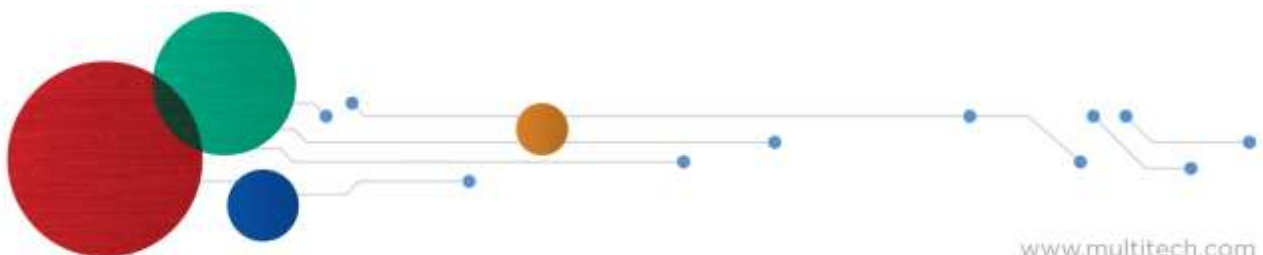




MultiConnect[®] OCG-E Open Communications Gateways

Developer Guide



MultiConnect™ OCG-E Developer Guide**MT100EOCG -H5 and radioless model****S000516, Revision E****Copyright**

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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 and caution to avoid corruption of device file system. |
| E | 12/11/2017 | Removed obsolete -EV2 and -G2 models. Updated GPIO information and added notes. |

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

Overview

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.

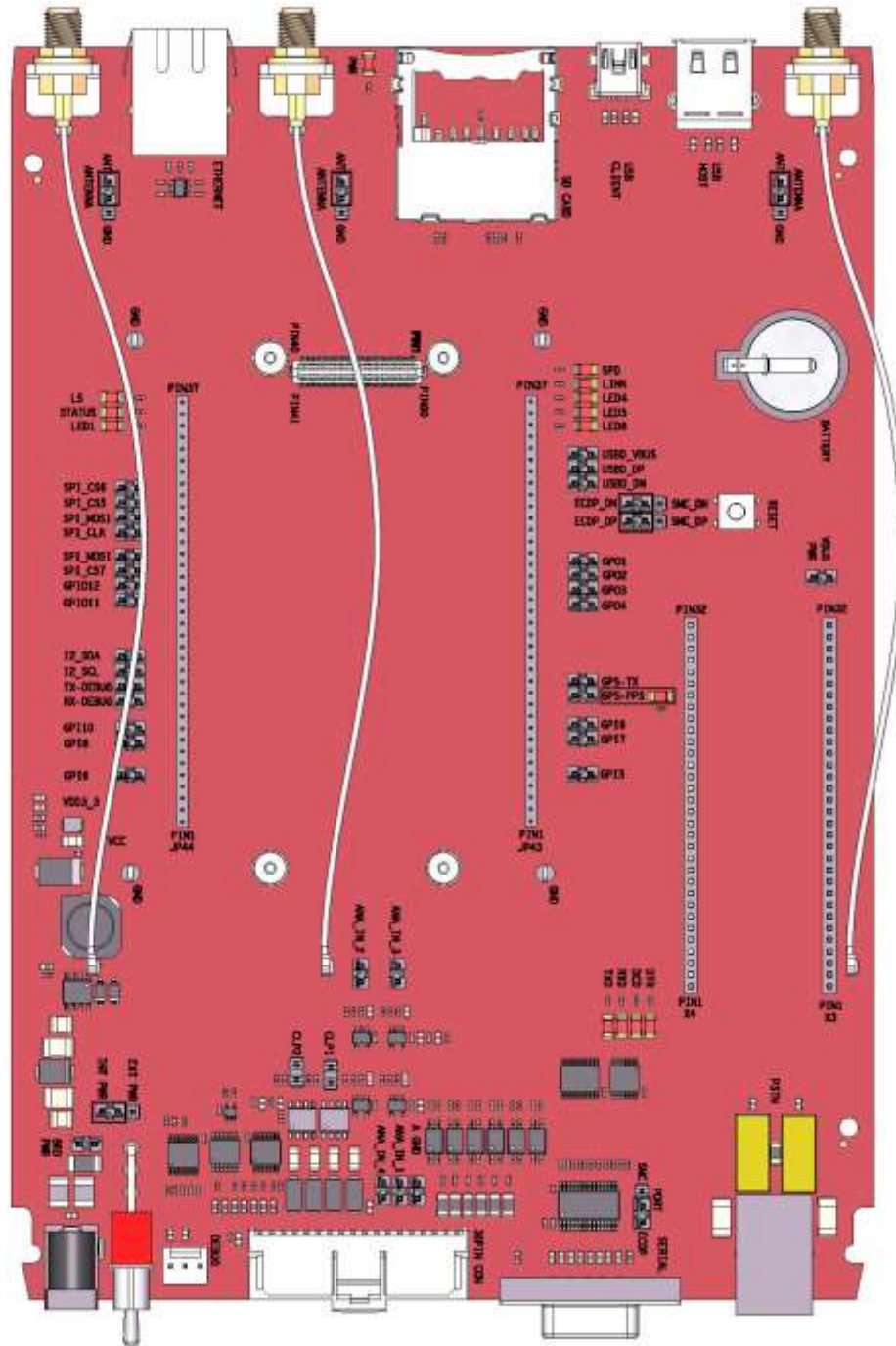
Applications that require device networking capability can now reside directly on select MultiTech gateways. This product brings together a cellular hardware development kit, MultiTech’s CoreCDP Linux distribution and a complete Linux build environment, allowing you to quickly create custom applications. 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 MultiTech 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 H5 models
- AT command compatible
- Carrier approved

An illustration of the developer board follows.



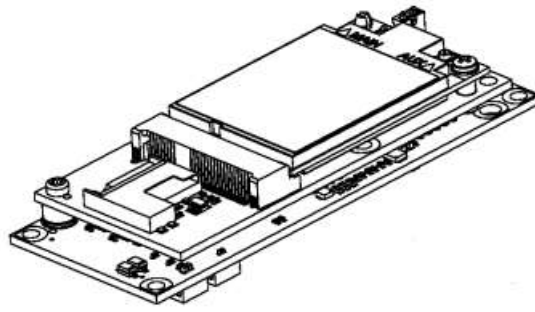
The developer's board is available without a cellular modem.

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

- HSPA or HSDPA, by selecting the MT100EOCG-H5 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 (-H5 or no cellular modem).



Product Ordering Options

| Product | Description | Region |
|-----------------|--|--------|
| MT100EOCG-H5 | 3G, HSPA Embedded OCG | Global |
| MT100EOCG-H5-GP | 3G, HSPA Embedded OCG with GPS, Telus | Global |
| 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 | 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
- Four screws for mounting gateway to developer’s board.
- One MultiTech screwdriver
- Generic activation card

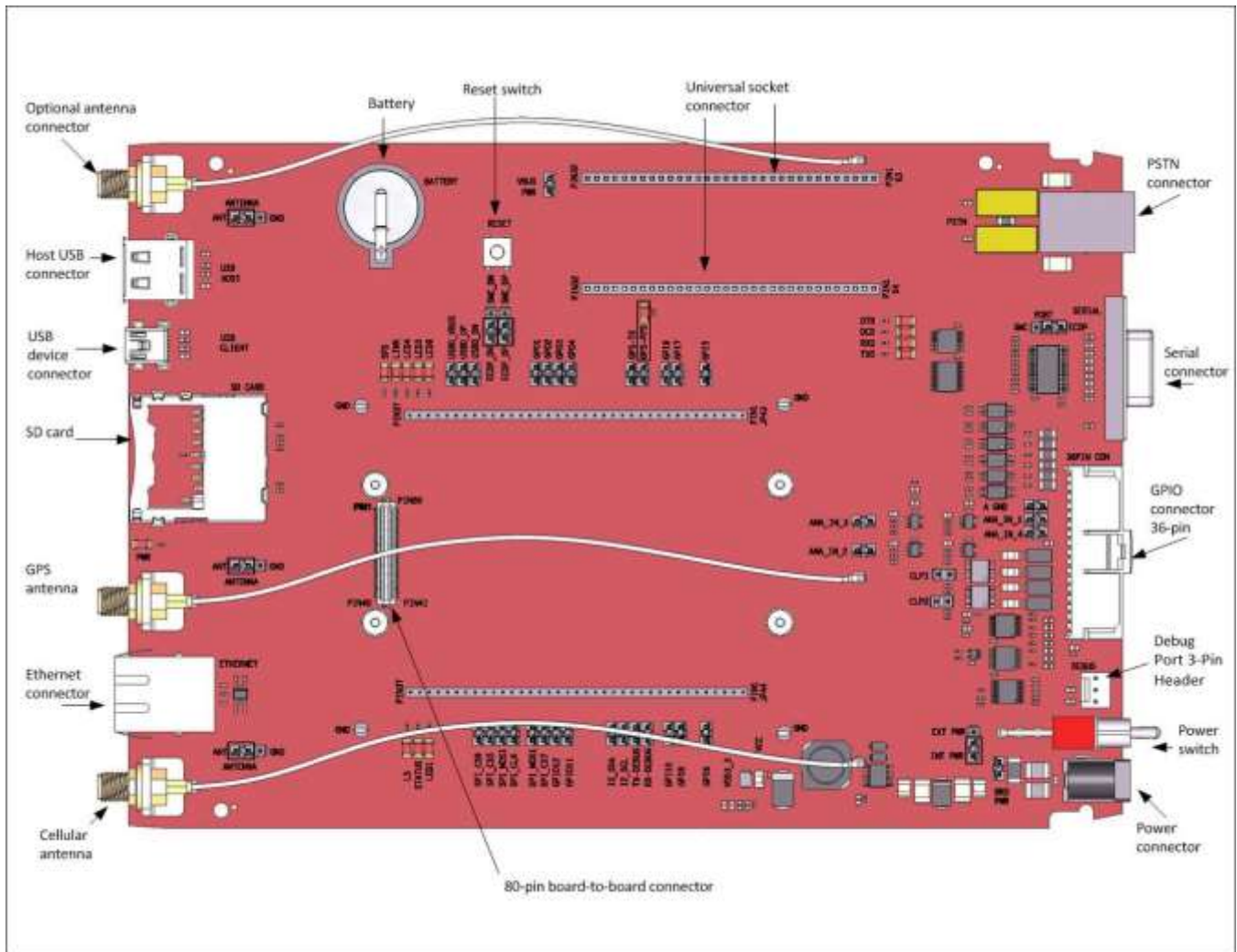
Developer’s Board Components

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

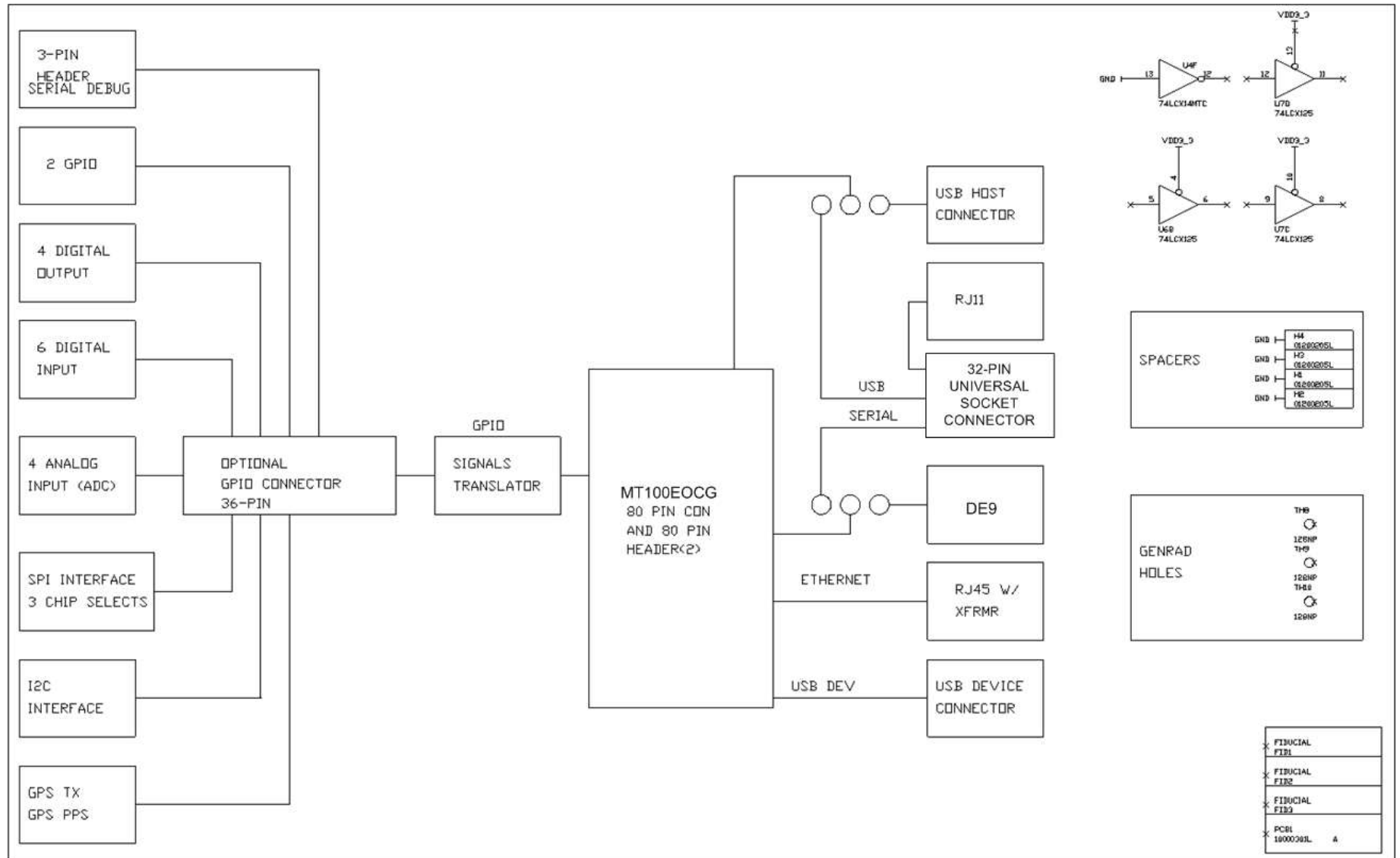
The MultiConnect OCG-E gateway connects to the developer board using an 80-pin board to board connector. This section describes the connector’s pins.

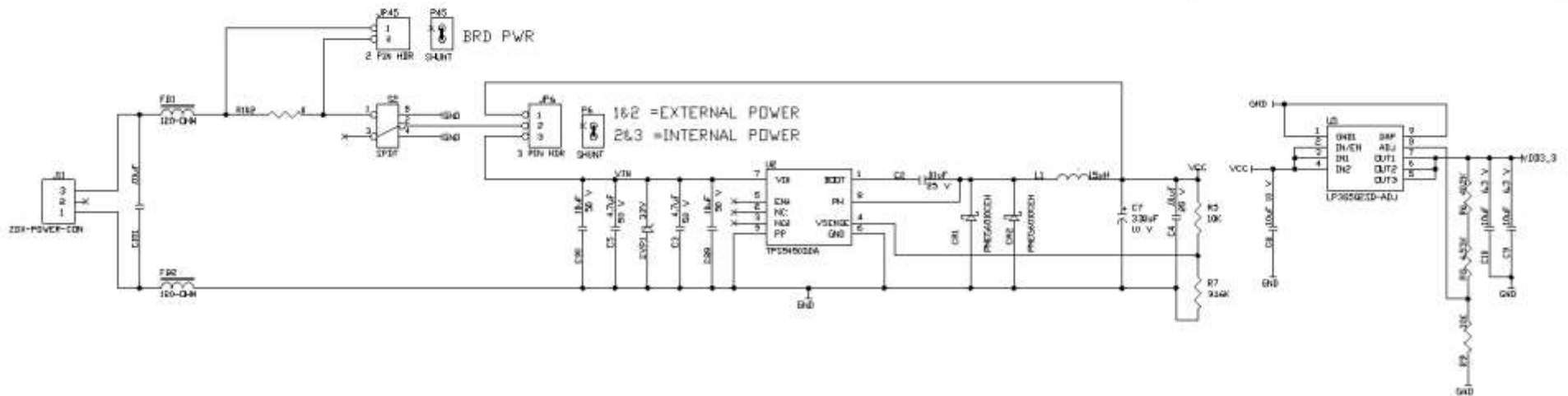
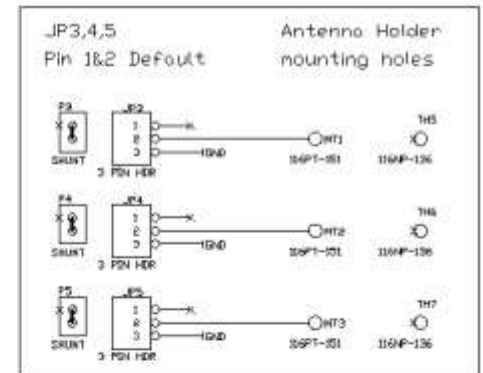
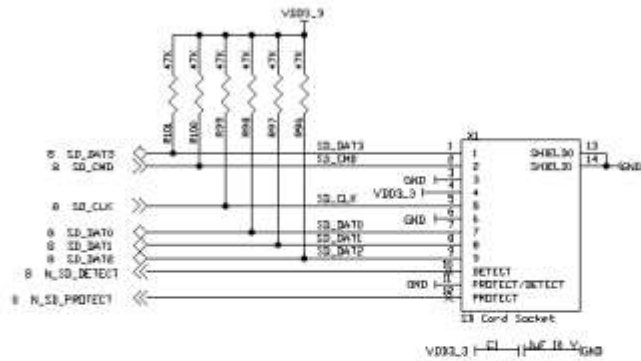
| Pin | Signal Name | In/Out | Description |
|-----|-------------|--------|---|
| 1 | VCC | I | DC Input Power. 5V DC power |
| 2 | VCC | I | DC Input Power. 5V DC power |
| 3 | VCC | I | DC Input Power. 5V DC power |
| 4 | GND | | Logic Ground. |
| 5 | SD_CLK | O | SDIO Clock |
| 6 | SD_CMD | O | SDIO 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 |

| Pin | Signal Name | In/Out | Description |
|-----|--------------|--------|---|
| | | | 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.) |
| 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 status 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 | Debug serial transmitted data. Gateway transmits serial debug data to DTE on this pin. |

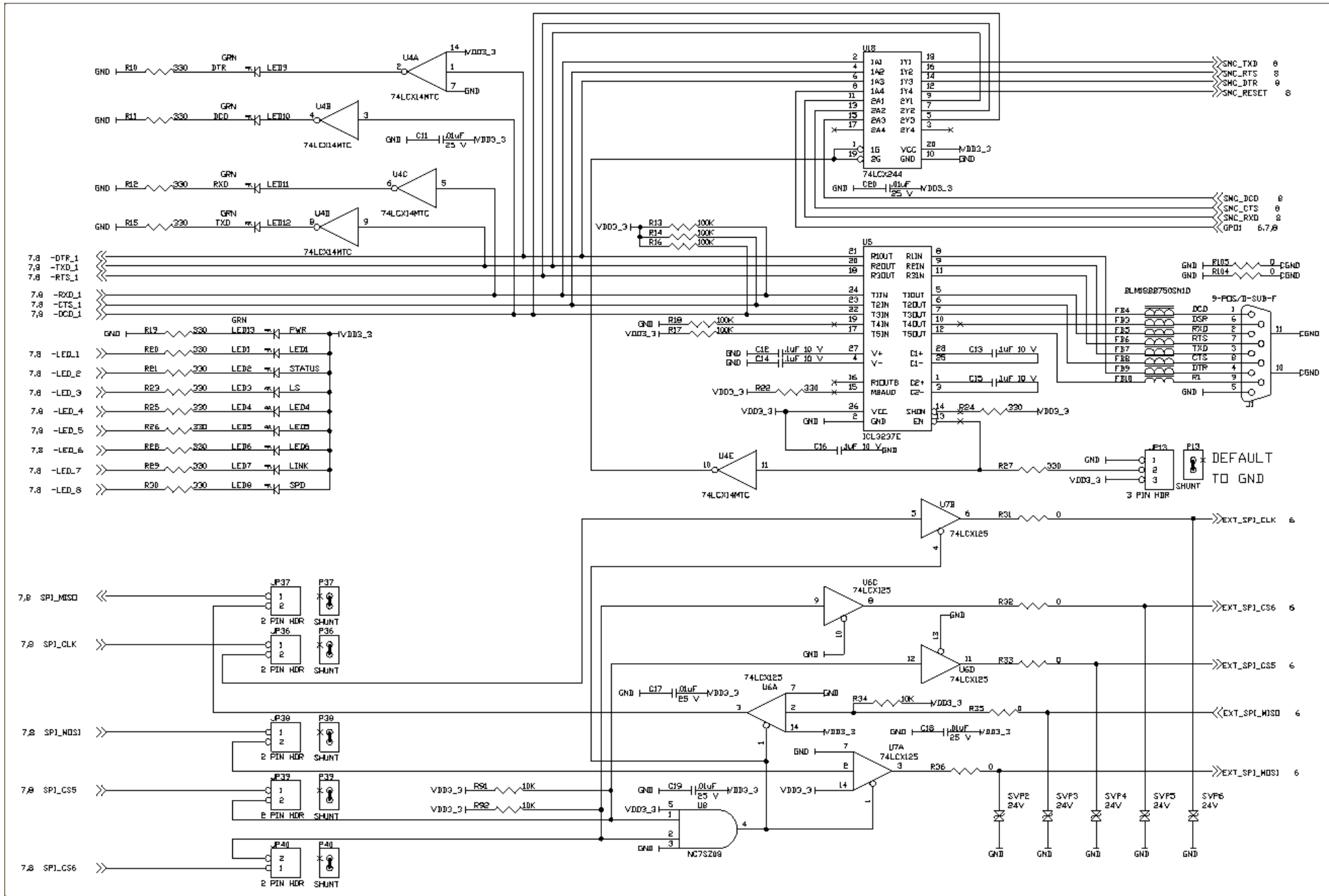
| Pin | Signal Name | In/Out | Description |
|-----|-------------|--------|--|
| 66 | -RXD-Debug | O | Debug serial received data. Gateway receives debug serial data from DTE on this pin. |
| 67 | TCK | I | JTAG Clock |
| 68 | TDI | I | JTAG Data Input |
| 69 | GPI10 | I | General-Purpose Input. |
| 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 |

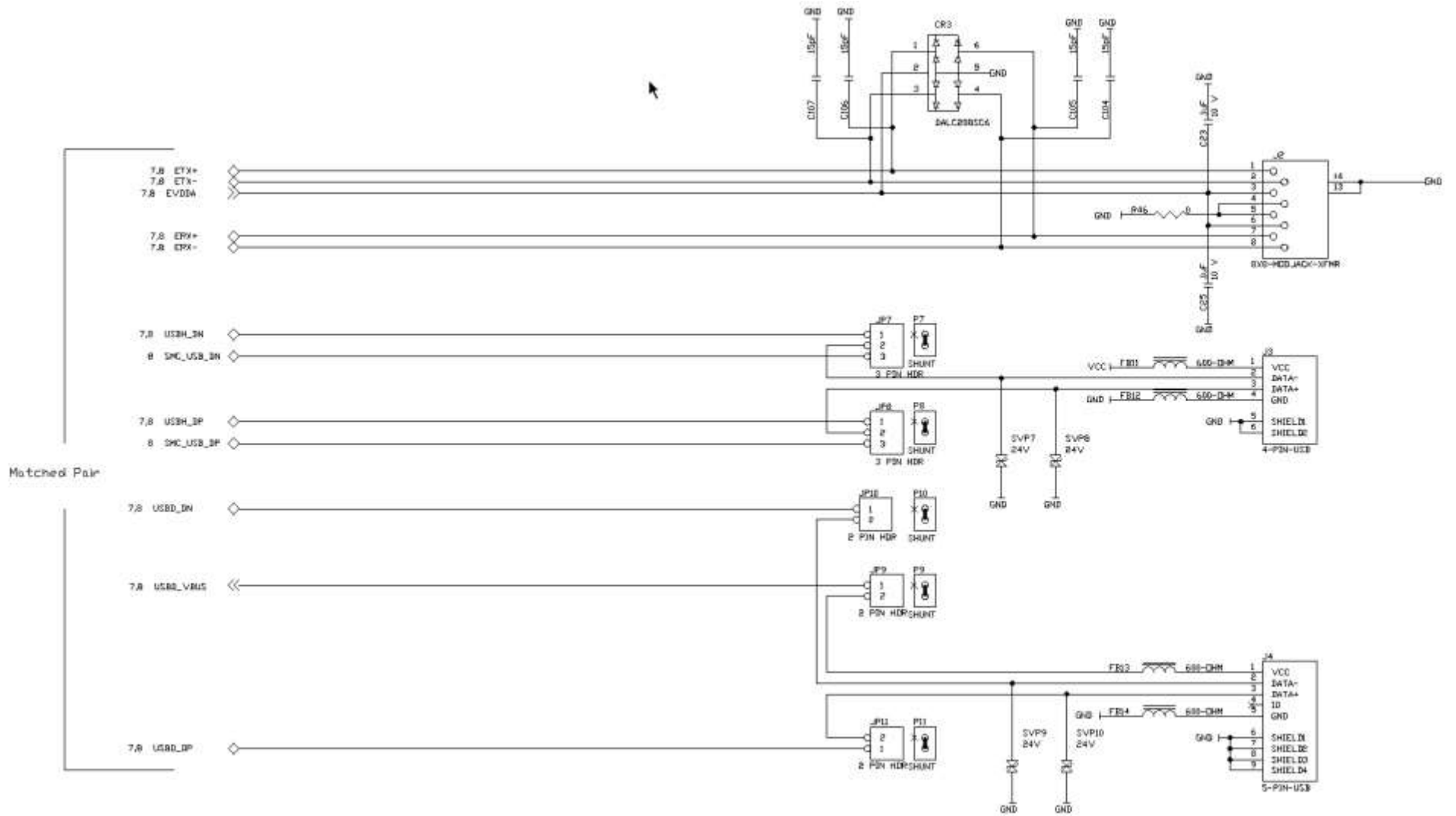
Developer’s Board Block Diagram and Schematics



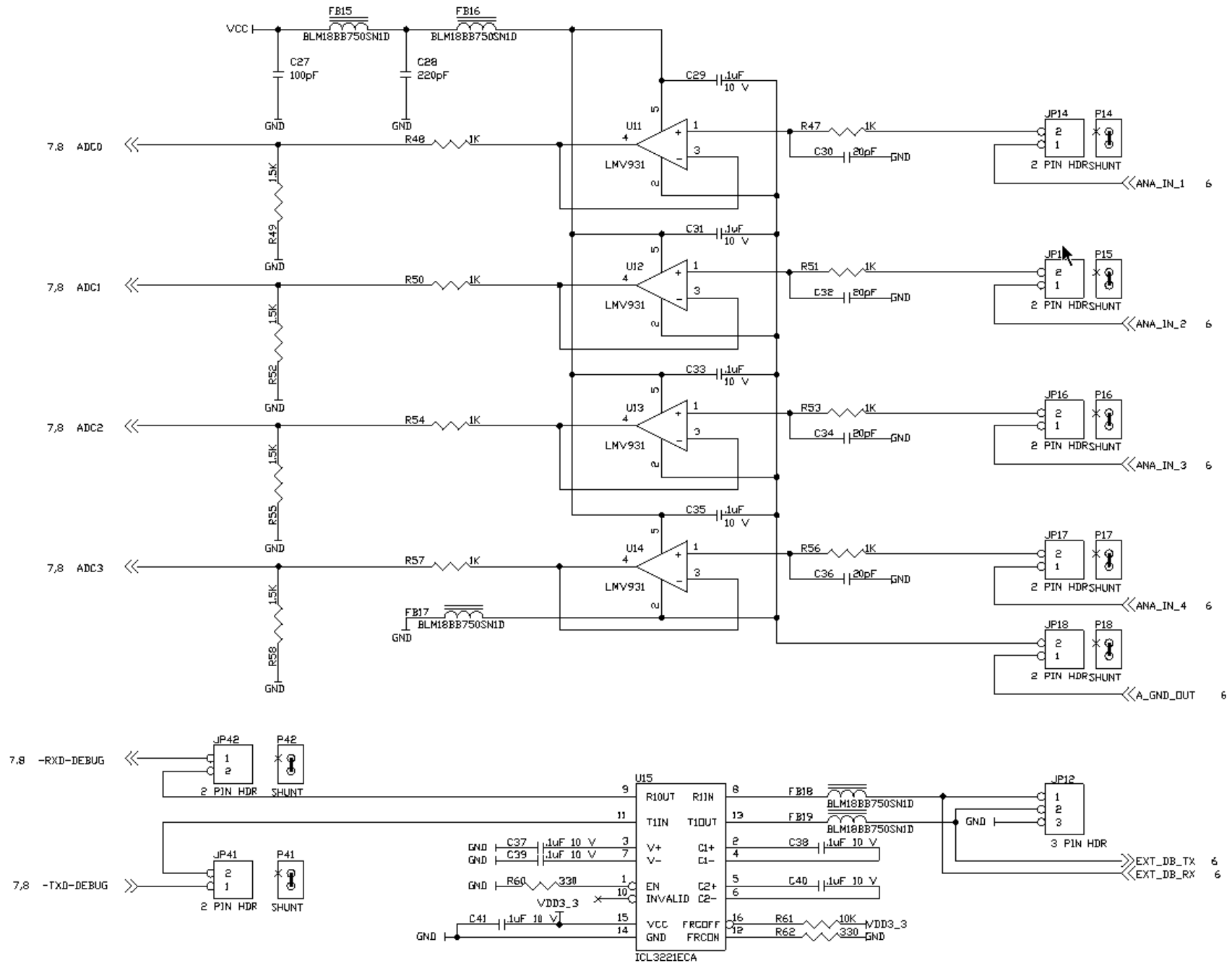


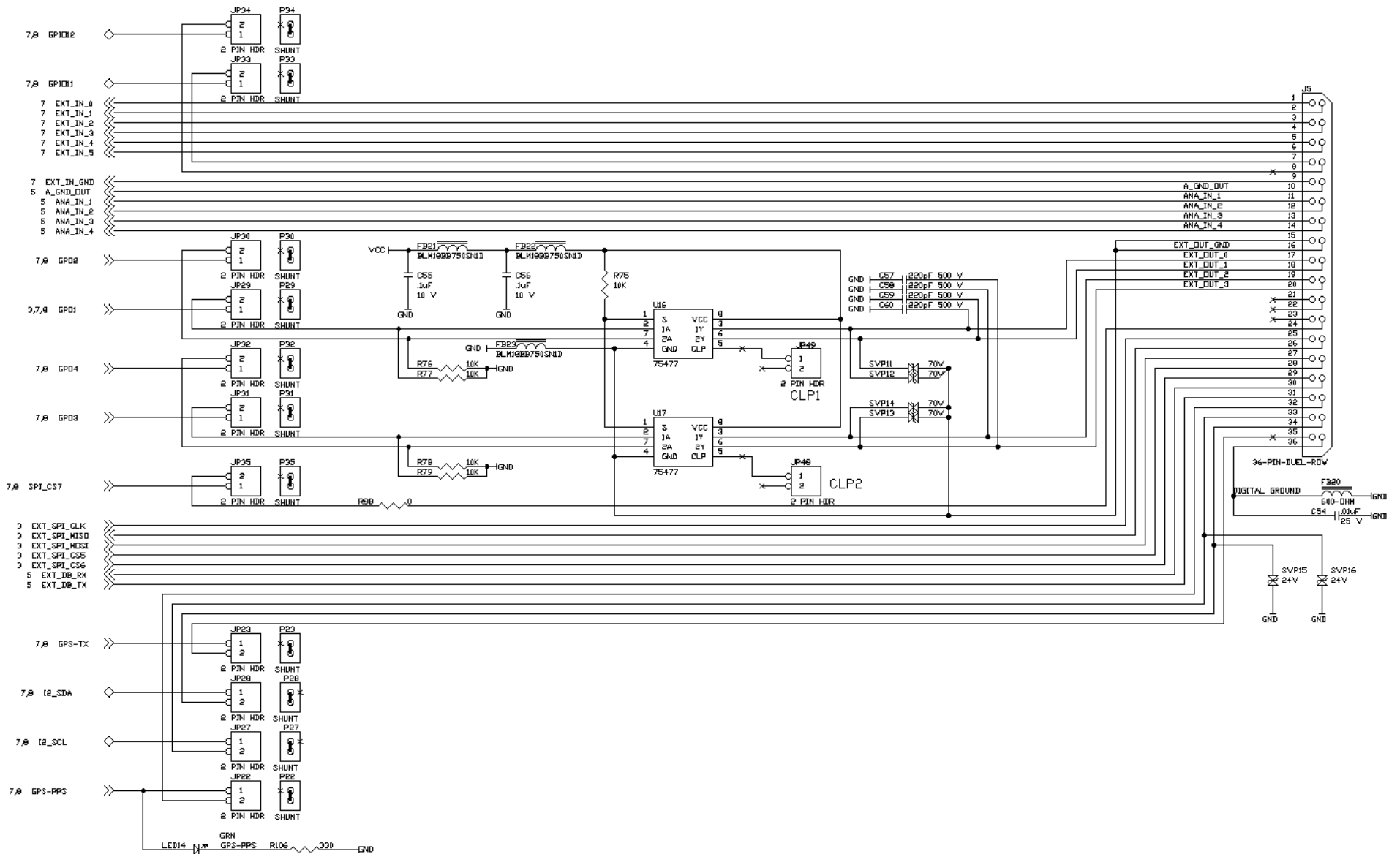
CHAPTER 1 – DEVELOPER'S KIT AND DEVELOPER'S BOARD OVERVIEW



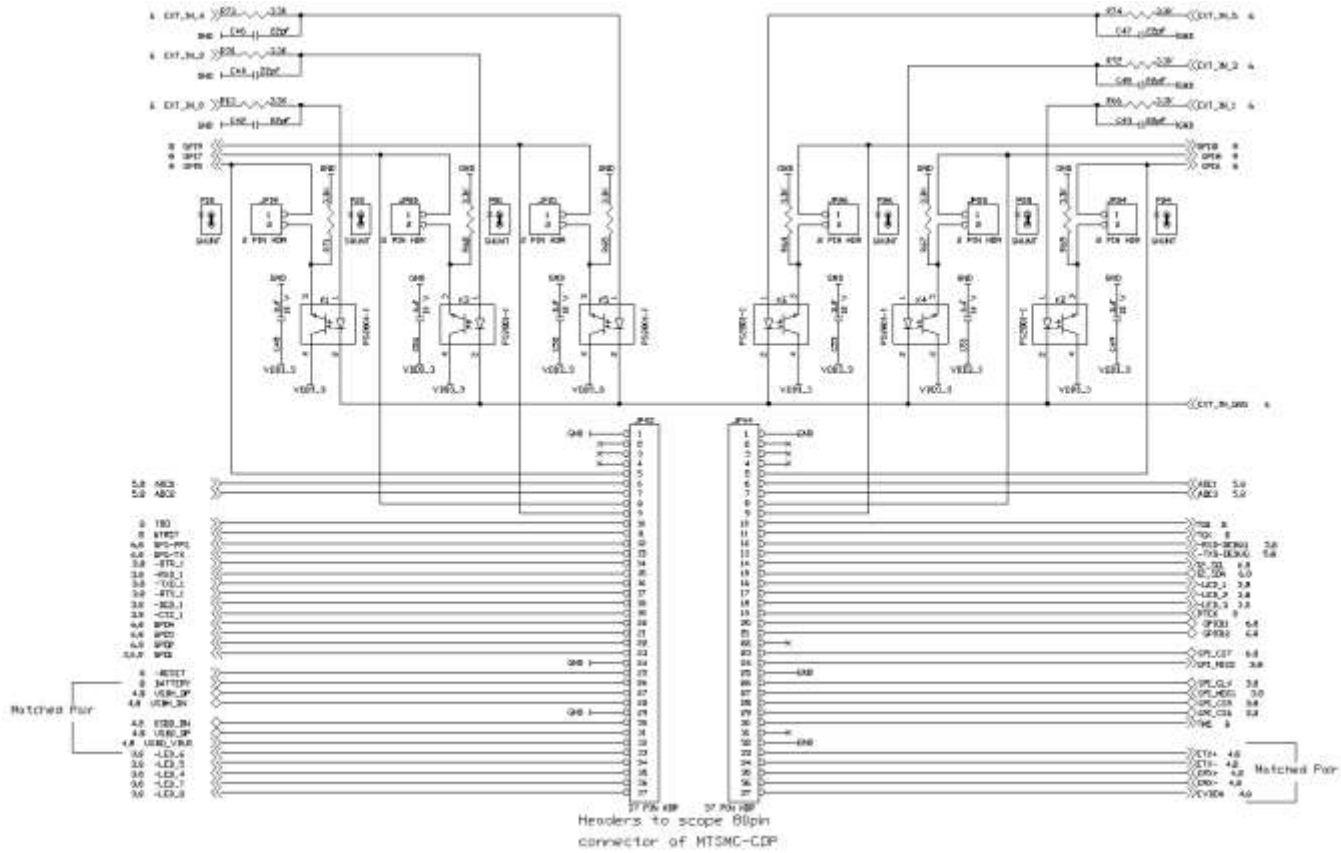


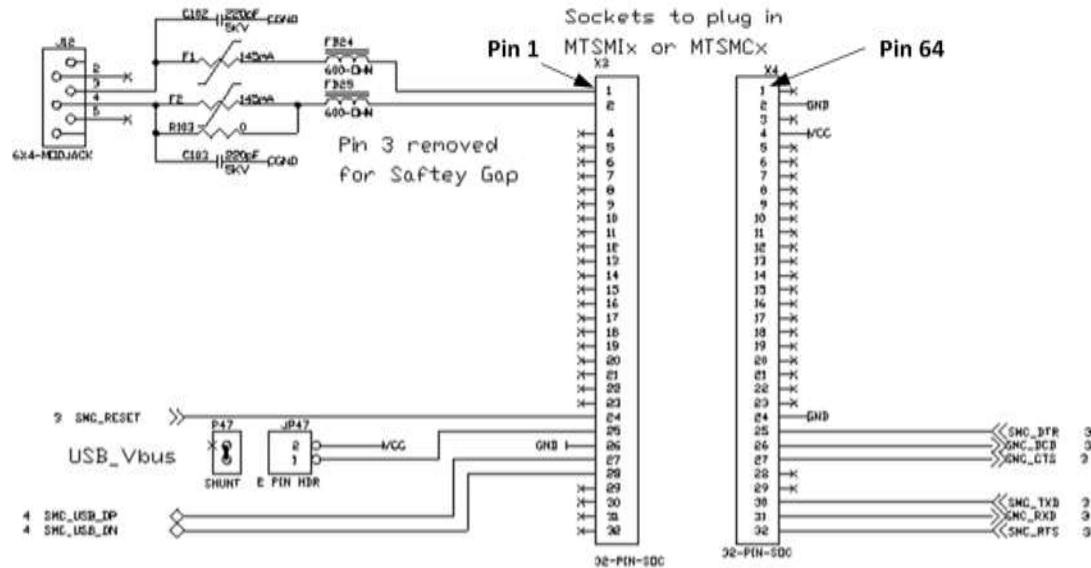
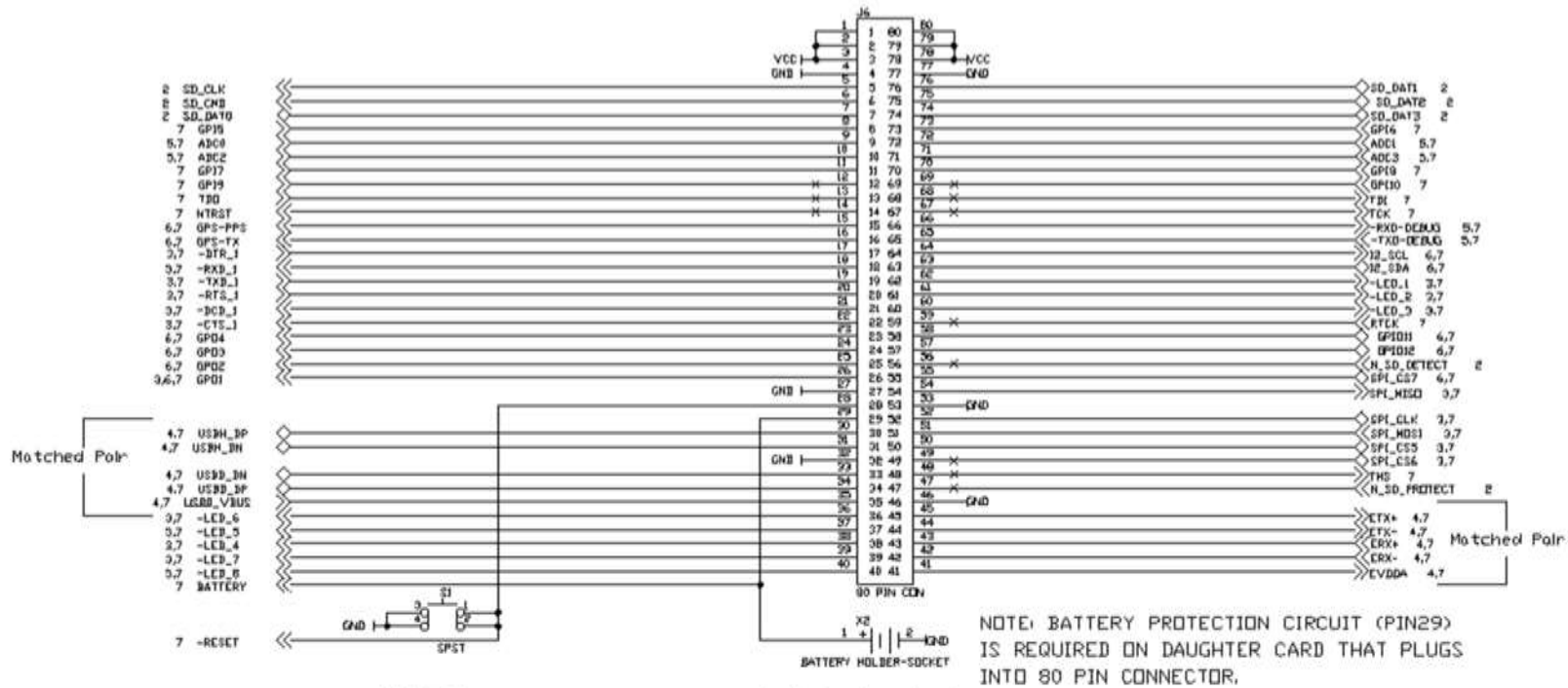
CHAPTER 1 – DEVELOPER’S KIT AND DEVELOPER’S BOARD OVERVIEW





CHAPTER 1 – DEVELOPER’S KIT AND DEVELOPER’S BOARD OVERVIEW





Technical Specifications

All models of the MultiConnect OCG-E gateway share the following specifications. Specifications that are unique to a particular model 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 | Description |
|-----|---|
| 1 | General Purpose LED1 output |
| 2 | General Purpose LED2 output (status) |
| 3 | General Purpose LED3 output (Link status) |
| 4 | General Purpose LED4 output |
| 5 | General Purpose LED5 output |
| 6 | General Purpose LED6 output |
| 7 | Ethernet link |
| 8 | Ethernet speed |
| 9 | DTR |
| 10 | DCD |
| 11 | RXD |
| 12 | TXD |
| 13 | POWER |

Design Notes

MultiTech recommends consulting Intel's High Speed USB Platform Design Guidelines, Rev. 1.0 for information about USB signal routing, impedance, and layer stacking. Also:

- Shield USB cables with twisted pairs (especially those containing D+/D-).
- Use a single 5V power supply for USB devices. Consult your model's Device Guide for Power Draw section for current (ampere) requirements.
- Route D+/D- together in parallel with the trace spacing needed to achieve 90 ohms differential impedance for the USB pair and to maintain a 20 mil space from the USB pair and all other signals.
- If power is provided externally, use a common ground between the carrier board and device.

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.

1. 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**
2. 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

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 MultiTech or not compliant with MultiTech's accessory specifications may invalidate the warranty of the cellular device.
- In the unlikely event of a fault in the cellular device, contact MultiTech 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.

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:

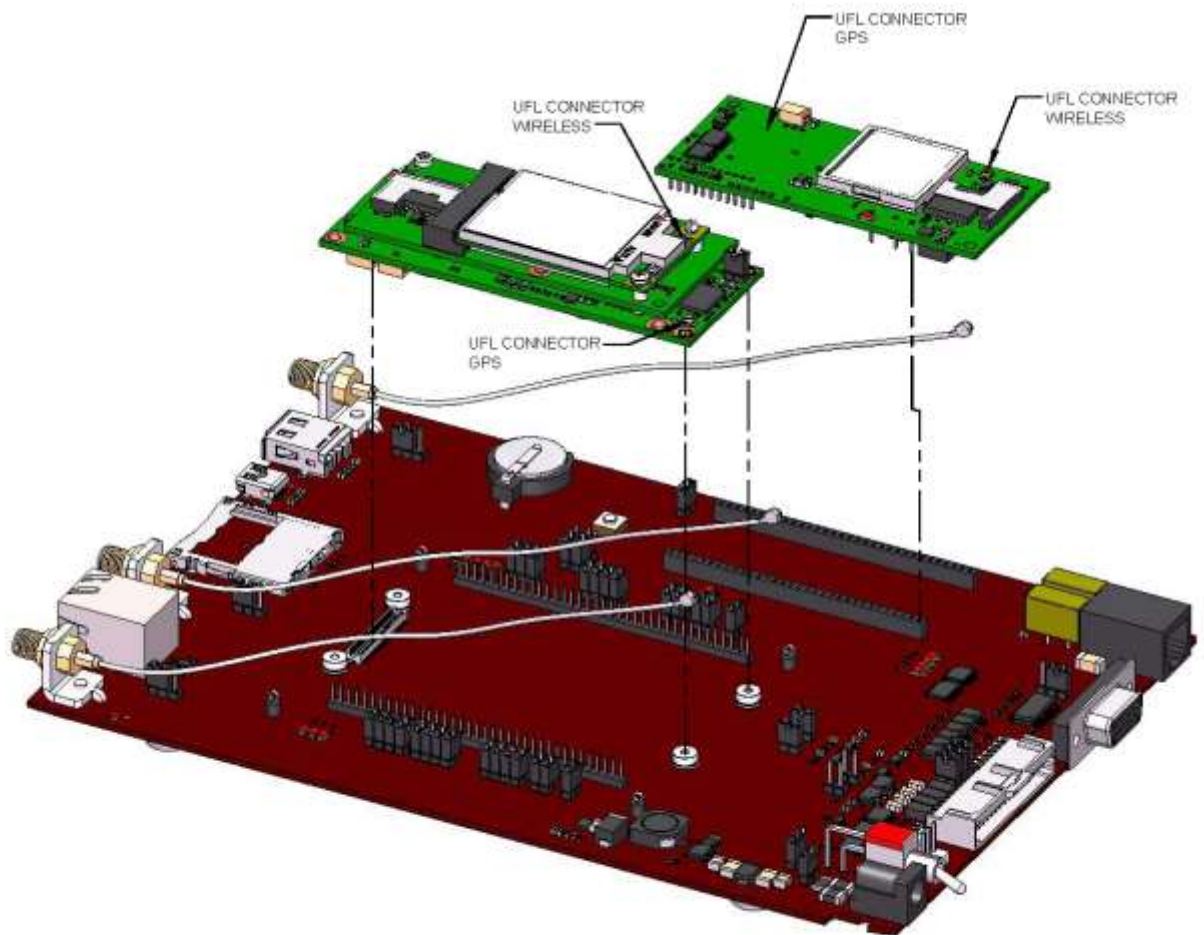
- Stop the pacemaker from delivering the stimulating pulses that regulate the heart's rhythm.
- Cause the pacemaker to deliver the pulses irregularly.
- Cause the pacemaker to ignore the heart's own rhythm and deliver pulses at a fixed rate.

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 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).

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:

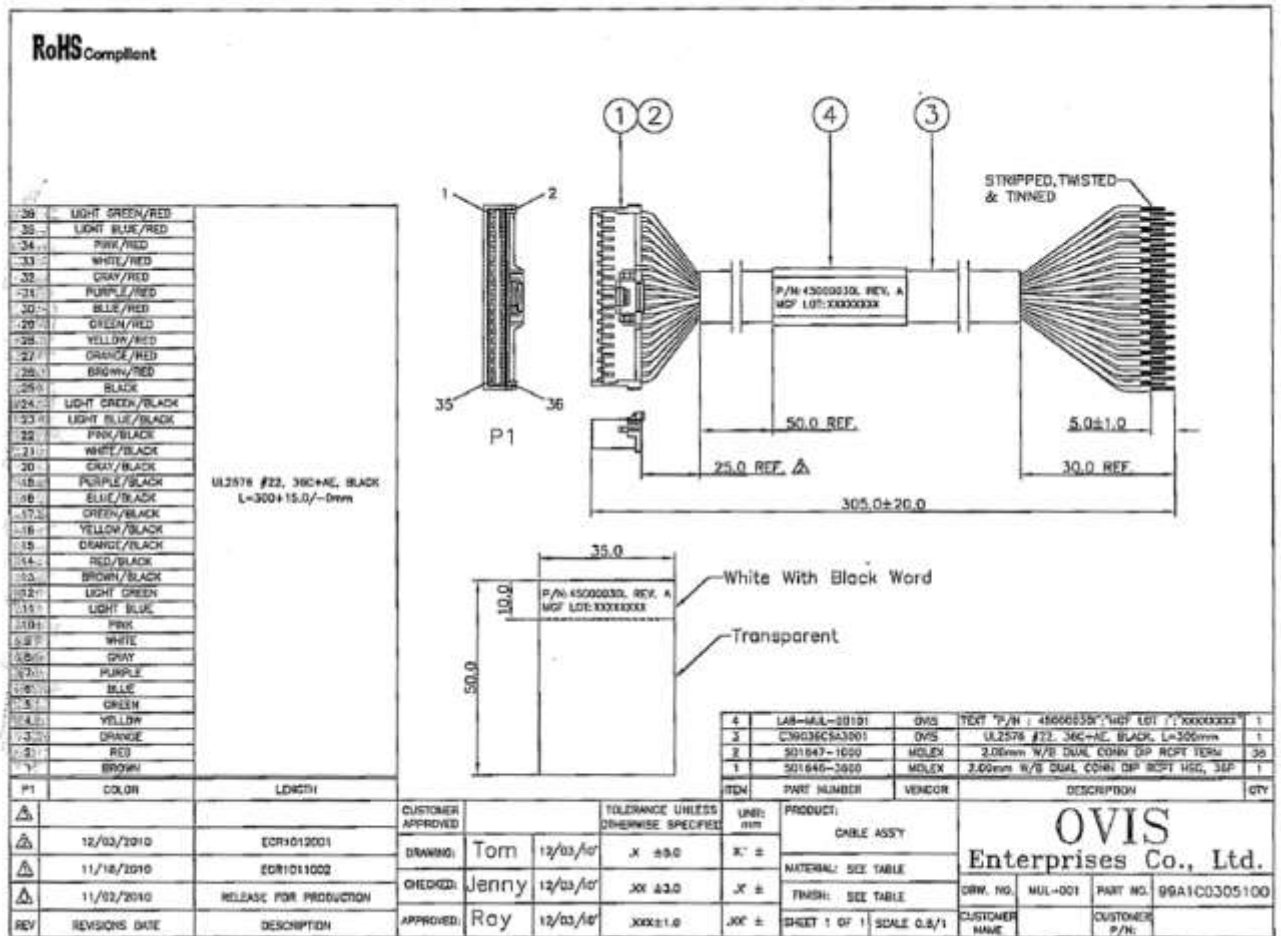
- Install the SIM card into the SIM card holder on the board.

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



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. |

Notes

The GPI and GPO pins use 74LV logic family for input and the 74LVC logic family for output.

GPI input range:

> 2.3 V for a high

< 1V for a low

GPI pins are 5 V tolerant.

GPI pins have a 10K pull-downs to ground. This increases the input current to 330 uA from the standard 1uA.

GPO pins output range:

> 2.58 V@4ma is a high

<= .36 V @4ma is a low

Maximum current on a GPO pin is +25 mA not to exceed 70ma total for all 4 GPO.

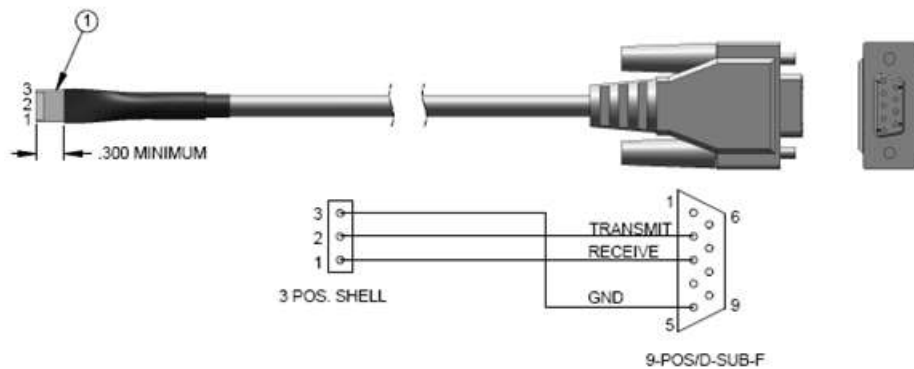
GPIO11 / GPIO 12 and SPI/I2C pins:

These are directly connected to the processor.

- If the pin is programmed as an output, the high is 2.9V minimum and low is 0.4V maximum with a maximum current draw of 8 mA. If the pin is programmed as an input, a high must be greater than 2.3V and a low must be less than 1V.
- These pins also have an optional pull-up resistor with a range of 40k ohm to 190k ohm, with a typical value of 75k ohm.
- Otherwise the input leakage is 1 uA.
- Additional hardware is needed to drive the I2E and SPI signals if any additional wire is added to the signals.
 - For the I2C there are bus repeaters available that would be suitable, for example, Texas Instruments LEVEL-TRANSLATING I2C BUS REPEATER PCA9517.
 - For the SPI signal, any logic level buffer that works at 3.3V would work.

LED Signals

- GPO1-GPO4, LED1, and LED4-LED6 are sourced from the same IC.
- Each pin can source 25 mA, but all pins, 4 GPO and 4 LED, can only source 70 mA total. This means the cumulative output current of those pins is limited by the maximum output current rating of the IC. GPO1-4 each can drive +25 mA, but total for all four is 70 mA (25 mA * 4 = 100 mA, but it cannot drive that much all at the same time). It also means that if the IC dies, then all of those outputs die.
- LED2 is directly connected to the processor GPIO pin PA30 and has the same characteristics as GPIO11 and GPIO12. The default operation of LED2 in CoreCDP is as a Linux Status indicator.
- LED3 is sourced by a LVC open drain buffer and has a max current draw of 32 mA. LED3 is directly connected to the Link Status pin of the device and is therefore dedicated.
- LED7 and LED8 are driven directly by the Ethernet PHY chip and can drive about 4 mA. They are usually used for Ethernet speed, link, and activity indicators.

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

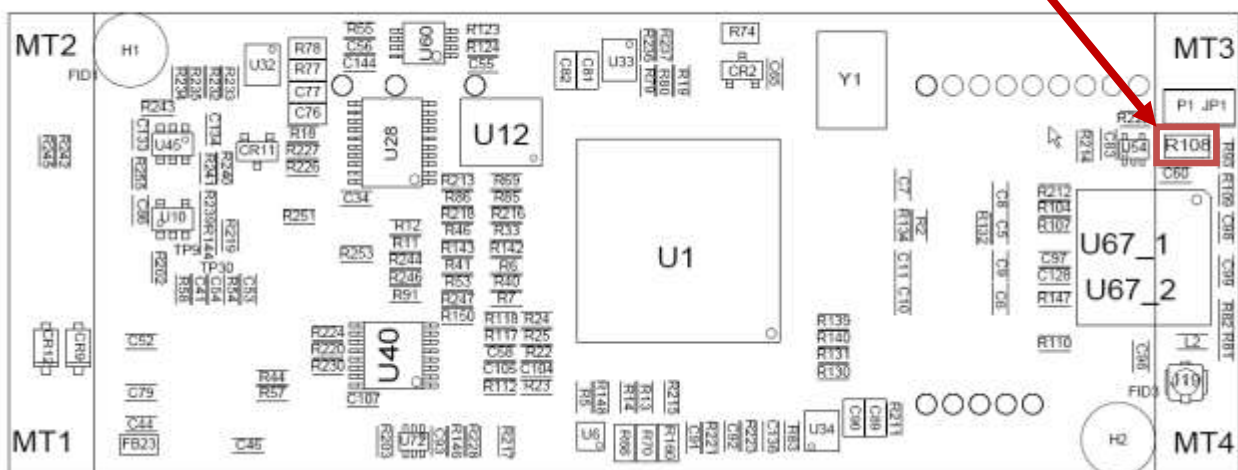
1. Power down.
2. Short out the R108 resistor by squeezing it with tweezers.
3. Restore power.
4. Remove tweezers from the resistor.
5. Restore the bootstrap memory or the u-boot memory.

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:

```
#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.

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

MultiTech Systems uses and recommends that others use anti-static boxes that create a faraday cage (packaging designed to exclude electromagnetic fields). MultiTech 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:

The closest separation among all simultaneous transmitting antennas is ≥ 20 cm;

or

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

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. |

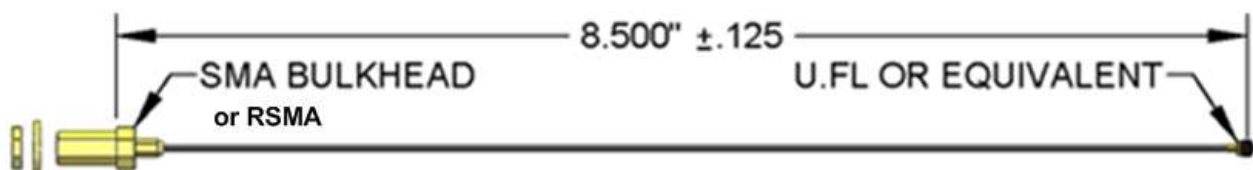
Coax Cables Specifications

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 MultiTech.

Antennas Available from MultiTech

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 MultiTech 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 MultiTech'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 MultiTech 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 MultiTech cellular model identification, not the identification of the host device model. See the label example.

The MultiTech model identification allows the carrier to verify the modem as one of its approved models. This information is located on the modem'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 MultiTech website

<https://www.multitech.com/brands/multiconnect-ocg-e/>

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 Communication) 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 |
|--|---|

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 MT100EOCG-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_D_DP/USB_D_DN (device side), respectively, or USB_H_DP/USB_H_DN (host side), respectively, in the OCG-E guide.

- Shield USB cables with twisted pairs, especially those containing USB_D_DP and USB_D_DN (device side), or USB_H_DP and USB_H_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.

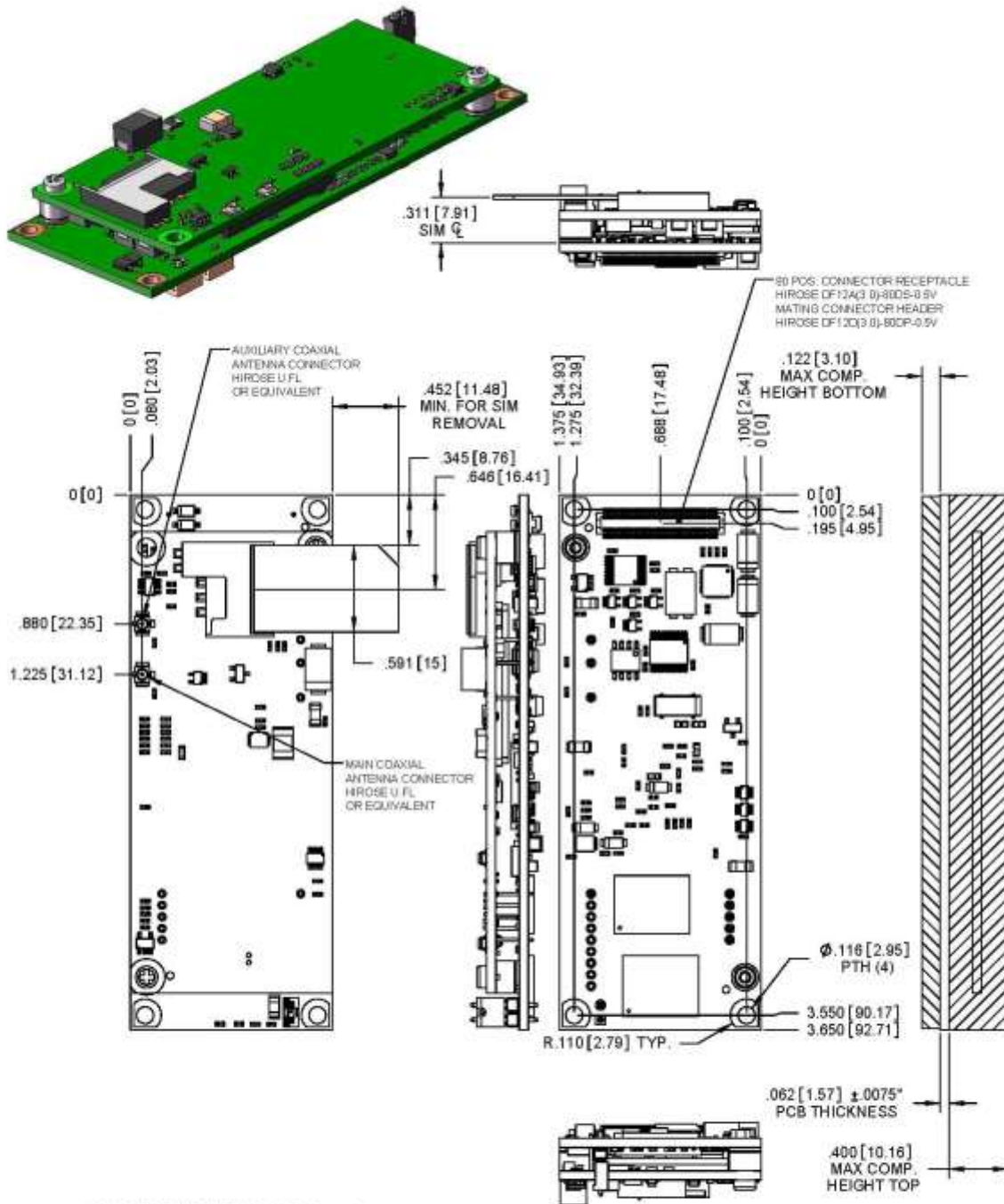
Powering Down Your Device (H5)

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.

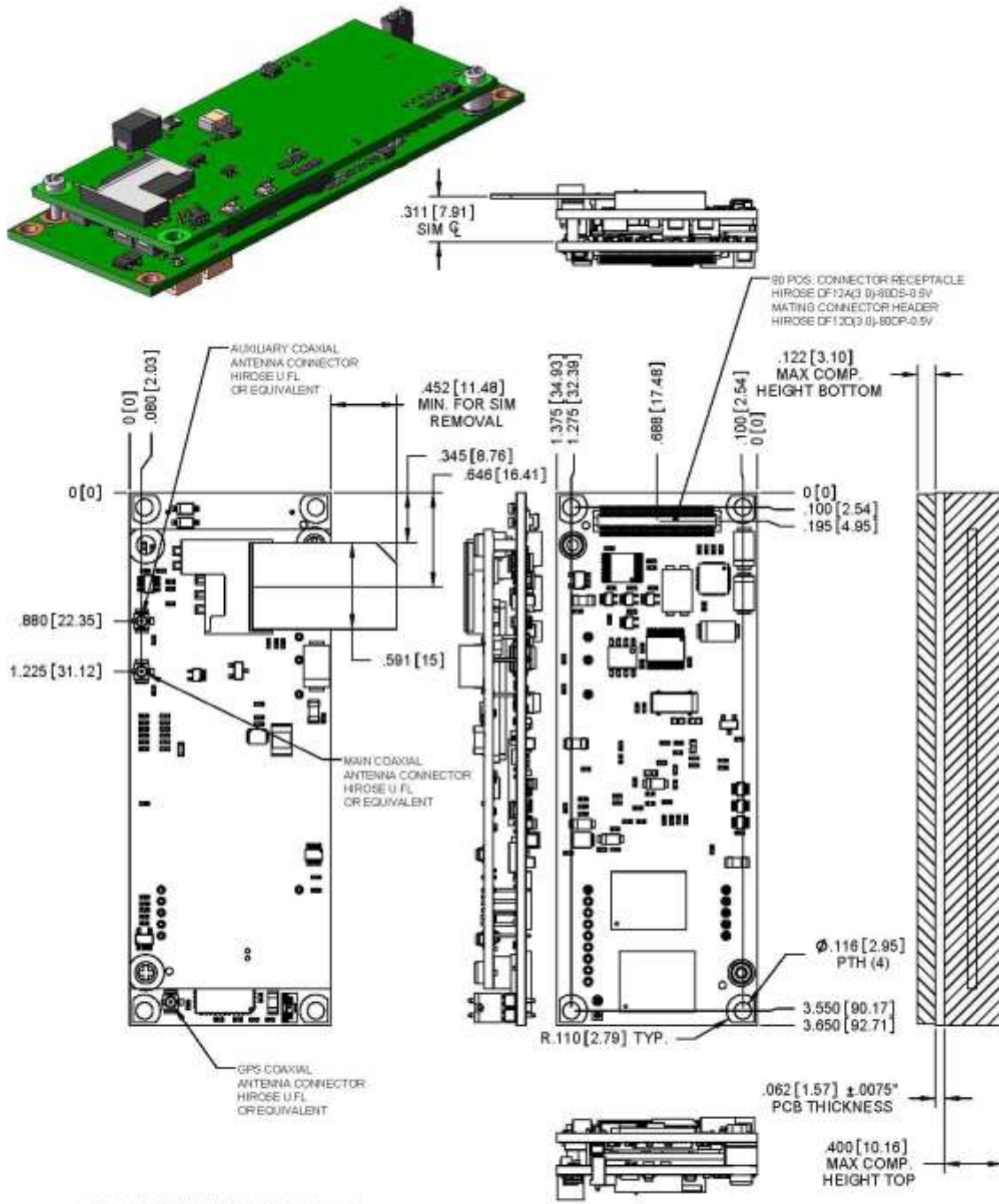
Mechanical Drawings for MT100EOCG-H5



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 | | |

* MultiTech 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 | | |

* MultiTech Systems 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 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.

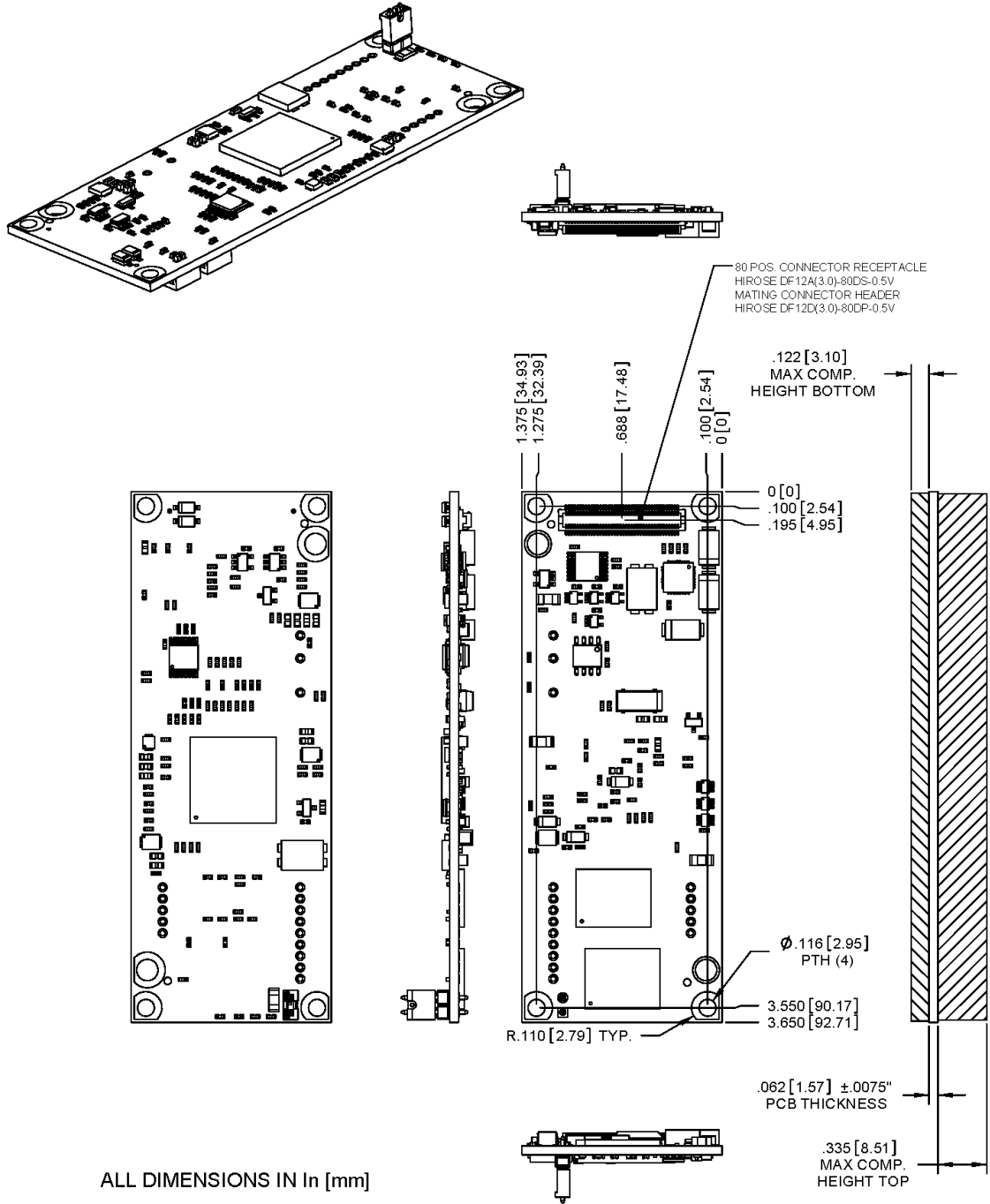
Technical Specifications

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 |

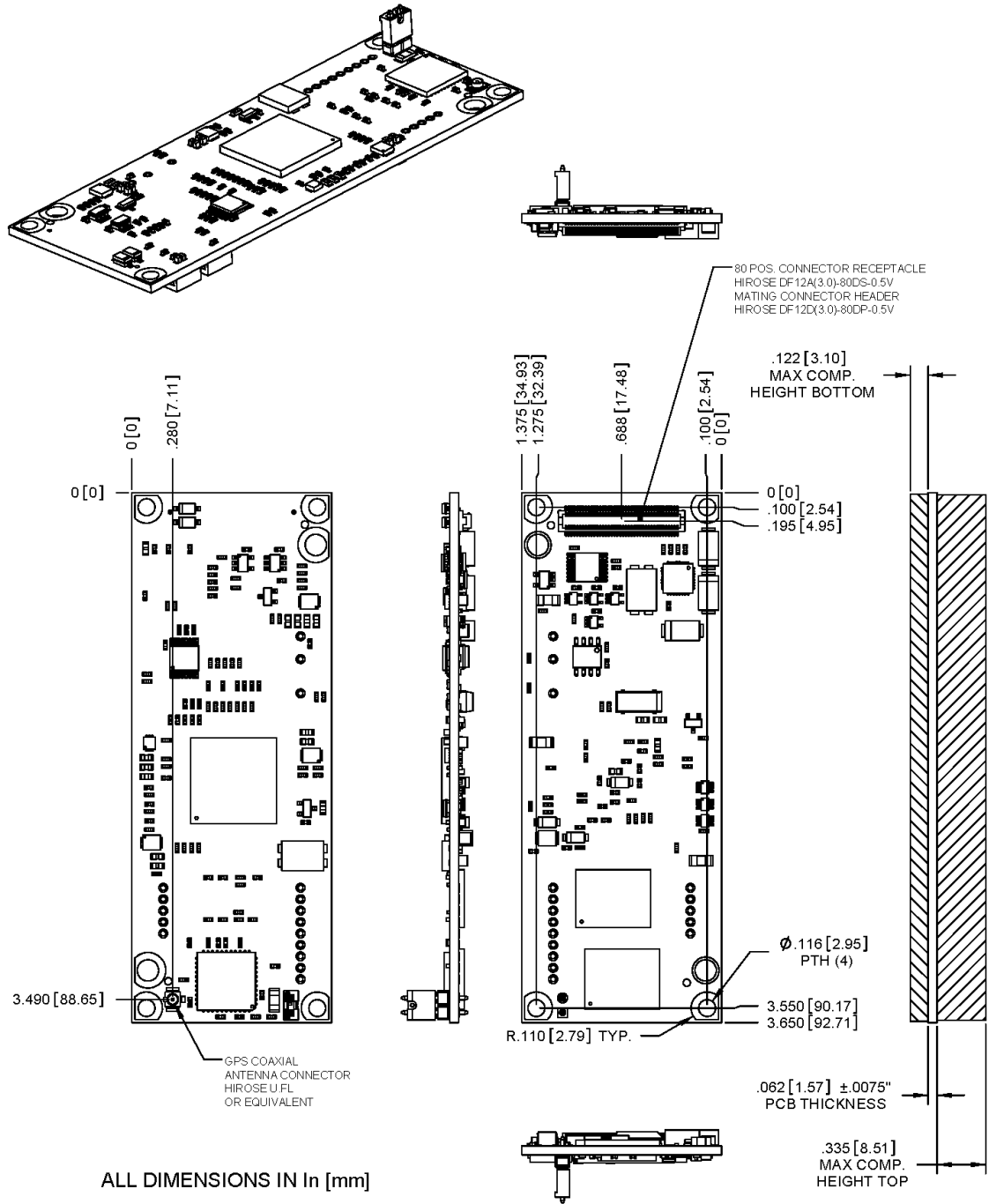
Notes: Limiting the airflow around the device may reduce the temperature range. If enclosing the gateway in a chassis, test and verify the operating temperature range

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 | | | | |

MultiTech 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 | | | | |

MultiTech 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 MultiTech's Technical Support.

Waste Electrical and Electronic Equipment Statement

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 MultiTech 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

MultiTech 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 MultiTech 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.

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 | 0 | 0 | 0 | 0 | 0 | 0 |
| 电阻器 | X | 0 | 0 | 0 | 0 | 0 |
| 电容器 | X | 0 | 0 | 0 | 0 | 0 |
| 铁氧体磁环 | 0 | 0 | 0 | 0 | 0 | 0 |
| 继电器/光学部件 | 0 | 0 | 0 | 0 | 0 | 0 |
| IC | 0 | 0 | 0 | 0 | 0 | 0 |
| 二极管/晶体管 | 0 | 0 | 0 | 0 | 0 | 0 |
| 振荡器和晶振 | X | 0 | 0 | 0 | 0 | 0 |
| 调节器 | 0 | 0 | 0 | 0 | 0 | 0 |
| 电压传感器 | 0 | 0 | 0 | 0 | 0 | 0 |
| 变压器 | 0 | 0 | 0 | 0 | 0 | 0 |
| 扬声器 | 0 | 0 | 0 | 0 | 0 | 0 |
| 连接器 | 0 | 0 | 0 | 0 | 0 | 0 |
| LED | 0 | 0 | 0 | 0 | 0 | 0 |
| 螺丝、螺母以及其它五金件 | X | 0 | 0 | 0 | 0 | 0 |
| 交流-直流电源 | 0 | 0 | 0 | 0 | 0 | 0 |
| 软件/文档 CD | 0 | 0 | 0 | 0 | 0 | 0 |
| 手册和纸页 | 0 | 0 | 0 | 0 | 0 | 0 |
| 底盘 | 0 | 0 | 0 | 0 | 0 | 0 |

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。

0 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。