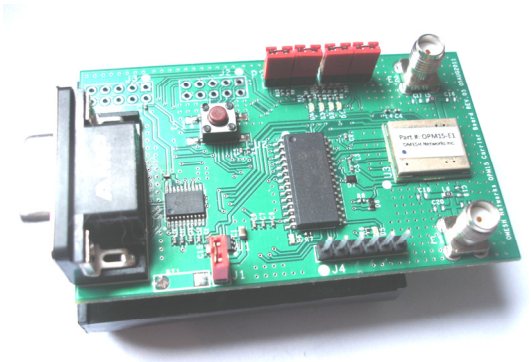
OPM15 Evaluation Board Manual

OMESH Networks Incorporation
www.omeshnet.com
3 Kilkenny Drive
Toronto ON, Canada M1W1J3
Tel: 1-416-837-8980
Fax: 1-416-977-2796
Email: info@omeshnet.com

Section 1: Purpose

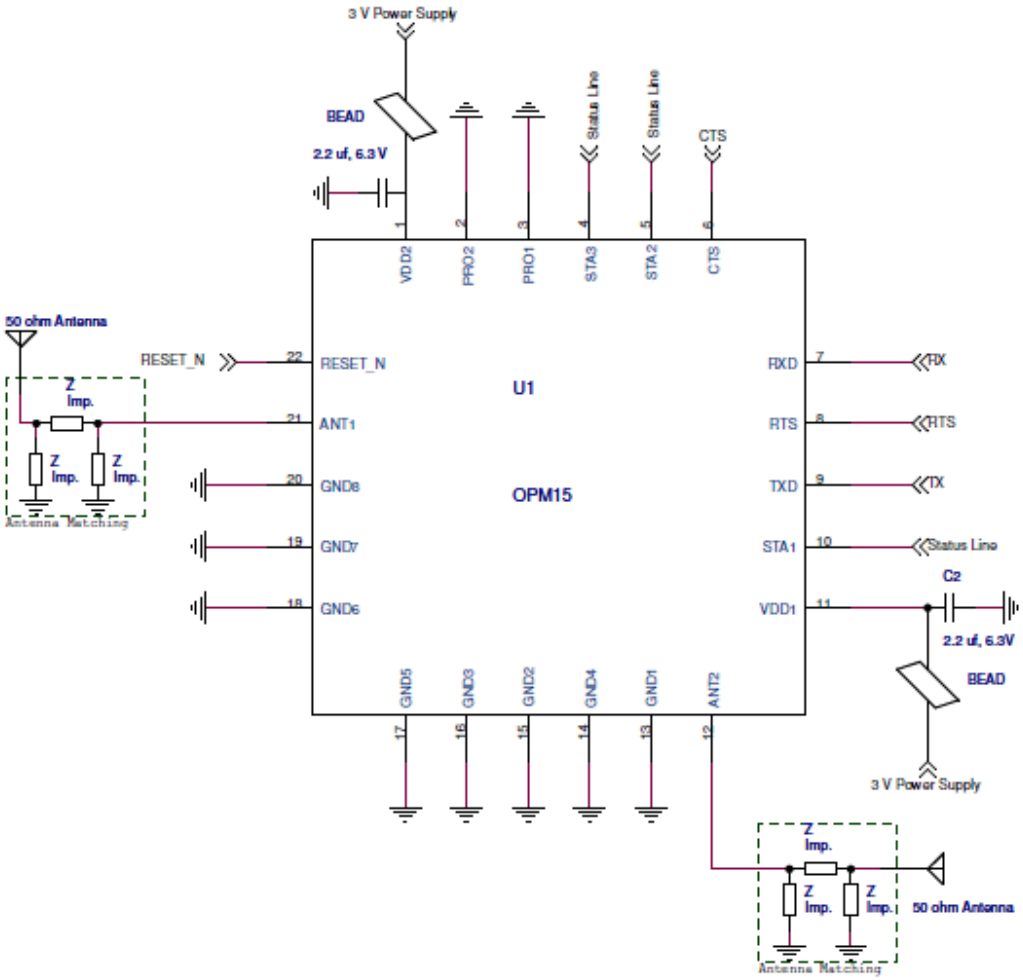
OPM15 is a large-scale cognitive wireless networking module, providing great flexibility for a wide range of applications. Powered by the OPM optimized radio design and networking stack, the result is a fully integrated module providing a complete system for dynamic wireless networking for real-time and high-performance communications. The module has the following attributes: 1) dynamic drop-and-play (supporting station mobility); 2) real-time communications over unlimited number of wireless hops; 3) low power consumption and small footprint; 4) compatible with the 802.15.4 standard; 5) tolerant of interference in unlicensed spectrum.

This document describes the functionalities of OPM15-E (low power version of OPM15, OMESH part #OPM15-E0, #OPM15-E1) Carrier Board (OMESH part #OPM15ECB) and also shows how to configure basic setup of the system.



Section 2: Board Description

A typical application circuit of the OPM15-E radio is described in [1]. There are four types of pins. Communication pins RXT, TXD, RTS, and CTS connect the Host (by default, the baud-rate of the UART serial interface is 9,600, with no parity or flow control). State pins STA1, STA2, and STA3 show states of the radio, as describe in [2]. Antenna pins ANT1 and ANT2 are analog and connect antennas. Factory pins PRO1 and PRO2 shall be either not connected, or connected to ground in application circuits.



1. ⏚ = Connection to low impedance ground plane
2. BEAD = Ferrite Bead BLM15HG102SN1D (MURATA) or an equivalent
3. Antenna's should be matched as required

Figure 1 – Typical Application of OPM15-E Radio

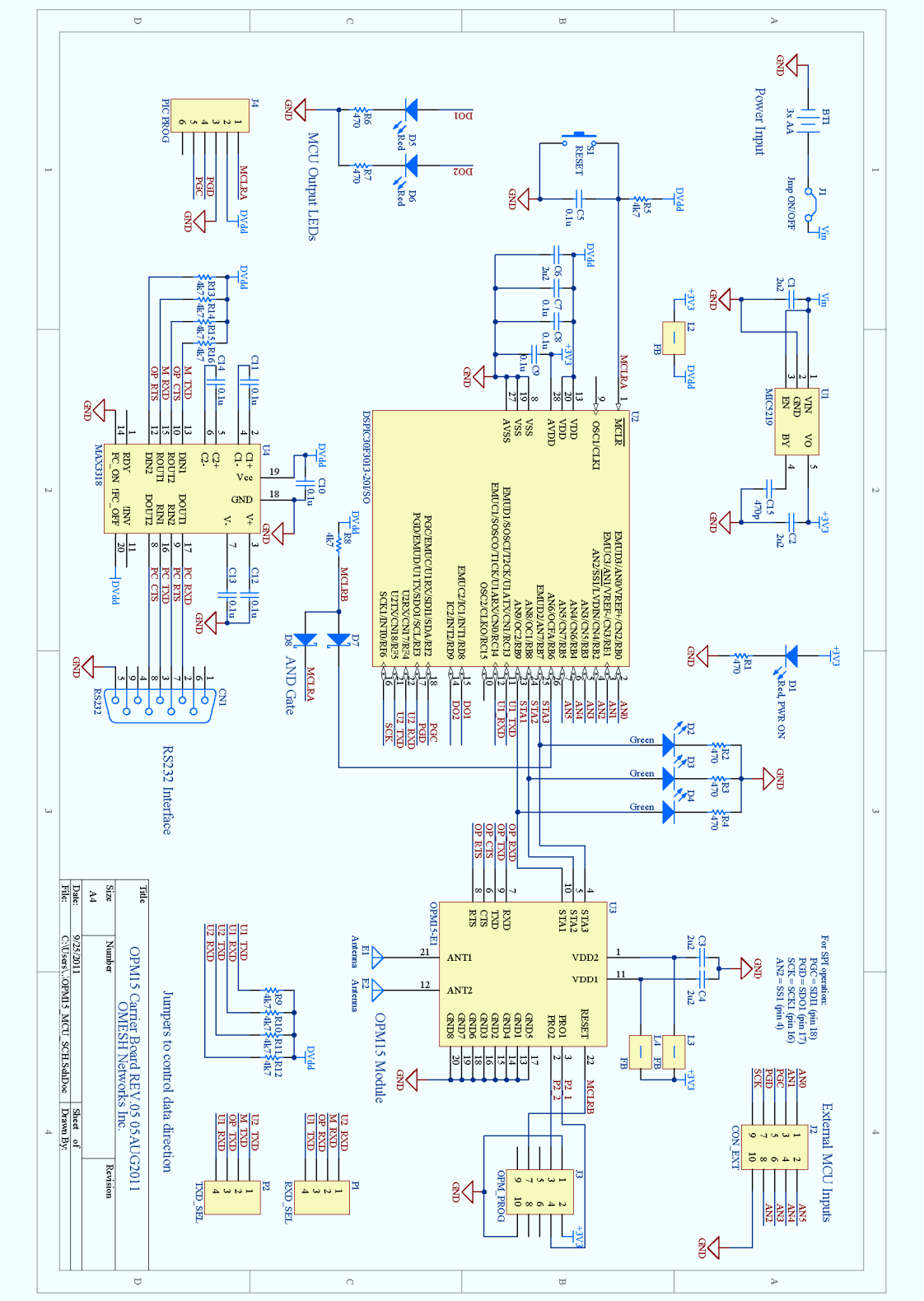


Figure 2 – Schematics

The schematics of OPM15-E Carrier Board are shown above. The board has a Microchip dsPIC30F3013 MCU, which can be connected to the OPM15-E radio via 2-line TTL serial. The two jumper selectors P1 and P2 can be used for serial configurations.

P1/P2 Configuration	Description
1-2; 3-4	The MCU is connected to OPM15 and external RS232 interface respectively.
2-3 only	OPM15 is connected directly to external RS232 interface.

The MCU can be programmed via the 6-pin interface J4. The development tools include Microchip MPLAB IDE and MPLAB C30 C compiler for dsPIC DSCs. These tools are free to download from Microchip. The MCU is by default loaded with OPM15 Test and Debug Tool for Windows Graphic User Interface (GUI). The source code of software and OPM15 Simplified Programming Interface (S-API) for MCU [3] are free to obtain from OMESH Networks (OMESH part # OPM15ETD) under GNU General Public License version 2 as published by the Free Software Foundation.

J1 is used for power on/off control. When powered, the red LED D1 shall be lighted. The antenna pins are connected to SMA sockets E1 and E2: any 50 Om SMA male antennas shall match. We recommend using ANTENOVA Titanis 2.4GHz Swivel SMA (Male) Antenna (DigiKey part #627-1000-ND).

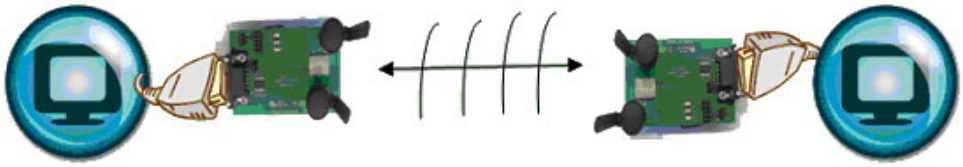
Important Notes:

- The board needs to be handled with standard Electrostatic Discharge Precautions. Any mechanical distortion may also break the soldering between the board and the radio module.

- Once powered on, the radio module will enter into a calibration mode and then (after a few seconds) light up the LED D4. Changing antenna position can affect the calibration results, so the antennas shouldn't be moved or rotated after the board being powered on.

- On board regulator MIC5219-3.3YM5 (U1) is a linear voltage regulator with regulated output 3.3V. The maximal input voltage Vin is 12V. The dropout voltage is typically 0.2V (please refer to MIC5219 datasheet). When Vin drops below 3.5V (3.3+0.2), the MCU dsPIC30F3013 shall stop working first. By using an A/D port on J2, a battery monitor can be implemented on the MCU reading the current voltage of Vin.

Section 3: Basic Setup



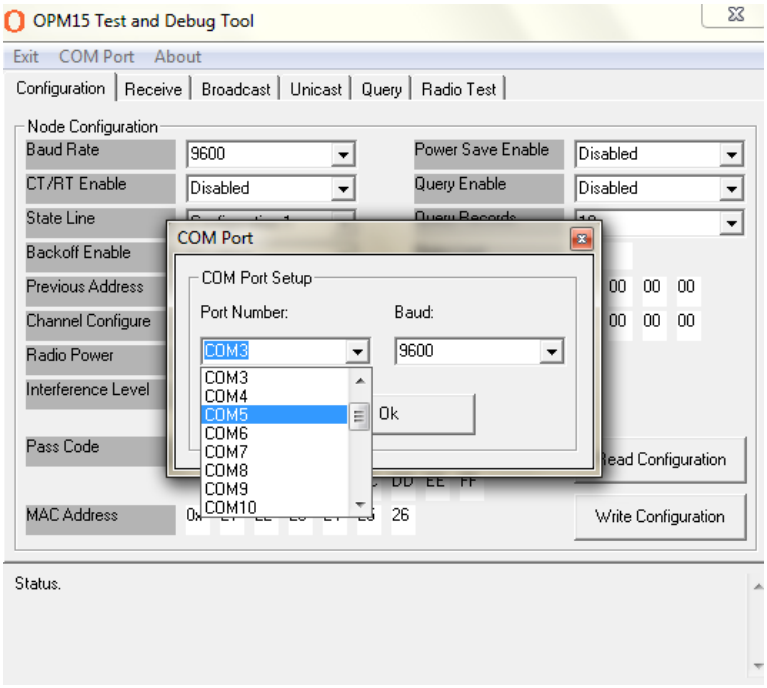
OPM15 Unit Test Setup:

- At least two OPM15 Carrier Board with antennas (4X) and AA Batteries (6X);
- Two Windows XP compatible computers (Laptops);
- Two USB-Serial DB9 Male Cables (Recommended: Cables to Go);
- OPM15 Test and Debug Tool from OMESH Networks (OMESH part #OPM15ETD).

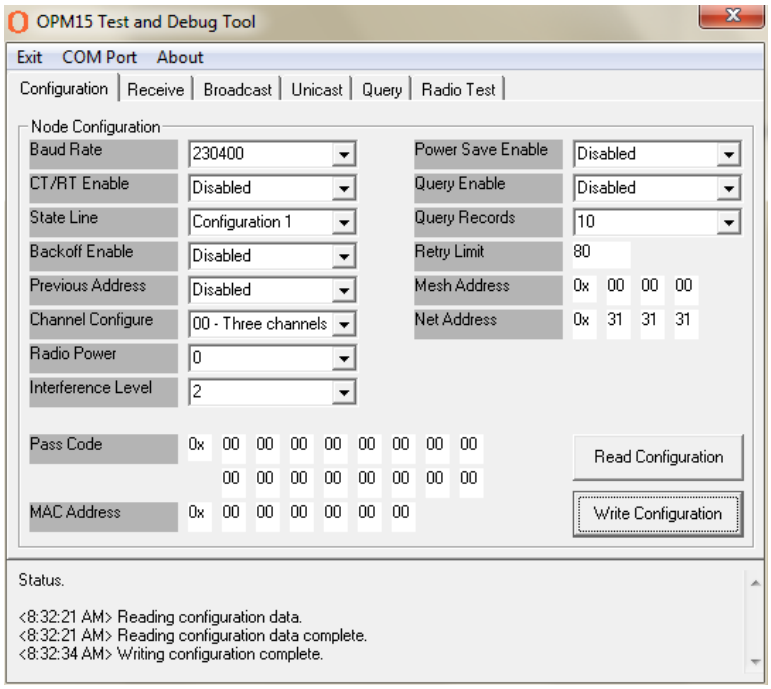
Follow the steps given below:

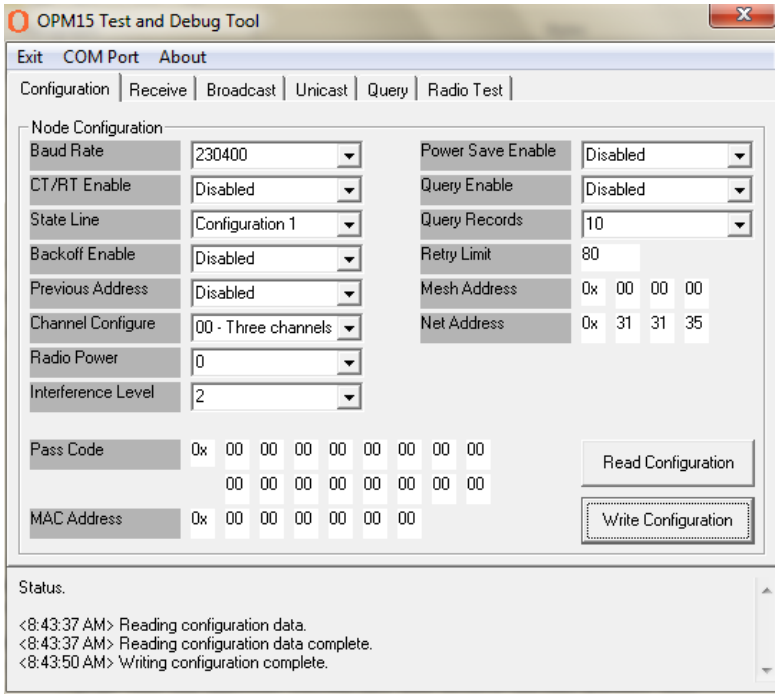
1. Load each computer with OPM15 Testing and Debug Tool PC Software;
2. Connect two USB-serial DB9 Male cables to two computers via USB port respectively;
3. Connect P1, P2 on both OPM15 Carrier Boards in the configuration 1-2, 3-4;
4. Put batteries under OPM15 Carrier Boards and connect J1;
5. Power on OPM15 Carrier Boards and wait until D4 to light up;
6. When this is set up, on both computers, go to:
    i. Control Panel > System > Hardware > Device Manager
    ii. From Device Manager select Com ports
    iii. Click on ports to verify the port numbers for receive and transmit (such as "Comx[1]")
7. Open a GUI of OPM15 Testing and Debug Tool on each computer, and configure the corresponding serial port. Use the "Comx" as identified in previous step and baud rate of 9,600.

[1] 'x' refers to one/two arbitrary digit number.

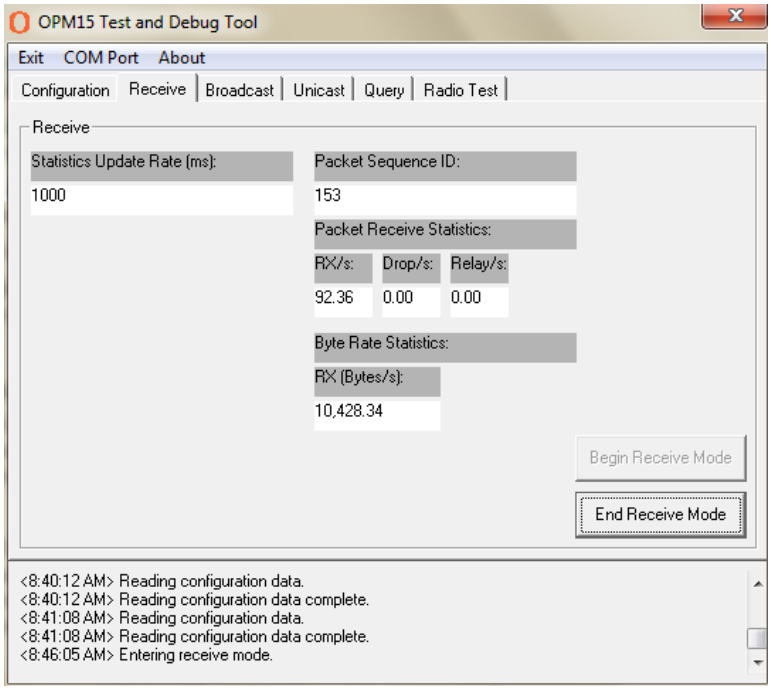


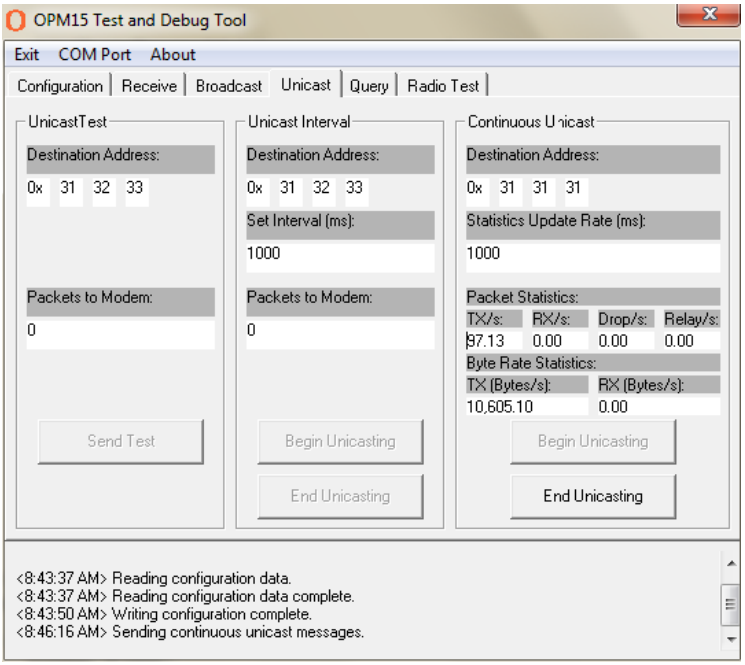
8. On the GUI of each computer, click "Read Configuration" to retrieve the current configuration data from the radio module, and configure the network address by the input fields and click "Write Configuration". The status bar shows that the actions have been taken. As an example, we can configure the network address of two radio modules to be (0x31 0x31 0x31) and (0x31 0x31 0x35) respectively.





9. Simply click "Begin Receive Mode" on one computer and "Begin Unicast" on the other computer with right destination address inputs. A point to point communication is set up between two radios, and the GUI displays the statistics of communication at each end.





10. When more than two OPM15-E Carrier Boards are available, one can configure the rest of the OPM15 Carrier Boards as relay stations by setting up network addresses as specified in [2]. For example, one can configure the mesh address of a relay station to be (0x31 0x31 0x33). Once the relay station is powered on, its network address will be automatically configured to be the saved mesh address; and it starts to relay for packets between (0x31 0x31 0x31) and (0x31 0x31 0x35) opportunistically when necessary (e.g., when direct transmission between source and destination fails).

Important Notes:

- The round trip latency on serial port may decrease attainable throughput of radio communications due to the API setup. Check the (advanced) serial port configuration to minimize any latency timer.

Section 4: Technical Attributes

Single Hop Range	Up to 1000m (outdoor with 14dBi antenna); and 200m (indoor with 3dBi antenna).
Switching Latency	< 20 ms
Communication Bandwidth	250kbps (Application throughput: up to 100kbps)

Communication Latency	<15ms/hop
Communication Jitter	Decreases to zero with larger network scale
Frequency Band	2.4GHz
Transmission Power	0.1-3mW
Power Consumption (Sleep)	~4uW
Power Consumption (Active)	~60mW
Receiver Sensitivity	-94dBm
Physical Size	12mm X 14.25mm X 2.25mm
Applications	Sensor/Location and Emergency Network; Supporting Data, Audio, Image; Long Battery (over one year) Life.

Section 5: Repair and Maintenance

Defective equipments shall be first reported to the OMESH Networks support team in order to be assigned a problem report number (PR). Be prepared to state your name, company and the serial number of the defective item to the support personnel. The item shall then be returned to OMESH Networks with the following documents:

- The PR number
- A copy of the delivery slip
- A detailed description of the default and the test context

The maintenance period is typically six (6) months starting from the date of reception of the equipment at the OMESH Networks headquarter.

Reference Documents:

	Document	Description
1	OPM15_E_Hardware_Datasheet	OPM15 Hardware Data Sheet Version 3.2.0
2	OPM15_Software_API_Guide	OPM15 Software API Guide Version 3.2.0
3	OPM15_Simplified_API_Programmers_Guide_0_9_2	OPM15 Simplified Application Programming Interface (S-API) Programmer's Guide Version 0.9.2

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