GE IEC eMCM Integration Specification

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GE IEC eMCM Integration Specification

014-0047-00 Rev. D

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Revision History

Revision	Release Date	Change Description
A	December 4, 2012	Initial release
B	March 11, 2013	Updated: ■ Document reference list in the Overview chapter ■ Provisioning Process and Work Flow information Added: ■ New chapter on Operating and Troubleshooting
C	May 13, 2013	Updated product names, block diagrams, and regulatory/certification information.
D	March 26, 2014	Updated to reflect new documentation standards and added new references. Added information related to REACH, RoHS, and export compliance.

1 Overview

The purpose of this document is to provide guidelines that allow an integrator to design a host product that uses the GE IEC electric Meter Communications Module (eMCM) for residential and commercial IEC-type meter applications. The GE IEC eMCM is an On-Ramp Wireless AMI circuit board that is designed to work with SGM3000 series meters. There are two eMCM models:

- An eMCM circuit board for IEC meters with ***internal antennas*** (PN 550-0015); Zigbee is optional
- An eMCM circuit board for IEC meters with ***external antennas***(PN 550-0017); Zigbee is optional

NOTE: Going forward throughout this document, the eMCM for IEC meters will be referred to as the eMCM.

1.1 On-Ramp Wireless Total Reach Network

The On-Ramp Wireless Total Reach Network is comprised of host modules, such as eMCM circuit boards equipped with microNodes and Access Points (APs). The network operates in the unlicensed 2.4 GHz ISM band. The eMCM circuit boards are designed to easily integrate into electric meters, through standard interfaces, enabling robust wireless communication with one or more APs interfaced with a service provider's local or wide area network.

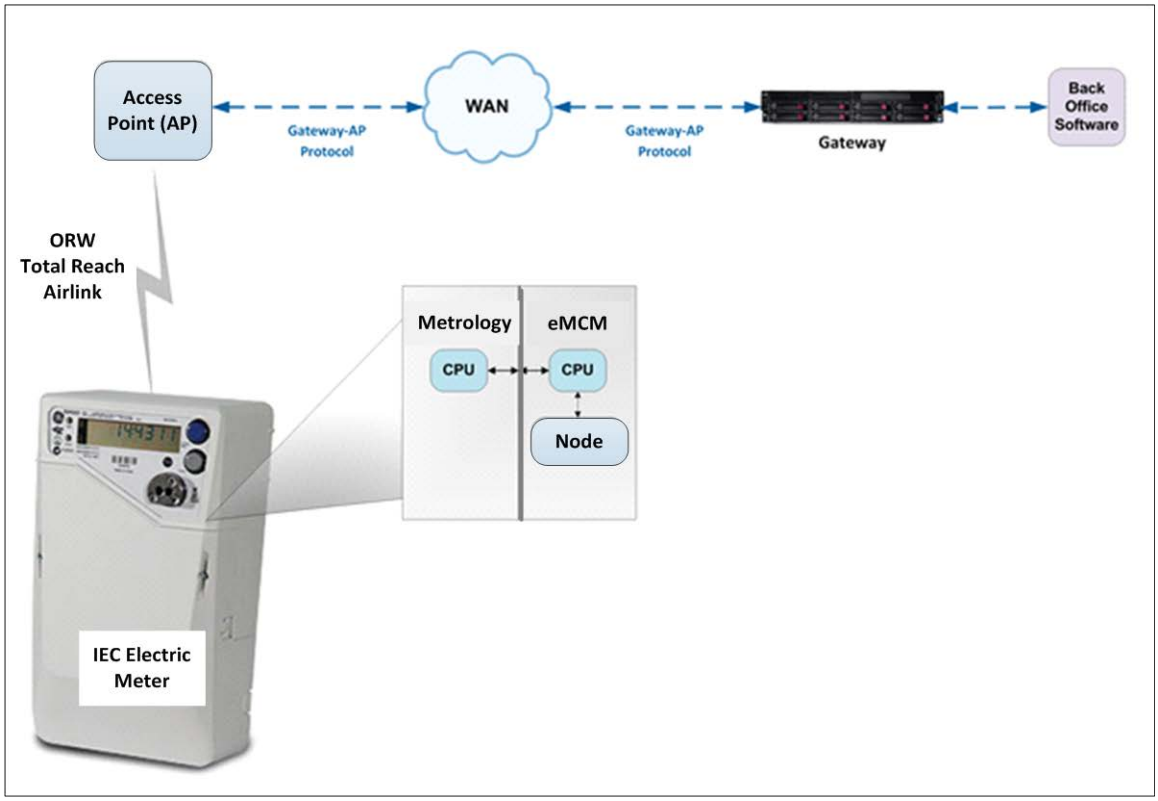


Figure 1. On-Ramp Wireless Total Reach Network

1.2 Referenced Documents and Tools

The following documents are referenced and provide more detail:

- **EMC Compliance Guide (010-0037-00)**
  Provides information for "driving" the eMCM through various modes in order to perform regulatory tests for FCC and ETSI.
- **ETSI EMC Test Reports for the IEC eMCM**
  EMC test reports from third party labs authorized to conduct these tests for the IEC eMCM.
- **ATE Transmit Test Mode Guide (010-0089-00)**
  This guide is useful for the provisioning factory where an On-Ramp Wireless eMCM is integrated into the meter. It provides information for factory testing the transmitter and antenna ports of the device including commands that allow the test station to force the eMCM DUT to "transmit" for TX measurement in order to determine whether the eMCM and antennas are working as expected.
- **Provisioning Guide (010-0074-00)**
  Describes the setup, configuration, and provisioning of Nodes with security keys during production.
- **Node Host Message Specification (014-0020-00)**
  Provides details relating to Node Host commands and messages.
- **GE Energy, Operating Level Procedure (OLP): On-Ramp Wireless' Meter Communication Module**
  Describes the incoming/outgoing inspection and RMA process. This is a GE document.
- **Return Material Authorization Procedure (008-0047-00)**
  Describes the handling and RMA process between GE and On-Ramp Wireless.
- **microNode Label Specification (014-0031-00)**
  This document specifies label and revision information for the microNode, which is part of the eMCM.
- **IEC eMCM Label Specification (014-0051-00)**
  This document specifies the main label on the IEC eMCM printed circuit assembly (PCA).
- **RF Deployment Test Tool (590-0038) and User Guide (010-0119-00)**
  The RF Deployment Test Tool is a handheld, battery-powered device that measures the Received Signal Strength (RSSI) of the network in the immediate deployment area of the meter.

2 Safety Considerations

Danger: High Voltages

When an eMCM is integrated into a meter, high voltages may be present:

CAUTION: When an eMCM is mounted in an SGM3000 series meter, the term "GND" or "Ground" does NOT refer to Earth ground. The SGM3000 is designed to provide isolation to the AMI module (i.e., the eMCM). However, it is recommended that additional isolation be used as a precaution.

The power supply from the SGM3000 to the eMCM is isolated to 18kV. However, it is recommended that you use the following isolation/drivers as an added safety precaution.

Isolator:

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

UART:

This cable is defined by On-Ramp Wireless part number (PN) 210-0023-00.

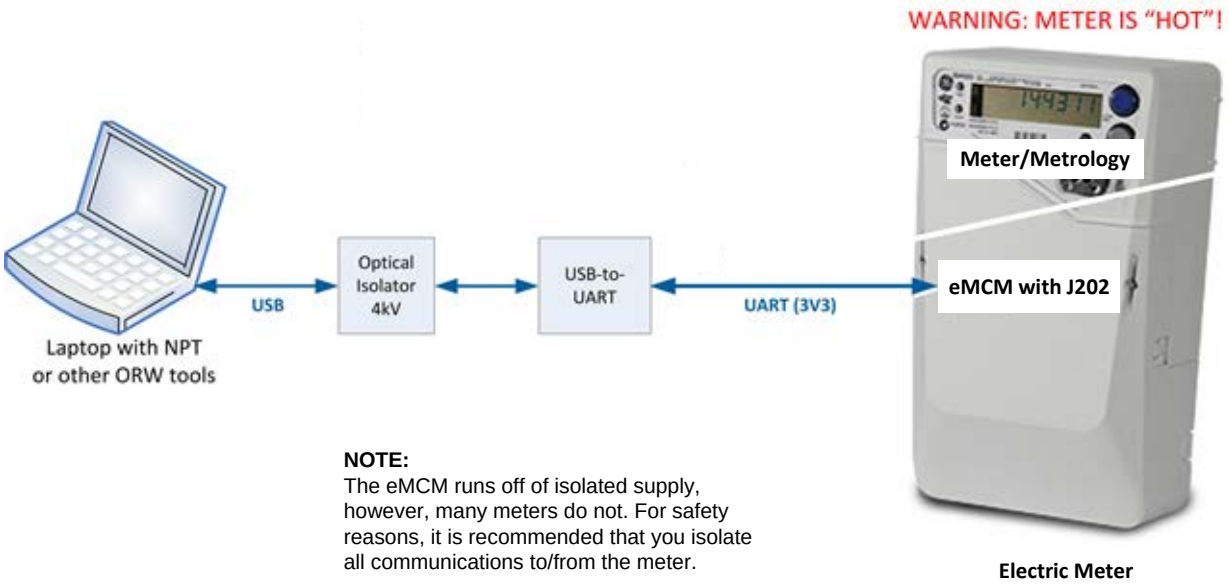


Figure 2. Meter Test Connection Diagram

3 DC and RF Characteristics

3.1 Absolute Maximum Ratings

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

Table 1. Absolute Maximum Ratings

Parameter	Min	Max	Unit
Storage Temperature (Ts)	-40	85	ºC
Ambient Temperature (Ta)	-40	85	ºC
Input Voltage (VBATT)	5	18.0	V

3.2 Recommended Operating Conditions

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

Table 2. Operating Conditions

Parameter	Min	Nominal	Max	Unit
Ambient Temperature (Ta)	-40	25C	85	ºC
Input voltage (VBATT)	8.0	12.0V	16.0	V

3.3 Operating Characteristics for all Models

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

Table 3. Operating Characteristics

Parameter	eMCM Module
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), factory configurable	+10 dBm (ETSI markets includes peak internal/external antenna gain) +21 dBm (FCC)
Receive Sensitivity	-134 dBm (includes peak internal or external antenna gain)
Antenna Options	Integrated antenna diversity **or** external antenna diversity
Data Throughput	60 kbps (at access point in 1 MHz channel bandwidth)
Maximum Allowable Path Loss	172 dB (FCC)
TX Burst Time	≈ 2.2 Seconds

Parameter	eMCM Module
RX Burst Time	≈ 2.5 Seconds
Current Consumption	0.10A max. @ 12VDC (during TX[1]) 0.13A max. @ 12VDC (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	FCC, ETSI, and ICASA. For more information relating to certifications, see section 5.3. **NOTE:** Meter ANSI and Unintentional Radiator certifications are 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. However under manual control (not a link) this current could be up to 0.14A.

NOTE 2: During RX mode the supercap charger is enabled. The supercap charge current is limited to about 40mA at 12VDC input.

4 Electrical Interface

This chapter describes the electrical interface for the eMCM (with internal antennas) and the eMCM (with external antennas).

4.1 Signal Connectors

Each of the sides of the eMCM printed circuit boards are shown in Figure 3: eMCM with Interal Antennas and Figure 4: eMCM with External Antennas.

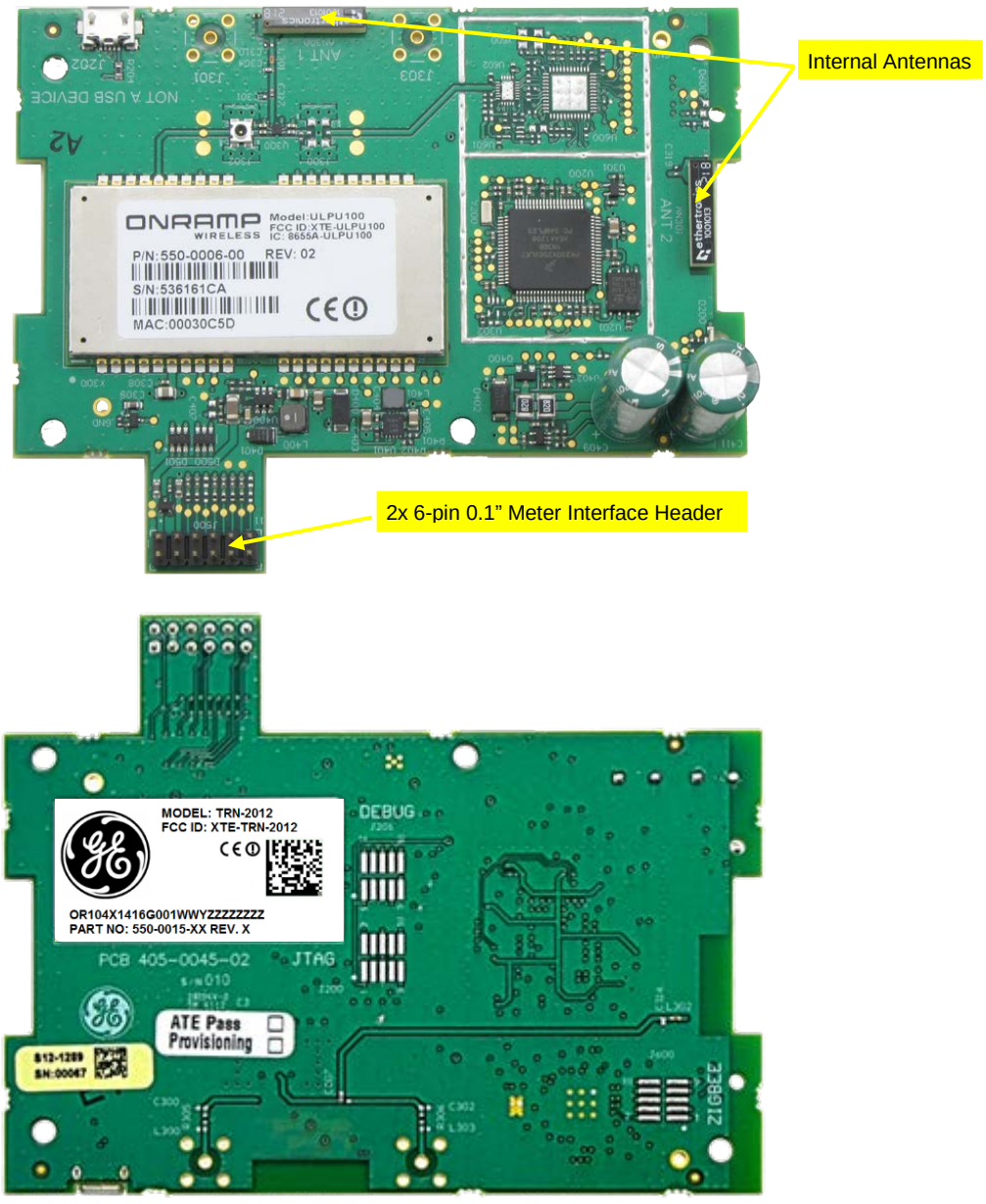


Figure 3. eMCM with Internal Antennas (Top and Bottom Views)

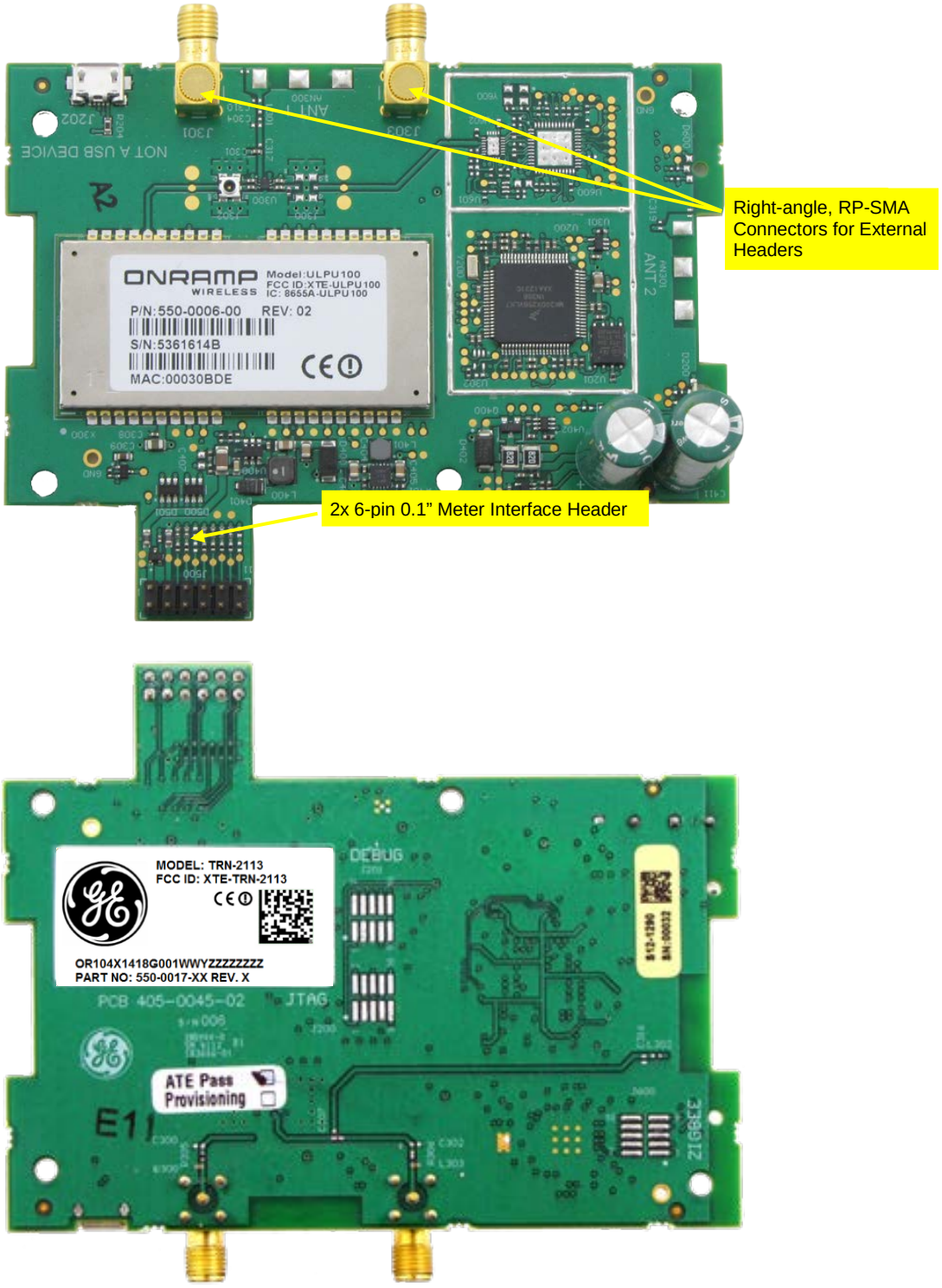


Figure 4. eMCM with External Antennas (Top and Bottom Views)

4.2 Pin and Signal Descriptions

4.2.1 Main Signal Connector

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

Table 4. Pins and Signals for J500 Signal and Power Connector

eMCM Pin #	Pin Name	Signal Description
1	DC Power input	12VDC input to the eMCM from the meter.
2	3.3VDC Power output	3.3V regulated power supply from the eMCM to the meter interface.
3	GROUND	Meter ground
4	GROUND	Meter ground
5	RESET_b	Reset signal from meter, active low.
6	M_RXD	Meter UART TXD, 9600 baud rate, 8bit data, 0 stop, 1 parity.
7	M_TXD	Meter UART RXD
8	M_SPARE0_F	Spare 0 is not used.
9	M_PWR_FAIL	Power fail signal from meter, active low = fail.
10	M_TROUBLE_MTR	Trouble signal from meter; 3.3V active high = trouble.
11	M_SPARE1_F	Spare 1 is not used.
12	M_TROUBLE_AMI	Trouble signal from the eMCM; 3.3V active high = trouble.

4.2.2 RF Connectors

The eMCM with external antennas has two reverse polarity SMA jack connectors for connection to external antennas. The proper mating connector is an SMA reverse polarity plug. The proper tightening torque is 80 N-cm (7 in-lbs).

4.3 Environmental

4.3.1 ESD

The eMCM circuit boards have ferrite beads, series resistors, and bidirectional ESD protection diodes on its 8 digital I/O pins providing protection to IEC 61000-4-2; level 4.

Table 5. ESD Rating

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

The SMA connectorized models have protection in the form of an inductor to ground, thus allowing some robustness to direct ESD strikes. The internal antenna models are encapsulated in the polycarbonate housing of the meter – so there is little chance of high voltages on the internal antennas.

4.3.2 Harsh Environments

The eMCM circuit boards are designed to be embedded into enclosed protective shells. They are not designed to be exposed to outdoor environments without a case or similar protection. The casing of the meter nominally provides robustness to harsh environments and has been tested to and meets IP 54 standards.

5 Regulatory Considerations

The eMCM model with internal antennas uses two integral diversity antennas for half-duplex communication. In contrast, the eMCM model with external antennas uses reverse polarity SMA connectors for external antenna connections. On-Ramp Wireless provides a separate FCC modular approval certification as well as ETSI certification for both models. Documents and test results are available to system integrators for review.

5.1 Block Diagrams

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

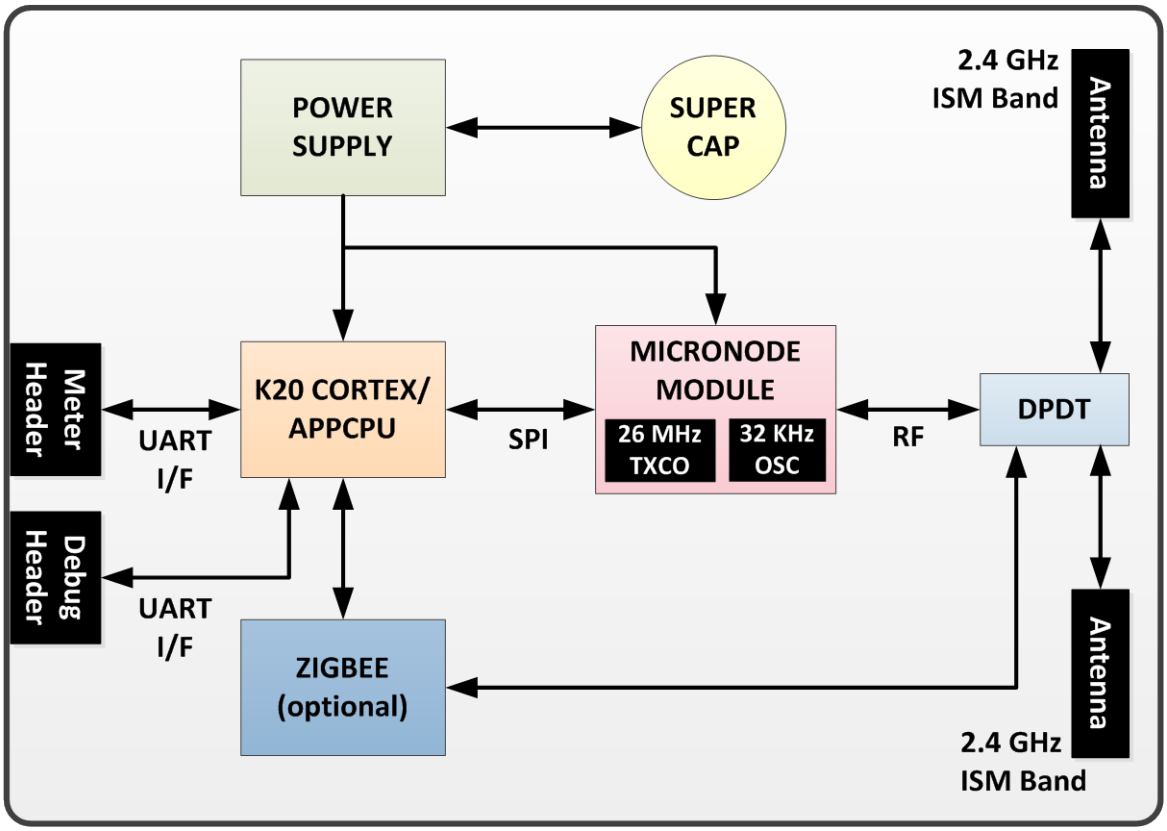


Figure 5. Block Diagram for eMCM with Internal Antennas

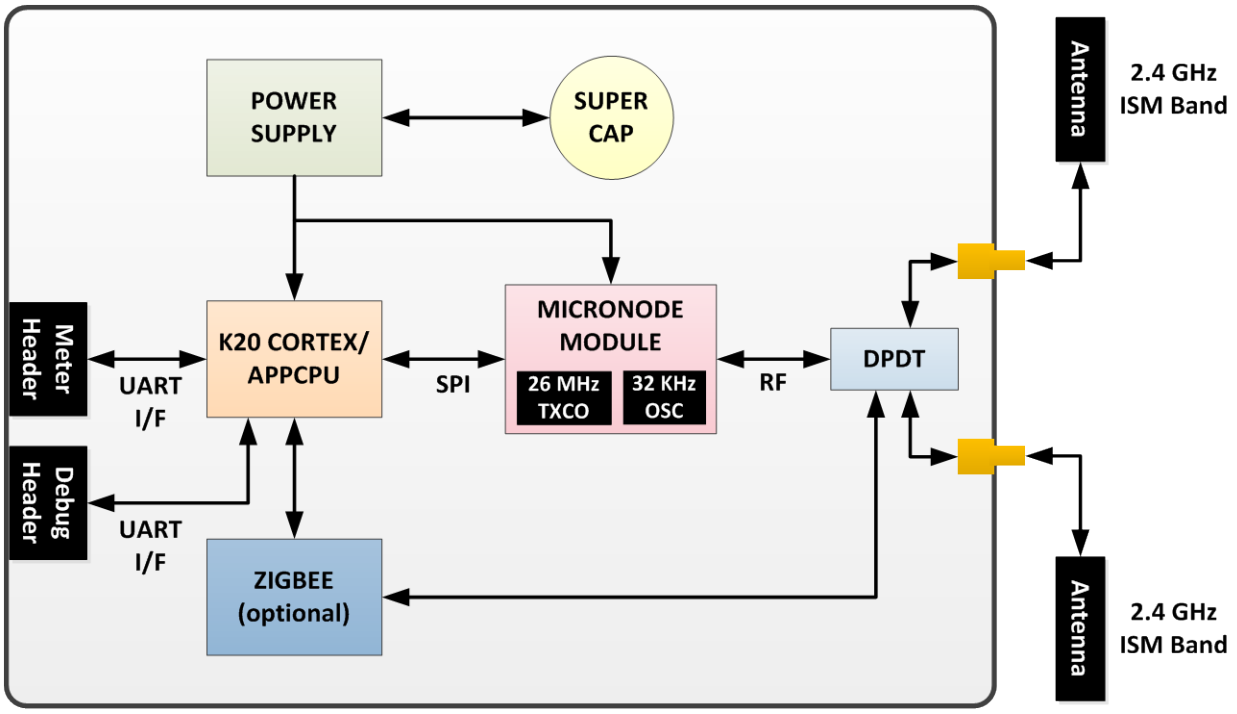


Figure 6. Block Diagram for eMCM with External Antennas

5.2 Antennas

The eMCM model with internal antennas has been certified to operate with the built-in (PCB chip) antenna (Ethertronics, PN: 1001013) and the eMCM model with external antennas has been certified to operate with the external paddle antenna (L-COM, PN: SP70550). Adherence to these EMC certifications requires that any antenna used has to be of the same type and equal of lesser gain than the antennas used. All other antennas of different type and/or with greater peak gain are strictly prohibited for use with the either of the eMCM models unless new EMC certifications are obtained.

Table 6. On-Ramp Wireless EMC Certified Antennas for eMCMs

Product	Manufacturer	Part Number	Gain	Type	Comments
eMCM with Internal Antennas	Ethertronics	1001013	2.1 dBi	Monopole	Internal PCB chip antenna
eMCM with External Antennas	L-COM	SP70550	4.72 dBi	Monopole	External SMA connectorized paddle antenna

For the eMCM model with external antennas, customers are free to follow one of two paths in their final product:

- Customers can use a monopole antenna with a gain ≤4.72 dBi. This path allows customers to use On-Ramp Wireless' modular certifications. While ideal from the perspective of program cost and schedule, the ability to reuse this antenna is highly dependent on the application.
- Customers can recertify the final product with any antenna type and gain desired. In the case of FCC EMC certifications, it is almost always required for the final product to be recertified with the Node. If this is the case, note that the recertification increases the required time to introduce the final product with the new antenna. In addition, a final product different from a Falcon meter is almost always required to validate the conducted emission limits.

5.3 EMC Certifications

Both models of the eMCM are designed to meet regulations for world-wide use. They have EMC modular approval certifications in the United States, Europe, and South Africa. These certifications allow the eMCMs to be installed in any final product in Europe, South Africa, and the United States and only Unintentional Radiator testing is required for the final product. This saves cost and time for System Integrators. The certifications currently achieved are listed in the following table.

Table 7. EMC Compliance Certifications for the eMCMs

Country	Certifying Agency	Certification(s)
United States	Federal Communications Commission (FCC)	■ 15.207 for power-line conducted emissions. ■ 15.215 for RF TX bandwidth, power, conducted and radiated emissions.
Europe	European Telecommunications Standards Institute (ETSI)	■ 300 440-1 and 440-2, ETSI Emissions. ■ 301 489-1, ETSI Immunity.
South Africa	ICASA	■ SABS CoC (EMC, based on ETSI)

The integrator of the final product is often required to do additional compliance tests. The integration application and market will determine the specifics. The integrator is advised to consult with local experts in compliance certifications for complete information.

- **FCC**
  Both models of the eMCM are Single-Modular Certified, therefore the final product may only need Class B unintentional radiator and power-line conducted emissions tests. This should be done with the actual production antenna.
- **ETSI**
  Europe's system is a self-declaration system. There are no documents to submit or certification grants to obtain. One must have the passing test results available for all applicable requirements at any time if challenged.
- Other countries will vary.

5.4 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.

Modifications: 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.**

5.5 ETSI Summary

Table 8. ETSI EN 301 489-1 V1.9.2 (2011-09) Radio and Ancillary Equipment for Fixed Use

Section	Spec Clause	Test Description	Result	Comments
-	8.2	Enclosure of ancillary equipment measured on a standalone basis	N/A	EN55022
-	8.3	DC power input/output ports	N/A	EN55022
-	8.3	DC power input ports (vehicular environment)	N/A	EN55022
2.1	8.4	AC mains power input/output ports	Compliant	EN55022
-	8.5	Harmonic current emission (AC mains input port)	N/A	EN 61000-3-2
-	8.6	Voltage fluctuations and flicker	N/A	EN 61000-3-3
-	8.7	(AC mains input ports) Telecommunication ports	N/A	EN55022

Section	Spec Clause	Test Description	Result	Comments
2.2	9.2	Radio frequency electromagnetic field (80 MHz to 1 000 MHz and1 400 MHz to 2 700 MHz)	Compliant	EN 61000-4-3
-	9.3	Electrostatic discharge	N/A	EN 61000-4-2
-	9.4	Fast transients common mode	N/A	EN 61000-4-4
-	9.5	Radio frequency common mode	N/A	EN 61000-4-6
-	9.6	Transients and surges in the vehicular environment	N/A	ISO 7637-2
-	9.7	Voltage dips and interruptions	N/A	EN 61000-4-11
-	9.8	Surges	N/A	EN 61000-4-5
-	B.2.1	Broadband electromagnetic interference (emissions) generated by the ESA	N/A	CISPR 25
-	B.2.2	Narrowband electromagnetic interference (emissions) generated by the ESA	N/A	CISPR 25
-	B.2.3	Immunity of the ESA to transient disturbances conducted along the supply lines	N/A	ISO 7637-2
-	B.2.4	Conducted disturbances (emissions) caused by the ESA	N/A	ISO 7637-2

Table 9. ETSI EN 300 440-2 V1.4.1 (2010-08) Electromagnetic Compatibility and Radio Spectrum Matters (ERM)

Section	Spec Clause	Test Description	Result	Comments
2.1	4.2.1.1	Equivalent Isotropic Radiated Power	Compliant	
-	4.2.1.2	Permitted Range Of Operating Frequencies	N/A	Results from RF module applies
2.2	4.2.1.3	Unwanted Emissions In The Spurious Domain	Compliant	
-	4.2.1.4	Duty Cycle	N/A	
-	4.2.2.1	Adjacent Channel Selectivity	N/A	
-	4.2.2.2	Blocking Or Desensitization	N/A	Results from RF module applies
2.3	4.2.2.3	Receiver Spurious Radiations	Compliant	
-	4.2.3	2, 45 GHz RFID Systems	N/A	
-	4.2.4.1	Effective Radiated Power	N/A	
-	4.2.4.2	Permitted Range Of Operating Frequencies	N/A	
-	4.2.4.3	DAA Threshold	N/A	
-	4.2.4.3. 1.1	Minimum Listen Time	N/A	
-	4.2.4.3. 1.2	Minimum Listen Time After Detection	N/A	
-	4.2.4.3. 1.3	Maximum Transmit On-Time	N/A	
-	4.2.4.3. 1.4	Minimum Transmit Off-Time	N/A	
-	4.2.4.4	Antenna Pattern	N/A	
-	4.2.4.5	Unwanted Emissions In The Spurious Domain	N/A	

5.6 Usage

FCC ID: XTE-TRN-2012 (or XTE-TRN-2113). 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.

5.6.1 Product Labels

A label showing the FCC ID designator, listed above, must be affixed to the exterior of any device containing the eMCM (if the eMCM is not visible). The exterior label must include: *Contains FCC ID: XTE-TRN-2012 (or XTE-TRN-2113)*.

Representative product labels for both models of the eMCMs are shown in Figure 7 and Figure 8. A carton label sample is shown in Figure 9.

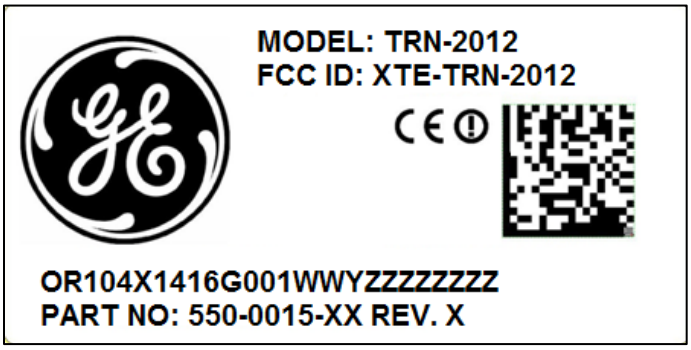


Figure 7. Product Label for the eMCM with Internal Antennas

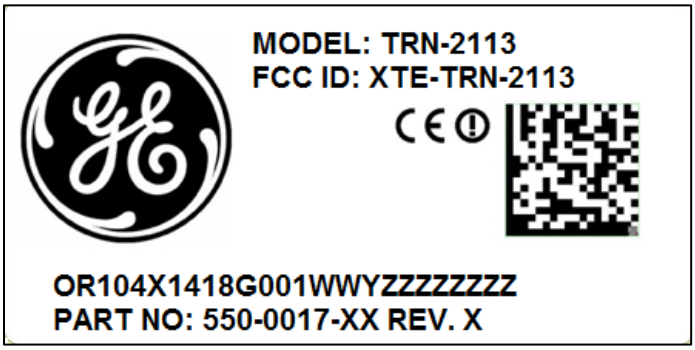


Figure 8. Product Label for the eMCM with External Antennas

Figure 9. Carton Label

5.6.2 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 – 2481 MHz for the ETSI 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.

5.7 WEEE Directive

The WEEE directives do not apply to the eMCM products. Neither the eMCMs nor the microNodes are considered “end products” that would put them under the WEEE initiatives in the EU.

5.8 REACH Directive

The eMCMs are REACH compliant under 1907/2006/EC. This certification is located in Appendix B.

5.9 RoHS Directive

The eMCMs and the microNodes all comply with RoHS directive 2002/95/EC. On-Ramp Wireless has received Certificates of Conformance (CoC) for all components, printed circuit boards, and contract manufacturers for the eMCMs and the microNodes. Copies of the CoCs are stored at On-Ramp Wireless and available upon request. RoHS compliance information is located in Appendix B.

5.10 Export Compliance

The eMCM is export compliant and falls under ECCN EAR99. For details relating to export compliance for the eMCM, refer to CCATS number G145349.

6 Installation of the eMCMs

The TRN-2012 and TRN-2113 circuit boards are simply inserted and removed as shown in the following figures. The two plastic side tabs of the SGM30xx lock the eMCM circuit board into place and the 12-pin connector is easily guided into the SGM30xx connector by form fit. Figure 10 and Figure 11 show how the eMCM circuit boards are mounted inside the meter. The eMCM circuit boards are hot-swappable into the meter.

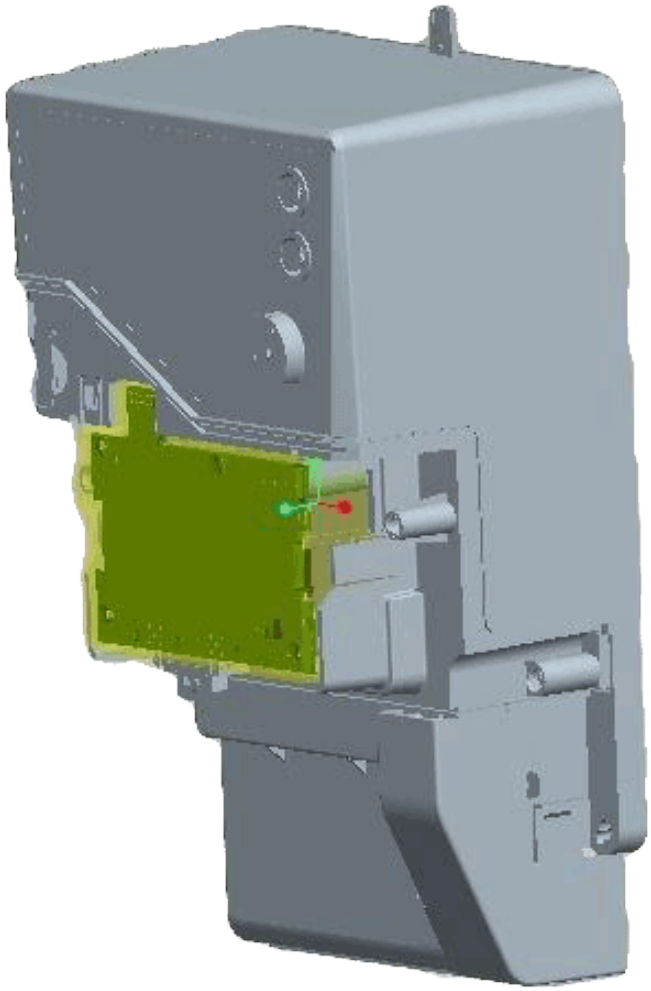


Figure 10. Meter Assembly with the eMCM Circuit Board

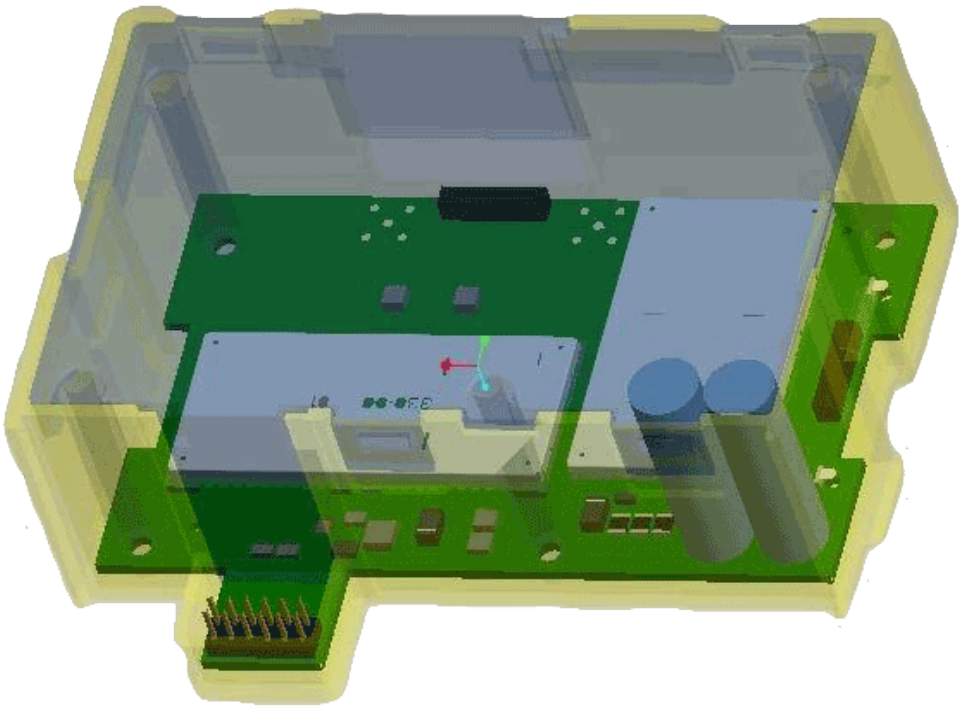


Figure 11. Detail of the eMCM Circuit Board Mounting in Plastic Case

NOTE: When mounting the eMCM circuit board that has external antennas, you must first remove the perforated tabs on the plastic case to allow the antenna connectors to extend outside of the plastic case.

7 Operating and Troubleshooting

This chapter provides an overview of the functionality of the eMCM and how best to troubleshoot any issues.

7.1 Operating

The operating mode of the eMCM is simple in concept but has many nuances. For a pictorial view of the system, refer to Figure 1. On-Ramp Wireless Total Reach Network.

1. When the eMCM powers up, it looks for a wireless Access Point (AP). This could take up to a minute or so, depending on a number of factors.
2. The eMCM uses a channel list that is set up and configured during provisioning at the factory. Provisioning configures the radio channels that the APs should use and the security keys required. The provisioned security keys keep customers isolated so that the eMCM will not join a non-authorized network.
3. When the eMCM finds an appropriate AP, it sends a registration request to the AP and is accepted onto the network, assuming all its security is good and intact.
4. When enabled on the RF network, the eMCM can be controlled by the network and share its meter readings with the network.
5. At a low level, the eMCM is connected to the meter via a 3.3V UART interface (12-pin connector). The physical interface of the eMCM is powered through the meter and gathers other detailed operational status of the meter. Another signal example of the physical interface is a power fail signal. This signal, when asserted, alerts the eMCM that the power is about to go away. The eMCM must then clean up services and send a radio “power fail” message back to the network.
6. Across this physical interface, the eMCM communicates via an ANSI C12.19 protocol. The meter and the eMCM share information in this way.
7. When the network requests a demand reading of the meter’s current energy consumption, the following occurs:
   - The message is sent wirelessly to the eMCM.
   - The eMCM decodes the messages and determines the actions.
   - The eMCM sends a request to the meter.
   - The meter responds to the eMCM with the requested information.
   - The eMCM wirelessly transmits the requested information back to the network, thus completing the action.
8. An asynchronous event in the eMCM is the Power Fail. When the meter detects power has disappeared, it generates a “power fail” to the eMCM. The eMCM receives this digital signal and sends a power-fail back to the network control center. Since there is no power from the meter, the eMCM resorts to its own super-capacitors. The super-capacitors on the eMCM board are two tall (usually green) electrolytic capacitors. These special capacitors are

charged with enough energy to allow the eMCM to run for a period of time and transmit the required “last gasp” message.

9. There are two LEDs (Red/Green) on the eMCM to indicate its status. These LEDs help troubleshoot the status of the eMCM in a meter. For more information about the LEDs, see Table 11. LED Blinking Patterns/States.

7.2 Troubleshooting at the Board Level

When the eMCM is properly inserted into the meter, both LEDs will flicker quickly for a few seconds during a brief self-check. If the power-on self-check is successful, the green LED blinks for a configurable amount of time (by default one hour) to indicate network connection status. However, if there is an issue, there is minimal troubleshooting for the installer to perform. This section provides some brief troubleshooting guidelines.

Table 10. Troubleshooting Guidelines

Problem	Action
Fatal error when powering on the eMCM	Note the LED color and pattern. Refer to Table 11. LED Blinking Patterns/States to determine the cause of the failure.
eMCM failed to power on	Try another known working eMCM to determine whether the failure is due to the eMCM or the meter.
eMCM failed due RF disadvantaged area (e.g., excessive foliage or metal objects nearby)	Presuming that you are using an eMCM with internal antennas (PN 550-0045), try using the eMCM that has two, 2dBi external antennas (PN 550-0048). For installation of the eMCM into the meter, refer to Chapter 6. Additionally, the RF Deployment Test Tool (PN 590-0038) is available from On-Ramp Wireless to determine RSSI of the Radio Link in the immediate area.

Table 11. LED Blinking Patterns/States

LED Color	LED Light Pattern	Activity Indicated
Green/Red	Blinks very rapidly between Green and Red	Both LEDs are simultaneously toggled for approximately 5 seconds immediately after boot as part of POST (Power-on Self-test).
Green	Blinks quickly – on for 0.3 seconds, off for 0.3 seconds	Node is scanning for the network but **Node has not JOINED** or the eMCM application is ***not*** in RUN state. The node may require up to 20 minutes to join the network.
Green	Blinks slowly – on for 1 second, off for 1 second	**The Node has JOINED** and the eMCM application is in RUN state. LEDs will turn off after a configurable amount of time, typically an hour after power-up.
Red	Blinks slowly	Error initializing the wireless modem or getting the meter information was unsuccessful.
None	LEDs do not blink	LEDs remain off possibly indicating that the eMCM is not powering up, or LEDs remain on indicating the software is not functioning properly. The module is likely defective, unless the meter itself is suspect.

7.3 Troubleshooting in the Field

If a meter and eMCM are installed in the field and it appears that they are not working, some troubleshooting is necessary. The LED status is one starting point (see section 7.2), but deeper analysis may be necessary. On-Ramp Wireless supplies a coverage diagnostic tool called the RF Deployment Test Tool and is briefly described in section 1.2. This tool provides the installer with the ability to determine whether RF coverage is the issue.

7.4 Return Material Authorization Process

For information related to the Return Material Authorization (RMA) process, refer to the document entitled, *Return Material Authorization Procedure (008-0047-00)*. For convenience, the On-Ramp Wireless RMA Request Form is located in Appendix D.

8 Provisioning

The tools and software required for provisioning the eMCM are described in this section. The Provisioning process can be handled in two main ways:

- Manual for small runs
- Automatic for full production

Please review the safety information provided in chapter 2 before proceeding with Provisioning.

8.1 Manual Provisioning

The Node Provisioning Tool can be used to provision eMCMs in small quantities. For more details, refer to the Provisioning Guide (010-0074-00). The PC attaches to the DUT (device under test) eMCM via its Provisioning header (UART is 3.3V) and a USB Isolator, as shown in Figure 12. The J202 connector on the eMCM requires a "TE Connectivity" connector (PN 1470364-3) to mate with it, as shown in Figure 13. Use the WECO provisioning software to provision one eMCM at a time.

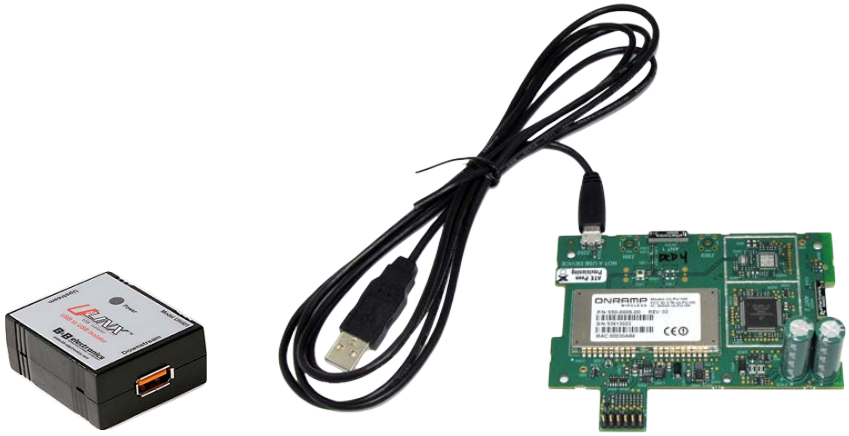


Figure 12. Manual Provisioning with Provisioning Cable and USB Isolator

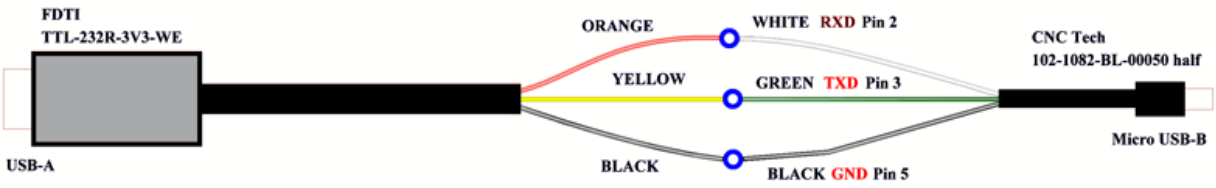


Figure 13. Diagram of Provisioning Cable for the eMCM

CAUTION: When the eMCM is mounted in an SGM30xx meter, the term "GND" or "Ground" does NOT refer to earth ground. All signals will have a 240VAC power imposed onto those lines. ***All signals to/from the eMCM circuit board must be isolated.*** No grounded instruments or computers should touch the eMCM circuit board signals. ***USE A USB ISOLATOR*** in the setup as shown in Figure 12.

8.2 Automatic Provisioning

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

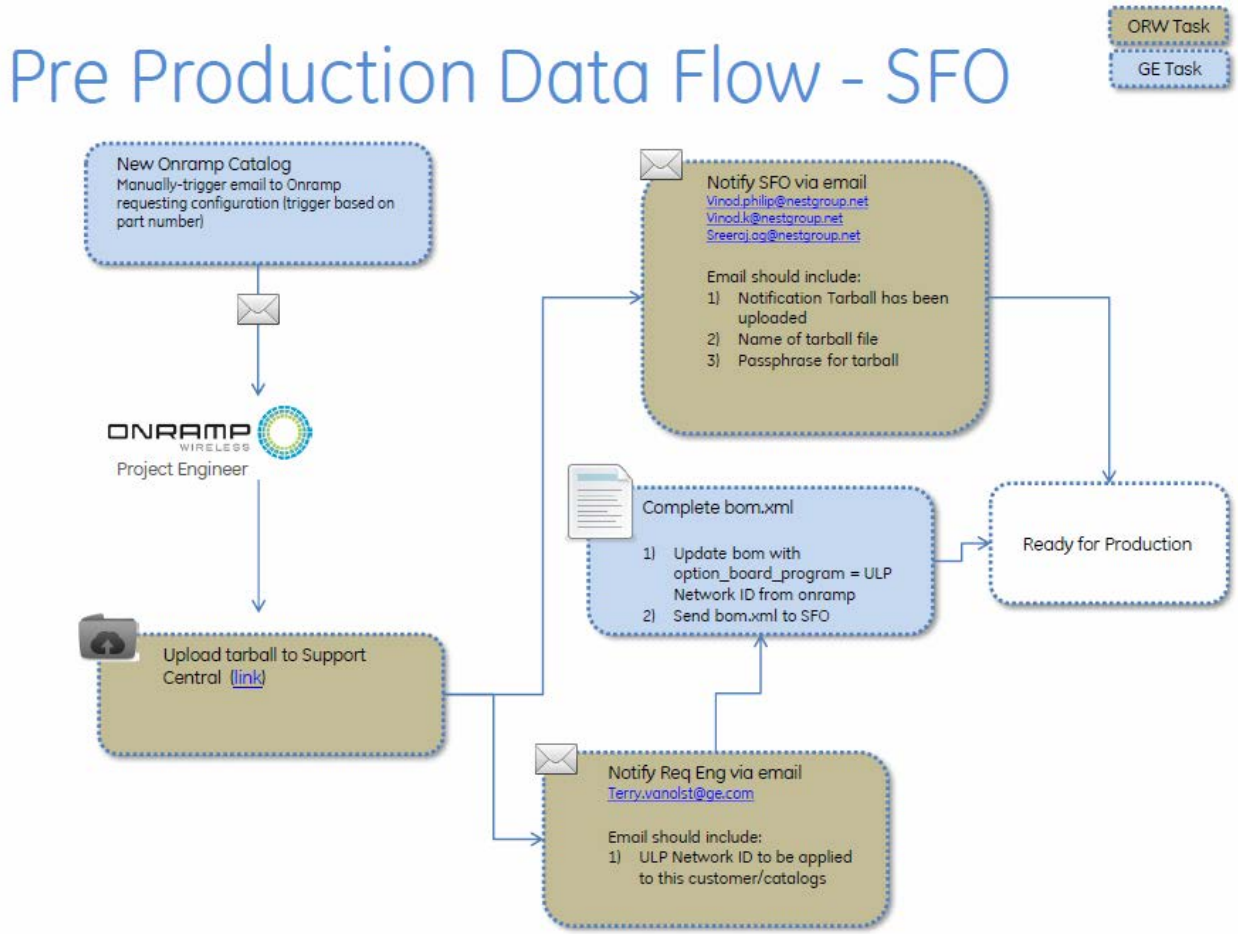
The provisioning process entails:

- 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 that the complete meter-to- eMCM antenna chain is verified
- Locking 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 illustration shows a graphical representation of the provisioning process.



Appendix B REACH and RoHS Compliance

FLEXTRONICS

CERTIFICATION OF CONFORMANCE

We hereby declare that the products(ORWH-550-0022-00, ORWH-550-0006-00, ORWH-550-0026-00, ORWH-550-0015-00, ORWH-550-0017-00) supplied are assembled and produced together with homogeneous materials and processes that are comply with RoHS (2011/65/EU) and REACH (1907/2006/EC) to the best of our knowledge.

This certificate of compliance does not in any way serve to certify that any product itself (including its constituent components) manufactured by Flextronics (Nanjing) Technology Co., Ltd or any production materials which have been specified by the customer is in compliance with such laws/regulations.

Flextronics (Nanjing) Technology Co., Ltd

(Date, 11th February 2014)

FEHSP-4.4.6-08-F002

Appendix C 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
CCATS	Commodity Classification Automated Tracking System. An alphanumeric code assigned by the Bureau of Industry and Security (BIS) to products that it has classified against the Export Administration Regulations (EAR).
CMOS	Complementary Metal-Oxide-Semiconductor
CPOL	Clock Polarity (for SPI)
CPU	Central Processing Unit
DFS	Dynamic Frequency Selection
DPLL	Digital Phase-Locked Loop
DUT	Device Under Test. Nominally the eMCM that is referenced in this document.
EMC	Electromagnetic Compatibility
eMCM	Electric Meter Communications Module
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
MCM	Meter Communications Module
microNode	The second generation of the On-Ramp Wireless module that communicates sensor data to an Access Point. The microNode forms the basis for On-Ramp Wireless Total Reach Network communications with the eMCM products.
MM	Machine Model

Abbreviation/Term	Definition
MSL	Moisture Sensitivity Level
Node	The generic term used interchangeably with eNode, microNode, or dNode.
On-Ramp Wireless Total Reach	On-Ramp Wireless proprietary wireless communication technology.
OTA	Over-the-Air
PA	Power Amplifier
PAPR	Peak-to-Average Power Ratio
PCB	Printed Circuit Board
PN	Part Number
POR	Power On Reset
QoS	Quality of Service
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
SMT	Surface Mount Technology
SNR	Signal-to-Noise Ratio
SPI	Synchronous Peripheral Interface
TX	Transmit/Transmitter
UART	Universal Asynchronous Receiver/Transmitter
VCO	Voltage Controlled Oscillator
VCTCXO	Voltage Controlled Temperature Compensated Crystal Oscillator
VSWR	Voltage Standing Wave Ratio
XO	Crystal Oscillator

Appendix D On-Ramp Wireless RMA Request Form

Instructions:

Step #1: Complete this form. (All fields are required.)

Step #2: Request an RMA # by emailing this completed form to RMAsupport@onrampwireless.com (preferred) or contact your On-Ramp Wireless account manager for assistance. RMA #'s are valid for 15 days.

Step #3: Pack items appropriately to prevent damage from vibration, shock, moisture and ESD during shipment. Mark the RMA # clearly on the outside of the box. ***Do not return items without an RMA number.***

Step #4: Ship items to: (**Note:** Shipping fees including insurance are the customer's responsibility.)

On-Ramp Wireless, Inc.
10920 Via Frontera Road, Suite 200
San Diego, CA 92127 USA
Attention: RMA Processing Department

For full details about the RMA process, refer to the document: *Return Material Authorization Procedure (008-0047-00).*

RMA #
(Supplied by On-Ramp)

Date of request:

Customer Contact: Email:

Company Name: Telephone:

Address:

Reference original purchase order or customer contract # (if available):
(Contact your On-Ramp account manager for assistance)

Reason for Return:

(List all items being returned. Copy and paste lines to add additional items)

On-Ramp Part #:		Item Description:		Serial #:	
On-Ramp Part #:		Item Description:		Serial #:	
On-Ramp Part #:		Item Description:		Serial #:	
On-Ramp Part #:		Item Description:		Serial #:	

Please provide detail about the environment in which the devices were being used and the circumstances of failure. This information will aid in determination of root cause and will help expedite failure analysis. Attachments are welcome.

Detail of circumstances:

If returned items employ IP addresses set by the customer, IP addresses must be supplied.
If returned items are MCMs, the associated log files must be sent in advance.

Appendix E Mechanical Drawing and Schematics for the eMCM

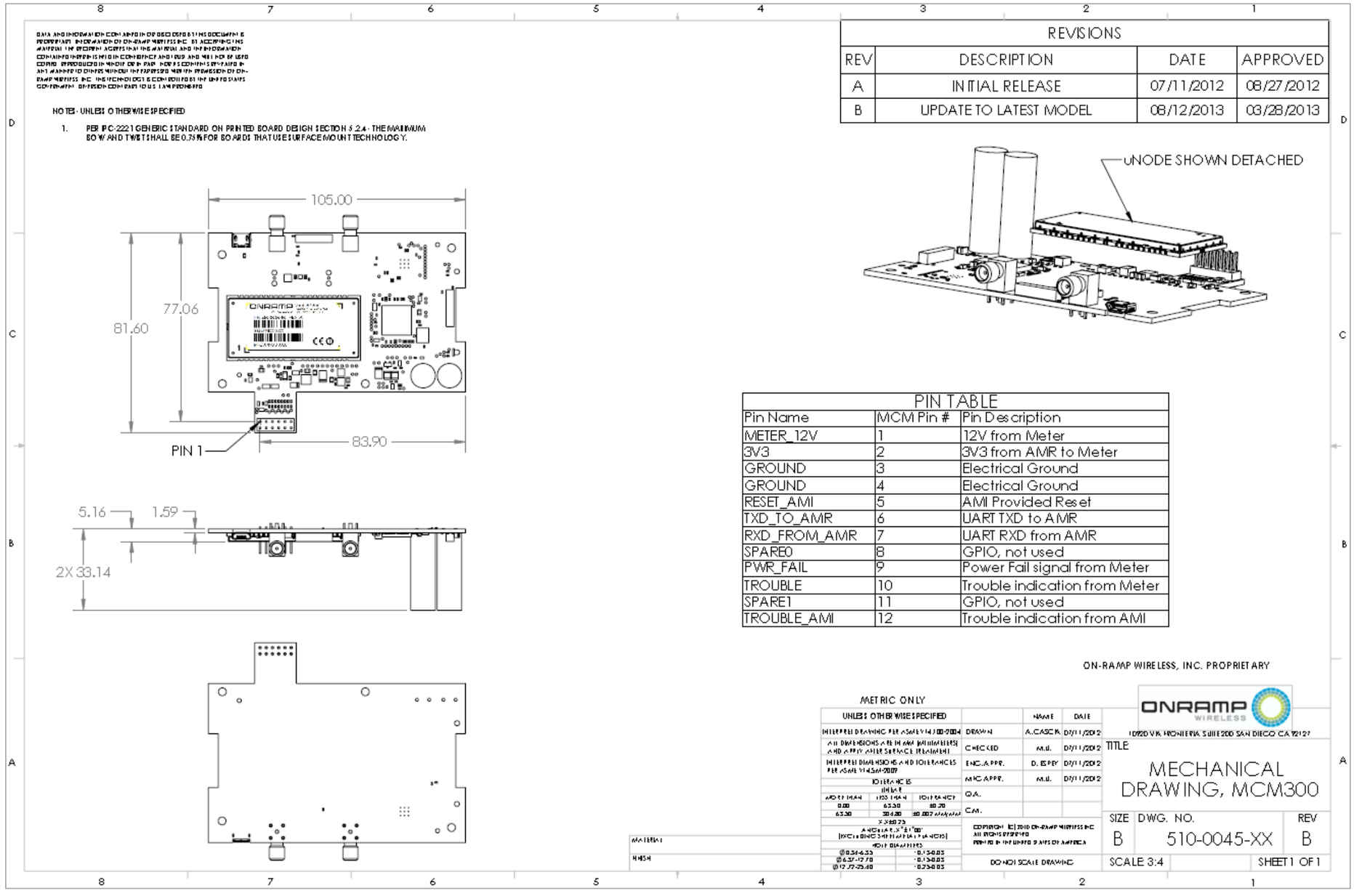


Figure 14. Mechanical Dimensions for the eMCM Circuit Board

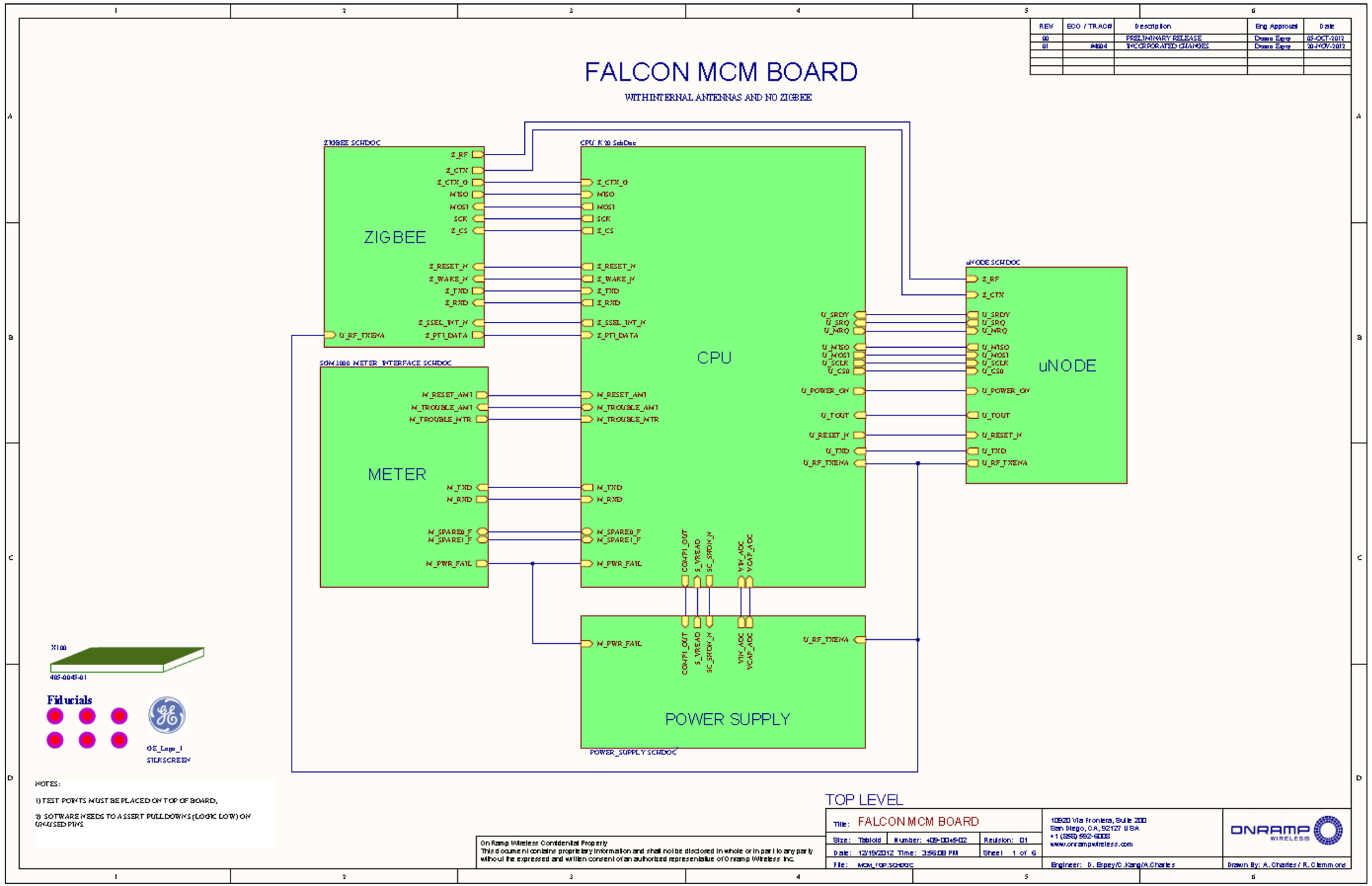


Figure 15. Schematics for the eMCM Circuit Board (Page 1 of 6)

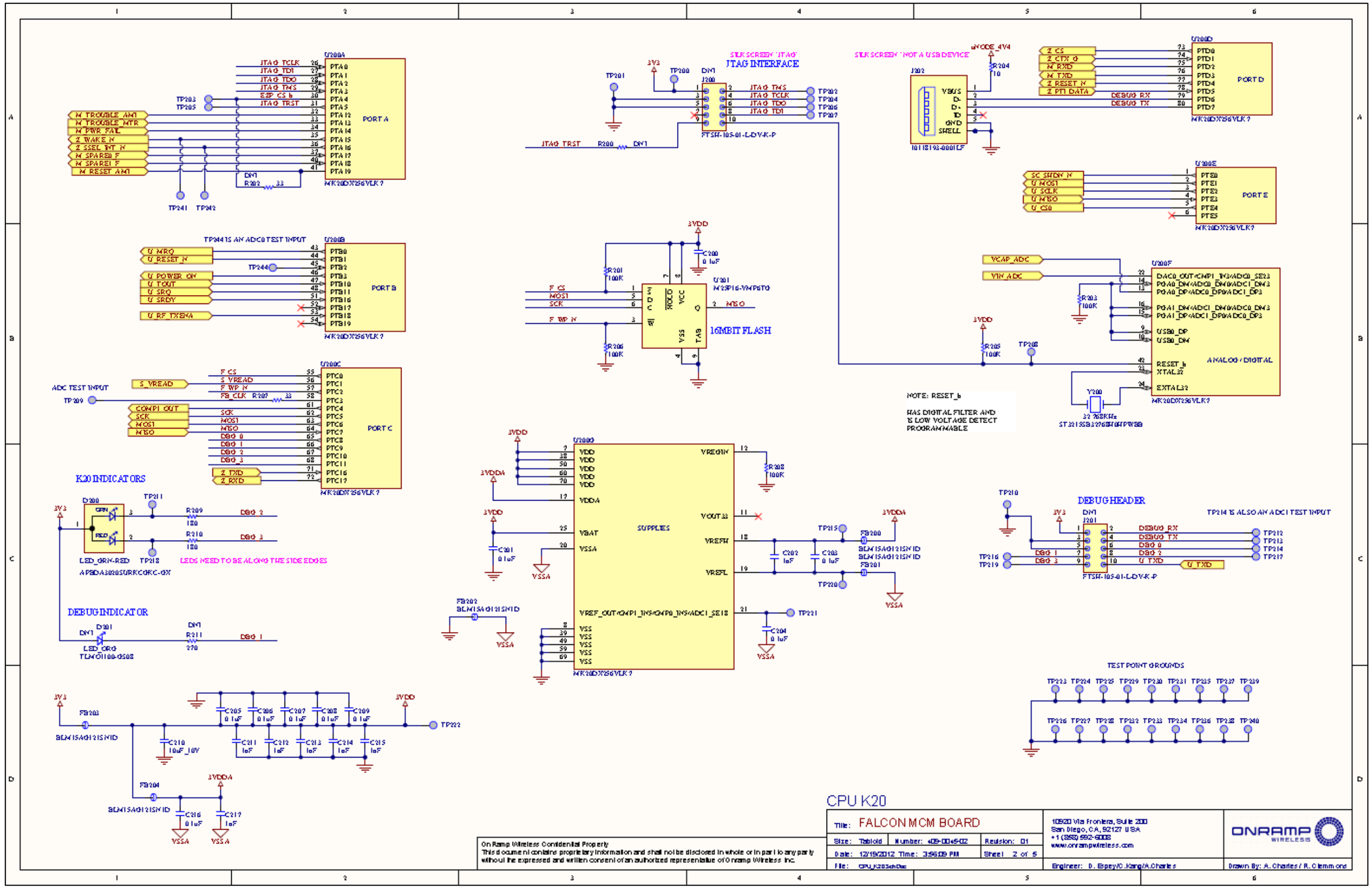


Figure 16. Schematics for the eMCM Circuit Board (Page 2 of 6)

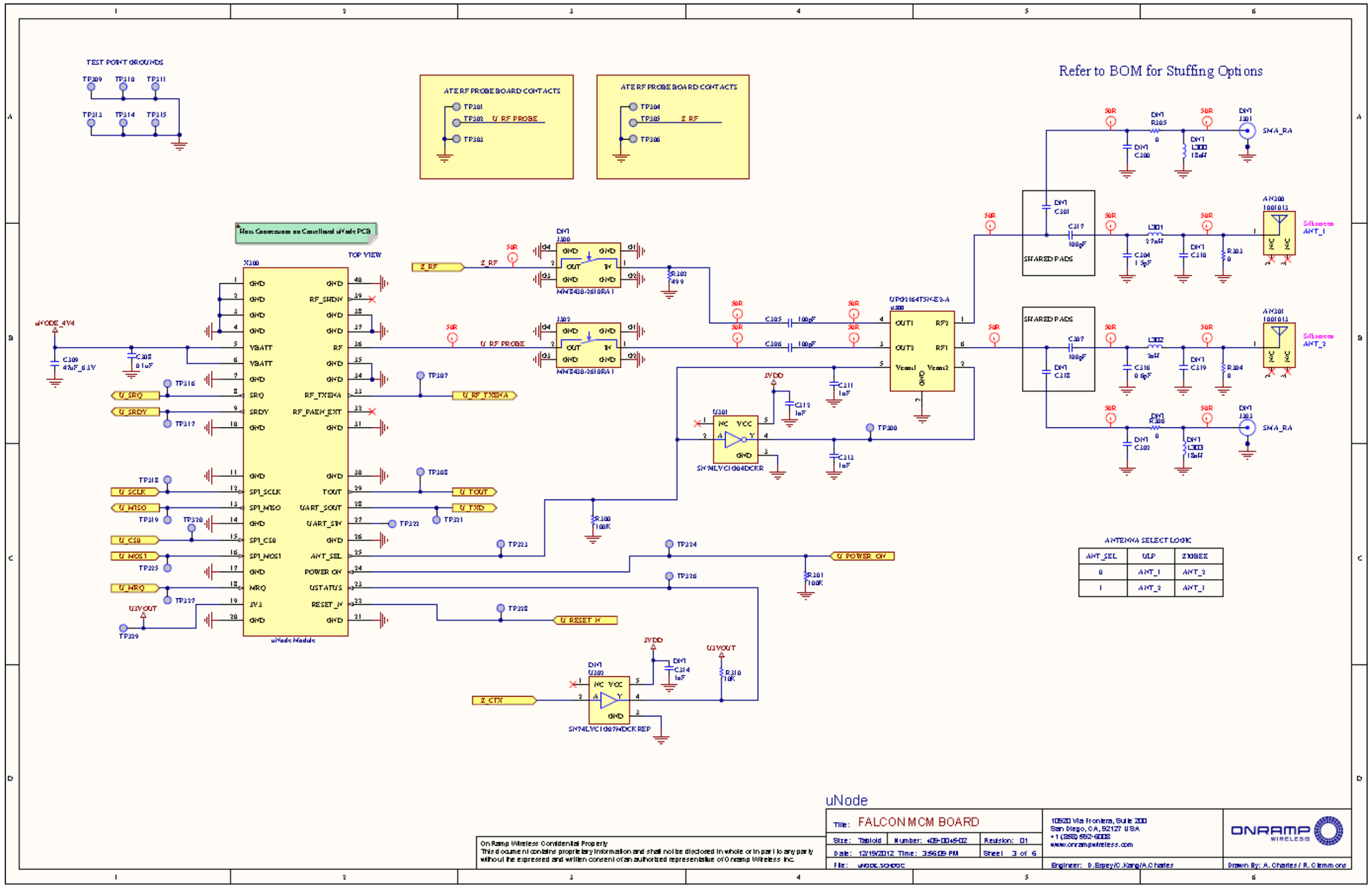


Figure 17. Schematics for the eMCM Circuit Board (Page 3 of 6)

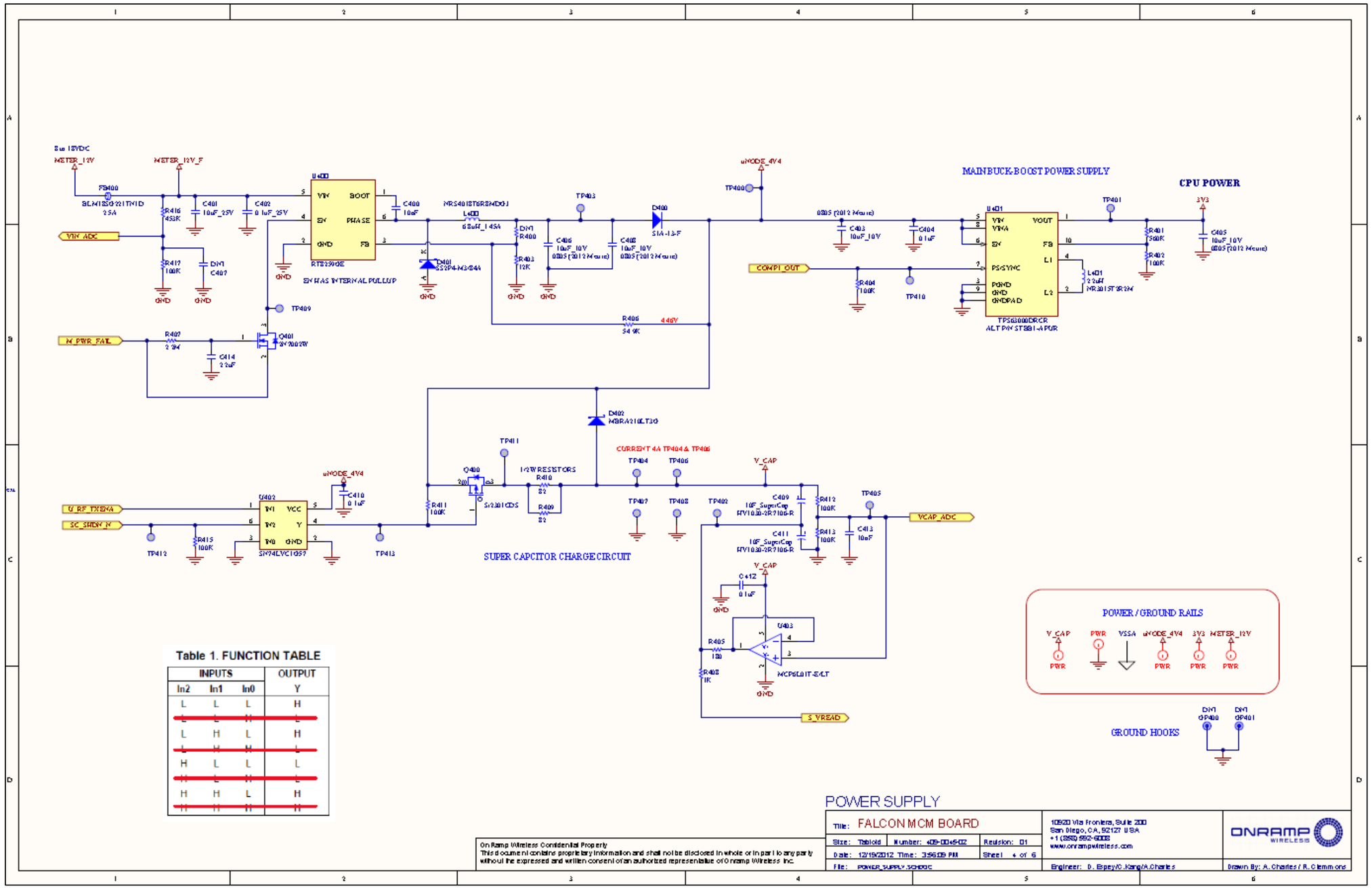


Table 1. FUNCTION TABLE

INPUTS			OUTPUT
In2	In1	In0	Y
L	L	L	H
L	L	H	L
L	H	L	H
L	H	H	L
H	L	L	L
H	L	H	L
H	H	L	H
H	H	H	H

Figure 18. Schematics for the eMCM Circuit Board (Page 4 of 6)

Pin #	Signal Name	AMI direction	Description
1	12V	--	+12V Regulated power supply
2	3V3_AMI	Output	+3.3VV Regulated power supply
3	IGND	--	Isolated Ground from Mains
4	IGND	--	Isolated Ground from Mains
5	RESET_AMI	Input	Reset Input to AMI
6	TXD/MOSI	Input	Meter Transmit/AMI Receive line or Master output / Slave input
7	RXD/MISO	Output	Meter Receive/AMI Transmit line or Master input / Slave output
8	SPI2_SPCK	Input	SPI Clock
9	PF_AMR	Input	Power fail signal from Meter
10	TROUBLE_MTR/CSM_AMI	Input	Trouble signal from Meter/SPI Chip Select Master
11	CSS_AMI/TROUBLE_MTR	Output/Input	SPI Chip Select Slave/Trouble signal from Meter
12	TROUBLE_AMI	Output	Trouble signal from AMI

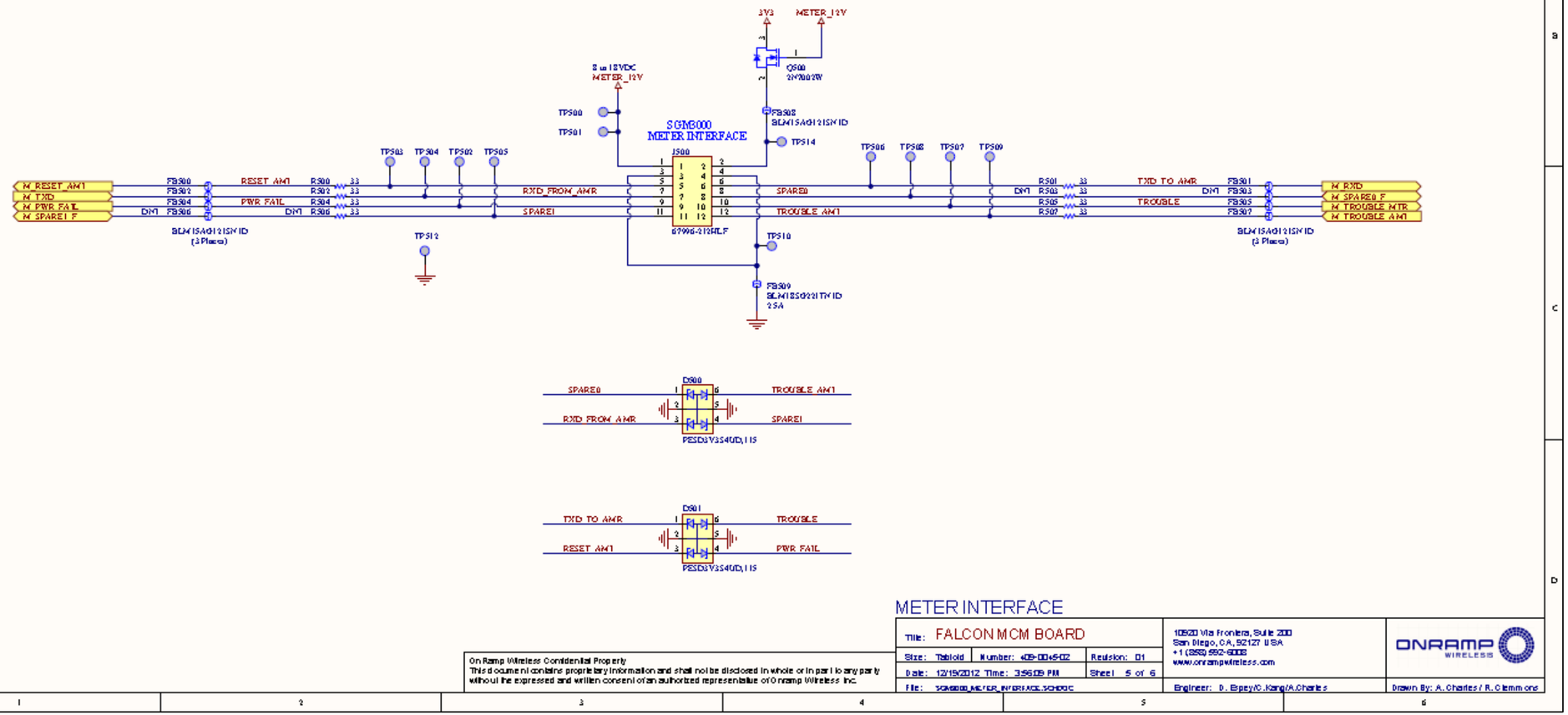


Figure 19. Schematics for the eMCM Circuit Board (Page 5 of 6)

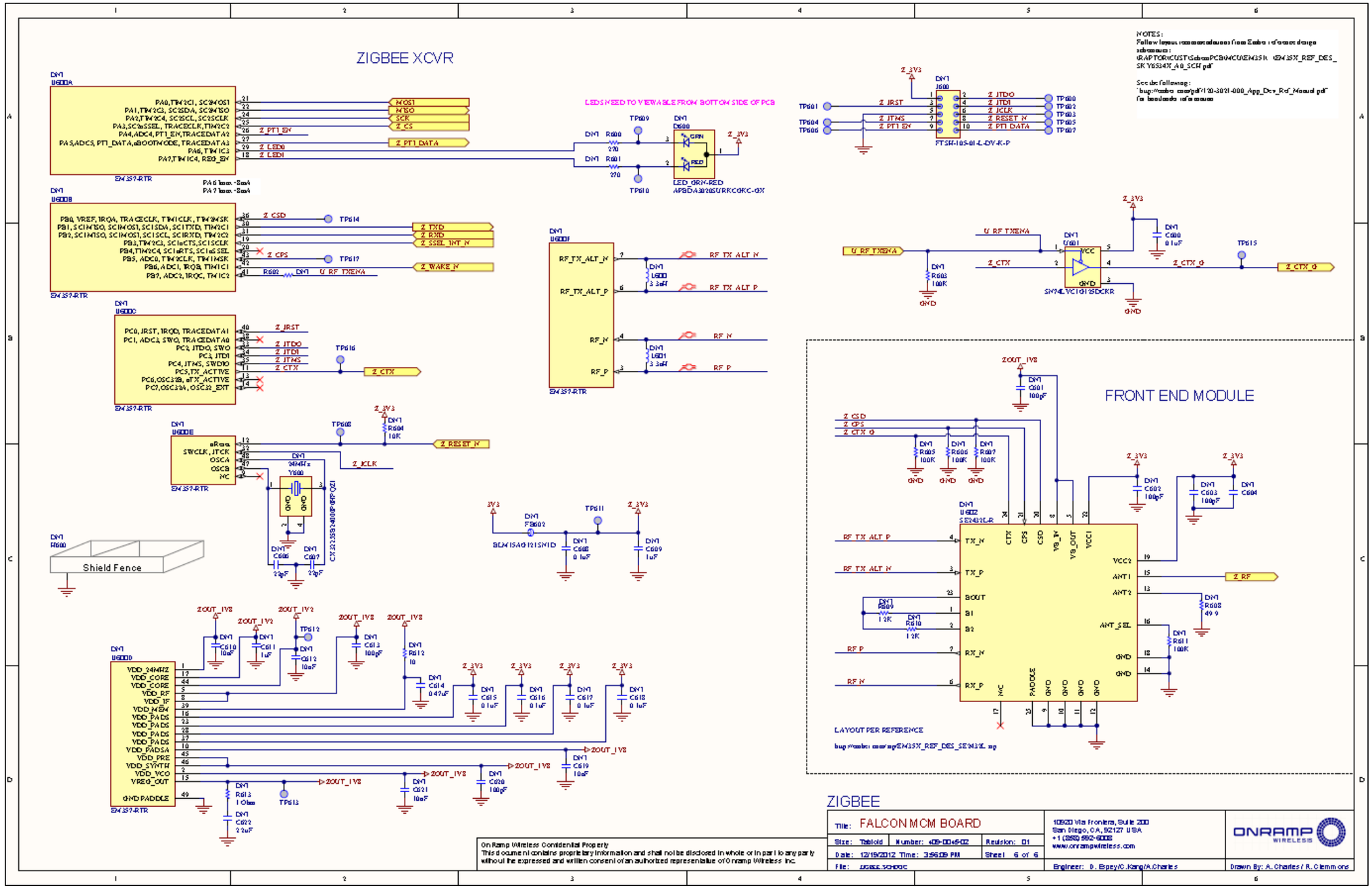


Figure 20. Schematics for the eMCM Circuit Board (Page 6 of 6)