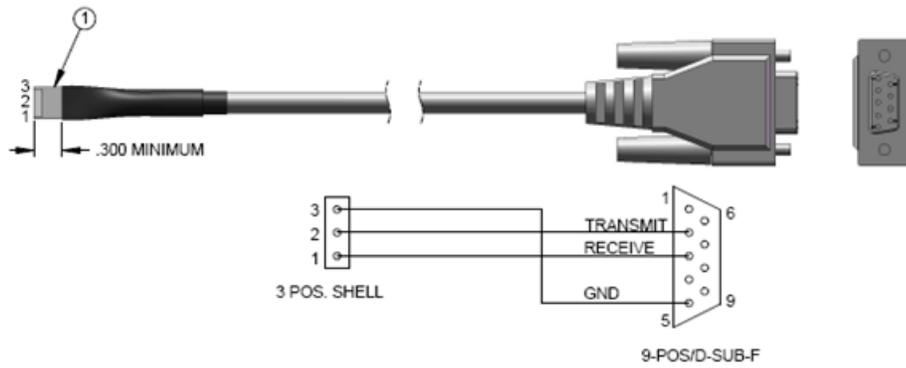
REV	REVISIONS	DATE	DESCRIPTION	CUSTOMER APPROVED	TOLERANCE UNLESS OTHERWISE SPECIFIED	UNIT: mm	PRODUCT:	OVIS Enterprises Co., Ltd.			
△		12/03/2010	ECR1012001	Tom	.X ±5.0	X' ±	CABLE ASSY	DRW. NO.	MUL-001	PART NO.	99A1C0305100
△		11/18/2010	ECR1011002	Jenny	.XX ±3.0	.X' ±	MATERIAL: SEE TABLE	FINISH: SEE TABLE	CUSTOMER NAME	CUSTOMER P/N:	
△		11/02/2010	RELEASE FOR PRODUCTION	Ray	.XXX±1.0	.XX' ±	FINISH: SEE TABLE				
REV	REVISIONS	DATE	DESCRIPTION	APPROVED:			SHEET 1 OF 1 SCALE 0.8/1				

GPIO Connector Pin Out

PIN #	NAME	INPUT/OUTPUT	Description
1	EXT_IN_0	I	General-Purpose Input.
2	EXT_IN_1	I	General-Purpose Input.
3	EXT_IN_2	I	General-Purpose Input.
4	EXT_IN_3	I	General-Purpose Input.
5	EXT_IN_4	I	General-Purpose Input.
6	EXT_IN_5	I	General-Purpose Input.
7	GPIO11	I/O	General-Purpose Input/Output. User-configurable input or output pin.
8	GPIO12	I/O	General-Purpose Input/Output. User-configurable input or output pin.
9	EXT_IN_GND	GND	Logic Ground from external.
10	A_GND_OUT	GND	Logic Ground from analog side of ADC.
11	ANA_IN_1	I	Analog-to-Digital converter Input. (0 to 3v)
12	ANA_IN_2	I	Analog-to-Digital converter Input. (0 to 3v)
13	ANA_IN_3	I	Analog-to-Digital converter Input. (0 to 3v)
14	ANA_IN_4	I	Analog-to-Digital converter Input. (0 to 3v)
15	EXT_OUT_GND	GND	Logic Ground to external.
16	EXT_OUT_GND	GND	Logic Ground to external.
17	EXT_OUT_0	O	General-Purpose Output.
18	EXT_OUT_1	O	General-Purpose Output.
19	EXT_OUT_2	O	General-Purpose Output.
20	EXT_OUT_3	O	General-Purpose Output.
21	NC		No Connect
22	NC		No Connect
23	NC		No Connect
24	SPI_CS7	O	SPI Chip Select 7
25	EXT_SPI_CLK	O	SPI Clock
26	EXT_SPI_MISO	I	SPI Master-In
27	EXT_SPI_MOSI	O	SPI Master-Out
28	EXT_SPI_CS5	O	SPI Chip Select 5
29	EXT_SPI_CS6	O	SPI Chip Select 6
30	EXT_DB_RX	O	Received Data. The gateway uses the RXD=debug line to send data to a DTE for debug purposes.
31	EXT_DB_TX	I	Transmitted Data. The DTE uses the -TXD3 line to send data to the model for transmission of Debug information.
32	GPS-PPS	O	GPS PPS - Pulse Per Second

33	I2_SCL	I/O	I2C Clock.
34	I2_SDA	I/O	I2C Data.
35	GPS-TX	O	GPS PPS - Transmit Data
36	GND	GND	Logic Ground.

Debug Cable Overview



MT100EOCG Electrical Characteristics

Operating Conditions - Units - Volts		
Parameter	Minimum	Maximum
Supply Range- Vcc	4.5	5.5
Absolute Maximum Rating - Units - Volts		
Parameter	Minimum	Maximum
Voltage at any signal pin	-0.3	3.6
Reset	-0.3	5.5
SPI	-0.3	3.6
ADC Operating Range - Units - Volts		
Parameter	Minimum	Maximum
ADC input operating range	0	3
DC Electrical Characteristics GPIO1-4/GP15-10/LED1,4,5,6 Units - Volts		
Parameter	Minimum	Maximum
Digital Signal Output Low Level		0.36
Digital Signal Output High Level	2.58	
Digital Signal Input Low Level		0.8
Digital Signal Input High Level	2.3	

DC Electrical Characteristics SPI/SD Flash Card Interface/JTAG/GPS-TX/Serial Ports/I2C/-LED2/GPIO11,12 SD Flash Card Status - Units - Volts		
Parameter	Minimum	Maximum
Digital Signal Output Low Level		0.4
Digital Signal Output High Level	2.9	
Digital Signal Input Low Level		0.8
Digital Signal Input High Level	2.3	
DC Electrical Characteristics GPS-PPS/-LED7,8 Unit - Volts		
Parameter	Minimum	Maximum
Digital Signal Output Low Level		0.4
Digital Signal Output High Level	2.4	
DC Electrical Characteristics-LED3 Unit - Volts		
Output is Open Drain with 10k pullup		
DC Electrical Characteristics Reset Unit - Volts		
Parameter	Minimum	Maximum
Reset (Low Active) Input Low		0.8
Reset (Low Active) Input High	2.3	
DC Electrical Characteristics USB Device Port		
Standard USB 2.0 Full Speed Device Port		
Pin 35 USB D+VBUS 5V input for detection of USB bus availability		
DC Electrical Characteristics USB Host Port		
Standard USB 2.0 Full Speed Host Port		
Digital Input Capacitance		

Troubleshooting

Restoring the U-Boot Memory or the Bootstrap Memory

If the U-boot memory or the bootstrap memory becomes corrupted, you can restore either of them.

Before You Begin

You need to short out a resistor to run internal boot code instead of code in bootstrap or u-boot memory. To do this, find some tweezers that fit around the resistor.

You also need to download a utility to help you restore memory. To do so:

1. Download Atmel SAM-BA utility from the following location:
<http://www.atmel.com/tools/ATMELSAM-BAIN-SYSTEMPROGRAMMER.aspx>
2. Unzip the utility package onto your Linux development system.

Restoring Memory Overview

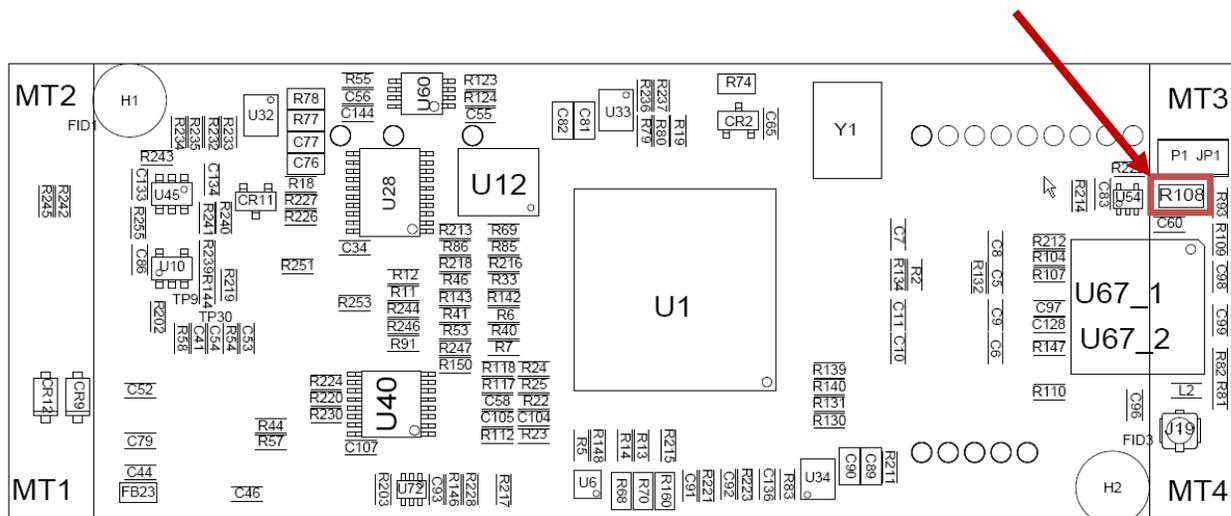
1. Power down.
2. Short out the R108 resistor by squeezing it with tweezers.
3. Restore power.
4. Remove tweezers from the resistor.
5. Restore the bootstrap memory or the u-boot memory.

The following sections describe these steps in greater detail.

Shorting the R108 Resistor

To access the internal boot code directly, first short the R108 resistor so the boot code and u-memory code do not run.

1. Power off the device.
2. Locate the R108 resistor on the board. The following figure shows the location of the resistor.



3. Place tweezers around the R108 resistor and squeeze the resistor, to short it out.
4. Power on the device.
5. Remove tweezers.

Restoring Memory

This topic describes how to restore memory by using the Atmel SAM-BA utility, connecting with the hardware, mounting the serial driver and restoring the bootstrap memory or u-boot memory.

Installing Atmel SAM-BA Utility

1. If you have not already done so, download the Atmel SAM-BA utility and unzip the utility package onto your Linux development system:
<http://www.atmel.com/tools/ATMELSAM-BAIN-SYSTEMPROGRAMMER.aspx>
2. Connect the USB cable between Linux system and the MTEOCG hardware.
3. Mount the USB CDC serial driver as described in the topic for the Ubuntu operating system you are using.

Mounting USB CDC serial driver for Ubuntu version 9.10 and older

1. Log in with administrator rights.
2. If the `usbserial` and `cdc_acm` module is already running, unload it by using the following command:

```
# rmmod cdc_acm
# rmmod usbserial
```
3. To load the `usbserial` kernel module, type:

```
1 #modprobe usbserial vendor=0x03eb product=0x6124
```
4. To verify that the USB connection is established, type:

```
#lsusb -d 03eb:6124
```
5. To determine which USB connection is established, type:

```
#dmesg
...
kernel: usb 4-2: new full speed USB device using uhci_hcd and address 5
kernel: usb 4-2: configuration #1 chosen from 1 choice kernel: usbserial_generic 4-2:1.0: generic converter
detected
kernel: usbserial_generic: probe of 4-2:1.0 failed with error -5
kernel: usbserial_generic 4-2:1.1: generic converter detected
kernel: usb 4-2: generic converter now attached to ttyUSBx
```
6. To connect to your board, use `/dev/ttyUSBx`.

Mounting USB CDC serial driver for Ubuntu 10.04 and newer with updated kernel

1. If you are using a 64-bit system, type the following to ensure 32-bit libraries are installed:

```
sudo apt-get install ia32-libs
```

2. To ensure that the abstract control model (ACM) device was detected and to check the port name:

```
#dmesg
```

```
...
```

```
kernel: usb 4-1: new full speed USB device using ohci_hcd and address 2
```

```
kernel: usb 4-1: configuration #1 chosen from 1 choice
```

```
kernel: cdc_acm 4-1:1.0: This device cannot do calls on its own. It is not a modem.
```

```
kernel: cdc_acm 4-1:1.0: ttyACM0: USB ACM device
```

```
kernel: usbcore: registered new interface driver cdc_acm
```

```
kernel: cdc_acm: v0.26:USB Abstract Control Model driver for USB modems and ISDN adapters
```

3. To connect to your board, use `/dev/ttyACMX`.

Using the Atmel SAM-BA utility to restore memory

1. To run the utility, type:
`# ./sam-ba`
2. Select your board at91sam9g20-ek and click **Connect**.
3. Select **NandFlash**.
4. Select the **Enable NandFlash** script and execute it.
5. Make sure the script executed successfully, otherwise the steps that follow do not work.

Restoring U-Boot Memory

To restore the u-boot memory:

1. Set the address to 0x20000.
2. Open and select **Send File Name**. Open the uboot bin file.
3. Click **Send File**.
4. Make sure the uboot bin file is programmed successfully. To check, click **Compare Sent File with Memory** and ensure the file and memory match.

Restoring Bootstrap Memory

To restore the bootstrap memory:

1. Select the **Send Boot File** script and execute.
2. Select the bootstrap file to program.
3. Make sure bootstrap is programmed successfully.

Chapter 3 – Design Considerations

Noise Suppression Design Considerations

Adhere to engineering noise-suppression practices when designing a printed circuit board (PCB) containing the MultiConnect OCG-E gateway. Noise suppression is essential to the proper operation and performance of the gateway and surrounding equipment.

Any OEM board design that contains the MultiConnect OCG-E gateway must consider both on-board and off-board generated noise that can affect digital signal processing. Both on-board and off-board generated noise that is coupled on-board can affect interface signal levels and quality. Noise in frequency ranges that affect modem performance is of particular concern.

On-board generated electromagnetic interference (EMI) noise that can be radiated or conducted off-board is equally important. This type of noise can affect the operation of surrounding equipment. Most local government agencies have stringent certification requirements that must be met for use in specific environments.

Proper PC board layout (component placement, signal routing, trace thickness and geometry, and so on.) component selection (composition, value, and tolerance), interface connections, and shielding are required for the board design to achieve desired modem performance and to attain EMI certification.

Other aspects of proper noise-suppression engineering practices are beyond the scope of this developer's guide. The developer must consult noise suppression techniques as described by other sources, such as technical publications, electronics and electrical engineering text books, and component supplier application notes.

PC Board Layout Guidelines

In a 4-layer design, provide adequate ground plane covering the entire board. In 4-layer designs, power and ground are typically on the inner layers. Ensure all power and ground traces are 0.05 inches wide.

All creepages and clearances for the gateway have been designed to meet requirements of safety standards EN60950 or EN60601. The requirements are based on a working voltage of 125V or 250V. When the recommended DAA* circuit interface is implemented in a third party design, all creepage and clearance requirements must be strictly followed in order to meet safety standards. The third party safety design must be evaluated by the appropriate national agency according to the required specification.

User accessible areas: Based on where the third party design is to be marketed, sold, or used, it may be necessary to provide an insulating cover over all TNV exposed areas. Consult with the recognized safety agency to determine the requirements.

Note: Even if the recommended design considerations are followed, there are no guarantees that a particular system will comply with all the necessary regulatory requirements. It is imperative that a qualified/recognized agency completely evaluate specific designs.

*DAA stands for Data Access Arrangement. DAA is the telephone line interface of the gateway.

Mounting Hardware

When mounting modems to the board, use #4 or M2/M3 hardware.

Electromagnetic Interference (EMI) Considerations

The following guidelines help minimize EMI generation. Some of these guidelines are the same as, or similar to, the general guidelines. This developer's guide mentions them again to reinforce their importance. To minimize the contribution of the gateway-based design to EMI, the designer must understand the major sources of EMI and how to reduce them to acceptable levels.

1. Keep traces carrying high frequency signals as short as possible.
2. Provide a good ground plane or grid. In some cases, a multilayer board may be required with full layers for ground and power distribution.
3. Decouple power from ground with decoupling capacitors as close to the gateway power pins as possible.
4. Eliminate ground loops, which are unexpected current return paths to the power source and ground.
5. Decouple the telephone line cables at the telephone line jacks. Typically, use a combination of series inductors, common mode chokes, and shunt capacitors. Methods to decouple telephone lines are similar to decoupling power lines; however, telephone line decoupling may be more difficult and deserves additional attention. A commonly used design aid is to place footprints for these components and populate as necessary during performance/EMI testing and certification.
6. Decouple the power cord at the power cord interface with decoupling capacitors. Methods to decouple power lines are similar to decoupling telephone lines.
7. Locate high frequency circuits in a separate area to minimize capacitive coupling to other circuits.
8. Locate cables and connectors so as to avoid coupling from high frequency circuits.
9. Lay out the highest frequency signal traces next to the ground grid.
10. If a multilayer board design is used, make no cuts in the ground or power planes and be sure the ground plane covers all traces.
11. Minimize the number of through-hole connections on traces carrying high frequency signals.
12. Avoid right angle turns on high frequency traces. Forty-five degree corners are good; however, radius turns are better.
13. On 2-layer boards with no ground grid, provide a shadow ground trace on the opposite side of the board to traces carrying high frequency signals. This will be effective as a high frequency ground return if it is three times the width of the signal traces.
14. Distribute high frequency signals continuously on a single trace rather than several traces radiating from one point.

Electrostatic Discharge Control

Handle all electronic devices with certain precautions to avoid damage due to the accumulation of static charge.

See the ANSI/ESD Association Standard (ANSI/ESD S20.20-1999) – a document “for the Development of an Electrostatic Discharge Control for Protection of Electrical and Electronic Parts, Assemblies and Equipment.” This document covers ESD control program administrative requirements, ESD training, ESD control program plan technical requirements (grounding/bonding systems, personnel grooming, protected areas, packaging, marking, equipment, and handling), and sensitivity testing.

Multi-Tech Systems strives to follow all of these recommendations. Input protection circuitry has been incorporated into the Multi-Tech devices to minimize the effect of this static buildup. You must take proper precautions to avoid exposure to electrostatic discharge during handling.

Multi-Tech Systems uses and recommends that others use anti-static boxes that create a faraday cage (packaging designed to exclude electromagnetic fields). Multi-Tech Systems recommends that you use our packaging when returning a product and when you ship your products to your customers.

Chapter 4 – OEM Integration

FCC Grant Notes

OEMs must follow all the grant notes that follow. Otherwise, further testing and device approvals may be necessary.

The antenna gain, including cable loss, for the radio you are incorporating into your product design must not exceed the requirements at 850 MHz and 1900 MHz as specified by the FCC grant for mobile operations and fixed mounted operations as defined in 2.1091 and 1.1307 of the FCC rules for satisfying RF exposure compliance. Power output listed is conducted.

This device is a mobile device with respect to RF exposure compliance. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons, and must not be collocated or operate in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter product guidelines. Installers and end-users must be provided with specific information required to satisfy RF exposure compliance for installations and final host devices. (See note under Grant Limitations.) Compliance of this device in all final host configurations is the responsibility of the Grantee.

Grant Limitations

This device has been granted modular approval for mobile applications. Portable applications may require further RF exposure (SAR) evaluations. Examples of mobile devices include wireless routers, desktop computers, utility meters, and so on. Examples of portable applications include devices such as a laptop, USB dongle, mobile phone, tablet PC, and any device that can be worn on the body during use.

Your final product with this embedded device may need to pass FCC Part 15B.

This device has not been evaluated or approved for simultaneous transmission. Evaluate any simultaneous transmission conditions according to the current FCC KDB 447498 requirements. Section 8 describes simultaneous transmission requirements for mobile devices.

KDB 447498 Section 8

- a. Transmitters and modules certified for mobile or portable exposure conditions and categorically excluded by § 2.1091(c) can be incorporated in mobile host devices without further testing or certification when:
 - i. The closest separation among all simultaneous transmitting antennas is ≥ 20 cm;or
 - ii. The antenna separation distance and MPE compliance boundary requirements that enable all simultaneous transmitting antennas incorporated within the host to comply with MPE limits are specified in the application filing of at least one of the certified transmitters incorporated in the host device. In addition, when transmitters certified for portable use are incorporated in a mobile host device the antenna(s) must be ≥ 5 cm from all other simultaneous transmitting antennas.
- b. All antennas in the final product must be at least 20 cm from users and nearby persons.

If the host device requires further authorization, consult an accredited FCC laboratory for guidance.

FCC Definitions

Portable: (§2.1093) — A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.

Mobile: (§2.1091) — A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter’s radiating structure(s) and the body of the user or nearby persons.

Host Labeling

The host label is required to contain the following statements:

- This device contains FCC ID: {Add the FCC ID of the specific device}
- This device contains equipment certified under IC ID: {Add the IC ID of the specific device}

For labeling examples, see the section “Cellular Approvals and Labeling Requirements” in this guide.

Chapter 5 – Cellular Information

Antenna System for Cellular Devices

The cellular performance depends on the implementation and antenna design. The integration of the antenna system into the product is a critical part of the design process. Therefore, it is essential to consider it early so the performance is not compromised.

If changes are made to the certified antenna system of the gateway, then recertification is required by specific network carriers such as Sprint. The antenna system is defined as the UFL connection point from the OCG-E gateway to the specified cable specifications and specified antenna specifications.

Antenna Specifications

CDMA Antenna Requirements/Specifications

Category	Description
Frequency range	824 – 894 MHz / 1850 – 1990 MHz
Impedance	50 Ohms
VSWR	VSWR shall not exceed 2.0:1 at any point across the bands of operation
Typical radiated gain (to meet PTCRB)	0 dBi on azimuth plane / 2 dBi on azimuth plane
Maximum radiated gain allowed by FCC	10 dBi on azimuth plane / 8.9 dBi on azimuth plane
Radiation	Omni-directional
Polarization	Vertical
TRP/TIS	The total radiated power (TRP) at the antenna shall be no less than +21/20 dBm for PCS/CELL channels respectively, and the total isotropic sensitivity (TIS) at the antenna shall be no less than -104/104 dBm for PCS/CELL channels respectively.

PTCRB Requirements for the Antenna

There cannot be any alteration to the authorized antenna system. The antenna system must maintain the same specifications. The antenna must be the same type, with similar in-band and out-of-band radiation patterns.

GSM Antenna Requirements and Specifications

Category	Description
Frequency range	824 – 960 MHz / 1710 – 1990 MHz
Impedance	50 Ohms
VSWR	VSWR shall not exceed 2.0:1 at any point across the bands of operation
Typical radiated gain (to meet PTCRB)	0 dBi on azimuth plane / 2 dBi on azimuth plane
Maximum radiated gain allowed by FCC	6.9 dBi on azimuth plane / 3.1 dBi on azimuth planes
Radiation	Omni-directional
Polarization	Vertical
TRP/TIS	Including cable loss the total radiate power (TRP) at the antenna can be no less than +22/24.5 dBm for 850/1900 MHz respectively, and the total isotropic sensitivity (TIS) at the antenna can be no less than -99/101.5 dBm for 850/1900 MHz respectively.

HSPA / UMTS Antenna Requirements and Specifications

Category	Description
Frequency range	824 – 960 MHz / 1710 – 1990 MHz / 1920 – 2170 MHz
Impedance	50 Ohms
VSWR	VSWR shall not exceed 2.0:1 at any point across the bands of operation
Typical radiated gain (to meet PTCRB)	0 dBi on azimuth plane / 2 dBi on azimuth plane
Maximum radiated gain allowed by FCC	5.0 dBi on azimuth plane/4.3 dBi on azimuth plane
Radiation	Omni-directional
Polarization	Vertical
TRP/TIS	Including cable loss the total radiate power (TRP) at the antenna shall be no less than +22/24.5 dBm for 850/1900/ MHz respectively, and the total isotropic sensitivity (TIS) at the antenna shall be no less than -99/101.5 dBm for 850/1900 MHz respectively.

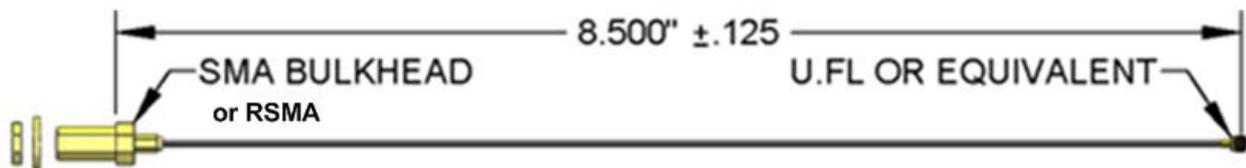
Coax Cables Specifications

SMA-to-UFL and RSMA-to-UFL Coax Cables

- One SMA-to-UFL cable is included in the developer kit for use with all cellular modems that have a UFL antenna connector.
- A second SMA-to-UFL cable is included in the developer kit for use with universal socket communications device.
- RSMA to UFL for GPS receiver
- RSMA to MMCX for socket modem, if needed

Coax Cable Specifications

Category	Description
Cable Type	Coaxial Cable
Attenuation	<1.0db
Connector Impedance	50 ohm
Maximum Cable Length	16" (40 cm)



You can order optional antenna cables from Multi-Tech Systems, Inc.

Antennas Available from Multi-Tech

Quad Band

Description	Qty	Part Number
Hinged Right Angle 800/900/1800/1900 MHz Cellular Antenna, 7.5"	1	ANQB-1HRA
Hinged Right Angle 800/900/1800/1900 MHz Cellular Antenna, 7.5"	10	ANQB-10HRA
Hinged Right Angle 800/900/1800/1900 MHz Cellular Antenna, 7.5"	50	ANQB-50HRA

Dual Band

Description	Qty	Part Number
Hinged Right Angle 900/1800 MHz Cellular Antenna, 4"	1	ANF1-1HRA
Hinged Right Angle 900/1800 MHz Cellular Antenna, 4"	10	ANF1-10HRA
Hinged Right Angle 900/1800 MHz Cellular Antenna, 4"	50	ANF1-50HRA
Hinged Right Angle 800/1900 MHz Cellular Antenna, 4"	1	ANCF2-1HRA
Hinged Right Angle 800/1900 MHz Cellular Antenna, 4"	10	ANCF2-10HRA
Hinged Right Angle 800/1900 MHz Cellular Antenna, 4"	50	ANCF2-50HRA

Mag Mount Dual Band

Description	Qty	Part Number
Mag Mount 900/1800 MHz 1/2 Wave Cellular Antenna, 12.5"	1	ANF1-1MMHW
Mag Mount 900/1800 MHz 1/2 Wave Cellular Antenna, 12.5"	10	ANF1-10MMHW
Mag Mount 900/1800 MHz 1/2 Wave Cellular Antenna, 12.5"	50	ANF1-50MMHW
Mag Mount 900/1800 MHz 1/4 Wave Cellular Antenna, 4"	1	ANF1-1MMQW
Mag Mount 900/1800 MHz 1/4 Wave Cellular Antenna, 4"	10	ANF1-10MMQW
Mag Mount 900/1800 MHz 1/4 Wave Cellular Antenna, 4"	50	ANF1-50MMQW
Mag Mount 850/1900 MHz 1/2 Wave Cellular Antenna, 12.5"	1	ANCF2-1MMHW
Mag Mount 850/1900 MHz 1/2 Wave Cellular Antenna, 12.5"	10	ANCF2-10MMHW
Mag Mount 850/1900 MHz 1/2 Wave Cellular Antenna, 12.5"	50	ANCF2-50MMHW
Mag Mount 850/1900 MHz 1/4 Wave Cellular Antenna, 4"	1	ANCF2-1MMQW
Mag Mount 850/1900 MHz 1/4 Wave Cellular Antenna, 4"	10	ANCF2-10MMQW
Mag Mount 850/1900 MHz 1/4 Wave Cellular Antenna, 4"	50	ANCF2-50MMQW

Penta Band

Description	Qty	Part Number
Hinged Right Angle 850/900/1800/1900/2100MHz Antenna, 3"	1	ANPB-1
Hinged Right Angle 850/900/1800/1900/2100MHz Antenna, 3"	10	ANPB-10
Hinged Right Angle 850/900/1800/1900/2100MHz Antenna, 3"	50	ANPB-50

Combo

Description	Qty	Part Number
Mag Mount Cellular/GPS Combo Antenna, Penta Band	1	ANGSM-GPS-1mm
Mag Mount Cellular/GPS Combo Antenna, Penta Band	10	ANGSM-GPS-10mm
Mag Mount Cellular/GPS Combo Antenna, Penta Band	50	ANGSM-GPS-50mm

GPS

Description	Qty	Part Number
Mag Mount GPS Antenna, 5 Meter Cable	1	ANGPS-1MM
Mag Mount GPS Antenna, 5 Meter Cable	10	ANGPS-10MM

Approved Antenna Cable Parts

GC Protronics: 20930C

Samtec: ASP-116785-01

The Coax Cable is an RG-178/U

Activating an Account for Cellular Devices

Some Multi-Tech cellular modems have been pre-configured to operate on a specific cellular network, such as Sprint and Verizon Wireless.

Before you can use the modem, you must set up a cellular data account with your cellular network provider. Go to Multi-Tech's cellular activation website <http://www.multitech.com/activation.go> for information on activating your cellular modem.

Cellular Approvals and Labeling Requirements

Approvals and Certification

The MT100EOCG gateway is Industry and/or Carrier Approved as an End Product modem.

Note: For approvals and certifications, CDMA has a few exceptions. The CDMA carrier can provide these exceptions to you.

In most cases, when integrated and used with an antenna system that was part of the Multi-Tech modem certification, no additional approvals or certifications are required for the device you develop as long as the following are met:

- **PTCRB Requirements:** The antenna system **cannot** be altered.
- **Model Identification:**

Important: When the cellular carrier asks you to provide the modem's model identification, give the Multi-Tech cellular model identification, not the identification of the host device model. See the label example.

The Multi-Tech model identification allows the carrier to verify the modem as one of its approved models. This information is located on the modem's label.

Example GPRS Label on End Product

The following is an example of a GPRS label:

Host Device Model
Identification

Model: ACME-AA-BB-CC
Order P/N: ACME-AA-BB-CC
Serial #: 12345678 SKU: 999999999 DOM:2011:12.27



Power Requirements
+5 to 32Vdc 650mA
Road Runner Inc
Vegas, AZ USA
Product of USA



Multi-Tech OCG-E
Model Identification

CARRIER ACTIVATION INFORMATION

Device Uses Approved Radio: MT100EOCG-G2

IMEI
(International Mobile
Equipment Identity)



IC: 125A **FCC ID:AU792000A11700**
This device complies with part 15 of the FCC rules and does not exceed the class A limits for radio noise emissions from digital apparatus as set out in the Industry Canada Standard ICES-033 Operation is subject to the following two conditions (1) This device may not cause harmful interference and (2) This device must accept any interference received including interference that may cause undesired operations



COFETEL RCPMuMT08-CO13

Example CDMA OCG-E Gateway Label

The following is an example of a label for a CDMA MT100EOCG gateway.

Note: The label is shown larger than actual size.

Multi-Tech Model Identification → Model: MT100EOCG
 B/O: - N2

Multi-Tech Ordering Part Number → Order P/N: 12345678
 SKU: 999999999 DOM:2011:12.27
 IC: 125A - 0034FCC ID: AU792U09G17825

Multi-Tech Systems
 Mounds View, MN USA
 Product of USA
 w/ foreign content
 www.multitech.com

Serial#:xxxxxxxK

FC
 Home or
 office use

CE
 E150299

RoHS
 (Restriction of Hazardous Substances)

MEID:
**Mobile Equipment Identifier in
 Hexadecimal Format** →



MEID: *R100000940034C*

Providing Other Information to the Cellular Carrier

A cellular carrier may also ask for the following information:

- **For CDMA OCG-E gateways:** The gateway's MEID (Mobile Equipment Identifier) written in hexadecimal format is printed under the barcode on the modem.
- **For GSM OCG-E gateways:** The gateway's 15-character IMEI (International Mobile Equipment Identity) number is printed on the gateway's label.

Chapter 6 — MultiConnect OCG-E HSPA Model (MT100EOCG-H5)

MT100EOCG-H5 Product Overview

Use the MT100EOCG-H5 model to design and develop solutions for use on GSM/HSPA networks. The model uses High Speed Packet Access (HSPA) technology to deliver fast cellular data speeds. Based on industry-standard open interfaces, the MT100EOCG-H5 can be used worldwide on all existing GSM networks.

Related Documentation

Use the HSPA-H5 AT Commands to configure the MT100EOCG-H5 model. These commands are documented in the HSPA-H5 AT Commands Reference Guide part number S000574. You can download this manual from the Multi-Tech website

http://www.multitech.com/en_US/DOCUMENTS/Collateral/Manuals/

Technical Specifications

The MT100EOCG-H5 gateway meets the following specifications:

Category	Description
Standards	High Speed Packet Access Plus (HSPA+) GPRS CS1-CS4 (GPRS is General Packet Radio Service) EDGE MCS1-MCS9 (EDGE is Enhanced Data Rates for Global Evolution) Circuit-Switched (CS) domain data service based on UMTS and GSM (UMTS is Universal Mobile Telecommunications System and GSM is Global System for Mobile Communications) SMS is based on CS/Packet-Switched (PS) domain of GSM and WCDMA USB Interface is CDC-ACM compliant
Data Speeds	HSPA+ data up to 21.0 Mbps downlink and 5.76 Mbps uplink UMTS PS domain data service of up to 384 kbps EDGE packet data service of up to 236.8 kbps GPRS packet data service of up to 85.6 kbps
Frequency Bands	GSM/GPRS/EDGE Quad-band: 850/900/1800/1900 MHz Penta-band HSPA: 850/900/1700/1900/2100 MHz
SMS	Point-to-Point messaging Mobile-Terminated SMS Mobile-Originated SMS
Weight	1.7 oz
Connectors	Antennas: All models have surface mount UFL antenna connectors. Standard and Rx diversity antennas are also supported. GPS models support an additional UFL antenna. SIM: Standard 1.8 / 3V SIM receptacle
Operating Temperatures	-30° C to +85° C
Compliance	EMC Compliance FCC Part 15 Class B EN 55022 Class B EN 55024 Radio Compliance FCC Part 22 FCC Part 24

	RSS 132 RSS 133 EN 301 511 EN 301 489-1 EN 301 489-7 EN 301 489-24 Safety Compliance UL 60950-1 cUL 60950-1 EN 60950-1 AS/NZ 60950-1 Network Compliance PTCRB AT&T
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Notes: Extreme temperatures can impact the radio's performance. This is normal. The radio is designed to automatically fallback in class and to reduce transmitter power to avoid damaging the radio. There is no single cause for this function. Rather, it is the result of an interaction of several factors, such as the ambient temperature, the operating mode and the transmit power.

Limiting the airflow around the device may reduce the temperature range. If enclosing the gateway in a chassis, test and verify the operating temperature range.

USB Power and Enumeration

- There are signaling differences and requirements for low-speed, full-speed, and high-speed devices.
 - The H5 supports high-speed which can impact signaling design.
 - The H5 connected through the MT100OCG-E through ARM9 only supports full-speed
- For trace routing, route D+ and D- together in parallel. Make sure traces are the same length. D+/D- are named as USB_DP/USB_DN (device side), respectively, or USBH_DP/USBH_DN (host side), respectively, in the OCG-E guide.
- Shield USB cables with twisted pairs, especially those containing USB_DP and USB_DN (device side), or USBH_DP and USBH_DN (host).
- Use a single 5V source for power for the USB devices. This power source must support the current (ampere) requirements specified in the Power Draw section.

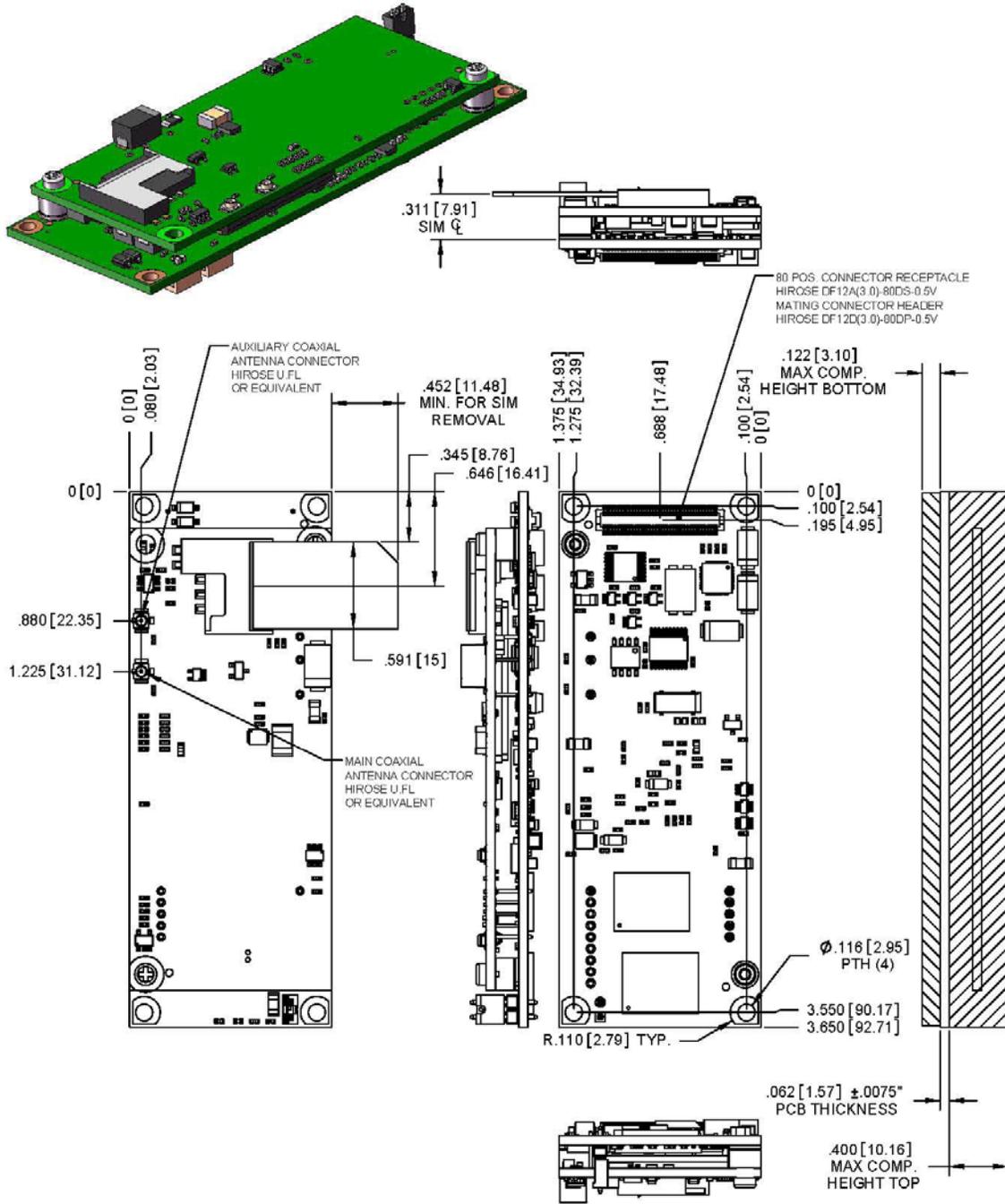
Powering Down Your Device (H5)

CAUTION: Failing to properly shutdown the device before removing power may corrupt your device's file system.

For the H5, to properly power down your device, use the following sequence:

1. Issue the AT#SHDN command.
2. Wait 30 seconds.
3. Power off the device. Disconnect power from the device.

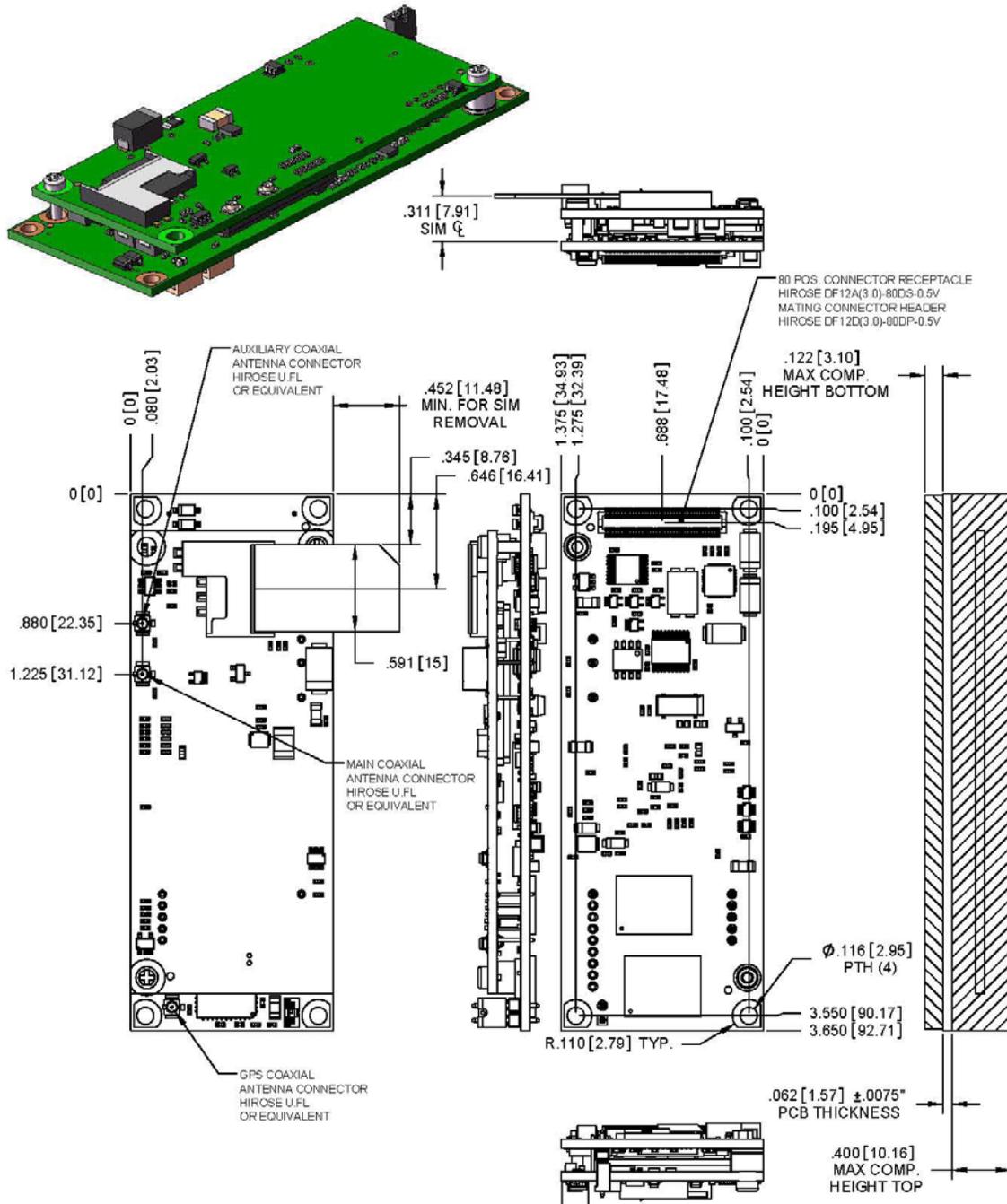
Mechanical Drawings for MT100EOCG-H5



ALL DIMENSIONS IN In [mm]

MT100EOCG-H5

Mechanical Drawing for MT100EOCG-H5-GP



ALL DIMENSIONS IN In [mm]

MT100EOCG-H5-GP

Power Measurements

Power* Draw for the MT100EOCG-H5

GSM850

Input Voltage= 5.0Volts	Typical	Maximum ¹	Peak ² TX	Peak Power Up (Inrush) ³
AMPS	0.311	0.475	1.81	3.84
Watts	1.55	2.36		

HSDPA

Input Voltage= 5.0Volts	Typical	Maximum ¹	Peak ² TX	Peak Power Up (Inrush) ³
AMPS	0.430	0.655	0.740	3.84
Watts	2.14	3.20		

* Multi-Tech Systems, Inc. recommends that you incorporate a 10% buffer into your power source when determining product load.

¹ Maximum: The continuous current during maximum data rate with the radio transmitter at maximum power

² Peak Tx: The peak current during a GSM850 transmission burst period or HSDPA connection

³ Inrush Current: The input current during power up, or a reset.

Power* Draw for the MT100EOCG-H5-GP

GSM850

Input Voltage= 5.0Volts	Typical	Maximum ¹	Peak ² TX	Peak Power up (inrush) ³
AMPS	0.363	0.526	1.87	3.590
Watts	1.82	2.64		

HSDPA

Input Voltage= 5.0Volts	Typical	Maximum ¹	Peak ² TX	Peak Power up (inrush) ³
AMPS	0.518	0.736	0.832	3.590
Watts	2.58	3.63		

* Multi-Tech Systems, Inc. recommends that you incorporate a 10% buffer into your power source when determining product load.

¹ Maximum: The continuous current during maximum data rate with the radio transmitter at maximum power

² Peak Tx: The peak current during a GSM850 transmission burst period or HSDPA connection

³ Inrush Current: The input current during power up, or a reset.

Application Notes

RF Performances

The module's radio transceiver meets the requirements of 3GPP Release 5 and 6. All values indicated are conducted.

Receiver Features

Category	Description
GSM 850 Sensitivity	< -106 dBm
E-GSM 900 Sensitivity	< -106 dBm
DCS 1800 Sensitivity	< -105 dBm
PCS 1900 Sensitivity	< -105 dBm
UMTS Band I 2100 Sensitivity	< -109 dBm
UMTS Band II 1900 Sensitivity	< -109 dBm
UMTS Band V 850 Sensitivity	< -110 dBm
UMTS Band VI 800 Sensitivity	< -110 dBm

Transmitter Features

Category	Description
Maximum output power (GSM 850 / GSM 900)	+32 dBm \pm 1 dBm GSMK mode (class 4) +27 dBm \pm 1 dBm 8PSK mode (class E2)
Maximum output power (DCS 1800 / PCS 1900)	+29 dBm \pm 1 dBm GSMK mode (class 1) +26 dBm \pm 1 dBm 8PSK mode (class E2)
Maximum output power (UMTS Band II 1900, V 850, &VI 800)	+23 dBm \pm 1 dBm (class 3)
Maximum output power (UMTS Band I 2100)	+23 dBm \pm 1 dBm (class 3)

Supported Frequency Bands

WCDMA Frequency Band Support

Band	Frequencies
Band I WCDMA 2100	Tx: 1920 – 1980 MHz Rx: 2110 – 2170 MHz
Band II WCDMA 1900	Tx: 1850 – 1910 MHz Rx: 1930 – 1990 MHz
Band V WCDMA 850	Tx: 824 – 849 MHz Rx: 869 – 894 MHz

GSM Frequency Band Support

Band	Frequencies
GSM 850	Tx: 824 – 849 MHz Rx: 869 – 894 MHz
EGSM 900	Tx: 800 – 915 MHz Rx: 925 – 960 MHz
GSM 1800	Tx: 1700 – 1785 MHz Rx: 1805 – 1880 MHz
GSM 1900	Tx: 1850 – 1910 MHz Rx: 1930 – 1990 MHz

GPS Frequency Band Support (for Models with GPS)

Band	Frequency
GPS	1575.42 MHz

RF Connection and Antenna

The RF connector on the MultiConnect OCG-E gateway is a UFL standard type. For antenna system details, see Chapter 5.

Chapter 7 — MultiConnect OCG-E EV-DO Model (MT100EOCG-EV2)

MT100EOCG-EV2 Product Overview

The MT100EOCG-EV2 model is a 3G model supporting CDMA EV-DO Rev A and below. Based on industry-standard open interfaces, the MT100EOCG-EV2 model is equipped with dual-band 800/1900 MHz bands with receive diversity support on both bands. Use this model to design and develop solutions for CDMA networks.

Related Documentation

Use the CDMA 1xEV-DO AT Commands to configure the MT100EOCG-EV2 model. These commands are documented in the CDMA 1xEV-DO AT Commands Reference Guide part number S000482x. You can download this manual from the Multi-Tech website.

http://www.multitech.com/en_US/DOCUMENTS/Collateral/Manuals/

Technical Specifications

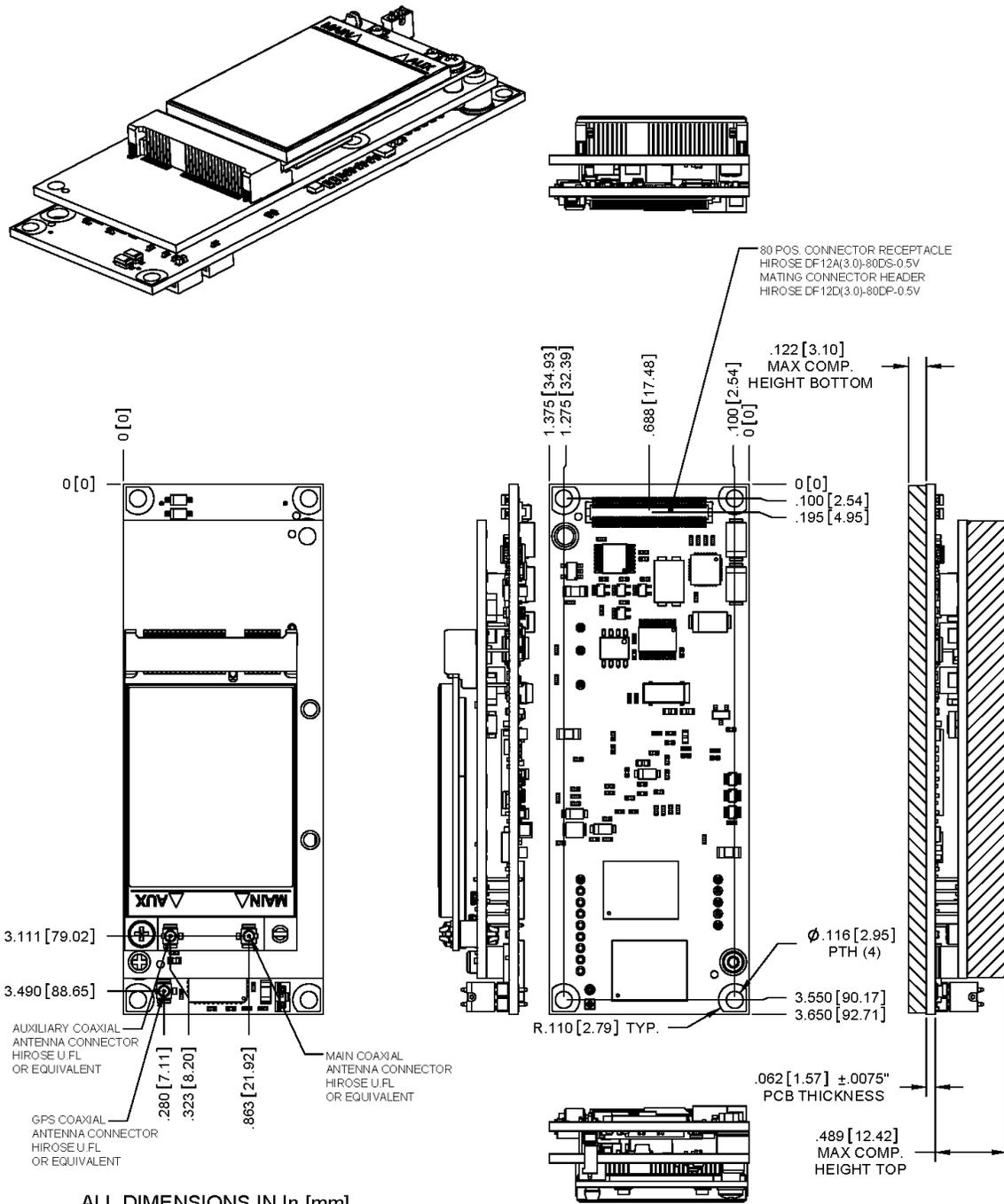
The EV-DO model of the MultiConnect OCG-E gateway (MT100EOCG-EV2) meets the following specifications:

Category	Description
Standard	CDMA2000 1xRTT EV-DO Rev. A (backward compatible to EV-DO Rev. 0 and CDMA 1x networks) SMS is based on CS/Packet-Switched (PS) domain of GSM and WCDMA
Data Speed	Serial interface supporting DTE speeds to 230K Peak downlink speeds up to 3.1 Mbps Peak uplink speeds up to 1.8 Mbps IS-95 Circuit-switched data up to 14.4K bps
Frequency Bands	Dual-band 800/1900 MHz bands with Receive Diversity support on both bands
SMS	Point-to-Point messaging Mobile-Terminated SMS Mobile-Originated SMS
Weight	1.7 oz
Connectors	Antenna: All models have surface mount UFL antenna connectors. Standard and Rx diversity antennas are also supported. GPS models support an additional UFL antenna.
Operating Temperature	-35° C to +85° C
Compliance	EMC Compliance FCC Part 15 Class B Radio Compliance FCC Part 22 FCC Part 24 Safety Compliance UL 60950-1 cUL 60950-1 IEC 60950-1 Network Compliance CDG 1 and 2 Verizon Sprint Aeris

Notes: Extreme temperatures can impact the radio's performance. This is normal. The radio is designed to automatically fallback in class and to reduce transmitter power to avoid damaging the radio. There is no single cause for this function. Rather, it is the result of an interaction of several factors, such as the ambient temperature, the operating mode and the transmit power.

Limiting the airflow around the device may reduce the temperature range. If enclosing the gateway in a chassis, test and verify the operating temperature range

Mechanical Drawing for MT100EOCG-EV2-GP



MT100EOCG-EV2-GP-Nx

Power Measurements

Power Draw* for the MT100EOCG-EV2

Input Voltage= 5.0 Volts	Sleep Mode	Typical	Maximum ¹	Peak ² TX	Peak Rst (Inrush Current)
US Cellular Current (AMPS)	0.240	0.490	1.03	1.29	2.88
Watts	1.18	2.38	4.85		
US PCS Current (AMPS)	0.240	0.510	1.10	1.30	
Watts	1.18	2.48	5.17		
EV-DO Current (AMPS)	0.240	0.540	1.05	1.30	
Watts	1.18	2.57	4.91		
Inrush Current (AMPS) (approximately 3ms duration) ³					

* Multi-Tech Systems, Inc. recommends that you incorporate a 10% buffer into your power source when determining product load.

¹ Maximum: The continuous current during maximum data rate with the radio transmitter at maximum power

² Peak Tx: The peak current during a GSM850 transmission burst period or HSDPA connection

³ Inrush Current: The input current during power up, or a reset.

Power Draw* for the MT100EOCG-EV2-GP

Input Voltage= 5.0 Volts	Sleep Mode	Typical	Maximum ¹	Peak ² TX	Peak Rst (Inrush Current)
US Cellular Current (AMPS)	0.240	0.575	1.100	1.29	2.88
Watts	1.181	2.800	5.18		
US PCS Current (AMPS)	0.240	0.600	1.200	1.30	
Watts	1.18	2.92	5.64		
EV-DO Current (AMPS)	0.240	0.630	1.14	1.30	
Watts	1.18	2.99	5.34		
Inrush Current (AMPS) (approximately 3ms duration) ³					

* Multi-Tech Systems, Inc. recommends that you incorporate a 10% buffer into your power source when determining product load.

¹ Maximum: The continuous current during maximum data rate with the radio transmitter at maximum power

² Peak Tx: The peak current during a GSM850 transmission burst period or HSDPA connection

³ Inrush Current: The input current during power up, or a reset.

RF Performances

All values indicated are conducted.

Receiver Features

Category	Description
CDMA 1xRTT US Cellular 800 (Verizon) sensitivity	< -108 dBm
CDMA 1xRTT US PCS 1900 (Sprint) sensitivity	< -107 dBm
EV-DO 1x Rev 0 US Cellular 800 (Verizon) sensitivity	< -111 dBm
EV-DO 1x Rev 0 US PCS 1900 (Sprint) sensitivity	< -109 dBm

Transmitter Features

Category	Description
Maximum output power (CDMA 1x RTT & EV-DO 1x Rev 0/Rev A)	+24 dBm \pm 1 dBm

Chapter 8 — MultiConnect OCG-E GPRS Model (MT100EOCG-G2)

MT100EOCG-G2 Product Overview

The MT100EOCG-G2 model uses cellular, quad-band GPRS technology. It is a complete, ready-to-integrate model that offers standards-based multi-band GSM/GPRS Class 10 performance. It is based on industry-standard open interfaces.

Related Documentation

Use the GPRS AT Commands to configure the MT100EOCG-G2 model. These commands are documented in the GPRS AT Commands for Multi-Tech G2 Cellular Modems part number S000463x. You can download this manual from the Multi-Tech website.

http://www.multitech.com/en_US/DOCUMENTS/Collateral/Manuals/

Technical Specifications

The MT100EOCG-G2 meets the following specifications:

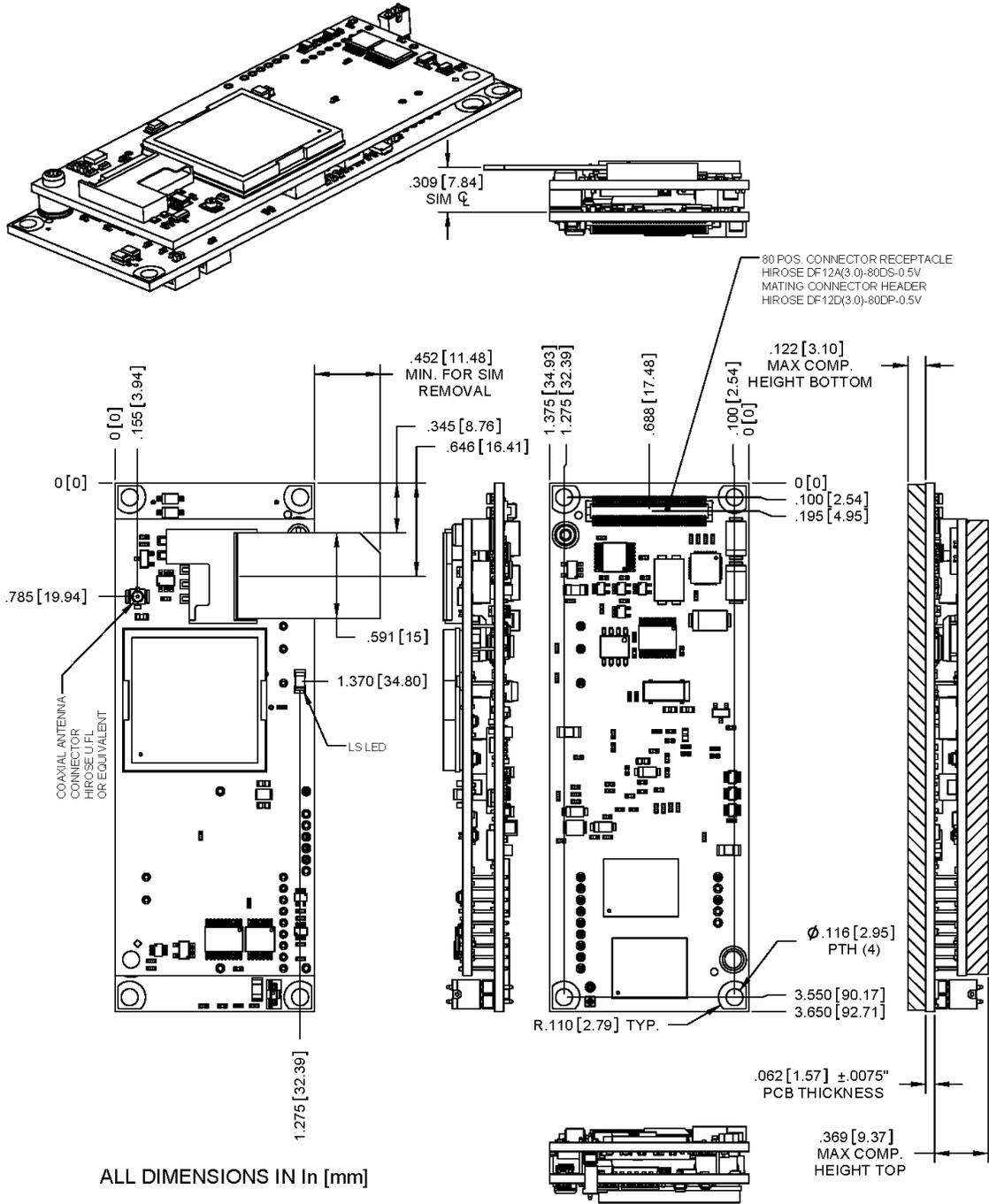
Category	Description
Standards	GPRS Class 10
Frequency Bands	Quad-band GSM/EGPRS 850/900/1800/1900 MHz
Serial/Data Speed	Serial interface supports DTE speeds up to 921.6K IP interface supports DTE speeds at the fixed rate of 115.2 Packet data up to 85.6K bps Circuit-switched data (GPRS) up to 14.4K bps transparent and non-transparent Supports data rates of 921600, 460800, 230400, 115200 bps
Data Format	10 bit Serial Asynchronous
Data Error Correction	MNP2
Data Compression	V.42bis
Operating Temperature	-35° C to +85° C
Operating Voltage	Supply Range: VCC Maximum: 5.5
Voltage at Any Signal Pin	Minimum: GND Maximum: VCC
Weight	1.4 oz.
Connectors	Antennas: All models have surface mount UFL antenna connectors. Standard and Rx diversity antennas are also supported GPS models support an additional UFL antenna. SIM: Standard 1.8V and 3V SIM holder
Compliance	EMC Compliance FCC Part 15 Class B EN 55022 Class B EN 55024 Radio Compliance FCC Part 22 FCC Part 24 RSS 132 RSS 133 EN 301 511

	EN 301 489-1 EN 301 489-7 EN 301 489-24 Safety Compliance UL 60950-1 cUL 60950-1 IEC 60950-1 Network Compliance PTCRB AT&T
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Notes: Extreme temperatures can impact the radio's performance. This is normal. The radio is designed to automatically fallback in class and to reduce transmitter power to avoid damaging the radio. There is no single cause for this function. Rather, it is the result of an interaction of several factors, such as the ambient temperature, the operating mode and the transmit power.

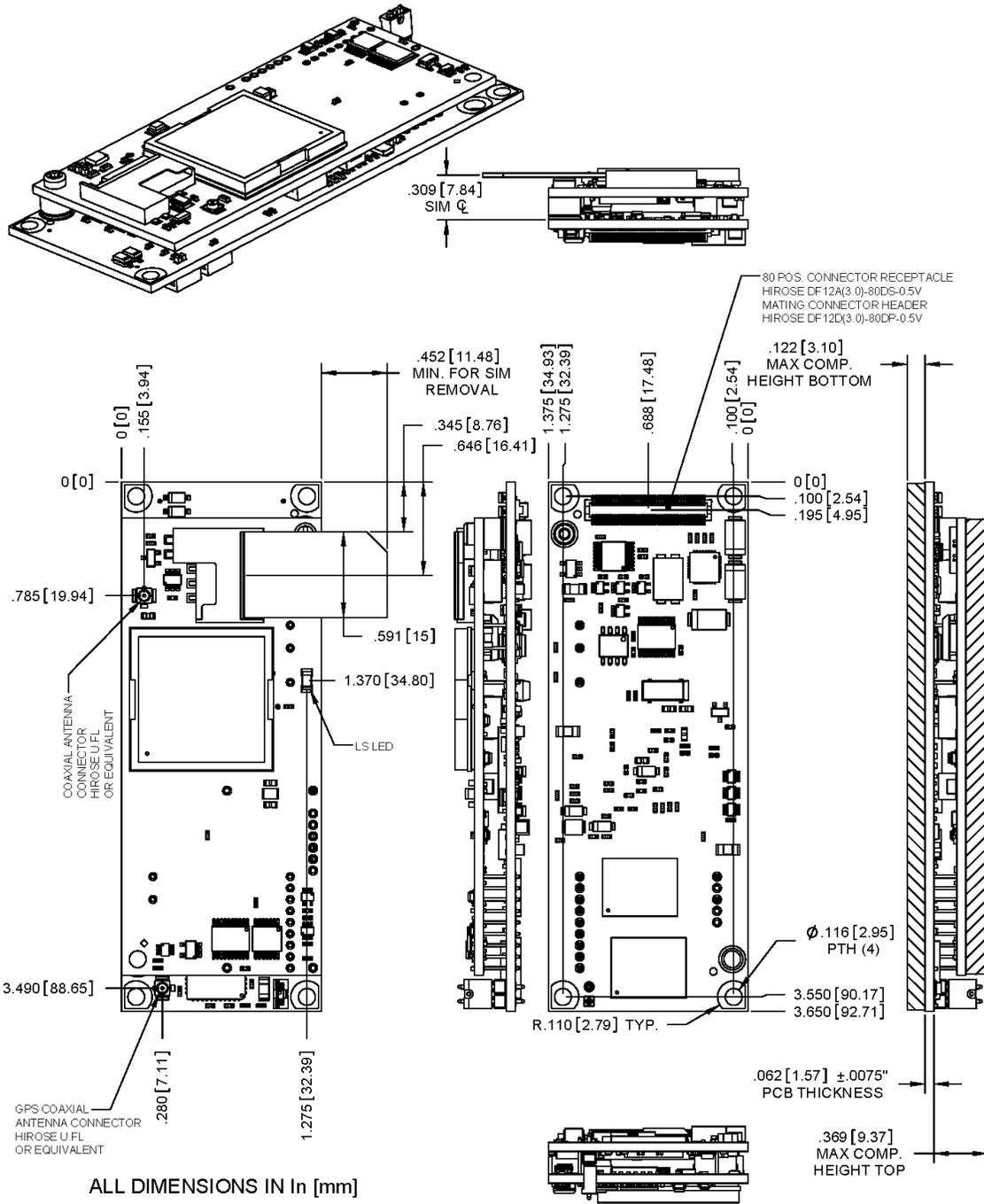
Limiting the airflow around the device may reduce the temperature range. If enclosing the gateway in a chassis, test and verify the operating temperature range

Mechanical Drawing for MT100EOCG-G2 Build



MT100EOCG-G2

Mechanical Drawing for MT100EOCG-G2-GP



MT100EOCG-G2-GP

Power Measurements

Power* Draw for MT100EOCG-G2

Input Voltage= 5.0 Volts	Sleep Mode	Typical	Maximum ¹	Peak ² TX	Peak Rst (Inrush Current)
GSM850 Current (AMPS)	0.190	0.390	0.515	1.50	1.15
Watts	0.948	1.930	2.52		
Inrush Current (AMPS) (approximately 3ms duration) ³					

Multi-Tech Systems, Inc. recommends that you incorporate a 10% buffer into your power source when determining product load.

¹ Maximum: The continuous current during maximum data rate with the radio transmitter at maximum power

² Peak Tx: The peak current during a GSM850 transmission burst period or HSDPA connection

³ Inrush Current: The input current during power up, or a reset.

Power* Draw for MT100EOCG-G2-GP

Input Voltage= 5.0 Volts	Sleep Mode	Typical	Maximum ¹	Peak ² TX	Peak Rst (Inrush Current)
GSM850 Current (AMPS)	0.190	0.485	0.620	1.50	1.15
Watts	0.948	2.400	3.04		
Inrush Current (AMPS) (approximately 3ms duration) ³					

Multi-Tech Systems, Inc. recommends that you incorporate a 10% buffer into your power source when determining product load.

¹ Maximum: The continuous current during maximum data rate with the radio transmitter at maximum power

² Peak Tx: The peak current during a GSM850 transmission burst period or HSDPA connection

³ Inrush Current: The input current during power up, or a reset.

Application Notes

LED Interface

The LED signals indicate the working status of the gateway.

LED 1 – Link Status – Available for G2 and G2-GP Models

LED 1 Signal	Link Status LED	
OFF	Download mode or switched OFF	
ON	Continuously lit	Switched ON (not registered on the network)
	Blinking	Switched ON (registered on the network)

RF Performances

RF performances are compliant with 3GPP TS 05.05 (R99).

All values indicated are conducted.

Receiver Features

Category	Description
GSM 850 Sensitivity	< -108 dBm
E-GSM 900 Sensitivity	< -108 dBm
DCS 1800 Sensitivity	< -107 dBm
PCS 1900 Sensitivity	< -107 dBm

Transmitter Features

Category	Description
Maximum output power (E-GSM 900 & GSM 850)	33 dBm \pm 2 dB
Maximum output power (DCS 1800 & PCS 1900)	30 dBm \pm 2 dB

RF Connection and Antenna

The RF connector on the gateway is a UFL standard type. See Chapter 5 for Antenna System details.

Changing the Quad Band

If you want to change the band—because for example you are moving the modem from one geographical area to another—use the **+WMBS** AT Command.

To change the band:

1. Log into the MultiConnect OCG-E gateway using either SSH or the Debug serial port.
For more information see “Logging into the MultiConnect OCG-E Gateway” in this manual.
2. To access the modem port, run `microcom`.
Run `'microcom -s 115200 /dev/ttyS1'`
3. Type **AT+WMBS=<Band><Param>**. Press **Enter**.
 - For **<Band>**, enter the option you desire:
 - 4** = Dual-band mode 850/1900MHz
 - 5** = Dual-band mode 900/1800MHz
 - For **<Param>**, enter the option you desire:
 - 0** = Modem must be reset in order to use the specified band(s). This is the default.
 - 1** = Modem restarts immediately using the specified band(s).Example: `AT+WMBS=4,0`. Press Enter.
4. To exit `microcom` press CTRL-X.

Chapter 9 — MultiConnect OCG-E without Cellular Modem (MT100EOCG)

Product Overview

The MultiConnect OCG-E model helps you develop solutions that do not involve a cellular modem. Model MT100EOCG also offers GPS and non-GPS capability.

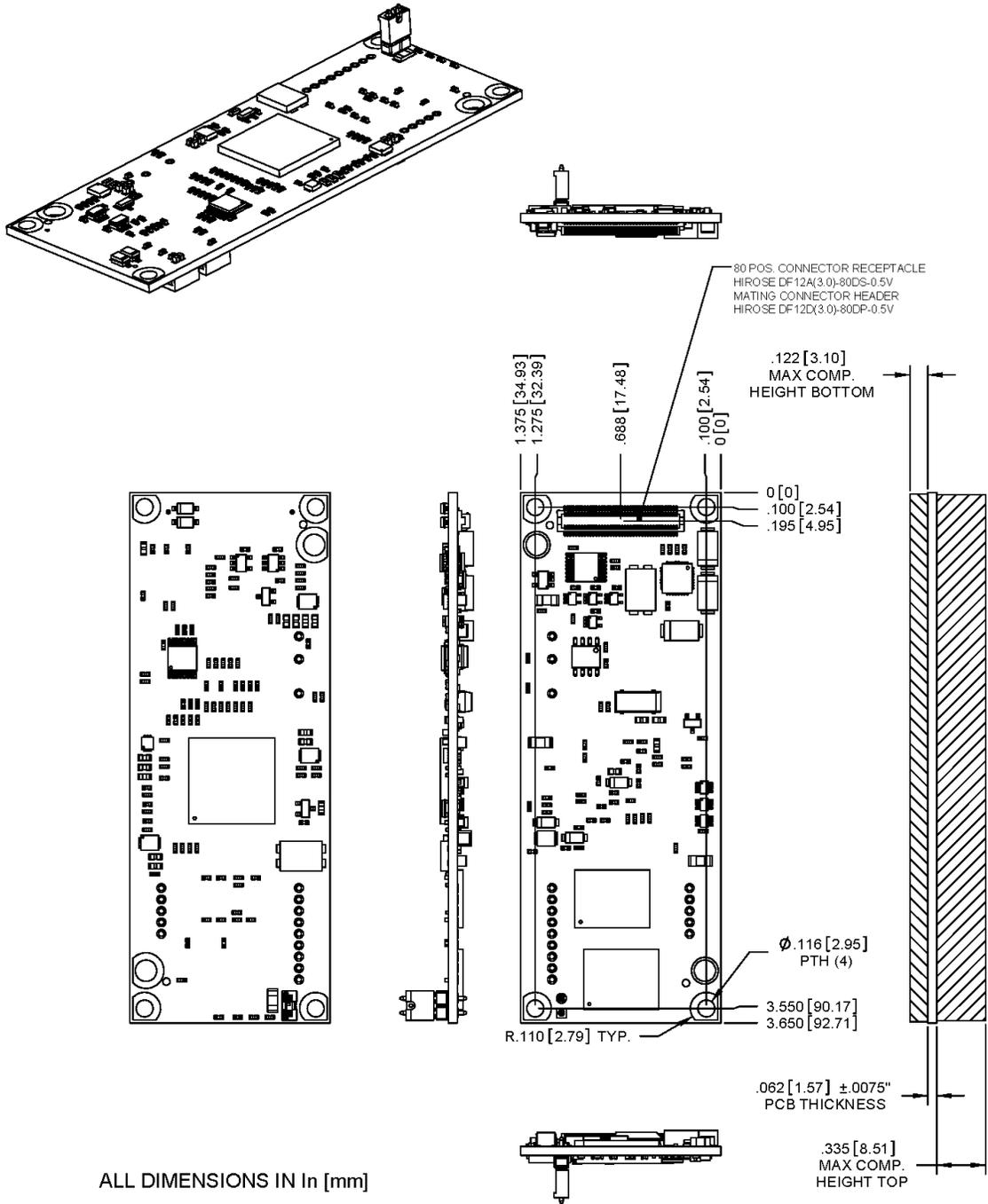
Technical Specifications

The MT100EOCG meets the following specifications:

Category	Description
Serial/Data Speed	Serial interface supports DTE speeds up to 921.6K IP interface supports DTE speeds at the fixed rate of 115.2
Operating Temperature	-40° C to +85° C
Operating Voltage	Supply Range: VCC Maximum: 5.5
Voltage at Any Signal Pin	Minimum: GND Maximum: VCC
Weight	.7 oz.
Connectors	GPS models use a UFL antenna.
Compliance	EMC Compliance FCC Part 15 Class B EN 55022 Class B EN 55024 Safety Compliance UL 60950-1 cUL 60950-1 IEC 60950-1

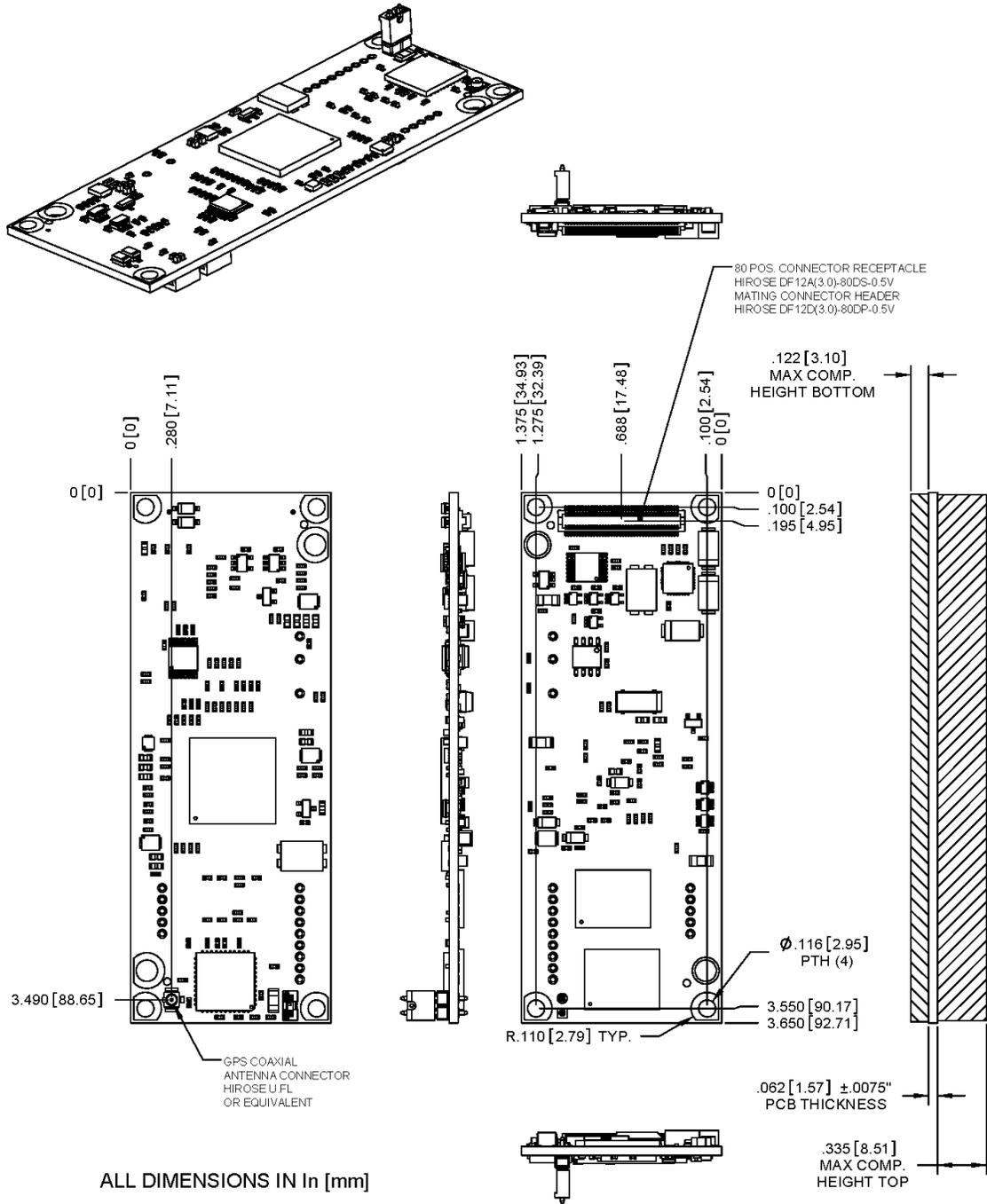
Notes: Limiting the airflow around the device may reduce the temperature range. If enclosing the gateway in a chassis, test and verify the operating temperature range

Mechanical Drawing for MT100EOCG



MT100EOCG

Mechanical Drawing for MT100EOCG-GP Build



MT100EOCG-GP

Power Measurements

Power* Draw for MT100EOCG No Cellular Radio, No GPS

Input Voltage= 5.0 Volts	Typical ¹	Maximum ²	Peak ³ TX	Peak Rst (Inrush Current)
Current (AMPS)	0.185	0.260	0.330	1.36
Watts	0.942	1.32		
Inrush Current (AMPS) (approximately 3ms duration) ⁴				

Multi-Tech Systems, Inc. recommends that you incorporate a 10% buffer into your power source when determining product load.

¹ Typical: The current measured with power applied and Ethernet cable attached.

² Maximum: Maximum current measured during maximum operation.

³ Peak: Maximum peak current measured during maximum operation.

⁴ Inrush Current: The input current during power up, or a reset.

Power* Draw for MT100EOCG-GP, No Cellular Modem, Uses GPS

Input Voltage= 5.0 Volts	Typical ¹	Maximum ²	Peak ³ TX	Peak Rst (Inrush Current)
Current (AMPS)	0.245	0.305	0.380	1.40
Watts	1.240	1.55		
Inrush Current (AMPS) (approximately 3ms duration) ⁴				

Multi-Tech Systems, Inc. recommends that you incorporate a 10% buffer into your power source when determining product load.

¹ Typical: The current measured with power applied and Ethernet cable attached.

² Maximum: Maximum current measured during maximum operation.

³ Peak: Maximum peak current measured during maximum operation.

⁴ Inrush Current: The input current during power up, or a reset.

Appendix A – Regulatory Compliance Statements

EMC, Safety, and R&TTE Directive Compliance

The CE mark is affixed to this product to confirm compliance with the following European Community Directives:

- Council Directive 2004/108/EC of 15 December 2004 on the approximation of the laws of Member States relating to electromagnetic compatibility;
and
- Council Directive 2006/95/EC of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits;
and
- Council Directive 1999/5/EC of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

International Modem Restrictions

Some dialing and answering defaults and restrictions may vary for international modems. Changing settings may cause a modem to become non-compliant with national telecom requirements in specific countries. Also note that some software packages may have features or lack restrictions that may cause the modem to become non-compliant.

EMC Requirements for the United States

47 CFR – FCC Part 15 Regulation – Class B

This equipment has been tested and found to comply with the limits for a **Class B** digital device, pursuant to 47 CFR – FCC Part 15 regulations. The stated limits in this regulation are designed to provide reasonable protection against harmful interference in a residential environment. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Plug the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with 47 CFR – FCC Part 15 rules. Operation of this device is subject to the following conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference that may cause undesired operation.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

EMC Requirements for Industry Canada

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement Canadien sur le matériel brouilleur.

This device complies with Industry Canada RSS Appliance radio exempt from licensing. The operation is permitted for the following two conditions:

1. the device may not cause harmful interference, and
2. the user of the device must accept any interference suffered, even if the interference is likely to jeopardize the operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Other Countries

This developer's manual does not describe countries with specific regulations. For help to determine your country's requirements, contact Multi-Tech's Technical Support.

Waste Electrical and Electronic Equipment Statement

Note to OEMs: This statement is included for your information and may be used in your product documentation.

WEEE Directive

The WEEE directive places an obligation on EU-based manufacturers, distributors, retailers, and importers to take-back electronics products at the end of their useful life. A sister Directive, ROHS (Restriction of Hazardous Substances) complements the WEEE Directive by banning the presence of specific hazardous substances in the products at the design phase. The WEEE Directive covers all Multi-Tech products imported into the EU as of August 13, 2005. EU-based manufacturers, distributors, retailers and importers are obliged to finance the costs of recovery from municipal collection points, reuse, and recycling of specified percentages per the WEEE requirements.

Instructions for Disposal of WEEE by Users in the European Union

The symbol that follows is on the product or on its packaging, which indicates that this product must not be disposed of with other waste. Instead, it is the user's responsibility to dispose of their waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service or where you purchased the product.

July, 2005



Restriction of the Use of Hazardous Substances (RoHS)



Multi-Tech Systems, Inc. Certificate of Compliance 2011/65/EU

Multi-Tech Systems confirms that its embedded products comply with the chemical concentration limitations set forth in the directive 2011/65/EU of the European Parliament (Restriction of the use of certain Hazardous Substances in electrical and electronic equipment - RoHS)

These Multi-Tech products do not contain the following banned chemicals¹:

- Lead, [Pb] < 1000 PPM
- Mercury, [Hg] < 1000 PPM
- Hexavalent Chromium, [Cr+6] < 1000 PPM
- Cadmium, [Cd] < 100 PPM
- Polybrominated Biphenyl, [PBB] < 1000 PPM
- Polybrominated Diphenyl Ether, [PBDE] < 1000 PPM

Environmental considerations:

- Moisture Sensitivity Level (MSL) =1
- Maximum Soldering temperature = 260C (in SMT reflow oven)

¹Lead usage in some components is exempted by the following RoHS annex, therefore higher lead concentration would be found in some modules (>1000 PPM);

–Resistors containing lead in a glass or ceramic matrix compound.

Interference with Pacemakers and Other Medical Devices

Potential interference

Radiofrequency energy (RF) from cellular devices can interact with some electronic devices. This is electromagnetic interference (EMI). The FDA helped develop a detailed test method to measure EMI of implanted cardiac pacemakers and defibrillators from cellular devices. This test method is part of the Association for the Advancement of Medical Instrumentation (AAMI) standard. This standard allows manufacturers to ensure that cardiac pacemakers and defibrillators are safe from cellular device EMI.

The FDA continues to monitor cellular devices for interactions with other medical devices. If harmful interference occurs, the FDA will assess the interference and work to resolve the problem.

Precautions for pacemaker wearers

If EMI occurs, it could affect a pacemaker in one of three ways:

- Stop the pacemaker from delivering the stimulating pulses that regulate the heart's rhythm.
- Cause the pacemaker to deliver the pulses irregularly.
- Cause the pacemaker to ignore the heart's own rhythm and deliver pulses at a fixed rate.

Based on current research, cellular devices do not pose a significant health problem for most pacemaker wearers. However, people with pacemakers may want to take simple precautions to be sure that their device doesn't cause a problem.

- Keep the device on the opposite the side of the body from the pacemaker to add extra distance between the pacemaker and the device.
- Avoid placing a turned-on device next to the pacemaker (for example, don't carry the device in a shirt or jacket pocket directly over the pacemaker).

Information on HS/TS Substances According to Chinese Standards in English

In accordance with China's Administrative Measures on the Control of Pollution Caused by Electronic Information Products (EIP) # 39, also known as China RoHS, the following information is provided regarding the names and concentration levels of Toxic Substances (TS) or Hazardous Substances (HS) which may be contained in Multi-Tech Systems Inc. products relative to the EIP standards set by China's Ministry of Information Industry (MII).

Name of the Component	Hazardous/Toxic Substance/Elements					
	Lead (PB)	Mercury (Hg)	Cadmium (CD)	Hexavalent Chromium (CR6+)	Polybrominated Biphenyl (PBB)	Polybrominated Diphenyl Ether (PBDE)
Printed Circuit Boards	O	O	O	O	O	O
Resistors	X	O	O	O	O	O
Capacitors	X	O	O	O	O	O
Ferrite Beads	O	O	O	O	O	O
Relays/Opticals	O	O	O	O	O	O
ICs	O	O	O	O	O	O
Diodes/ Transistors	O	O	O	O	O	O
Oscillators and Crystals	X	O	O	O	O	O
Regulator	O	O	O	O	O	O
Voltage Sensor	O	O	O	O	O	O
Transformer	O	O	O	O	O	O
Speaker	O	O	O	O	O	O
Connectors	O	O	O	O	O	O
LEDs	O	O	O	O	O	O
Screws, Nuts, and other Hardware	X	O	O	O	O	O
ac-dc Power Supplies	O	O	O	O	O	O
Software / Documentation CDs	O	O	O	O	O	O
Booklets and Paperwork	O	O	O	O	O	O
Chassis	O	O	O	O	O	O

- X** Represents that the concentration of such hazardous/toxic substance in all the units of homogeneous material of such component is higher than the SJ/Txxx-2006 Requirements for Concentration Limits.
- O** Represents that no such substances are used or that the concentration is within the aforementioned limits.

Information on HS/TS Substances According to Chinese Standards in Chinese

依照中国标准的有毒有害物质信息

根据中华人民共和国信息产业部 (MII) 制定的电子信息产品 (EIP) 标准—中华人民共和国《电子信息产品污染控制管理办法》(第 39 号), 也称作中国 RoHS, 下表列出了 Multi-Tech Systems, Inc. 产品中可能含有的有毒物质 (TS) 或有害物质 (HS) 的名称及含量水平方面的信息。

成分名称	有害/有毒物质/元素					
	铅 (PB)	汞 (Hg)	镉 (CD)	六价铬 (CR6+)	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
印刷电路板	O	O	O	O	O	O
电阻器	X	O	O	O	O	O
电容器	X	O	O	O	O	O
铁氧体磁环	O	O	O	O	O	O
继电器/光学部件	O	O	O	O	O	O
IC	O	O	O	O	O	O
二极管/晶体管	O	O	O	O	O	O
振荡器和晶振	X	O	O	O	O	O
调节器	O	O	O	O	O	O
电压传感器	O	O	O	O	O	O
变压器	O	O	O	O	O	O
扬声器	O	O	O	O	O	O
连接器	O	O	O	O	O	O
LED	O	O	O	O	O	O
螺丝、螺母以及其它五金件	X	O	O	O	O	O
交流-直流电源	O	O	O	O	O	O
软件/文档 CD	O	O	O	O	O	O
手册和纸页	O	O	O	O	O	O
底盘	O	O	O	O	O	O

X 表示所有使用类似材料的设备中有害/有毒物质的含量水平高于 SJ/Txxx-2006 限量要求。

O 表示不含该物质或者该物质的含量水平在上述限量要求之内。