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1.0 Introduction

Machine to Machine (M2M) technology allows two or more devices to exchange data even though they may not have originally been designed to communicate with each other. M2M technology bridges disparate communications technologies to a common and universal protocol. It allows two or more devices to communicate without being tied to a physical location.

In traditional command and control applications, data acquisition and information exchange methods such as SCADA, wired Ethernet (802.3), wireless Ethernet (802.11) or Bluetooth require devices to be either physically wired to a network (SCADA and 802.3), or be located near each other (802.11 and Bluetooth). M2M uses radio technology based on the cellular phone network. This means that M2M devices can be at opposite ends of the world, or even mobile, and still communicate with each other.

M2M devices are viable solutions in such applications as weather balloons, asset tracking, pet collars, utility monitoring, and many others. The Microchip M2M Development Platform for CDMA is a development platform certified for use on the Verizon network and can be used either as a platform for developing custom M2M solutions or used as a drop-in-place solution for existing applications.

2.0 RF Exposure Information

This product complies with FCC RF radiation exposure limits. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

This product complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. The wireless system must not be co-located or operating in conjunction with any other antenna or transmitter.

FCC ID: ZPV-TT10315

IC: 9772A-TT10315

FCC Part 15.21 Information Regarding Un-Approved Changes or Modifications:

Changes and/or modifications not approved by the responsible party could void the user's authority to operate the equipment.

FCC Part 15.105 Information to the User

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. 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.
- Connect 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.

RSS-210 Compliance:

This device complies with Industry Canada RSS-210. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

RSS-210 Conformité:

Cet appareil est conforme avec Industrie Canada RSS-210. Son fonctionnement est soumis aux deux conditions suivantes: (1) cet appareil ne doit pas provoquer d'interférences, et (2) cet appareil doit accepter toute interférence, y compris les interférences pouvant provoquer un fonctionnement indésirable de l'appareil.

ICES-003 Compliance Statement:

This Class B digital apparatus complies with Canadian ICES-003.

Déclaration de conformité à la norme NMB-003:

Cet appareil de classe B est conforme à la norme NMB-003 du Canada.

3.0 Feature Overview

The Microchip M2M Development Platform for CDMA is designed to provide a Verizon-certified M2M solution out-of-the-box, as well as provide an extensible platform for custom applications. The platform provides a variety of sensors and interfaces to allow the designer to tailor the solution for a specific application.

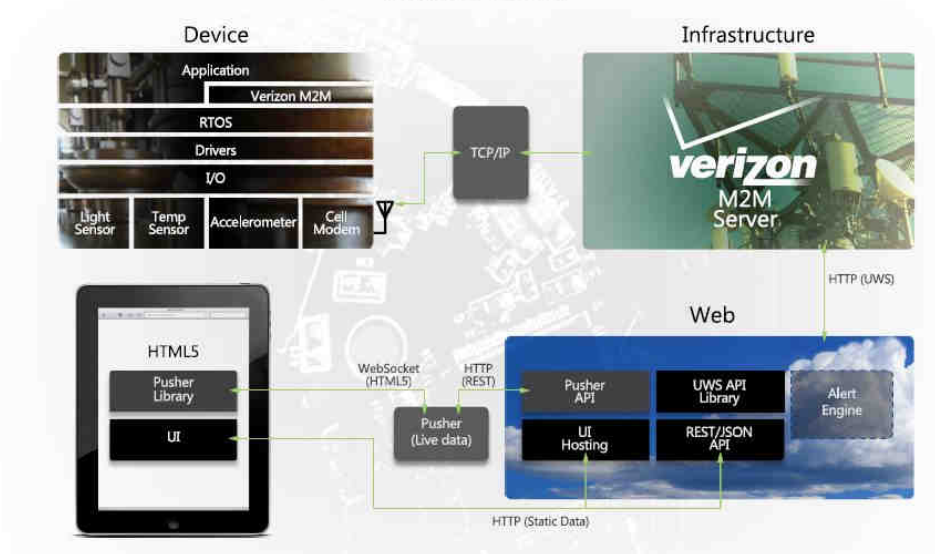
Need Functional diagram here

The software for the platform is designed to allow the developer to customize the platform for a particular application while maintaining Verizon certification. The certified software components are the software for the cell radio firmware and DCF (Device Client Framework) binary library, which are provided as binary modules. The DCF API is described in section TBD of this document. The operating system, communications stacks and application software are provided with full source code.

4.0 Functional Description

The Microchip M2M Development Platform for CDMA makes it easy to learn and develop M2M solutions that communicate over the Verizon Mobile Network. The platform is one part of an integrated, cloud-based M2M ecosystem. The installed platform communicates with the ecosystem via the Verizon CDMA Cell network. Data is sent and received through the cloud-based M2M data-management center hosted by nPhase, which is owned and operated by Verizon. The center is accessed by the user via a web portal accessible by any internet browser. Through the portal, the user can monitor and control any number of M2M platforms.

PIC Based M2M Ecosystem (HTML5 / Verizon)



4.1 Data Rate

The cellular connection is capable of at least 50kbps data transfers while uploading or downloading. The data-rate may vary based on the environment in which the device is located.

4.2 Mesh Network Connectivity

The M2M device provides Zigbee/802.15.4 for mesh network connectivity.

4.2.1 IEEE 802.15.4

When configured to support a custom 802.15.4 protocol, the device provides the necessary hardware to communicate on the network. The protocol is defined by the software in the device's host processor and will allow the device to communicate with other devices in the network. Mesh networking allows up to four hops between devices on the network. The protocol supports a burst mode which allows a single device to send a large amount of data from itself to a gateway while ensuring that other nodes in the system do not communicate. Furthermore, since the RF sensitivity decreases during burst mode, the device checks the link margin to determine whether the link will be lost when it enters burst mode. If the link is not of sufficient quality, the device will not transmit using burst mode.

4.3 Certifications

The M2M device is FCC certified for operation of the cellular and 802.15.4 radios and for operation on the Verizon Wireless CMDA network.

4.4 Programming Support

4.5.1 Wired Firmware Updates

The device provides a Microchip ICSP debug/program interface (J9) for physically connecting a Microchip Real-Ice or ICD3 programmer and updating the firmware in the host Microchip PIC32.

4.5 Power Supply

The purpose of the power supply in the device is to regulate the input DC voltage to voltage required by the processor and wireless module.

4.6.1 Input

The power supply input supports voltages between 6V and 12V. The current draw of the supply provides up to 1.5A of current draw at the supply voltage.

4.6.2 Output

4.7 Sleep Mode

The device is capable of entering a low current draw sleep mode when instructed by the application software. In this mode the current draw will be less than 5mA. Exiting this mode may be triggered by a timeout, button press, or action on a digital I/O from the general purpose interface. In this mode the device is not able to use the cellular module. When the device is not communicating through the cellular module it will utilize power saving features of the module to limit the current draw of the

Comment [DK1]: Sleep mode has not been proven out yet. The 5mA target will not be hit, as there are two LEDs in the power supply that are always on and will draw more... Will need to follow up on this.

4.7 Operating Temperature

All functions of the device operate between -20C and 85°C. (Batteries may not meet this requirement)

4.8 User Interface

4.8.1 LED Indicators

The device has several LED indicators. LED's 1,2 and 3 (D13,D14 and D15 bi-color controlled directly by the PIC32 firmware.. D12 is controlled by the cell module (LED4). There are also LED indicators under the control of the cellular module. The function of these indicators is to indicate TBD of the cellular module **Create table of LED vs function.**

4.8.2 Buttons

Two buttons are provided. **More description**

4.9 General Purpose Interface

In order to support a wide range of use cases, the device contains a general purpose terminal block. This header provides access to a wide variety of communication interfaces and features of the host processor. The functions provided on the header are software controlled by the host processor application.

4.9.1 SPI

The M2M device provides an SPI communication interface through the general purpose header. The host processor supports either master or slave roles on the SPI bus. However both uses the same pins as the Ethernet connection, so only one is available at a time. **DIP switches are used. What are the label of the DIP switches and there settings.**

4.9.2 Digital I/O

The device provides access to up to 4 digital I/O. The digital I/O are software configurable as either inputs or outputs. All digital I/O are 5V tolerant.

The inputs have configurable pull-up and high-Z settings. Two of the inputs (EXTGPIO1 which corresponds to CN13 and EXTGPIO2 which corresponds to CN4) are capable of generating interrupts in the processor and waking it from sleep mode. The outputs can be configurable as push-pull or open drain. The digital I/O goes through an ST2149 4-array level shifter, which sets the direction based on input voltage. It can be disabled (set to high-Z) by turning off the output enable pin (this effects all lines at once). The microcontroller has pull-ups available.

4.9.3 Analog Input

The device provides 2 analog inputs (EXT_AN1 and EXT_AN2) capable of measuring signals between 0 and TBD V with 10 bit A/D of resolution.

4.9.4 PWM Output

EXTGPIO3 which corresponds to the OC4 output can be configured as a PWM on the general purpose interface. The PWM outputs have software configurable duty cycles ranging from 0 to 100% with at least 8 bit resolution (how many bit resolution has been implemented?). The frequency is configurable up to 100 kHz with at least 8 bit resolution.

4.9.5 UART

The device supports UART communication through the general purpose interface. Only transmit and receive signals can be used. The device supports all standard data-rates between 2400 and 230400 baud as well as software and hardware flow control.

4.10 Additional Interfaces

Each of the following interfaces have a dedicated connector and all required hardware in order to meet their specifications.

4.10.1 USB

The device provides a USB mini-B connector. When connected to a USB host, the device appears as a Mass Storage Device.

4.10.2 CAN

The device provides off-board CAN communication via the DB9 connector. The CAN is compliant to CAN2.0B specification. The data-rate is programmable up to 1Mbps.

4.10.3 Ethernet

The device supports Ethernet 802.3 communication at 10/100 data-rates through an RJ45 connector and 802.11 via Microchip MRF24J40 transceiver. Not supported in first release. Somewhere in this document we need a table of interfaces/features showing what will be supported by the firmware at launch. We should also make clear that the interface is provided so the customer can add that functionality if desired. Make sure to provide links to stacks and code examples that the customer can use to add the functionality.

4.11 SD Card Support

The device provides an optional connection for an SD card. The SD card be connected through a standard SD card holder mounted onto the PC9 of the device. The SD card is readable and writable by the host processor for writing log files or storing measurement data or other purposes that a running application may need.

4.12 Sensing

4.12.1 Accelerometer

The device includes an accelerometer capable of measuring acceleration in three axes. The typical type of movement which will be sensed is vibration. The update rate is configurable by **software**

4.12.2 Light Level

The device includes a photo-sensitive device which responds to the surrounding light level.

4.12.3 Temperature

The device includes an internal temperature sensor capable of measuring temperature within +/- 1 °C over the entire operating temperature range. The temp sensor is the Microchip MCP9800 an I2C interface with the I2C address set to 0x48. Although temperatures are in Celsius, TT Web site supporting the M2M demo converts temperature data into Fahrenheit.

5.0 Hardware Description

Put photos of the device here.

Put board photo balloons/U# cross index table here?

5.1 Power and Bus Connectors

Balloon ID TBD 1 Power Adaptor Input - The power supply supports an input DC supply voltage between 6 and 12VDC. Optionally, up to 24VDC input may be supported. A switch controls the activation of power to the board.

- **Balloon ID TBD** 5VDC out

Balloon ID TBD Debugging/Programming Port - **J9**. Programming/debugging connector. Standard Microchip connector for plugging into ICD3/Real ICE.

Balloon ID TBD Sensor Input Header – The processor provides 2 analog to digital converter connections to the external header, 4 general purpose digital I/O connections, 1 SPI connection, 1 UART connection. One of the analog to digital inputs can be configured to measure a 5 to 20mA current source through the placement or non-placement of a component. There is a single power output which supplies 100mA of current at 5VDC and there is 1 ground connection to the circuit board. In addition, the processor provides 1 PWM output on the external header.

Need Pin-out diagram for Sensor Input Header

5.2 Communication Devices

Balloon ID TBD CDMA Radio/GPS - The cellular module certified for operation on the Verizon Wireless cellular network.

Balloon ID TBD Cellular Antenna - The cellular antenna operates in the CDMA (869-894MHz) and PCS (1930-1990MHz) bands.

Balloon ID TBD 802.15.4 - The 802.15.4 transceiver is able to transmit in 'normal' (250kbps) mode and 'burst' mode. The burst mode data-rate supported is 500kbps. The transceiver provides a sleep mode with current draw less than

1mA. The transceiver communicates with the host processor through an SPI interface. The 802.15.4 antenna operates in the 2.4GHz ISM band.

Balloon ID TBD Ethernet 802.3 - The Ethernet PHY operates at 10/100 data-rates and communicates with the MCU Ethernet MAC through MII or RMI interface. Physical connectivity is via an RJ-45 adaptor. **J3. J7.** Ethernet RJ45 connector. Standard Ethernet connector, with Link and Activity LEDs. 10/100Mbps Ethernet supported by hardware.

Balloon ID TBD RS-232 - The device supports RS232 communication through a DB-9 connector. **J11.** DB9 serial port connector. Standard serial port connector for RS232, with optional support for hardware handshake CTS/RTS lines.

Balloon ID TBD DB9 CAN - The CAN transceiver operates at speeds up to 1Mbps and conforms to the ISO 11898 standard. The hardware interface is a D9-9 connector.

Balloon ID TBD Micro USB **J12.** DC Power jack with 2.5mm center; center is positive. Provides power for the unit; nominally 12V DC, but accepts 7-16V. Power supply must provide at least 250mA @ 12V, but 500mA preferred.

Balloon ID TBD **J8.** Micro USB receptacle. A standard Micro USB receptacle, this connects directly to the cell module, and is only used for evaluation and possible firmware update of the cell module. Generally not used.

4.3 Board Memory

Balloon ID TBD SD Card - Accepts standard sized SD cards which supports up to 2GB flash cards. The SD card interface communicates with the host processor through SPI. **J15.** Micro SD card slot. Fits a standard micro SD card. Note that the slot is on the bottom of the board, so when inserting micro SD card, it must be "upside down" with the contacts facing up. Micro SD card is pushed in to insert, and pushed in again to remove.

Balloon ID TBD 8MBit Flash Memory - The external flash communicates with the processor through SPI. This flash memory supplies 512 KB of storage which the devices uses for storing configuration information.

5.4 On-Board Sensors

Balloon ID TBD Temperature - The temperature sensor is able to measure temperature within +/- 1°C over the entire operating temperature range of the device.

Balloon ID TBD Light - The light sensor produces an analog voltage between 0 and 3V proportional to the light intensity incident on the sensor.

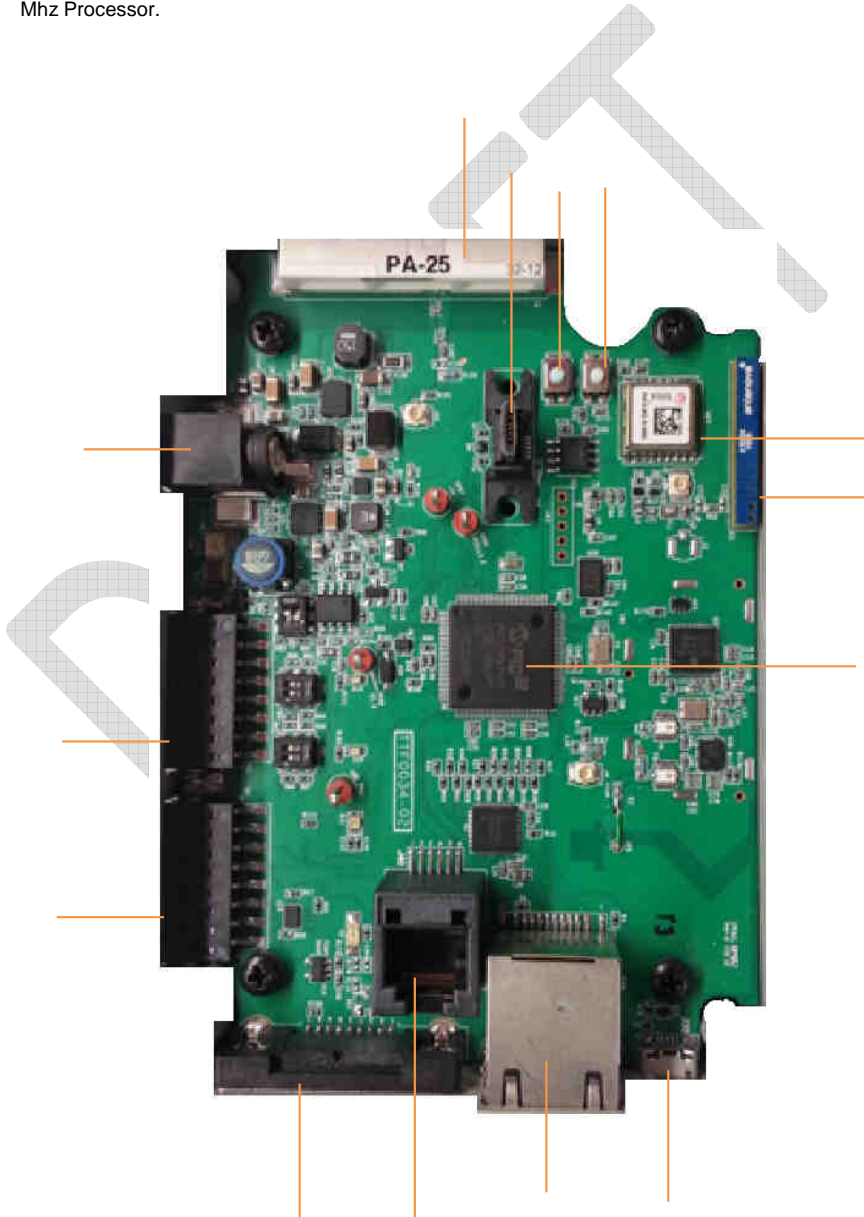
Balloon ID TBD Accelerometer - The accelerometer is able to measure acceleration in three perpendicular axes and is capable of measuring accelerations between 0 and 8g's with a 10 bit resolution. It is capable of supplying a sample rate of 200Hz. The accelerometer can be configured to provide the host processor with a wakeup signal when the acceleration exceeds a pre-programmed limit. The accelerometer communicates with the host processor through SPI.

5.5 User Interface

- Balloon ID TBD Power LED
- Balloon ID TBD Cellular Signal LED
- Balloon ID TBD Cellular Activity LED
- Balloon ID TBD Zigbee Status LED
- Balloon ID TBD Button 1
- Balloon ID TBD Button 2

5.6 PIC 32 Processor

- Balloon ID TBD MCU32 model [PIC32MX795F512L](#) contains 512 KB flash memory, 128 KB RAM, 32 Bit 80 Mhz Processor.



This picture is rev2 It needs to be replaced with Rev3

6.0 Getting Started

6.1 Signup

6.1.1 Obtaining the Boards MEID Number

1. The MEID value is printed on the sticker on the side or bottom of the platform, is also printed to the serial port upon power up. Attach a serial cable to the DB9 RS-232 connector of your M2M device and the other end to a serial port on another computer running a terminal emulation program. Configure your terminal emulation program to operate at 115200 baud, No parity, No flow control, 8 bits per character and 1 stop bit.
2. Inert a power cable into the D/C power adaptor located on the side of the unit.
3. Once power is applied the board begins transmitting health and status data to the serial port, boot progress and sensor information. Near the beginning of this output is a line similar to:
01/01/13 00:00:02.537 <Cell > MEID = 0xA1000013F617DF

6.1.2 Purchase a Verizon Data Plan

Before you can run your board, you will need to first purchase a data plan from Verizon.

1. Go to Verizon and purchase plan.

When they buy the device from MCHP Direct, the information they provide will be sent to TT. They will receive an email within one business day with instructions for purchasing a data plan, activating the device, and logging into the portal. Need to work with TT to make this as quick and painless as possible.

6.1.3 Register With Twist M22 Developer Web Site

1. To capture your sensor data within the TwistThink TT database (see *Fundamental Description* for explanation), you must first register the MEID with the M2M web server located at <http://ttm2m.spindance.net>. Enter your MEID (minus the leading 0x), a password and then click "New Account" button



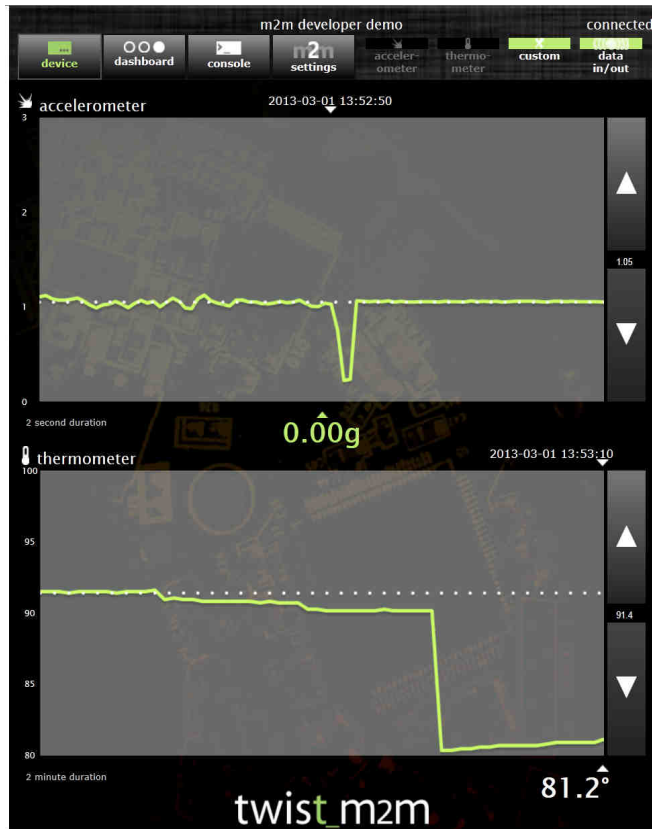
These are old pcs The web portal is being modified per Marketing. You will need new screen caps.

6.2 Interacting with the Web Site

The M2M Developers web site is specifically tailored to work with the example code programmed into your M2M board.

6.2.1 Device Tab

The device page is the first page that you are taken to when you successfully log into the m2m developer demo web site. If your device is active when you log into the web site, you should see the “data in/out” status indicator in the upper right hand corner as highlighted indicating that the m2m developer web server is receiving data from your device over the cellular phone system.

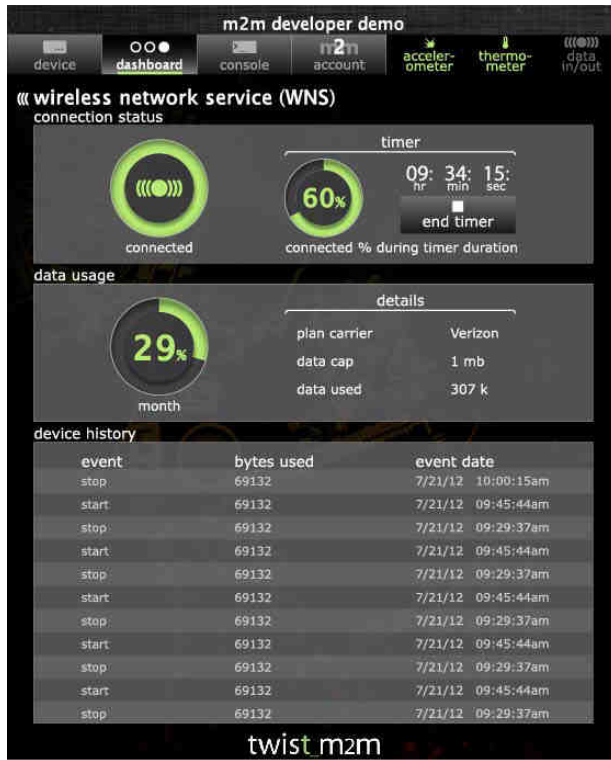


These are old pcs The web portal is being modified per Marketing. You will need new screen caps.

The device page graphically depicts the sensor status for the accelerometer in g's and the thermometer in degrees Each graph has a movable trend line that you can move using the arrows provided on the side margin of each graph.

6.2.2 Dashboard Tab

sdfsf



These are old pcs The web portal is being modified per Marketing. You will need new screen caps.

6.2.3 Console Tab
sdfsdf

6.2.4 Account Tab

sdfsdf

6.2.5 Accelerometer Tab

sdfsdf

6.2.6 Thermometer Tab

sdfsdf

7.0 Software API

Include SW block diagram and short description of each block as a lead-in to the API. Just document the DCF API in detail. Refer to the FreeRTOS site for FreeRTOS API documentation. Refer to MCHP site for stack and plib documentation.

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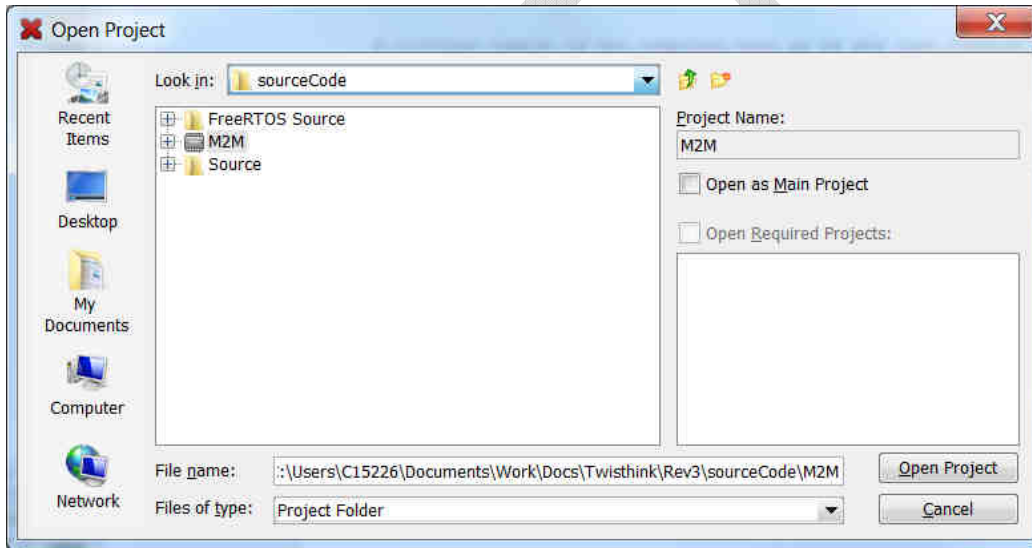
Appendix A Compiling the Project

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A.1 Connecting the Real-ICE – The M2M board has a RJ-11 receptacle that is used for downloading binary images and for debugging. The M2M board is designed to be used with Microchips [MPLAB REAL ICE](#) debugger/programmer. To connect the REAL ICE to the M2M board, remove the M2M top cover to expose the RJ-11 receptacle mounted inside. Attach the REAL-ICE RJ11 telephone cable into the M2M's RJ-11. Attach one end of a USB cable to your REAL ICE and the other end into your PC.

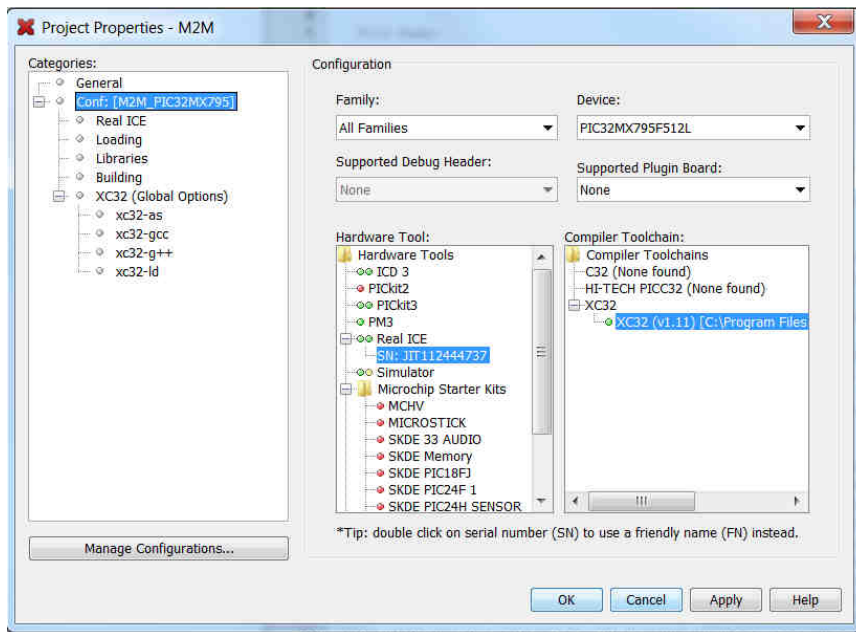
A.1 Opening the Project

MPLAB is Microchips integrated development solution used to develop, program and debug your M2M device. Plug an external 12v 0.5 Amp power supply into the M2M barrel adapter to power-on the M2M device. Start the MPLAB IDE and open the File menu option and select Open Project. Using the Open Project dialog box shown below navigate to the directory that contains the M2M project as shown below. Once you select the project and press the Open Project button on the lower right hand corner of the dialog box, the IDE will begin loading and parsing the project.

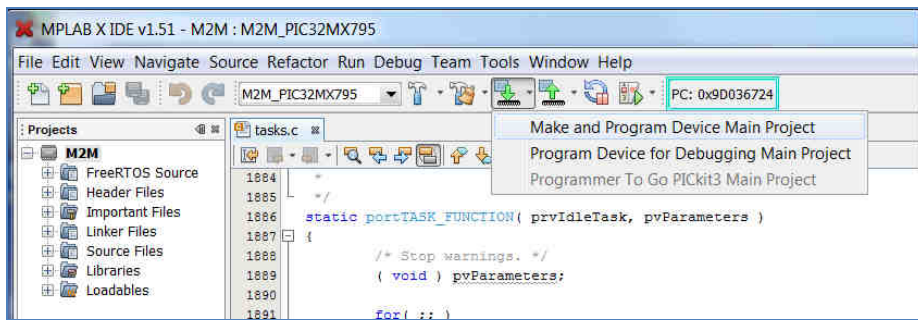


A.3 Making the Project and Programming the Board

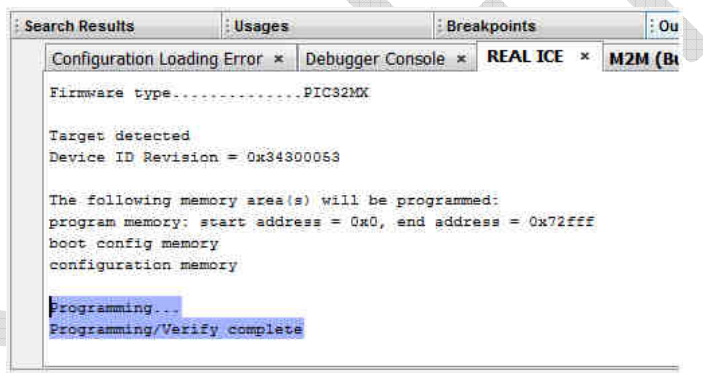
1. At this point the MPLAB main window title bar should contain the name of the M2M project.
2. Be sure that the M2M project is the active project by right clicking on its name within the project window pane.
3. From the pop menu that shows-up select "Set as Main Project".
4. Be sure that the project is configured to work with the REAL-ICE by right clicking on its name within the project window pane and selecting Properties to bring up the Project Properties dialog box shown below.



5. Be sure that the Real ICE SN: ##### is selected and press apply.
6. Be sure that the Device in Project Properties is set as PIC32MX795F512L
7. Click Apply to accept the changes if any. Then press OK to close the dialog box.
8. Near the top there is an icon button much like the one shown below. Press the small arrow on the side of the button to expose the attached menu. Select Make and Program Device Main Project to rebuild outdated file, program the device and start a debug session.



Making and programming the project

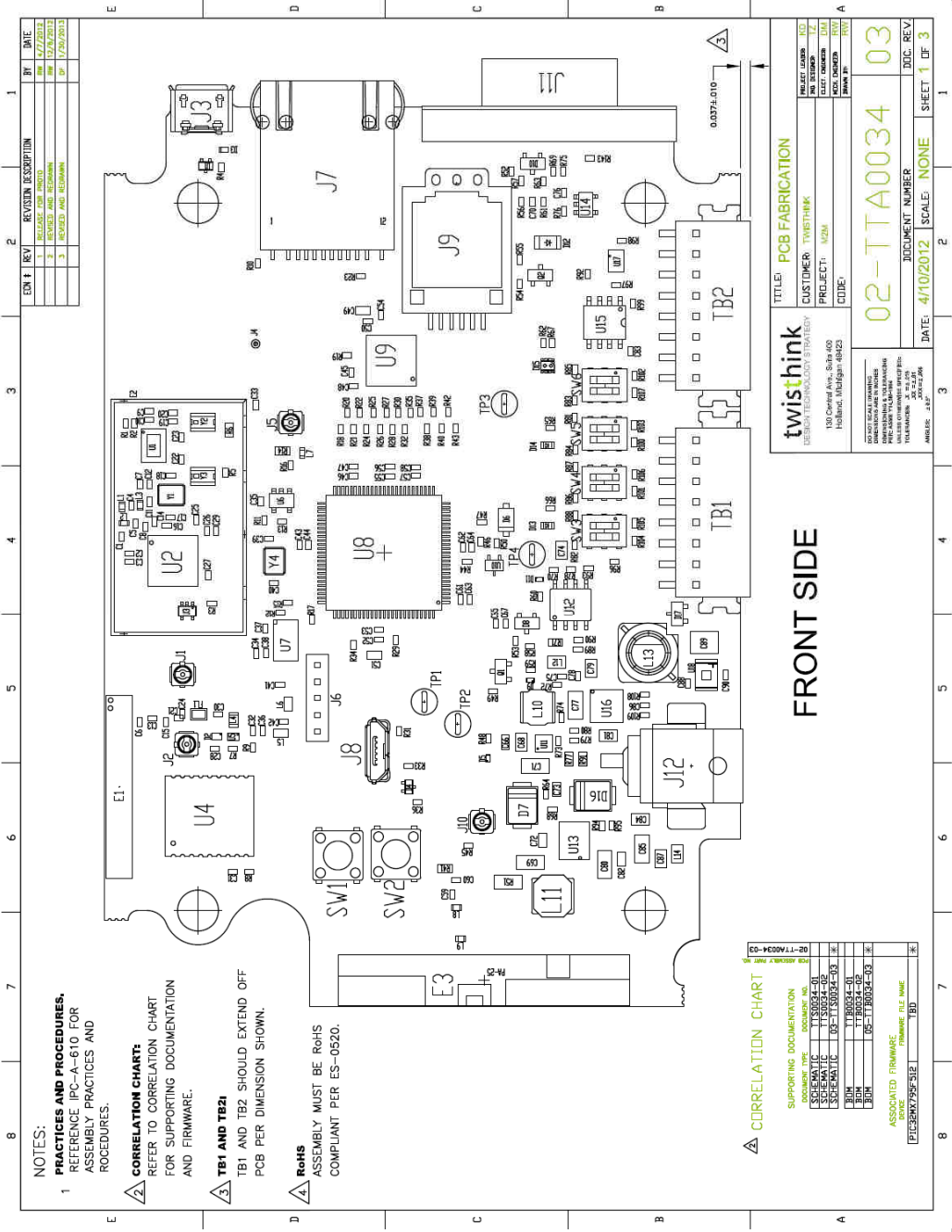


The above picture shows message indicating the board has been programmed and is now running.

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Appendix B Board Schematics

B.1



- NOTES:**
- PRACTICES AND PROCEDURES.**
REFERENCE IPC-A-610 FOR ASSEMBLY PRACTICES AND PROCEDURES.
 - CORRELATION CHART:**
REFER TO CORRELATION CHART FOR SUPPORTING DOCUMENTATION AND FIRMWARE.
 - TB1 AND TB2:**
TB1 AND TB2 SHOULD EXTEND OFF PCB PER DIMENSION SHOWN.
 - RoHS**
ASSEMBLY MUST BE ROHS COMPLIANT PER ES-0520.

△ CORRELATION CHART

| CO-PCB001-LI-20 | REV. A | REV. B |
|--------------------------|---------------|---------------|
| SUPPORTING DOCUMENTATION | DOCUMENT NO. | DOCUMENT NO. |
| SCHEMATIC | 1153034-02 | 1153034-02 |
| SCHEMATIC | 02-TTA0034-03 | 02-TTA0034-03 |
| BOM | 1153034-01 | 1153034-01 |
| BOM | 02-TTA0034-02 | 02-TTA0034-02 |

ASSOCIATED FIRMWARE: **firmware file name**
[PTE280X759F512] / **firmware** / **TB1**

FRONT SIDE

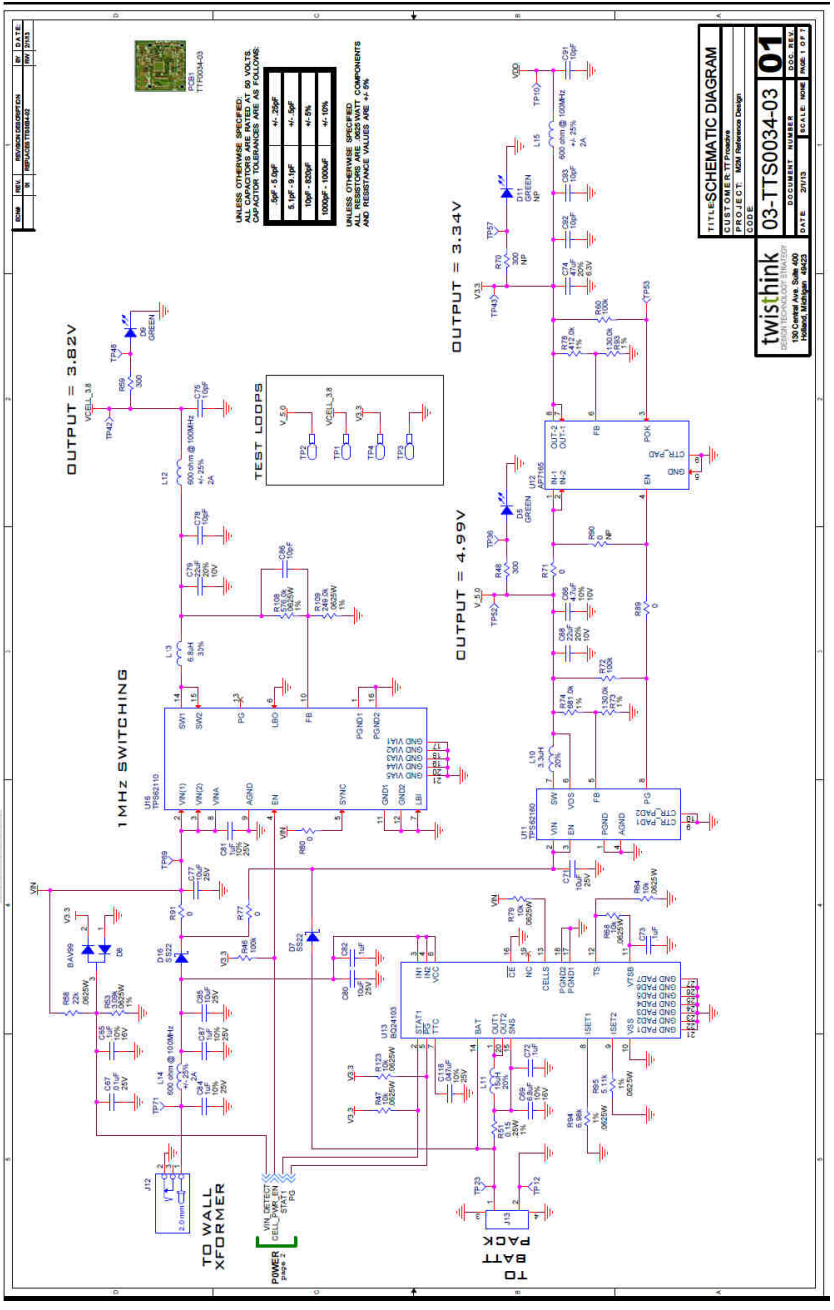
twisthink
TECHNICAL SUPPORT & TRAINING
100 Chertok Ave, Suite 400
Hoboken, New Jersey 07030

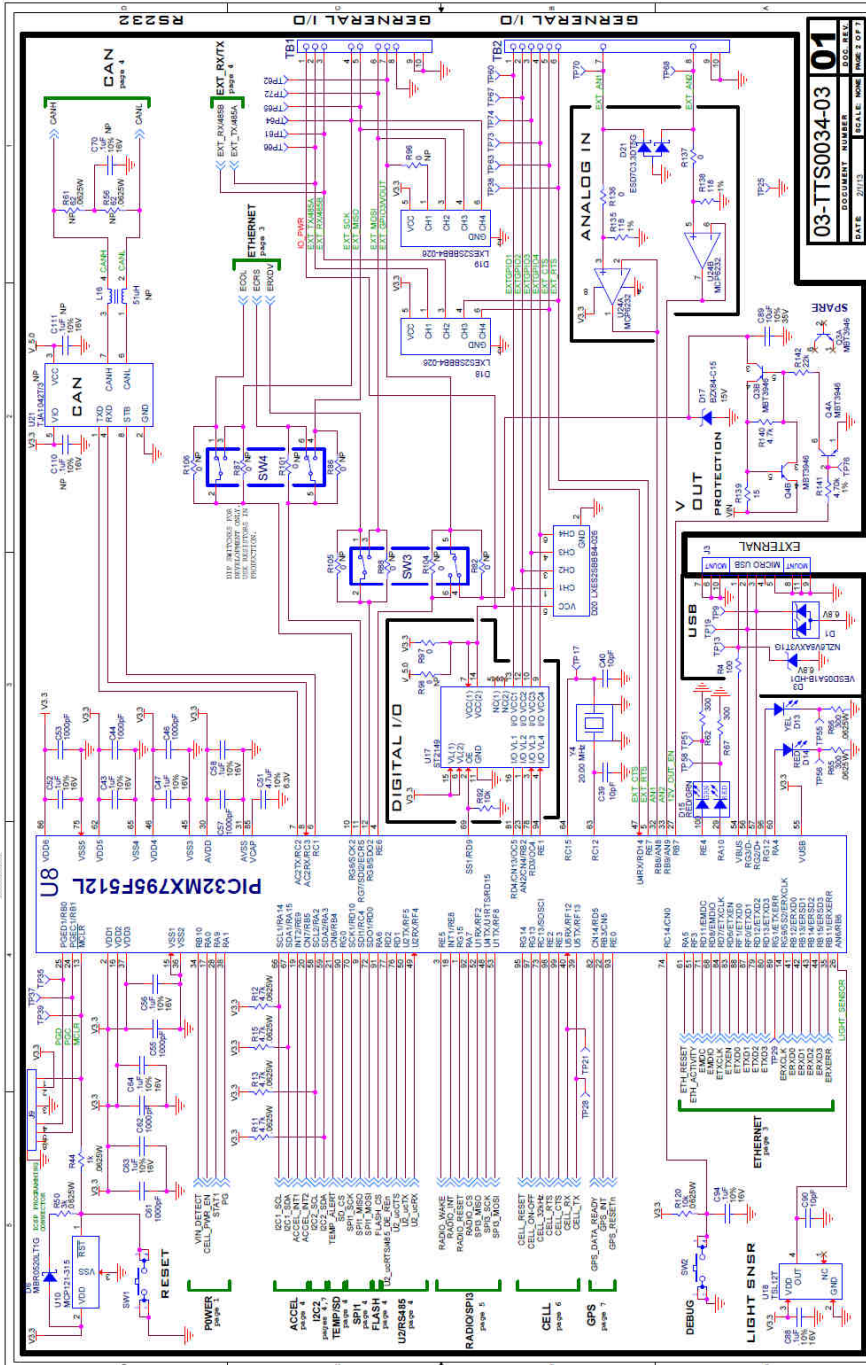
02-TTA0034 03

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CUSTOMER: **TYWETHINK**
PROJECT: **NON**
CODE:

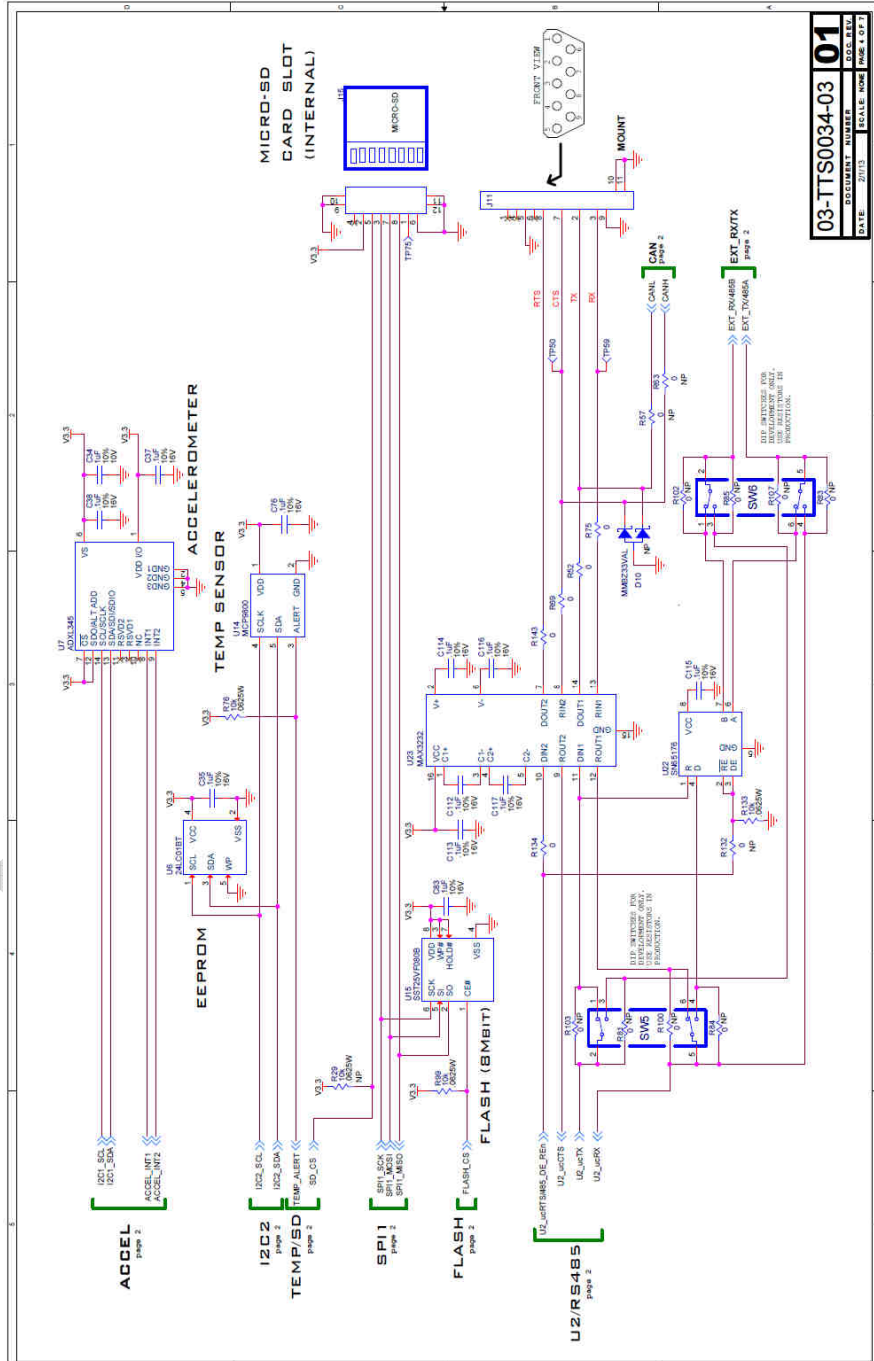
DATE: **4/10/2012** SCALE: **NONE** SHEET **1** OF **3**

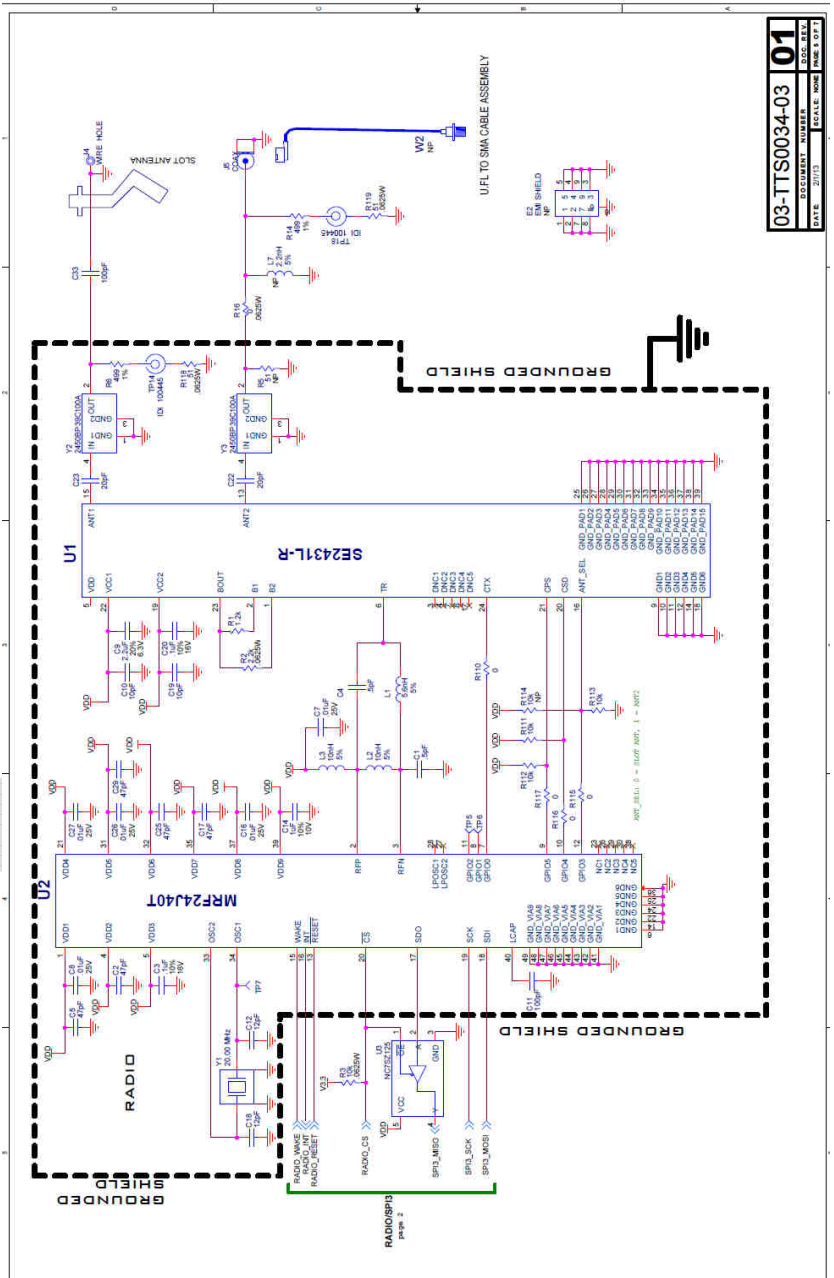
REVISIONS:
REV. NO. | DATE | BY | DATE | BY | DATE
1 | 12/27/2011 | MM | 12/27/2011 |
2 | REVISED AND REDESIGNED | MM | 12/27/2011 |
3 | REVISED AND REDESIGNED | DP | 1/29/2012 |



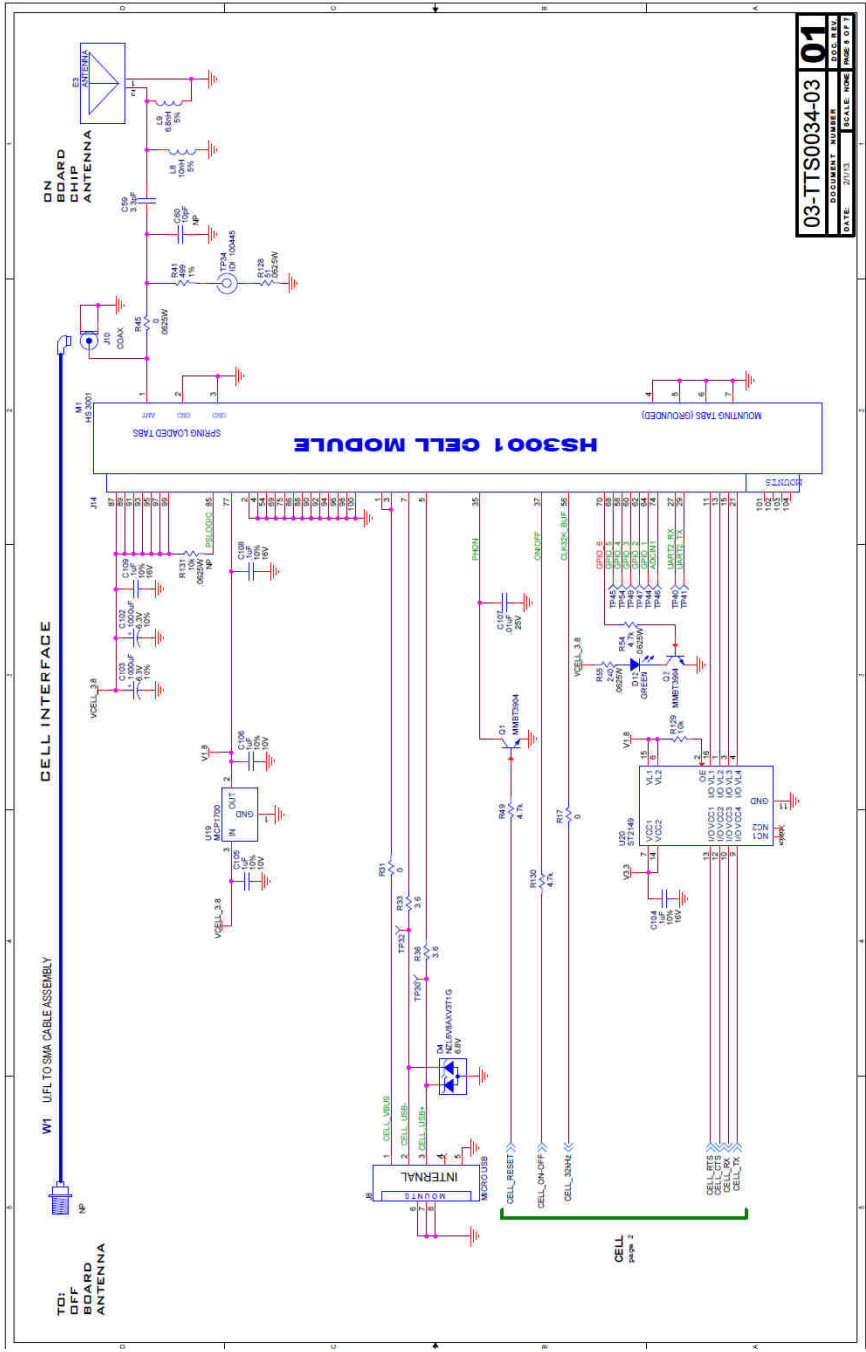


03-TTS0034-03
DOCUMENT NUMBER
DATE: 2013
SHEET NUMBER: 01





03-TTS0034-03
01
REVISION NUMBER
SCALE: 1:1
DATE: 2013
PAGE 3 OF 3



03-TTS0034-03 01
 DOCUMENT NUMBER 03-TTS
 DATE 2/13 SCALE NONE PAGE 1 OF 2

CELL
 page 2

