Model EM110100 “Raptor” Integration Specification

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Model EM110100 Integration Specification

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Revision History

Revision	Release Date	Change Description
A	September 13, 2012	Initial release

1 Overview

The purpose of this document is to provide guidelines allowing an integrator to design a host product that uses the “Raptor” MCM (Meter Communications Module) and ensures that the system meets all of its technical objectives and requirements.

1.1 ULP Wireless Network

The On-Ramp Wireless ULP network is comprised of Nodes (such as Raptor) and Access Points (AP) and operates in the unlicensed 2.4 ISM band. The Raptor circuit card is designed to easily integrate into electric meters, through standard interfaces, enabling robust wireless communication with one or more Access Points interfaced with a service provider’s local or wide area network.

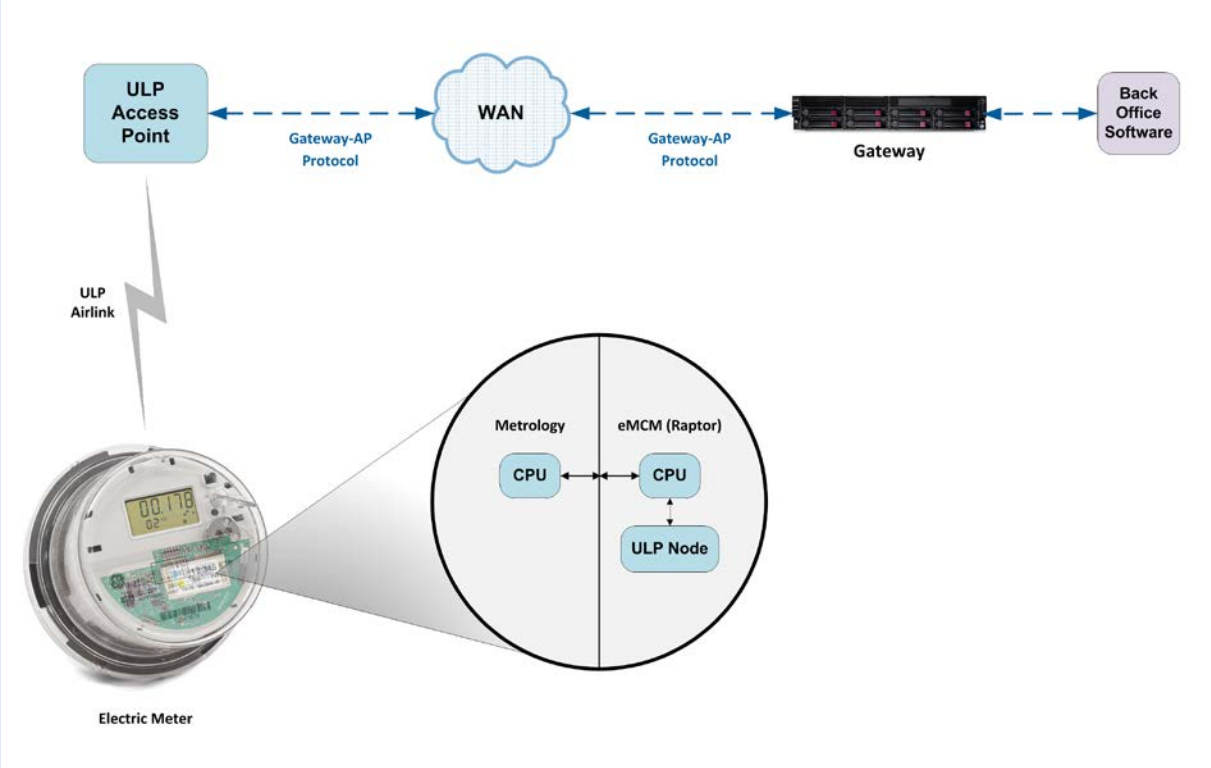


Figure 1. On-Ramp Wireless ULP Network

1.2 Referenced Documents

The following documents are referenced and provide more detail:

- **ULP Node Interface Library (UNIL) (010-0066-00)**
  Provides information about the library of portable C code provided by On-Ramp Wireless which can be integrated into a customer's existing software architecture.
- **UNIL API (010-0072-00)**
  Provides details relating to the UNIL Application Programming Interface.
- **Test Mode Interface** (in Appendix A)
  Provides details relating to the Test Mode Interface.
- **ULP Node Host Message Specification (014-0020-00)**
  Provides details relating to Node Host commands and messages.
- **Raptor FCC/IC/TELEC EMC Compliance Grants** (TBD, not yet issued)
  These are the Regulatory Grants issued by their respective governments.
- **NPT User Guide (010-0060-00)**
  Describes setup, configuration, and use of a collection of utilities called Node Provisioning Tools (NPT) used for Node provisioning.

2 Safety and Regulatory Considerations

2.1 Danger: High Voltages

When the Raptor is integrated to the meter, high voltages are present:

CAUTION: When the Raptor is mounted in an I210 Meter, the term "GND" or "Ground" does NOT refer to Earth ground. All signals will have a 120/240VAC power superimposed onto those lines. All signals to/from the raptor need to be isolated. No grounded instruments, or computers, should touch the Raptor signals.

It is recommended to use the following isolation/drivers.

Isolator:

http://www.bb-elec.com/product_family.asp?FamilyId=651&webSyncID=85656815-ad8a-a188-b050-1143ad0dee45&sessionGUID=bc450985-a6c1-9981-a0d7-6391dcb1c046

UART:

http://www.digikey.com/product-detail/en/TTL-232R-3V3-WE/768-1016-ND/1836394

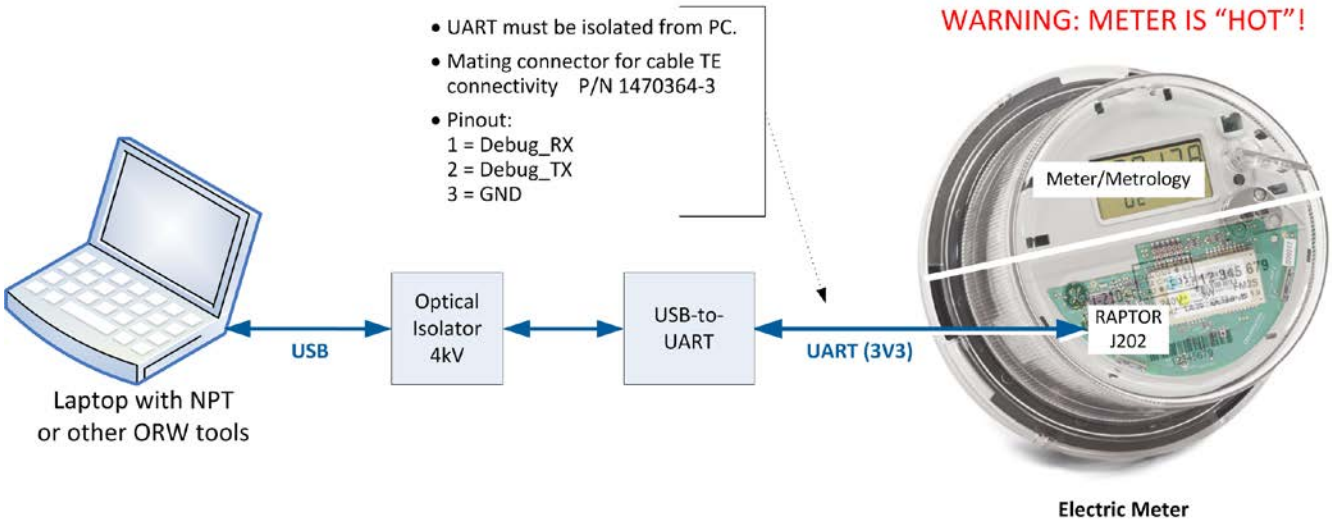


Figure 2. Meter Test Connection Diagram

2.2 FCC Warnings

This device complies with part 15 of the Federal Communications Commission (FCC) Rules. Operation is subject to the following two conditions:

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

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

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.

WARNING: This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instructions, this equipment 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:

- **Re-orient 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.**

2.3 IC Warnings

The installer of this radio equipment must ensure that the antenna is located or pointed so that it does not emit RF field in excess of Health Canada limits for the general population. Consult Safety Code 6 which is obtainable from Health Canada's website http://www.hc-sc.gc.ca/index-eng.php.

Operation is subject to the following two conditions:

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

To reduce potential radio interference to other users, select the antenna type and its gain so that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication.

Canadian Two Part Warning Statement:

This device complies with Industry Canada licence-exempt RSS standard(s). 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.

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.

2.4 TELEC Warnings

None known.

2.5 Usage

FCC ID: XTE-EM110100. IC: 8655A-EM110100. This device is only authorized for use in fixed and mobile applications. To meet FCC and other national radio frequency (RF) exposure requirements, the antenna for this device must be installed to ensure a separation distance of at least 20cm (8 inches) from the antenna to a person.

2.5.1 Note to Integrators

A label showing the FCC ID and IC designators, listed above, must be affixed to the exterior of any device containing the Raptor (if the Raptor is not visible). The exterior label must include: *Contains FCC ID: XTE-EM110100, IC: 8655A-EM110100, TELEC: TBD, not yet issued*.

2.5.2 RF Exposure Statement

The air interface supports operation on channels in the 2402 MHz – 2476 MHz range for FCC/IC regulatory domains and 2402 MHz – 2482 MHz for the TELEC regulatory domain.

Before this product becomes operational it must undergo a commissioning procedure, during which critical information required for operation is entered into the device and stored in non-volatile storage. It is during the initial commissioning procedure that the regulatory domain, under which the device will operate, is set. Subsequent configuration of the device during operation is checked against the commissioned regulatory domain and non-permitted channels or transmit power levels are rejected and the device will not transmit until a permissible configuration per the commissioned regulatory domain is set.

2.6 Antennas

This device has been certified to operate with the built-in (PCB chip) antenna listed below. To adhere to these EMC certifications requires that only this antenna be used. All other antennas are strictly prohibited for use with the Raptor unless new EMC certifications are obtained. The antenna impedance is 50 ohms.

Table 1. On-Ramp Wireless EMC Certified Antenna

Manufacturer	Part Number	Gain	Type
Ethertronics	1001013	2 dBi	Monopole

2.7 Block Diagram

Some regulatory domains require a block diagram of the module for their documentation similar to that shown in the following figure.

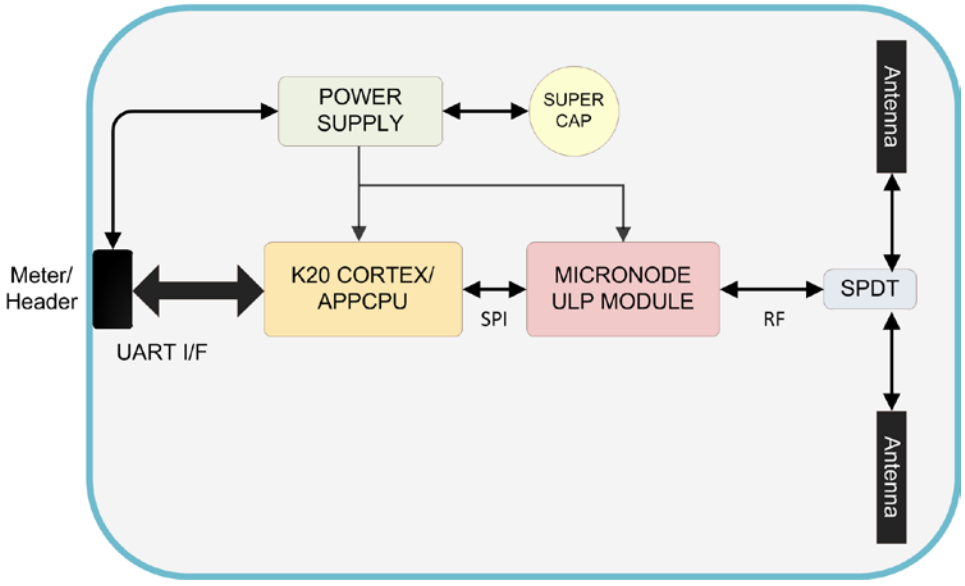


Figure 3. Raptor Block Diagram

2.8 EMC Certifications

The Raptor is designed to meet regulations for world-wide use. It has EMC modular approval certifications in the United States, Canada, and Japan. This allows the Raptor to be installed in any final product and only Unintentional Radiator testing is required of the final product. This saves much cost and time for System Integrators. The certifications currently achieved are listed in the following table. Other countries will vary.

Table 2. Raptor EMC Compliance List

Country	Certifying Agency	Requirement Documents or Paragraph
United States	Federal Communications Commission (FCC)	■ 15.207 for powerline conducted emissions. ■ 15.215 for TX 20dB bandwidth ■ 15.247 for RF TX 6dB bandwidth, power, conducted and radiated emissions.
Canada	Industry Canada (IC)	■ RSS210e includes FCC tests and IC-specific tests (RX radiated emissions, 99% BW).
Japan	TELEC	■ ARIB STD-T66[1] for frequency error, bandwidth, process gain, spurious emissions, antenna power, and EiRP.

[1]Note: ARIB STD-T66 is sometimes also referred to as Japanese Radio Law; Article 2, Item 19, Paragraph 1, Category WW with DSSS modulation.

The Grants issued by their respective governments for Raptor are available to System Integrators to ensure that the product has been certified. For more information about these documents, see the list of documents referenced in section 1.

2.9 WEEE Directive

Neither the Raptor nor node are considered “end products” that put them under the WEEE initiatives in the EU. The WEEE directives do not apply to the Raptor product.

2.10 REACH Directive

As of August 2012 the Raptor by itself is REACH compliant under 1907/2006/EC. On Ramp Wireless expects to receive a declaration of conformance from the Taiwan-based manufacturer of the node starting in September 2012. REACH compliance statements are found in Appendix C.

2.11 RoHS Directive

The Raptor and node comply with RoHS directive 2002/95/EC. On Ramp Wireless has received Certificates of Conformance (CoC) for all components, printed circuit board and contract manufacturers for the Raptor and uNode. Copies of the CoCs are stored at On Ramp Wireless and available upon request.

3 DC and RF Characteristics

3.1 Absolute Maximum Ratings

Operation outside of the Absolute Maximum Ratings may damage the unit.

Table 3. Absolute Maximum Ratings

Parameter	Min	Max	Unit
Storage Temperature (Ts)	-40	85	ºC
Ambient Temperature (Ta)	-40	85	ºC
Input Voltage (VBATT)	0.0	5.0	V

3.2 Recommended Operating Conditions

Operation outside of the Recommended Operating Conditions may not yield proper operation.

Table 4. Operating Conditions

Parameter	Min	Max	Unit
Ambient Temperature (Ta)	-40	85	ºC
Input voltage (VBATT)	3.0	4.4	V

3.3 Operating Characteristics

The following characteristics apply across the -40°C to +85°C temperature range unless otherwise noted.

Table 5. Operating Characteristics

Parameter	**ORW Raptor Module**
Wireless Frequency	2.4 GHz ISM
Bandwidth	1 MHz nominal
Modulation	Dynamic-Direct Sequence Spread Spectrum (D-DSSS)
Multiple Access Scheme	Random Phase Multiple Access (RPMA)
Transmit Power (peak EiRP)	+23 dBm (FCC/IC) +12 dBm (TELEC)
Receive Sensitivity	-136 dBm (includes peak antenna gain)
Antenna	Integrated antenna diversity
Data Throughput	60 kbps (at access point in 1 MHz channel bandwidth)
Outdoor Range (FCC/IC markets)	Pole Top: 4 – 6 square miles Building Top: 70 – 400 square miles Communication Tower: 140 – 420 square miles

Maximum Allowable Path Loss	172 dB (FCC/IC) 152 dB (TELEC)
Current Consumption	0.22A max. @ 4VDC (during TX[1]) 0.20A max. @ 4VDC (during RX[2])
Operating Temperature	-40°C to 85°C
Relative Humidity	5% to 95% non-condensing
Security	AES 128-bit payload encryption, mutual authentication of network elements
Certifications	Raptor FCC, IC, and TELEC EMC certifications pending. Meter ANSI and Unintentional Radiator certifications required once integrated into the meter product.
Note: Specifications subject to change	

Note 1: During TX mode the supercap charger is disabled to reduce peak currents.
Note 2: During RX mode the supercap charger is enabled. The supercap charge current is limited to about 110mA.

3.4 Power Supplies

The Raptor utilizes two main power supplies when it is functioning:

1. **Main switching power supply (3.3VDC output).**
   This main buck-boost power supply is operating at all times. It supplies power to all digital and radio circuits.
2. **Supercap Charger (~4.4VDC output).**
   This boost type switching power supply is used to charge the super capacitors. It can only operate with an input supply up to about 4.4VDC. It is in use at all times when primary power is applied. Once primary power is interrupted this power supply is disabled and the super caps supply power to the main switching power supply.

Additionally the ULP uNode module on the Raptor PCB has its own switching power supply (buck-boost) that uses the Raptor's main switching power supply as its source.

4 Electrical Interface

This chapter describes the electrical interface of the MCM110.

4.1 Signal Connectors

An image of both sides of the MCM110 PCB (circuit card) is shown below.

Figure 4. MCM110 Circuit Card

4.2 Pin and Signal Descriptions

The following table lists the pins and signals for the J500 connector.

MCM Pin #	Pin Name	Signal Description
1	SPARE 1	GPIO to/from AMI, Not Used.
2	SPARE 2	GPIO to/from AMI, Not Used.
3	M_COMM_BD_FORCE	AMI input; 2 functions, Board Detect and Meter in optical communication session.
4	METER_VDD	AMI power input; 4.0VDC nominal.
5	M_PWR_FAIL	AMI input; Power Good = HIGH, Power Off = LOW.
6	GROUND	Electrical Ground.
7	M_RXD_FROM_AMR	AMI output to UART. 9600 bps, 8-bit, no parity, 1 stop bit.
8	M_COMM_BD_SENSE	AMI output for AMR detection initial handshaking.
9	M_TXD_TO_AMR	AMI input to UART. 9600 bps, 8-bit, no parity, 1 stop bit.
10	M_TROUBLE	AMI input for meter trouble notification.
11	M_LINE_ZC	AMI Input, AC line zero crossing signal.
12	M_MUX_CTRL	AMI output, set low to communicate with meter.

4.3 Environmental

4.3.1 ESD

The Raptor has bidirectional ESD protection diodes on its 8 digital I/O pins providing protection to IEC 61000-4-2; level 4.

Table 6. ESD Rating

ESD Model	Class and Minimum Voltage
HBM	Class 1C (>1000V)
MM	Class A (>100V)

The antennas have protection in the form of an inductor to ground, thus allowing some robustness to direct ESD strikes. Additionally, the antennas are encapsulated in the polycarbonate housing of the meter – so there is little chance of high voltages on the antennas, or others of the board.

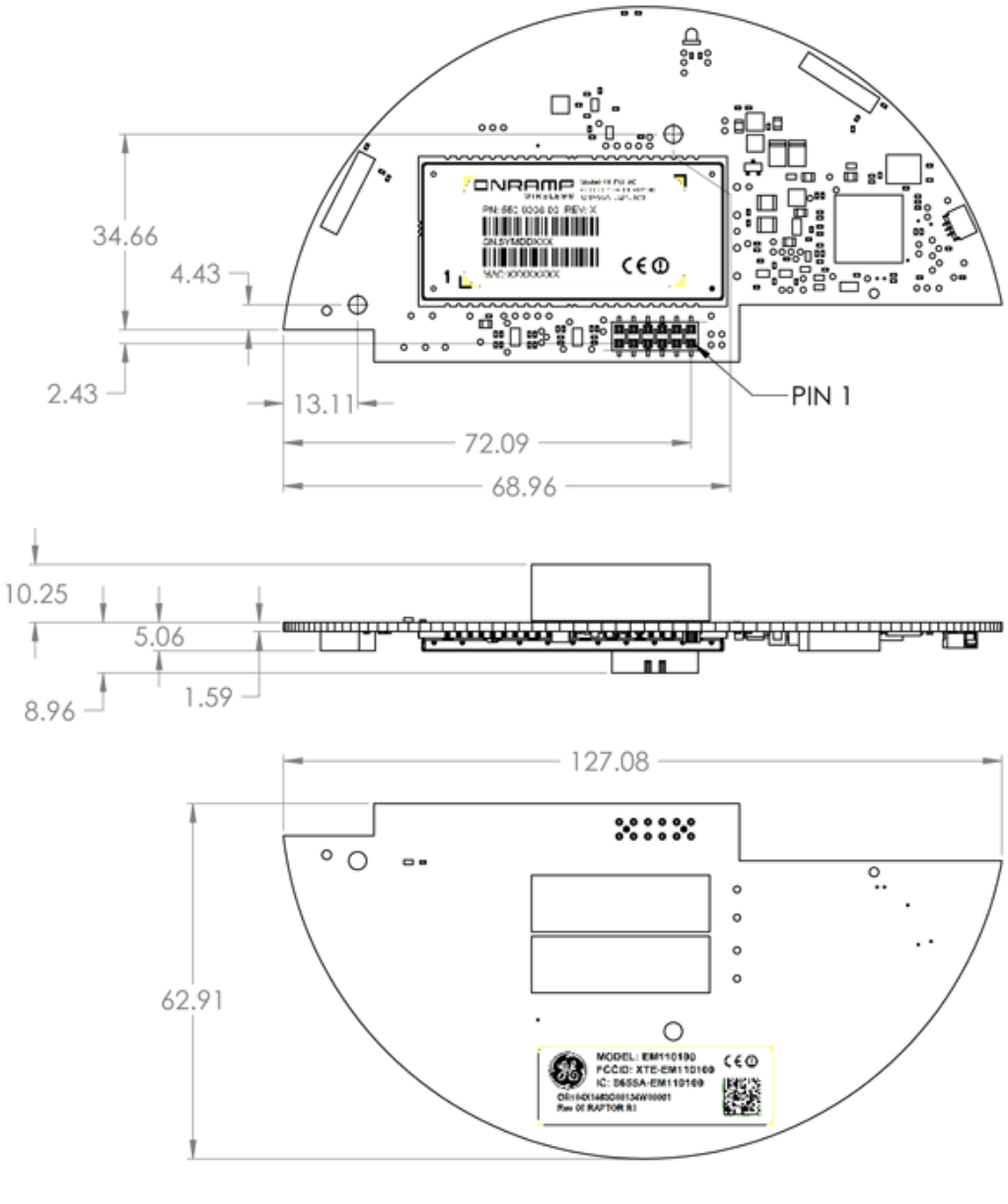
4.3.2 Harsh Environments

The Raptor is designed to be an embedded circuit card in an enclosed protective shell. It is not designed to be exposed to outdoor environments without a case or similar protections. An IP 67 or better protective casing is strongly recommended. The polycarbonate dome of the meter nominally provides robustness to harsh environments.

5 Mechanical Information

5.1 Mechanical Drawing

A complete mechanical drawing of the EM110100 board is in Appendix C of this document.



All units in millimeters.

Figure 5. Raptor Mechanical Drawing

6 Installation and Assembly Drawings

6.1 EM110100 Raptor Schematics

Raptor board schematics are found in Appendix C of this document.

6.2 Installation and Assembly

Figures 6 and 7 show how Raptor is mounted inside the GE meter.

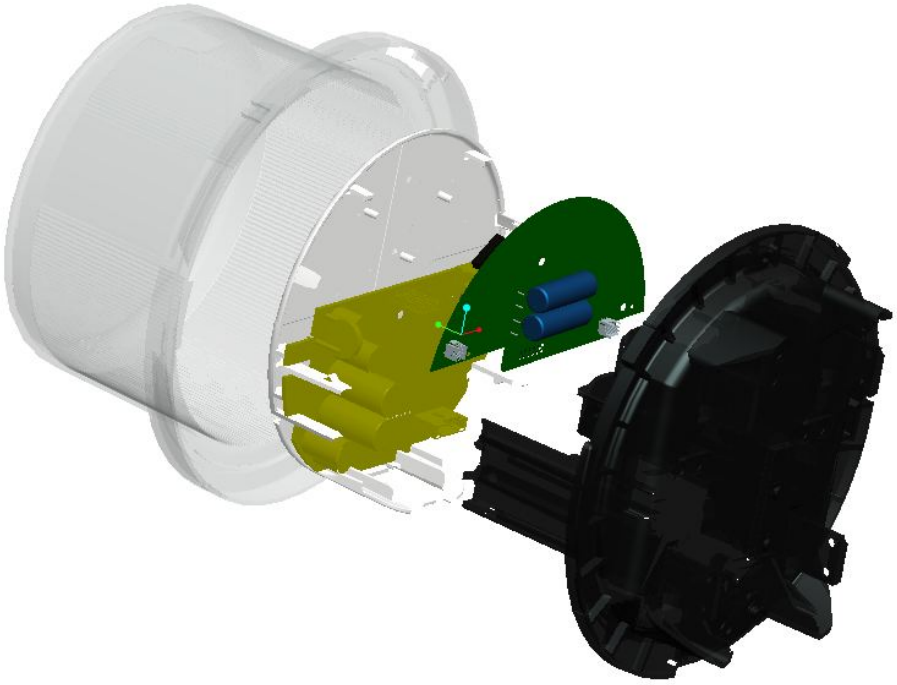


Figure 6. Meter Assembly with Raptor MCM

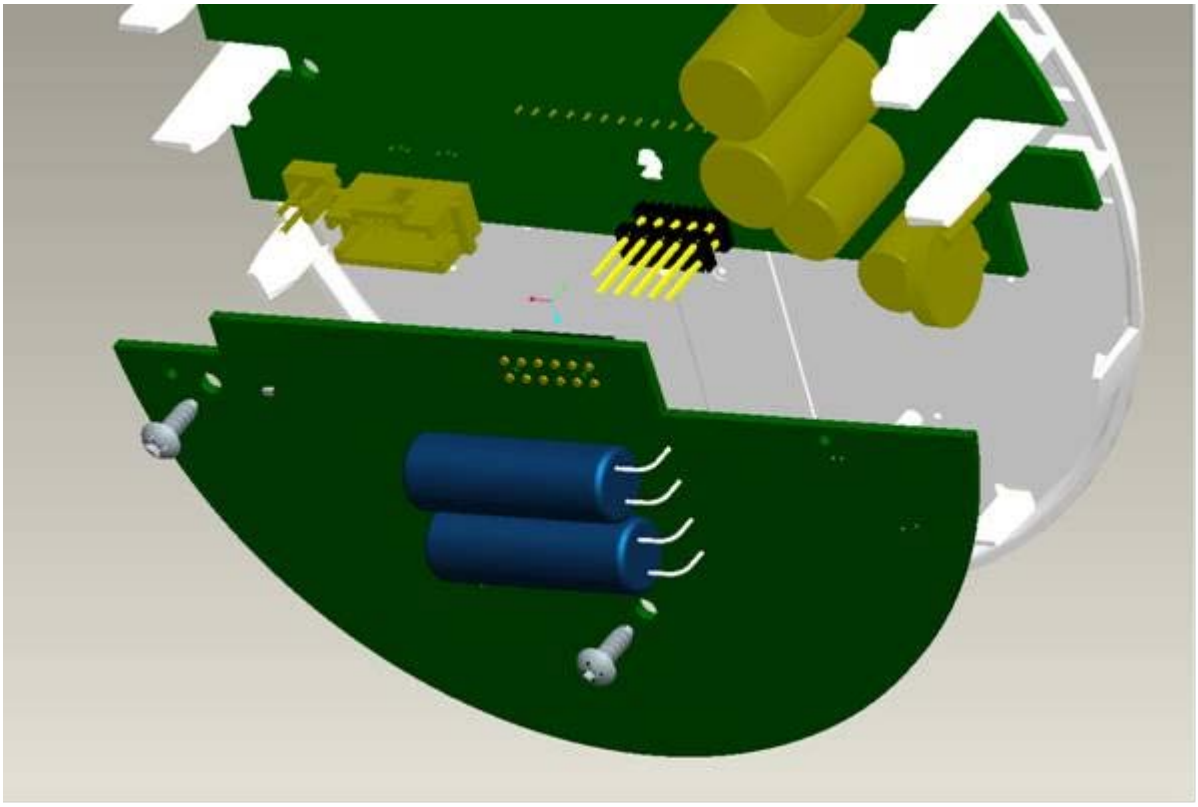


Figure 7. Detail, Raptor Board Mounting

6.2.1 Assembly Torque Values

Two screws (P/N 9925887027, #4-24X.31 self-tapping, type BF Phillips pan-head steel zinc screw) are required to mount Raptor in place. The screws have the following recommended torque values: 6 to 7 in.-lbf.

6.3 Product Labels

The product label is shown in Figure 8.

NOTE: The TELEC ID number shown is NOT our number for this product. It is shown for placement only.

An example of the carton label is shown in Figure 9.

Figure 8. EM110100 Product Label

Sample Received Carton Label:

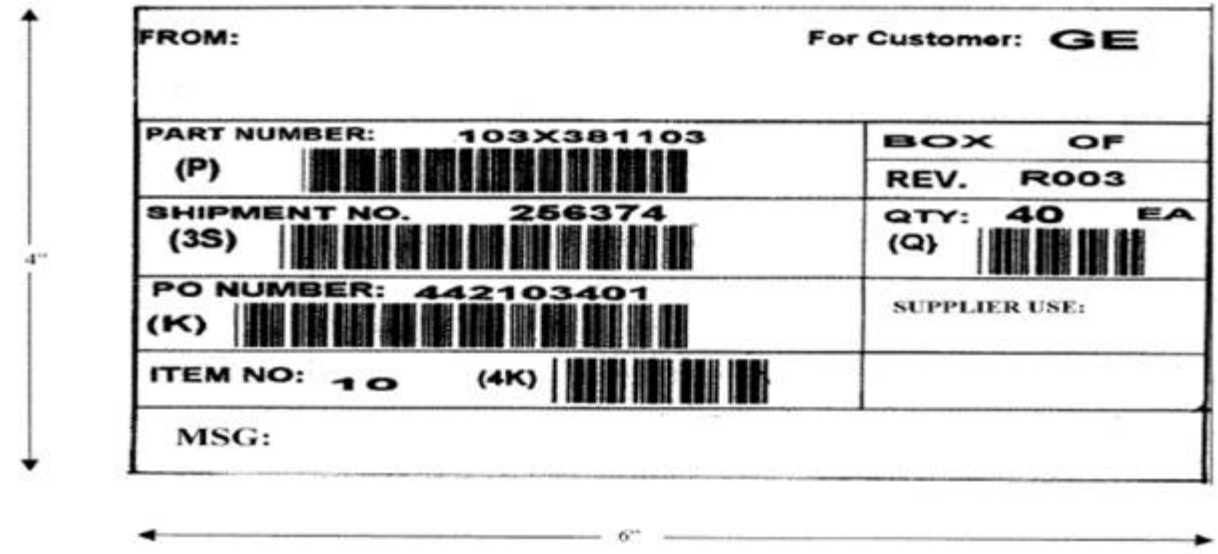


Figure 9. Carton Label

7 Provisioning

The tools and software required for provisioning the Raptor modules are described in this section.

The Provisioning process can be handled in two main ways:

- Manual for small runs
- Automatic for full production.

7.1 Manual

The Node Provisioning Tool (see referenced tools/documents) can be used to provision Raptors in small quantity. The PC will attach to the DUT Raptor via its Provisioning header (UART is 3.3V). The Raptor connector is J202 and requires a “TE Connectivity” connector PN 1470364-3 to mate with it. The pinout is:

- Pin 1 Debug_RX (3V3 logic)
- Pin 2 Debug_TX (3V3 logic)
- Pin 3 GND

CAUTION: When the Raptor is mounted in an I210 Meter, the term “GND” or “Ground” does NOT refer to Earth ground. All signals will have a 120/240VAC power imposed onto those lines. All signals to/from the Raptor board need to be isolated. No grounded instruments, or computers, should touch the Raptor board signals.
Use the setup as described in Figure 2.

7.2 Automatic

The automatic process is defined and built by the Customer. On-Ramp Wireless has assisted in development of these tools but are not a property of On-Ramp Wireless. It is the customer that owns, defines, develops, documents and maintains the Manufacturing Tools.

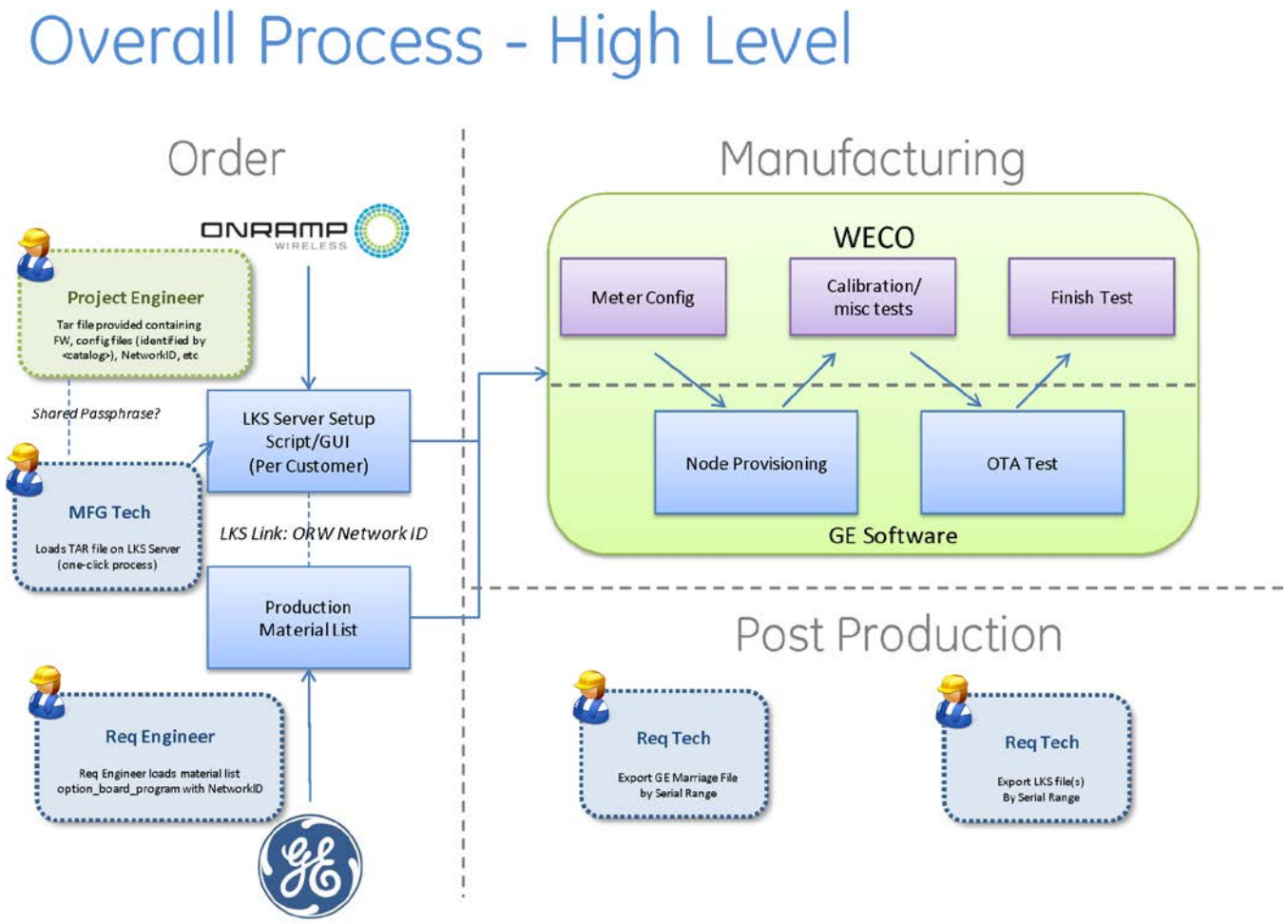
The Provisioning process nominally deals with:

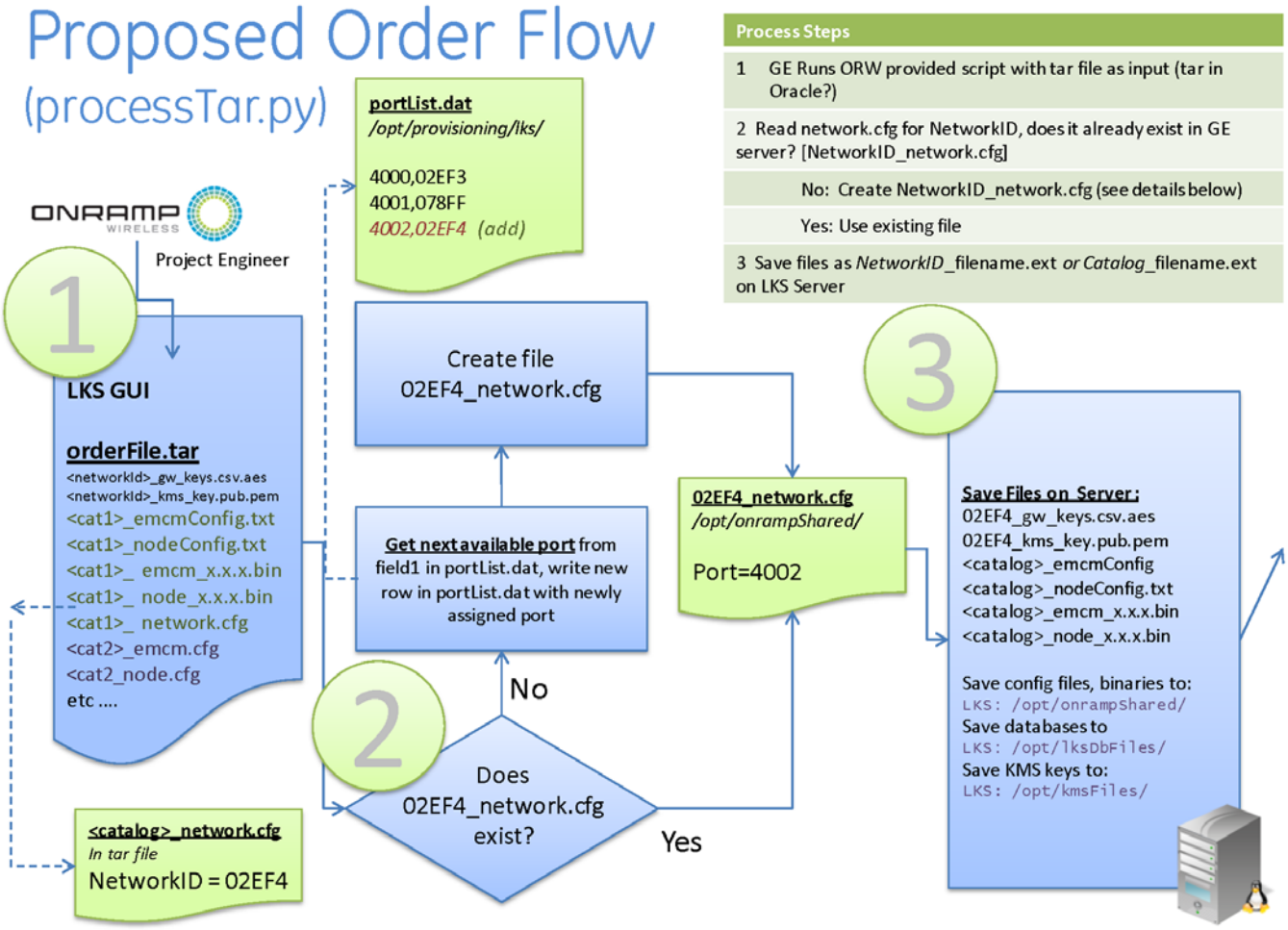
- Loading in current versions of Software to microNode and K20 processors
- Configuring (channels, TX power, etc)
- Setting and configuring Security Keys (via LKS server)
- Performing an OTA test to ensure the complete meter-Raptor-antenna chain is verified
- Lock down all access ports such as UART header and JTAG.

A graphical representation of the provisioning process is shown in Appendix A.

Appendix A Provisioning Process and Work Flow

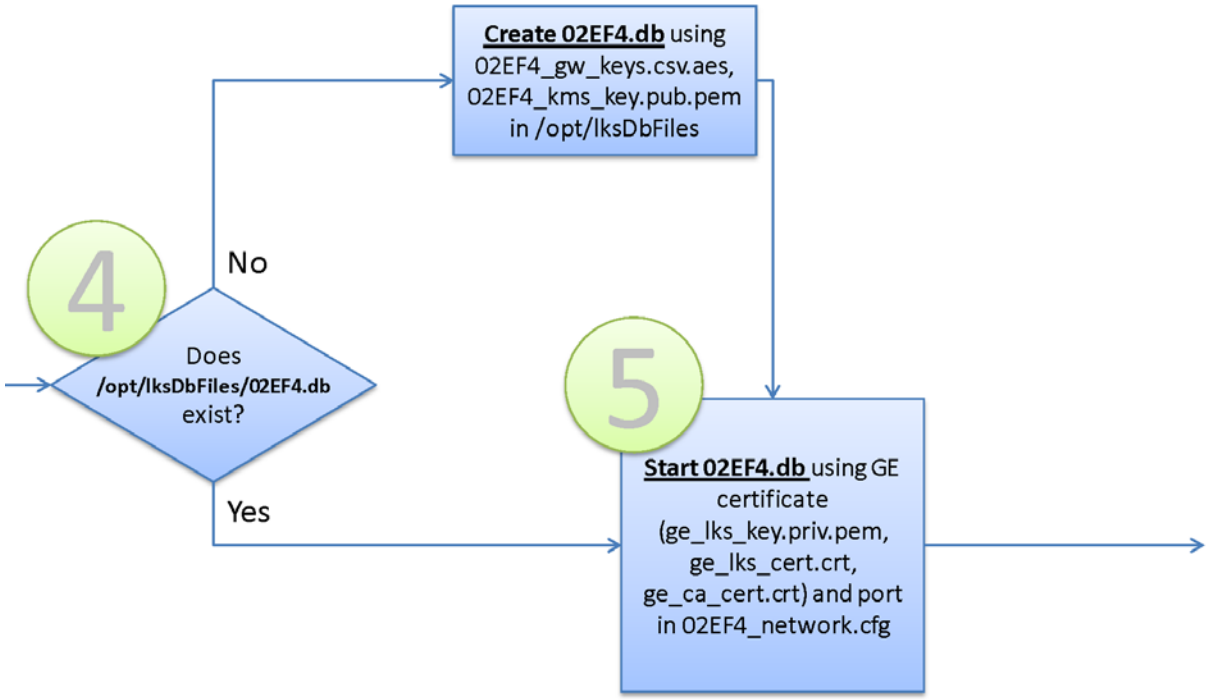
The following illustrations show a graphical representation of the provisioning process.



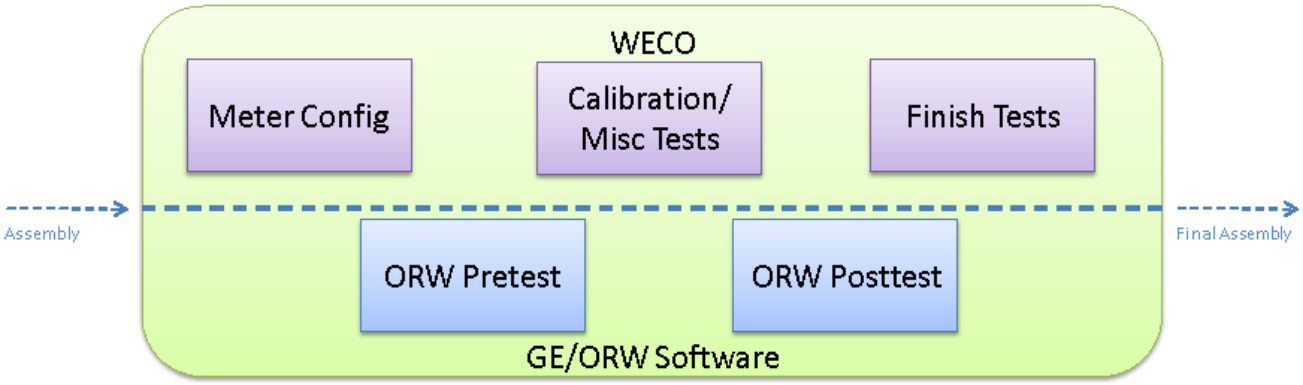

Proposed Order Flow
(processTar.py)
Process Steps
1 GE Runs ORW provided script with tar file as input (tar in Oracle?)
2 Read network.cfg for NetworkID, does it already exist in GE server? [NetworkID_network.cfg]
No: Create NetworkID_network.cfg (see details below)
Yes: Use existing file
3 Save files as NetworkID_filename.ext or Catalog_filename.ext on LKS Server
portList.dat
/opt/provisioning/lks/
4000,02EF3
4001,078FF
4002,02EF4 (add)
ONRAMP WIRELESS
Project Engineer
1
LKS GUI
orderFile.tar
<networkId>_gw_keys.csv.aes
<networkId>_kms_key.pub.pem
<cat1>_emcmConfig.txt
<cat1>_nodeConfig.txt
<cat1>_ emcm_x.x.x.bin
<cat1>_ node_x.x.x.bin
<cat1>_ network.cfg
<cat2>_emcm.cfg
<cat2_node.cfg
etc ....
Create file
02EF4_network.cfg
Get next available port from field1 in portList.dat, write new row in portList.dat with newly assigned port
2
No
Does
02EF4_network.cfg
exist?
Yes
<catalog>_network.cfg
In tar file
NetworkID = 02EF4
02EF4_network.cfg
/opt/onrampShared/
Port=4002
3
Save Files on Server:
02EF4_gw_keys.csv.aes
02EF4_kms_key.pub.pem
<catalog>_emcmConfig
<catalog>_nodeConfig.txt
<catalog>_emcm_x.x.x.bin
<catalog>_node_x.x.x.bin
Save config files, binaries to:
LKS: /opt/onrampShared/
Save databases to
LKS: /opt/lksDbFiles/
Save KMS keys to:
LKS: /opt/kmsFiles/

Proposed Order Flow

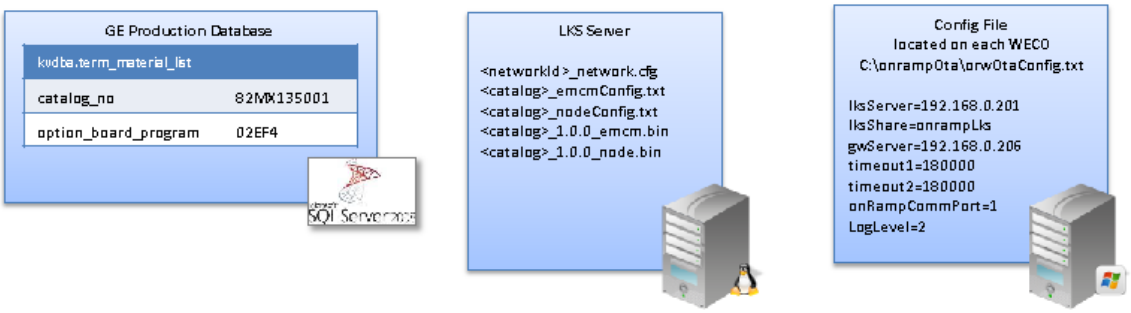
Process Steps
4 Does DB Exist?
No: Create 02EF4.db
5 Start 02EF4.db using GE Certs



Manufacturing Data Flow - WECO



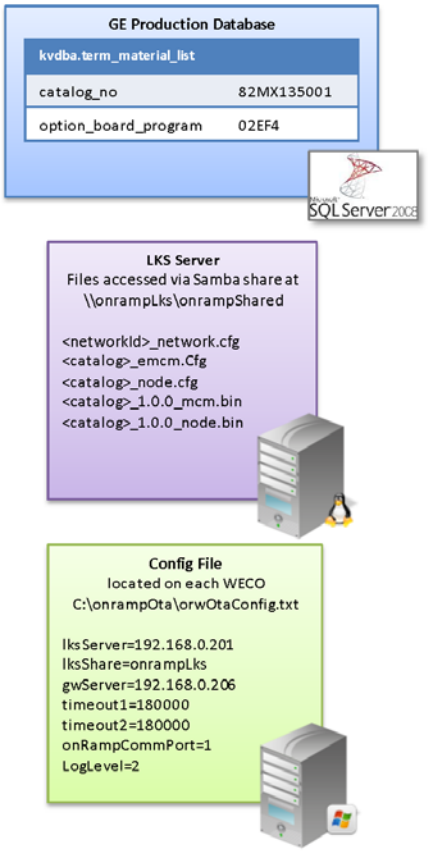
Data Sources



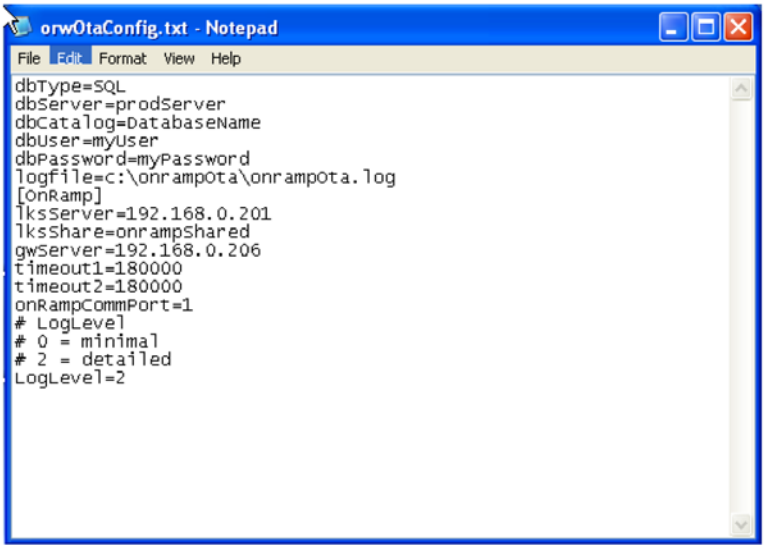
Detailed Manufacturing Data Flow

Building Command Line variables for python script

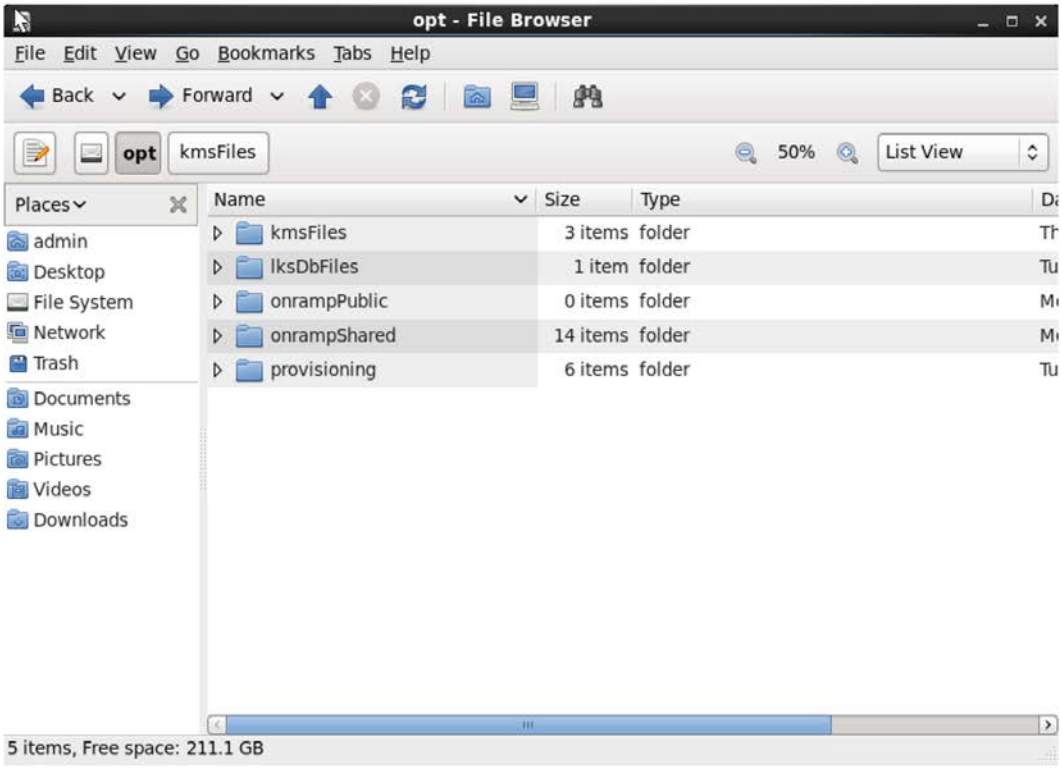
- **Batch:** GE Serial number (from WECO)
- **Config files:** based on <catalog_node/emcmConfig.txt
- **EMCM FW Version:** Get last (alpha) file matching pattern *<catalog>_emcm*.bin* (82MX135001_emcm_1.0.0.bin)
  - Extract FW version from filename
- **FW binaries:** based on <catalog>_node/emcm_x.x.x.bin
- **Gateway Server:** based on config file (gwServer)
- **LKS Port:** Get port from <networkId>_network.cfg
  - *Directory is determined by Config File:*
    - *lksServer*
    - *lksShare*
- **LKS Server:** is based on config File (lksServer)
- **Logfile:** is c:\onrampOta\onrampOta.log
- **NetworkID:** Query DB based on catalog
- **NodeId:** from WECO call (based on matchpoint scan)
- **Node FW Version:** Get last (alpha) file matching pattern *<catalog>_node*.bin* (example: 82MX135001_node_2.5.1.bin)
  - Extract FW version from filename
- **Pre-test timeout:** is based on config file (timeout1)
- **Post-test timeout:** is based on config file (timeout2)
- Config for MFG during pre-test is assumed to use filename mfgTest_emcmConfig.txt or mfgTest_nodeConfig.txt
- **Serial Port** based on config File (onRampCommPort)
- **Verbosity:** based on config file (LogLevel)



Sample config file

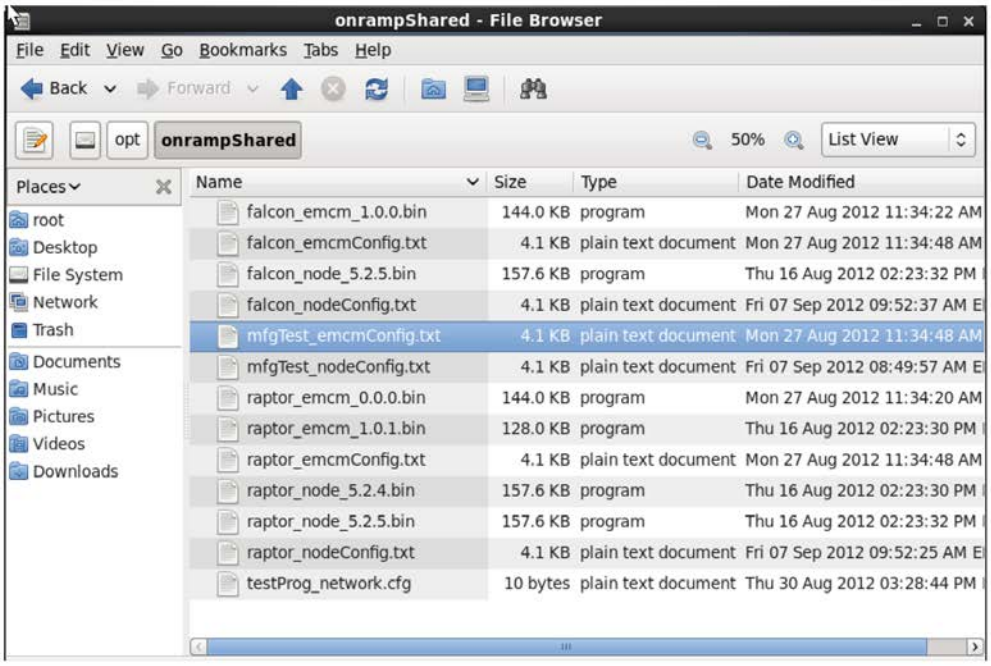


LKS structure - directories



LKS structure - onrampShared

- This shows configs for 2 catalogs (fake names for testing):
  - "raptor"
  - "falcon"
- mfgTest_config.txt for node/emcm exists for config during MFG AP join
- This shows a network.cfg file for a networkId of "testProg"



Sample Log Files (verbose)

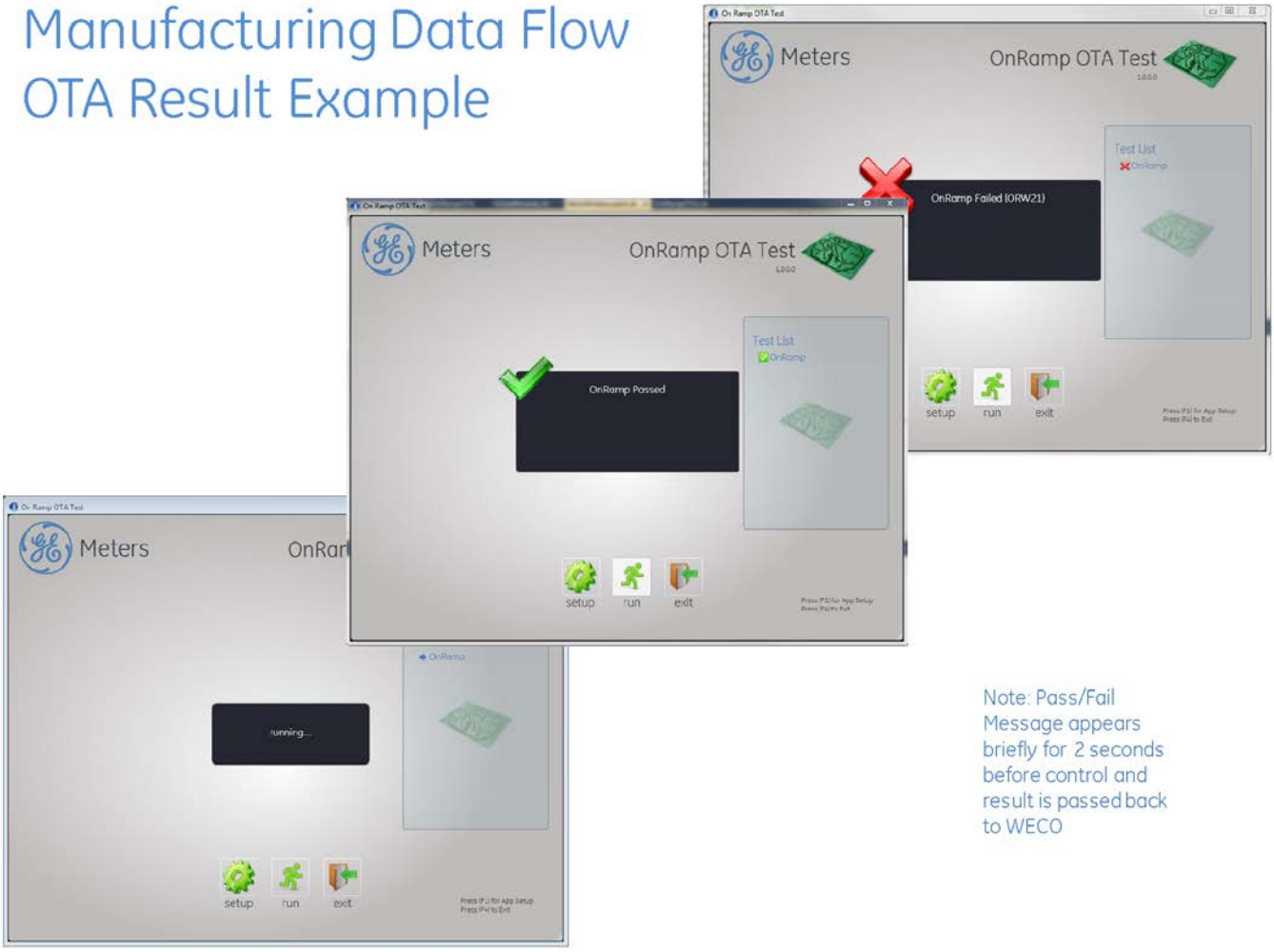
GE

```
onrampOta.log - SciTE
File Edit Search View Tools Options Language Buffers Help
1 onrampOta.log
09-11-2012 15:30:11  Running Pre Calibration Test
09-11-2012 15:30:11  Getting OnRamp Data
09-11-2012 15:30:11  Validating Node (000306e8)
09-11-2012 15:30:11  Valid=True
09-11-2012 15:30:11  Getting Network ID
09-11-2012 15:30:11  select option_board_program from kvdba.term_material_list where catalog_no = 'raptor'
09-11-2012 15:30:11  NetworkID = testProg
09-11-2012 15:30:11  Valid=True
09-11-2012 15:30:11  Getting Node FW Version
09-11-2012 15:30:11  getFileName(): Prefix: RAPTOR_NODE Extension: BIN Directory: \\192.168.0.201\onrampShared
09-11-2012 15:30:11  Getting list of files
09-11-2012 15:30:11  Found raptor_node_5.2.4.bin
09-11-2012 15:30:11  Found raptor_node_5.2.5.bin
09-11-2012 15:30:11  Last File Found:  raptor_node_5.2.5.bin
09-11-2012 15:30:11  Extracting FW version from filename raptor_node_5.2.5.bin
09-11-2012 15:30:11  Node FW = 5.2.5
09-11-2012 15:30:11  Valid=True
09-11-2012 15:30:11  Getting EMCM Firmware Version
09-11-2012 15:30:11  getFileName(): Prefix: RAPTOR_EMCM Extension: BIN Directory: \\192.168.0.201\
09-11-2012 15:30:11  Getting list of files
09-11-2012 15:30:11  Found raptor_emcm_0.0.0.bin
09-11-2012 15:30:11  Found raptor_emcm_1.0.1.bin
09-11-2012 15:30:11  Last File Found:  raptor_emcm_1.0.1.bin
09-11-2012 15:30:11  Extracting FW version from filename raptor_emcm_1.0.1.bin
09-11-2012 15:30:11  EMCM FW = 1.0.1
09-11-2012 15:30:11  Valid=True
09-11-2012 15:30:11  Getting LKS Port
09-11-2012 15:30:11  LKS Port = 4001
09-11-2012 15:30:11  Valid=True
09-11-2012 15:30:11  Completed Getting OnRamp Data
09-11-2012 15:30:11  python.exe py\orw_ge_factory.py -d COM1 --node_id=0x000306e8 --node_firmw
09-11-2012 15:30:32  Completed Pre Calibration Test
09-11-2012 15:30:32  Exit Code: 0
09-11-2012 15:30:32          Pass
09-11-2012 15:30:32  Exit Code: 0
09-11-2012 15:30:35  insert into kvdba.auxiliary_test_result (station_id, assembly_serial_no, ge_sn, cus
```

ORW

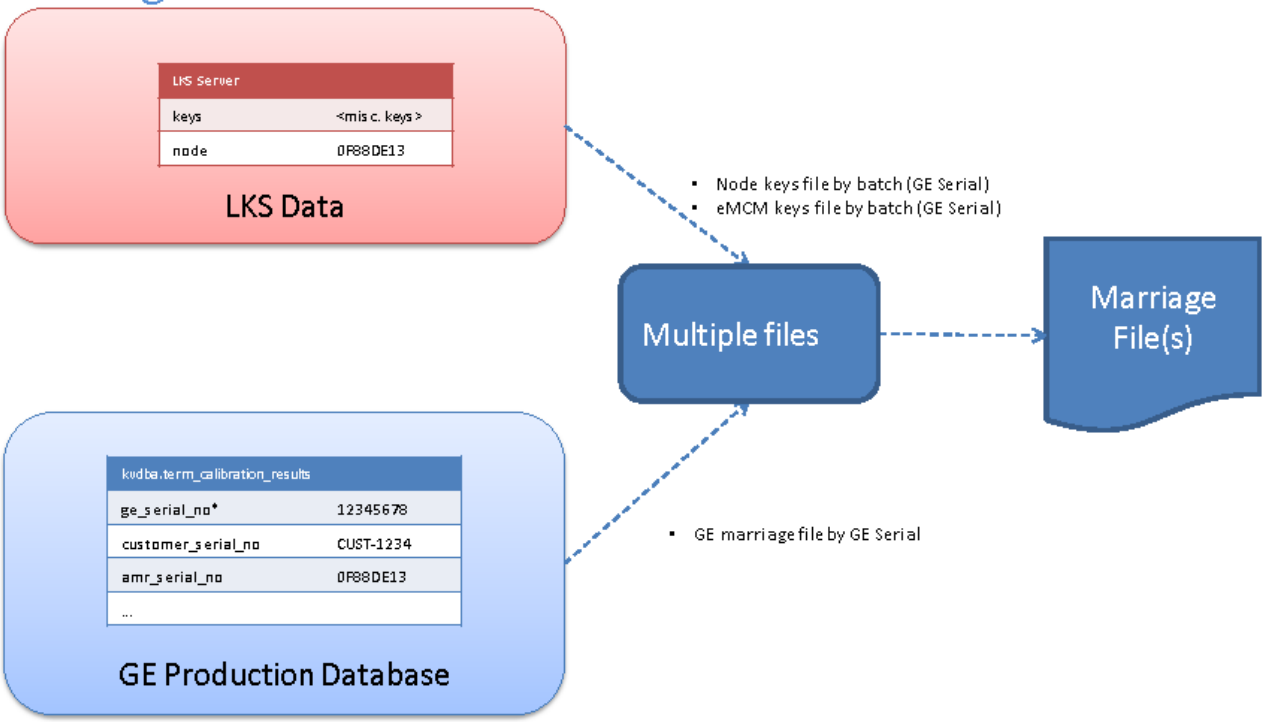
```
onrampOta.log.python - SciTE
File Edit Search View Tools Options Language Buffers Help
1 onrampOta.log.python
2012-09-11 15:30:22,515 INFO    config_node.py      163  : Finished writing configuration to flash.
2012-09-11 15:30:22,640 INFO    config_node.py      222  : Flash config read back matches.
2012-09-11 15:30:22,671 INFO    emcm_provision.py   134  : Node configuration successful
2012-09-11 15:30:22,671 INFO    emcm_provision.py   145  : Already running target version
2012-09-11 15:30:22,671 INFO    emcm_provision.py   181  : Configuring emcm from \\192.168.0.201\onrampShare
2012-09-11 15:30:22,780 INFO    emcm_set_cfg.py     205  : Success
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 221  : sending message: ucs_get_node_id_list
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 222  : sending message:
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_gw_ucs_keep_alive_
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_ap_phy_info_event
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_gw_ucs_keep_alive_
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_phy_stat_event
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_node_status_event
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_ap_phy_info_event
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_phy_stat_event
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_node_status_event
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_gw_ucs_keep_alive_
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_get_node_id_list_rsp
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 265  : >> SUCCESS RESPONSE: ucs_get_node_id_list_
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 514  : existing node list is [197117, 198657]
2012-09-11 15:30:22,780 INFO    orw_ge_factory.py    97  : Finished check Node existence.
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 181  : key nodeid, value 198376
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 181  : key apptype, value 0x0a
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 181  : key custid, value 0x00000000
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 221  : sending message: ucs_add_nodes
2012-09-11 15:30:22,780 DEBUG   emcm_ota_mfg_testing.py 222  : sending message: nodeid = 0x306e8
apptype = 0x0a
custid = 0x00000000

2012-09-11 15:30:23,000 DEBUG   emcm_ota_mfg_testing.py 181  : key ui, value 0x00
2012-09-11 15:30:23,000 DEBUG   emcm_ota_mfg_testing.py 181  : key li, value 0x00
2012-09-11 15:30:23,000 DEBUG   emcm_ota_mfg_testing.py 181  : key nodeid, value 198376
2012-09-11 15:30:23,000 DEBUG   emcm_ota_mfg_testing.py 221  : sending message: ucs_set_node_ui_li
2012-09-11 15:30:23,000 DEBUG   emcm_ota_mfg_testing.py 222  : sending message: ui = 0x00
li = 0x00
nodeid = 0x306e8

2012-09-11 15:30:23,000 DEBUG   emcm_ota_mfg_testing.py 260  : response message  is ucs_set_node_ui_li_rsp
2012-09-11 15:30:23,000 DEBUG   emcm_ota_mfg_testing.py 265  : >> SUCCESS RESPONSE: ucs_set_node_ui_li_rs
```

Manufacturing Data Flow
OTA Result Example



Note: Pass/Fail Message appears briefly for 2 seconds before control and result is passed back to WECO

Post Prodction Data Flow – Marriage Files



Appendix B Test Mode

The test modes, described below, are set by setting the "testMode" parameter in the EMCM's config file.

Normal Operating Mode 0

This mode is entered based on a flash configuration setting. This mode is persistent across boots. This is the normal operating mode of the EMCM. UNIL is initialized to communicate with the node. The meter software layer is initialized to communicate with the meter. Although the EMCM is in its normal operating mode, as determined by the flash config setting, other factors may subsequently cause the EMCM to change to a non-normal operating mode (e.g. meter is not in metering mode).

Non-Persistent Idle / Factory Test Mode 1

This mode is entered based on the testMode flash configuration setting. This mode is not persistent across boots (self clearing). UNIL is initialized to pass-through mode. Meter software layer is not initialized. The UART on the AMR (automatic meter reading) serial interface is placed in loopback mode (using the same baud rate as the meter, e.g. 9600). Same as mode 2 except the flash testMode setting is automatically cleared to mode 0 when entering this mode. A subsequent "set test mode" command can set the cleared value to some other test mode value.

Persistent Idle / Factory Test Mode 2

This mode is entered based on the testMode flash configuration setting. This mode is persistent across boots. UNIL is initialized to pass-through mode. Meter software layer is not initialized. The UART on the AMR serial interface is placed into loopback mode (using the same baud rate as the meter, e.g. 9600). Same as mode 1 except the flash testMode setting is persistent across boots. To exit this mode, the test mode configuration setting must be set to another value which will take effect on eMCM reset.

Non-Persistent Node RF Test Mode 3

This mode is entered based on the testMode flash configuration setting. This mode is not persistent across boots (self clearing). UNIL is initialized to pass-through mode. The meter software layer is not initialized. Same as mode 4 except the flash testMode setting is automatically cleared to mode 0 when entering this mode. A subsequent "set test mode" command can set the cleared value to some other test mode value.

- The TX test mode is controlled by the "txTestMode" parameter in the config file.
  - 1 = CW_CENTER
  - 2 = CW_OFFSET
  - 3 = MODULATED
- The antenna is controlled by the "txTestAntenna" parameter in the config file.
  - 0 or 1.

- The frequency is controlled by the "txTestCenterFreqKhzOffset" parameter in the config file.
  - KHz offset from 2.4 GHz
  - 2000 - 100000
  - e.g., 50000 = 2.45 GHz
- The VGA is controlled by the "txTestVga" parameter in the config file.
  - 0 - 63, 255
- The on/off duration is controlled by the "txTestModeSec" and "txTestModeUsec" parameters in the config file.

Persistent Node RF Test Mode 4

This mode is entered based on the testMode flash configuration setting. This mode is persistent across boots. UNIL is initialized to pass-through mode. The meter software layer is not initialized. Same as mode 3 except the flash testMode setting is persistent across boots. To exit this mode, the test mode configuration setting must be set to another value which will take effect on eMCM reset.

Non-Persistent Manufacturing Cal Mode 5

This mode is entered based on the testMode flash configuration setting. This mode is not persistent across boots (self clearing). UNIL is initialized normally so that it communicates with the node. The meter software layer is not initialized. The UART on the AMR serial interface is not initialized or used. Same as mode 6 except the flash testMode setting is automatically cleared to mode 0 when entering this mode. A subsequent "set test mode" command can set the cleared value to some other test mode value.

Persistent Manufacturing Cal Mode 6

This mode is entered based on the testMode flash configuration setting. This mode is persistent across boots. UNIL is initialized normally so that it communicates with the node. The meter software layer is not initialized. The UART on the AMR serial interface is not initialized or used. Same as mode 5 except the flash testMode setting is persistent across boots. To exit this mode, the test mode configuration setting must be set to another value which will take effect on eMCM reset.

Non-Persistent Meter Diagnostic Mode (Not Yet Implemented)

This mode is entered based on a flash configuration setting. This mode is not persistent across boots (self clearing). UNIL is initialized normally so that it communicates with the node. The meter software layer is initialized and communication to the meter is tested and validated. If communication with either the node or the meter fails (or any other error condition detected), then the red LED is blinked with an error code indefinitely (or until the deployment mode LED timer expires). If no errors are detected, the green LED is blinked normally to indicate network connection state (scanning, joined, etc). A reset is required to recover. Note: this mode may not be needed if a basic diagnostic or POST check is done by the EMCM as part of its initialization process.

Setting EMCM to Test Mode 1 - Non-Persistent Idle Factory Test Mode

How to Enter

- Set the 'testMode' flag in the config file to one.

  e.g. ./emcm_set_cfg.py -d /dev/ttyS0 --testMode=1

- Reset the EMCM to take effect.

  e.g. ./emcm_dev_reset.py -d /dev/ttyS0 --emcm

How to Exit

- Because this mode is non-persistent, it can be exited via an EMCM reset.
- Reset the EMCM to exit the test mode. By default, the EMCM will return to normal operational mode 0 after reset unless another mode was explicitly specified with the emcm_set_cfg.py command prior to resetting.

  e.g. ./emcm_dev_reset.py -d /dev/ttyS0 --emcm

- If a different mode is desired upon reset, explicitly

Description

- UNIL is in pass-through mode.
- Meter UART is in loopback mode.
- AHP debug port is functional.
- Mode is not persistent after resets.

Setting EMCM to Test Mode 2 - Persistent Idle Factory Test Mode

How to Enter

- Set the 'testMode' flag in the config file to two.

  e.g. ./emcm_set_cfg.py -d /dev/ttyS0 --testMode=2

- Reset the EMCM to take effect.

  e.g. ./emcm_dev_reset.py -d /dev/ttyS0 --emcm

How to Exit

- Because this mode is persistent, it will remain in effect across EMCM resets.
- Set the 'testMode' flag to the new desired mode, e.g. normal operational mode 0.

  e.g. ./emcm_set_cfg.py -d /dev/ttyS0 --testMode=0

- Reset the EMCM for the new mode to take effect.

  e.g. ./emcm_dev_reset.py -d /dev/ttyS0 --emcm

Description

- UNIL is in pass-through mode.
- Meter UART is in loopback mode.
- AHP debug port is functional.
- Mode is persistent across resets.

Setting EMCM to Test Mode 3 - Non-Persistent RF Test Mode

How to Enter

- Set the 'testMode' flag in the config file to three.
  e.g. ./emcm_set_cfg.py -d /dev/ttyS0 --testMode=3
- Reset the EMCM to take effect.
  e.g. ./emcm_dev_reset.py -d /dev/ttyS0 --emcm

How to Exit

- Because this mode is non-persistent, it can be exited via an EMCM reset.
- Reset the EMCM to exit the test mode. By default, the EMCM will return to normal operational mode 0 after reset unless another mode was explicitly specified with the emcm_set_cfg.py command prior to resetting.
  e.g. ./emcm_dev_reset.py -d /dev/ttyS0 --emcm
- If a different mode is desired upon reset, explicitly

Description

- UNIL is partially operational.
- Meter UART is disabled.
- AHP debug port is functional.
- Mode is not persistent after resets.

Setting EMCM to Test Mode 4 - Persistent RF Test Mode

How to Enter

- Set the 'testMode' flag in the config file to four.
  e.g. ./emcm_set_cfg.py -d /dev/ttyS0 --testMode=4
- Reset the EMCM to take effect.
  e.g. ./emcm_dev_reset.py -d /dev/ttyS0 --emcm

How to Exit

- Because this mode is persistent, it will remain in effect across EMCM resets.
- Set the 'testMode' flag to the new desired mode, e.g. normal operational mode 0.
  e.g. ./emcm_set_cfg.py -d /dev/ttyS0 --testMode=0
- Reset the EMCM for the new mode to take effect.
  e.g. ./emcm_dev_reset.py -d /dev/ttyS0 --emcm

Description

- UNIL is partially operational.
- Meter UART is disabled.
- AHP debug port is functional.

Mode is persistent across resets.

Appendix C REACH Compliance Statements

DDi

Building Tomorrow's Technology . . . Today

February 25, 2012

To Whom It May Concern:

Subject: REACH Regulations, http://echa.europa.eu/reach_en.asp

The European Union Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) Directive has become of significant interest to our customers. DDi considers manufactured Printed Circuit Boards (PCBs) to be an "article" per REACH, Article 3(3); thus, exempt from the REACH Regulations, unless;

1. DDi ships an article to the EU that exceeds a SVHC (Substance of Very High Concern) concentration of 0.1%w/w. , or
2. Greater than one metric ton per year is intended to be released under normal or reasonably foreseeable conditions of use.

The European Chemicals Agency (ECHA) issued its first list of Substances of Very High Concern (SVHC) in 2008. Various other chemicals have been published and included in the SVHC candidate list every year thereafter. The tables below contain all known chemicals that have been submitted by ECHA thus far; additional chemicals will be added to this statement as soon as they become available. It is DDi's commitment to insure current and accurate information is provided to our customers. We will continue to monitor updates to the SVHC list as they are submitted for consultation.

Candidate List Tables

2008 List			
Anthracene (CAS# 120-12-7)	4,4'-diaminodiphenylmethane (CAS# 101-77-9)	Dibutyl phthalate (CAS# 84-74-2)	Benzyl butyl phthalate (CAS# 85-68-7)
Hexabromocyclododecane (HBCDD) and all major diastereoisomers (CAS# 3194-55-6; 25637-99-4)	Cobalt dichloride (CAS# 7646-79-9)	Diarsenic pentoxide (CAS# 1303-28-2)	Diarsenic trioxide (CAS# 1327-53-3)
Sodium dichromate, dehydrate (CAS# 7789-12-0/ 10588-01-9)	Musk xylene (CAS# 81-15-2)	Bis (2-ethyl(hexyl)phthalate (CAS# 117-81-7)	Bis (tributyltin) oxide (CAS# 56-35-9)
Lead hydrogen arsenate (CAS# 7784-40-9)	Triethyl arsenate (CAS# 15606-95-8)	C10-C13 chlorinated paraffins (CAS# 85535-84-8)	

2009 List			
Anthracene oil (CAS# 90640-80-5)	Coal tar pitch, high temperature (CAS# 65996-93-2)	Diisobutyl Phthalate (CAS# 84-69-5)	Anthracene oil, Anthracene paste, (CAS# 90640-81-6)
Anthracene oil, Anthracene paste, distin. Lights (CAS# 91995-17-4)	Acrylamide (CAS# 79-06-1)	**Lead chromate** * (CAS# 7758-97-6)	2,4-Dinitrotoluene (CAS# 121-14-2)
Anthracene oil, Anthracene paste, Anthracene fraction (CAS# 91995-15-2)	Lead Sulfochromate yellow (C.I. Pigment Yellow 34) (CAS# 1344-37-2)	Lead Chromate Molybdate Sulphate red (C.I. Pigment Red 104) (CAS# 12656-85-8)	Tris (2-chloroethyl) Phosphate (CAS# 115-96-8)
Anthracene oil, Anthracene-low distin. (CAS# 90640-82-7)	Zirconia Aluminosilicate Refractory *Ceramic Fibres covered by index number 650-017-00-8 in Annex VI, part 3, table 3.2 of Regulation (EC) No 1272/2008*	Aluminosilicate Refractory *Ceramic Fibres are fibres covered by index number 650-017-00-8 in Annex VI, part 3, table 3.2 of Regulation (EC) No 1272/2008*	

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Gemtek
Wireless Broadband Anywhere

Gemtek Technology Co., Ltd
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TEL: 886-3-598-5535
FAX: 886-3-597-2103

DECLARATION OF CONFORMITY WITH RoHS DIRECTIVE AND REACH REGULATION

Gemtek declares that the product or part set forth below,

Customer Product Name: uNode/ 550-0006-00
Product Name: WMDO-142 jNode
Product Number: 990-900-0124R

has been manufactured in compliance with the EU Directive 2011/65/EU Restriction of Hazardous Substance (RoHS) and the regulation concerning Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) by meeting the following demand,

1. Said Gemtek Product is through utilization of exemption as below:

1) Copper alloy containing up to 4% lead by weight
2) Lead in high melting temperature type solders (i.e., lead-based alloys containing 85% by weight or more lead)
3) Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors ,e.g. piezoelectronic devices, or in a glass or cramic matrix compound。

2. In regard to the information on substances in the said product, in case a concentration therein is above 0.1 % weight by weight (w/w), Gemtek will provide customers with the information outlined in addendum A to allow safe use of the product.

Compliance with RoHS and REACH has been verified via internal design controls and/or analytical test data. The person undersigned below is entitled and authorized to furnish this letter to customers.

WMDO-142 jNode is under development and will follow RoHS & REACH rule.

Signature:
Printed Name: Eddy Chen
Title: A.V.P Quality
Date: 2012/08/20
Contact Information: Eddy chen@gemtek.com.tw +886 3 5985535 Ext.1060

Appendix D Abbreviations and Terms

Abbreviation/Term	Definition
AGC	Automatic Gain Control
ALC	Automatic Level Control
AMI	Advanced Metering Infrastructure
AMR	Automatic Meter Reading
AP	Access Point (this product)
API	Application Programming Interface
ASIC	Application-Specific Integrated Circuit
BOM	Bill of Materials
BW	Bandwidth
CMOS	Complementary Metal-Oxide-Semiconductor
CPOL	Clock Polarity (for SPI)
CPU	Central Processing Unit
DFS	Dynamic Frequency Selection
DPLL	Digital Phase-Locked Loop
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETSI	European Telecommunications Standards Institute
EVM	Error Vector Magnitude
FCC	Federal Communications Commission
FER	Frame Error Rate
GND	Ground
GPIO	General Purpose Input/Output
HBM	Human Body Model
IC	Industry Canada
IIP3	Input Third-Order Intercept Point
LDO	Low Drop Out
LNA	Low Noise Amplifier
LO	Local Oscillator
microNode	Second generation of the ULP wireless module that communicates sensor data to an Access Point. The microNode forms the basis for ULP communications of the Raptor product.
MISO	Master Input, Slave Output
MM	Machine Model
MOSI	Master Output, Slave Input
MRQ	Master Request
MSL	Moisture Sensitivity Level
Node	The generic term used interchangeably with eNode, microNode, or dNode.
NPT	Node Provisioning Tools

Abbreviation/Term	Definition
OTA	Over-the-Air
PA	Power Amplifier
PAPR	Peak-to-Average Power Ratio
PCB	Printed Circuit Board
POR	Power On Reset
QoS	Quality of Service
Raptor	On-Ramp Wireless AMI circuit card (PCB)
RF	Radio Frequency
RFIC	Radio Frequency Integrated Circuit
RoHS	Restriction of Hazardous Substances
RSSI	Receive Signal Strength Indicator
RT	Remote Terminal
RTC	Real Time Clock
RX	Receive/Receiver
SCLK	Serial Clock
SMT	Surface Mount Technology
SNR	Signal-to-Noise Ratio
SPI	Synchronous Peripheral Interface
SRDY	Slave Ready
SRQ	Slave Request
TX	Transmit/Transmitter
UART	Universal Asynchronous Receiver/Transmitter
ULP	Ultra-Link Processing™. On-Ramp Wireless proprietary wireless communication technology.
UNIL	ULP Node Interface Library
VCO	Voltage Controlled Oscillator
VCTCXO	Voltage Controlled Temperature Compensated Crystal Oscillator
VSWR	Voltage Standing Wave Ratio
XO	Crystal Oscillator

Appendix E Raptor Mechanical Drawing and Schematics

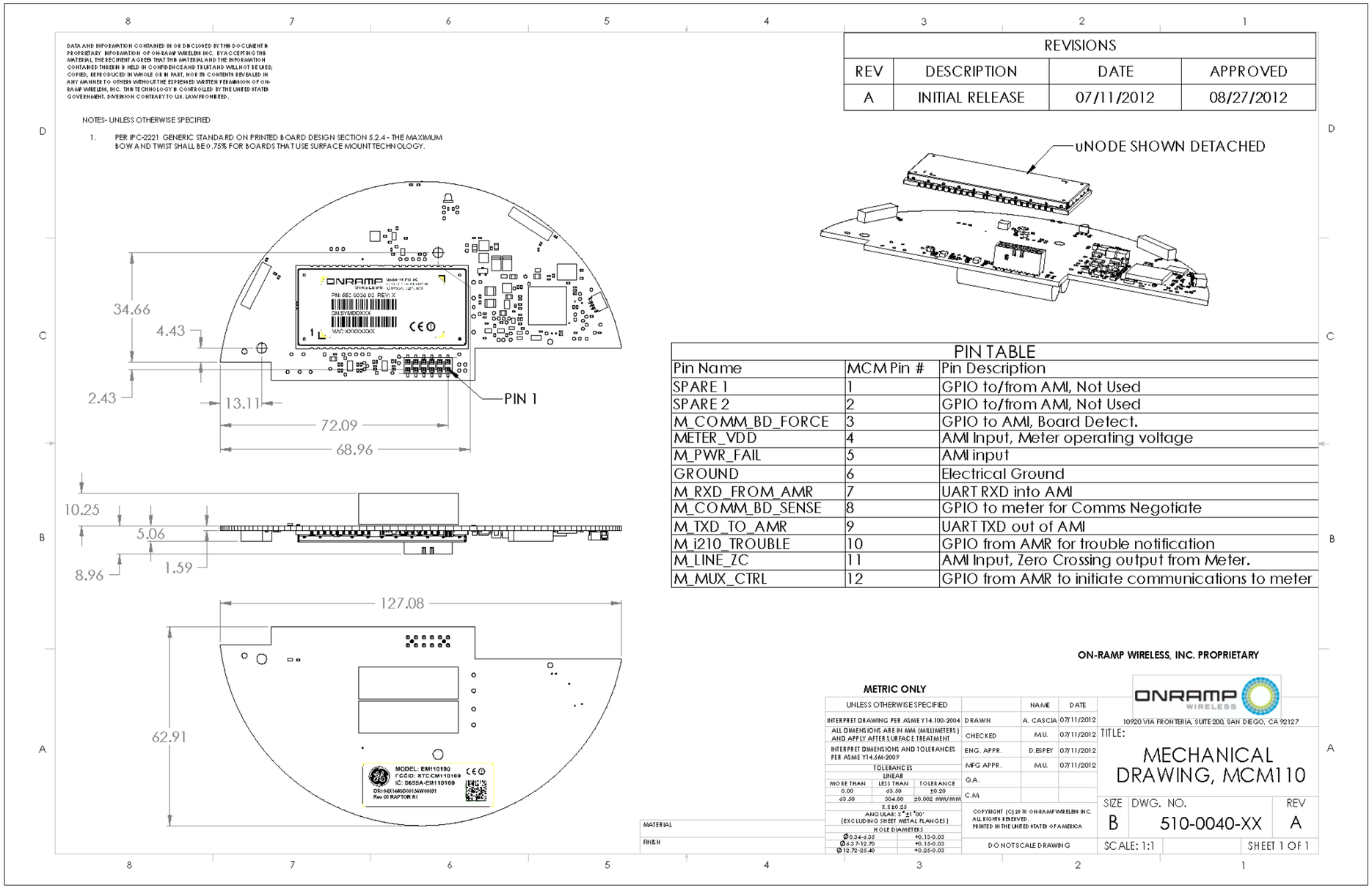
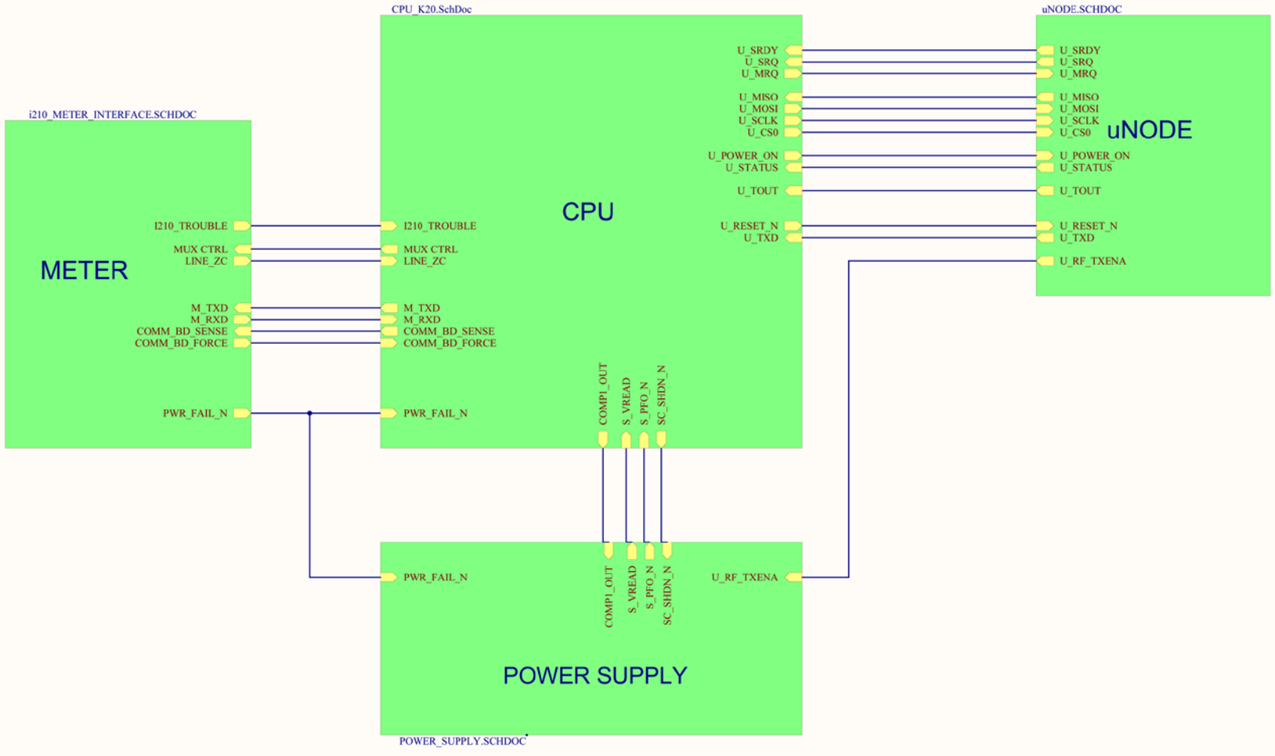


Figure 10. Raptor Mechanical Dimensions

REV	ECO / TRAC#	Description	Eng Approval	Date

RAPTOR BOARD



Fiducials

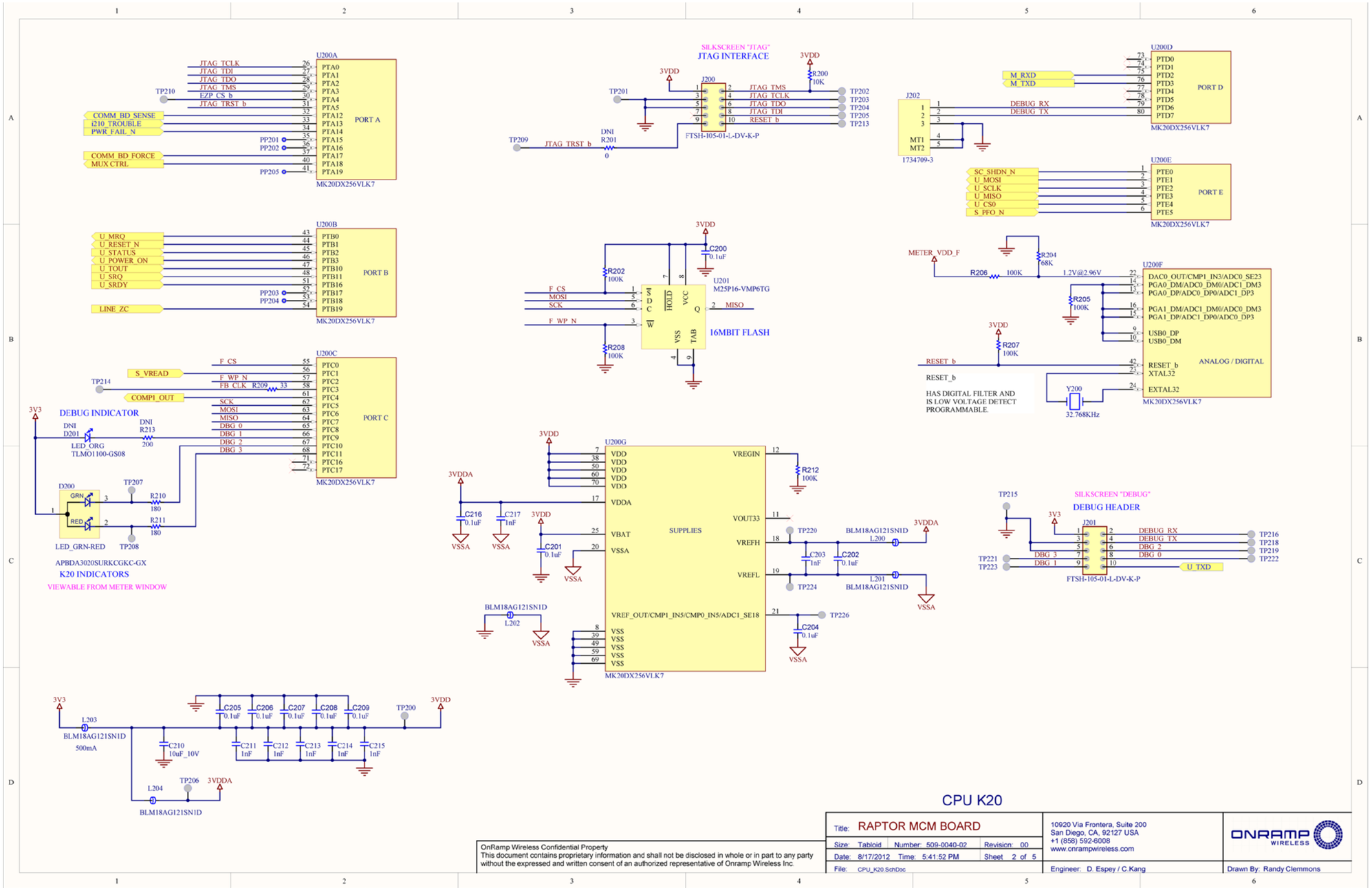
NOTES:

1) TEST POINTS MUST BE PLACED ON TOP OF BOARD,

2) SOTWARE NEEDS TO ASSERT PULLUPS ON UN-USED PINS.

TOP LEVEL

Title: RAPTOR MCM BOARD			10920 Via Frontera, Suite 200 San Diego, CA, 92127 USA +1 (858) 592-6008 www.onrampwireless.com
Size: Tabloid	Number: 509-0040-02	Revision: 00	
Date: 8/17/2012 Time: 5:41:52 PM	Sheet 1 of 5		
File: MCM_TOP.SCHDOC		Engineer: D. Espey / C.Kang	Drawn By: Randy Clemmons


U200A
JTAG_TCLK
JTAG_TDI
JTAG_TDO
JTAG_TMS
EZP_CS_b
JTAG_TRST_b
TP210
COMM_BD_SENSE
i210_TROUBLE
PWR_FAIL_N
COMM_BD_FORCE
MUX CTRL
PP201
PP202
PP205
PORT A
MK20DX256VLK7
SILKSCREEN "JTAG"
JTAG INTERFACE
3VDD
R200
10K
J200
TP201
TP202
TP203
TP204
TP205
TP213
JTAG_TMS
JTAG_TCLK
JTAG_TDO
JTAG_TDI
RESET_b
TP209
JTAG_TRST_b
DNI
R201
0
FTSH-105-01-L-DV-K-P
U200D
M_RXD
M_TXD
J202
DEBUG_RX
DEBUG_TX
MT1
MT2
1734709-3
PORT D
MK20DX256VLK7
U200E
SC_SHDN_N
U_MOSI
U_SCLK
U_MISO
U_CS0
S_PFO_N
PORT E
MK20DX256VLK7
U200B
U_MRQ
U_RESET_N
U_STATUS
U_POWER_ON
U_TOUT
U_SRQ
U_SRDY
LINE_ZC
PP203
PP204
PORT B
MK20DX256VLK7
3VDD
C200
0.1uF
R202
100K
F_CS
MOSI
SCK
F_WP_N
U201
M25P16-VMP6TG
MISO
16MBIT FLASH
R208
100K
METER_VDD_F
R206
100K
R204
68K
1.2V@2.96V
R205
100K
U200F
DAC0_OUT/CMP1_IN3/ADC0_SE23
PGA0_DM/ADC0_DM0/ADC1_DM3
PGA0_DP/ADC0_DP0/ADC1_DP3
PGA1_DM/ADC1_DM0/ADC0_DM3
PGA1_DP/ADC1_DP0/ADC0_DP3
USB0_DP
USB0_DM
RESET_b
XTAL32
EXTAL32
ANALOG / DIGITAL
MK20DX256VLK7
R207
100K
RESET_b
HAS DIGITAL FILTER AND
IS LOW VOLTAGE DETECT
PROGRAMMABLE.
Y200
32.768KHz
U200C
PTC0
PTC1
PTC2
PTC3
PTC4
PTC5
PTC6
PTC7
PTC8
PTC9
PTC10
PTC11
PTC16
PTC17
PORT C
MK20DX256VLK7
S_VREAD
TP214
COMPI_OUT
F_CS
F_WP_N
FB_CLK_R209
SCK
MOSI
MISO
DBG_0
DBG_1
DBG_2
DBG_3
3V3
DEBUG INDICATOR
DNI
D201
LED_ORG
TLMO1100-GS08
DNI
R213
200
D200
GRN
RED
R210
180
R211
180
TP207
TP208
LED_GRN-RED
APBDA3020SURKCGKC-GX
K20 INDICATORS
VIEWABLE FROM METER WINDOW
U200G
VDD
VDDA
VREGIN
VBAT
VOUT33
VREFH
VREFL
VSSA
VREF_OUT/CMP1_IN5/CMP0_IN5/ADC1_SE18
VSS
SUPPLIES
MK20DX256VLK7
R212
100K
3VDDA
C216
0.1uF
C217
1nF
C201
0.1uF
VSSA
TP220
BLM18AG121SN1D
L200
C203
1nF
C202
0.1uF
TP224
L201
BLM18AG121SN1D
TP226
C204
0.1uF
L202
BLM18AG121SN1D
TP215
SILKSCREEN "DEBUG"
DEBUG HEADER
J201
DEBUG_RX
DEBUG_TX
DBG_2
DBG_0
DBG_3
DBG_1
U_TXD
TP216
TP218
TP219
TP222
TP221
TP223
FTSH-105-01-L-DV-K-P
L203
BLM18AG121SN1D
500mA
C205
C206
C207
C208
C209
0.1uF
TP200
C210
10uF_10V
C211
C212
C213
C214
C215
1nF
L204
BLM18AG121SN1D
TP206
CPU K20
Title: RAPTOR MCM BOARD
Size: Tabloid
Number: 509-0040-02
Revision: 00
Date: 8/17/2012
Time: 5:41:52 PM
Sheet 2 of 5
File: CPU_K20.SchDoc
10920 Via Frontera, Suite 200
San Diego, CA, 92127 USA
+1 (858) 592-6008
www.onrampwireless.com
Engineer: D. Espey / C.Kang
Drawn By: Randy Clemmons
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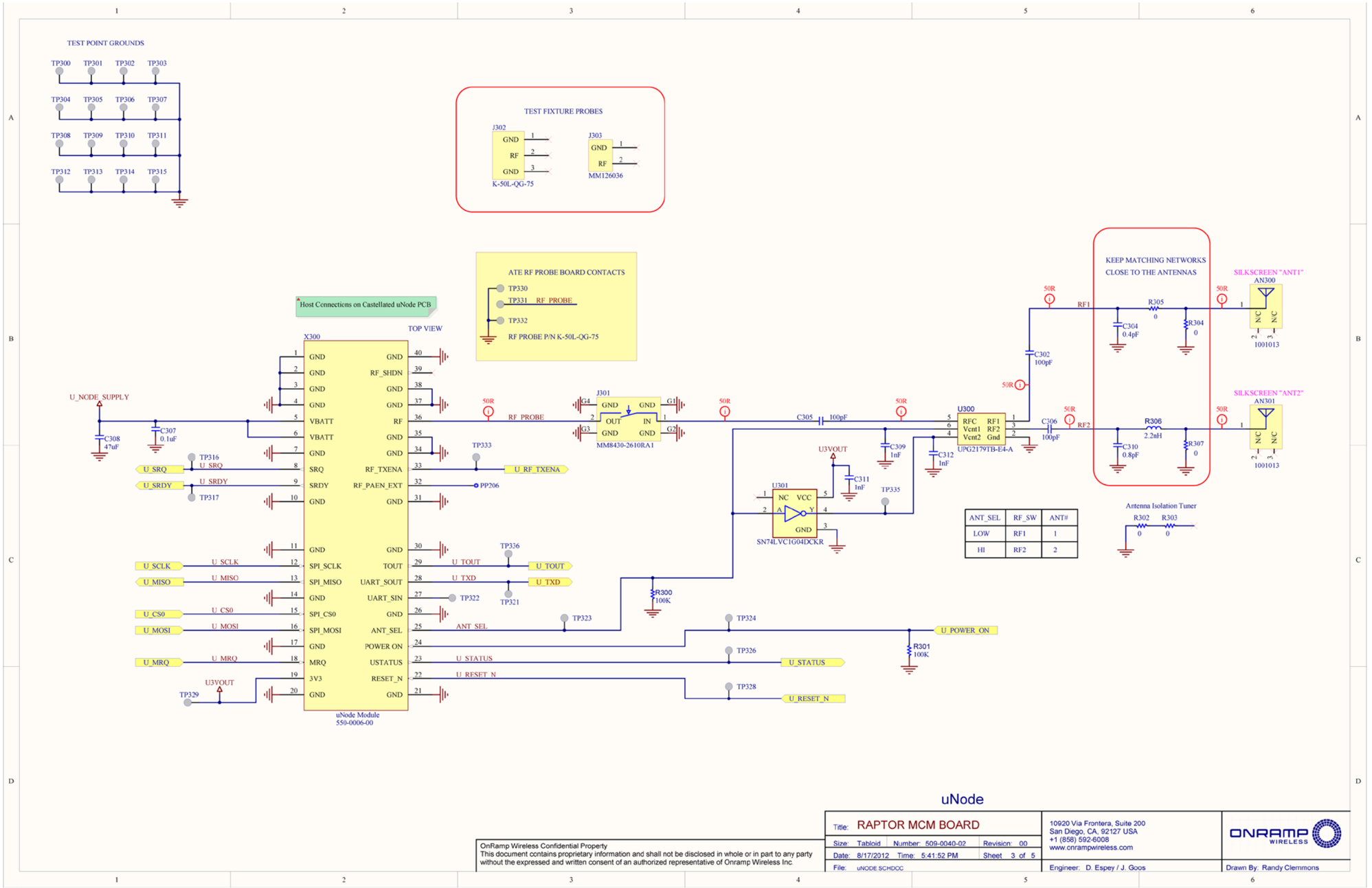
TEST POINT GROUNDS
TP300 TP301 TP302 TP303
TP304 TP305 TP306 TP307
TP308 TP309 TP310 TP311
TP312 TP313 TP314 TP315
TEST FIXTURE PROBES
J302
GND 1
RF 2
GND 3
K-50L-QG-75
J303
GND 1
RF 2
MM126036
ATE RF PROBE BOARD CONTACTS
TP330
TP331 RF_PROBE
TP332
RF PROBE P/N K-50L-QG-75
Host Connections on Castellated uNode PCB
TOP VIEW
X300
GND GND 40
GND RF_SHDN 39
GND GND 38
GND GND 37
VBATT RF 36
VBATT GND 35
GND GND 34
SRQ RF_TXENA 33
SRDY RF_PAEN_EXT 32
GND GND 31
GND GND 30
SPI_SCLK TOUT 29
SPI_MISO UART_SOUT 28
GND UART_SIN 27
SPI_CS0 GND 26
SPI_MOSI ANT_SEL 25
GND POWER ON 24
MRQ USTATUS 23
3V3 RESET_N 22
GND GND 21
uNode Module
550-0006-00
U_NODE_SUPPLY
C308 47uF
C307 0.1uF
TP316 U_SRQ
TP317 U_SRDY
U_SCLK
U_MISO
U_CS0
U_MOSI
U_MRQ
U3VOUT
TP329
RF_PROBE
TP333
U_RF_TXENA
PP206
TP336
U_TOUT
U_TXD
TP321
TP322
TP323
ANT_SEL
TP324
U_POWER_ON
R301 100K
TP326
U_STATUS
U_RESET_N
TP328
R300 100K
J301
G4 GND GND G1
OUT IN
G3 GND GND G2
MM8430-2610RA1
C305 100pF
U300
RFC RF1
Vcnt1 RF2
Vcnt2 Gnd
UPG2179TB-E4-A
C302 100pF
C306 100pF
C309 1nF
C312 1nF
C311 1nF
U3VOUT
U301
NC VCC
A Y
GND
SN74LVC1G04DCKR
TP335
50R
RF1
RF2
KEEP MATCHING NETWORKS
CLOSE TO THE ANTENNAS
R305 0
R304 0
C304 0.4pF
R306 2.2nH
R307 0
C310 0.8pF
SILKSCREEN "ANT1"
AN300
SILKSCREEN "ANT2"
AN301
NC NC
1001013
ANT_SEL RF_SW ANT#
LOW RF1 1
HI RF2 2
Antenna Isolation Tuner
R302 0
R303 0
uNode
Title: RAPTOR MCM BOARD
Size: Tabloid Number: 509-0040-02 Revision: 00
Date: 8/17/2012 Time: 5:41:52 PM Sheet 3 of 5
File: uNODE SCHDOC
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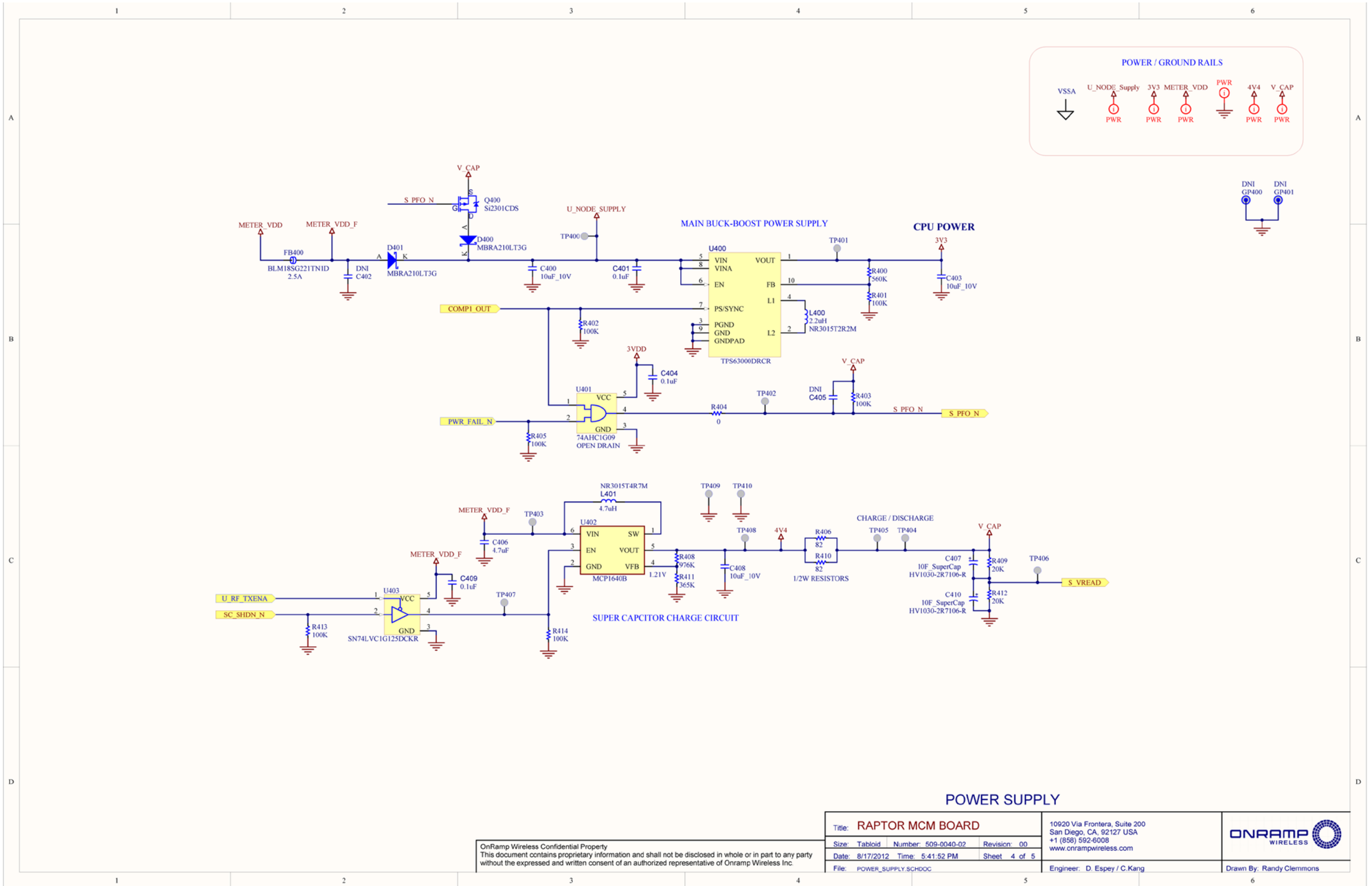
POWER / GROUND RAILS
VSSA
U_NODE_Supply
3V3
METER_VDD
PWR
4V4
V_CAP
DNI GP400
DNI GP401
MAIN BUCK-BOOST POWER SUPPLY
CPU POWER
V_CAP
S_PFO_N
Q400 Si2301CDS
U_NODE_SUPPLY
METER_VDD
METER_VDD_F
FB400 BLM18SG221TN1D 2.5A
DNI C402
D401 MBRA210LT3G
D400 MBRA210LT3G
C400 10uF_10V
C401 0.1uF
TP400
U400
VIN
VINA
EN
PS/SYNC
PGND
GND
GNDPAD
VOUT
FB
L1
L2
TPS63000DRCR
TP401
R400 560K
R401 100K
C403 10uF_10V
3V3
L400 2.2uH NR3015T2R2M
COMP1_OUT
R402 100K
3VDD
C404 0.1uF
U401
VCC
GND
74AHC1G09 OPEN DRAIN
PWR_FAIL_N
R405 100K
R404 0
TP402
DNI C405
R403 100K
S_PFO_N
NR3015T4R7M L401 4.7uH
TP409
TP410
METER_VDD_F
TP403
C406 4.7uF
U402
VIN
EN
GND
SW
VOUT
VFB
MCP1640B
R408 976K
R411 365K
1.21V
TP408
4V4
C408 10uF_10V
R406 82
R410 82
1/2W RESISTORS
CHARGE / DISCHARGE
TP405
TP404
V_CAP
C407 10F_SuperCap HV1030-2R7106-R
C410 10F_SuperCap HV1030-2R7106-R
R409 20K
R412 20K
TP406
S_VREAD
METER_VDD_F
C409 0.1uF
U403
VCC
GND
SN74LVC1G125DCKR
U_RF_TXENA
SC_SHDN_N
R413 100K
TP407
R414 100K
SUPER CAPCITOR CHARGE CIRCUIT
POWER SUPPLY
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Title: RAPTOR MCM BOARD
Size: Tabloid Number: 509-0040-02 Revision: 00
Date: 8/17/2012 Time: 5:41:52 PM Sheet 4 of 5
File: POWER_SUPPLY.SCHDOC
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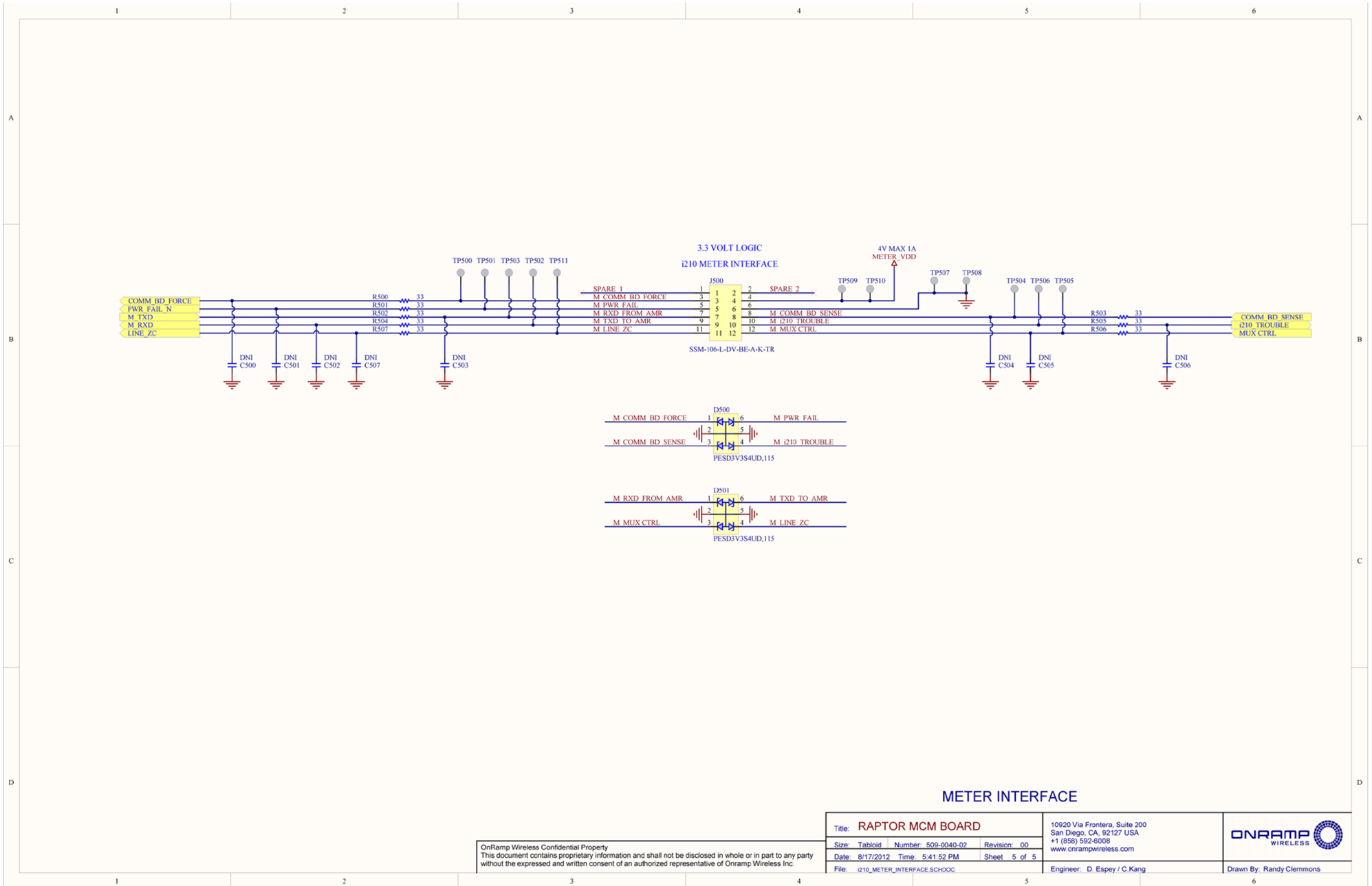
3.3 VOLT LOGIC
i210 METER INTERFACE
4V MAX 1A
METER_VDD
TP500 TP501 TP503 TP502 TP511
TP509 TP510
TP507 TP508
TP504 TP506 TP505
J500
SSM-106-L-DV-BE-A-K-TR
SPARE_1
M_COMM_BD_FORCE
M_PWR_FAIL
M_RXD_FROM_AMR
M_TXD_TO_AMR
M_LINE_ZC
SPARE_2
M_COMM_BD_SENSE
M_i210_TROUBLE
M_MUX CTRL
COMM_BD_FORCE
PWR_FAIL_N
M_TXD
M_RXD
LINE_ZC
COMM_BD_SENSE
i210_TROUBLE
MUX CTRL
R500 R501 R502 R504 R507
R503 R505 R506
33
DNI C500 DNI C501 DNI C502 DNI C507 DNI C503
DNI C504 DNI C505 DNI C506
D500
M_COMM_BD_FORCE
M_PWR_FAIL
M_COMM_BD_SENSE
M_i210_TROUBLE
PESD3V3S4UD,115
D501
M_RXD_FROM_AMR
M_TXD_TO_AMR
M_MUX CTRL
M_LINE_ZC
PESD3V3S4UD,115
METER INTERFACE
Title: RAPTOR MCM BOARD
Size: Tabloid Number: 509-0040-02 Revision: 00
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File: i210_METER_INTERFACE.SCHDOC
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