

**MeshConnect™** Sub-G Module Series**ZICM0868Px****ZICM0900Px****868 / 900 MHz Transceiver Based Modules****Development Kits Available:****ZICM0868P2-KIT1-1 and ZICM0900P2-KIT1-1****DESCRIPTION**

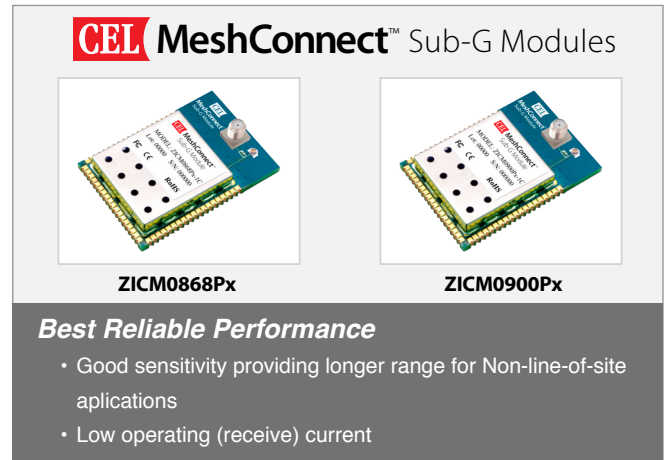
CEL's MeshConnect™ Module Series provides high performance and low cost Sub-G modules for a broad range of wireless networks. The MeshConnect certified and qualified modules enable customers to accelerate time to market by greatly reducing design and certification phases of development.

CEL's MeshConnect™ Sub-G modules (868/900MHz) are based on the Silicon Labs SoC ICs (single-chip solutions). Each IC consists of an RF transceiver with baseband modem, a hard-wired MAC and an embedded 8051 microcontroller with internal RAM (4kB) and Flash (64kB) memory. The device provides numerous general-purpose I/O pins and peripheral functions such as timers and UARTs.

The MeshConnect Sub-G modules have 2 different output powers (+12dBm and +19dBm). They provide a reliable transmission, to reduce the number of nodes in a network. They are especially useful for open outdoor applications where the nodes are physically far apart. The higher power Modules have an outstanding 118dB link budget ensuring high quality connections even in harsh environments.

**APPLICATIONS**

- Metering
- RFID
- Remote Keyless Entry
- Home Automation
- Security
- Irrigation
- Weather Stations
- And more...

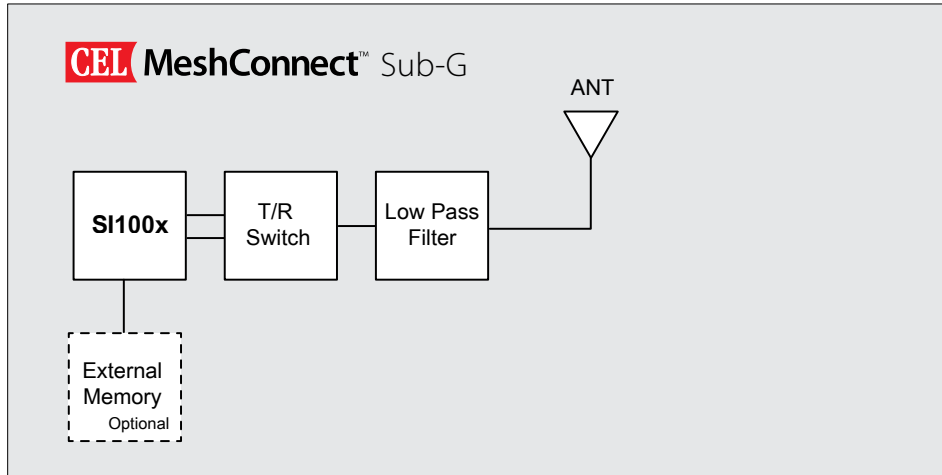
**FEATURES**

- **Frequency Range:**  
902-928 MHz  
868 MHz
- **Sensitivity: -99 dBm**
- **Max Output Power:**  
+ 12 dBm @ 3.6 VDC (ZICM0xxxP0)  
+ 19 dBm @ 3.6 VDC (ZICM0xxxP2)
- **Data Rate: 0.123 to 150 kbps**
- **Up to 21 GPIO Pins**
- **High Speed 8051 MCU:**  
30 MHz  
4kB RAM / 64 kB Flash
- **10-Bit ADC:**  
300 ksps, 18-ch inputs
- **Serial Communication:**  
UARTs, SPI (Master/Slave)  
SMBus, PCA
- **Modulation:**  
FSK
- **RF Power Consumption**  
24 mA Receive  
18 mA @ + 1 dBm transmit  
30 mA @ + 12 dBm transmit  
90 mA @ + 19 dBm transmit
- **Auto-Frequency Calibration (AFC)**
- **Frequency Hopping Capability**
- **Up to 12 miles of range**
- **Operating Temperature Range:**  
-40 to +85°C
- **Software Support:**  
Synapse SNAP Embedded Firmware  
Wireless M-Bus (868MHz Only)  
Silicon Labs EZMac  
CEL Protocol
- **FCC, CE and IC certifications in Progress**
- **ROHS compliant**

**ORDERING INFORMATION**

Part Number	Order Number	Description
MeshConnect™ Sub-G (Europe Only)	ZICM0868P0-1CU	868 MHz Module, +12dBm output power with U.FL connector for external antenna
	ZICM0868P2-1CU	868 MHz Module, +19dBm output power with U.FL connector for external antenna
	ZICM0868P0-1CS	868 MHz Module, +12dBm output power with RP-SMA connector for external antenna
	ZICM0868P2-1CS	868 MHz Module, +19dBm output power with RP-SMA connector for external antenna
	ZICM0868P0-1C	868 MHz Module, +12dBm output power with a connection for 1/4 wave wire antenna (in place of RP-SMA)
	ZICM0868P2-1C	868 MHz Module, +19dBm output power with a connection for 1/4 wave wire antenna (in place of RP-SMA)
	ZICM0868P0-1CU-SN	868 MHz Module, +12dBm output power with U.FL connector for external antenna with SNAP Operating System software and MAC address
	ZICM0868P2-1CU-SN	868 MHz Module, +19dBm output power with U.FL connector for external antenna with SNAP Operating System software and MAC address
	ZICM0868P0-1CS-SN	868 MHz Module, +12dBm output power with RP-SMA connector for external antenna with SNAP Operating System software and MAC address
	ZICM0868P2-1CS-SN	868 MHz Module, +19dBm output power with RP-SMA connector for external antenna with SNAP Operating System software and MAC address
	ZICM0868P0-1C-SN	868 MHz Module, +12dBm output power for 1/4 wave wire antenna (in place of RP-SMA) with SNAP Operating System software and MAC address
	ZICM0868P2-1C-SN	868 MHz Module, +19dBm output power for 1/4 wave wire antenna(in place of RP-SMA) with SNAP Operating System software and MAC address
	MeshConnect™ Sub-G	ZICM0900P0-1CU
ZICM0900P2-1CU		900 MHz Module, +19dBm output power with U.FL connector for external antenna
ZICM0900P0-1CS		900 MHz Module, +12dBm output power with RP-SMA connector for external antenna
ZICM0900P2-1CS		900 MHz Module, +19dBm output power with RP-SMA connector for external antenna
ZICM0900P0-1C		900 MHz Module, +12dBm output power with a connection for 1/4 wave wire antenna (in place of RP-SMA)
ZICM0900P2-1C		900 MHz Module, +19dBm output power with a connection for 1/4 wave wire antenna (in place of RP-SMA)
ZICM0900P0-1CU-SN		900 MHz Module, +12dBm output power with U.FL connector for external antenna with SNAP Operating System software and MAC address
ZICM0900P2-1CU-SN		900 MHz Module, +19dBm output power with U.FL connector for external antenna with SNAP Operating System software and MAC address
ZICM0900P0-1CS-SN		900 MHz Module, +12dBm output power with RP-SMA connector for external antenna with SNAP Operating System software and MAC address
ZICM0900P2-1CS-SN		900 MHz Module, +19dBm output power with RP-SMA connector for external antenna with SNAP Operating System software and MAC address
ZICM0900P0-1C-SN		900 MHz Module, +12dBm output power for 1/4 wave wire antenna (in place of RP-SMA) with SNAP Operating System software and MAC address
ZICM0900P2-1C-SN		900 MHz Module, +19dBm output power for 1/4 wave wire antenna (in place of RP-SMA) with SNAP Operating System software and MAC address
MeshConnect™ Sub-G Development Kits		ZICM0868P2-KIT1-1
	ZICM0900P2-KIT1-1	900 MHz Evaluation board for +19 dBm module

**MODULE BLOCK DIAGRAM**



**DEVELOPMENT KIT**

CEL's Development Kit assist users in both evaluation and development. As a stand-alone radio system, the kit allows users to place the modules into the target environment and evaluate performance on-site. The Development Kit also serves as an invaluable aid in application development. Through the many interface headers on the board, the user has access to all of the MeshConnect module pins, enabling easy connection to target systems for application development.

The interface board features a serial communication interface, a power management module, and peripherals such as a buzzer, push-button switches, LEDs, and GPIO headers.

For more detail information regarding MeshConnect Development Kits, refer to the respective development kit user guides documents. (Available at CEL's website <http://www.cel.com>)

**CEL MeshConnect™**  
Sub-G Module Development Kit



**Kit Contents:**

- Evaluation Boards w/Module (2)
- USB Cables (1)
- AA Batteries (4)
- Software & Technical Information CD (1)

**DEVELOPMENT KIT ORDERING INFORMATION**

Part Number	Order Number	Description
MeshConnect™ Sub-G Development Kits	ZICM0868P2-KIT1-1	868 MHz Evaluation board for +19dBm module
	ZICM0900P2-KIT1-1	900 MHz Evaluation board for +19dBm module

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## TRANSCEIVER IC

The MeshConnect Sub-G modules are based on the Silicon Labs Si1000 and Si1002 SOC transceiver ICs. These ICs incorporate the RF transceiver with the baseband modem, a hardwired MAC, and an embedded 8051 microcontroller, offering a high performance solution for all Sub-G applications.

For more information about the Silicon Labs ICs, visit <http://www.silabs.com>.

## ANTENNA

The MeshConnect Sub-G modules include RF connectors for external antenna options only (There is no trace antenna option). The following options are supported by CEL:

- U.FL connector
- RP-SMA connector
- A Connection for 1/4 wave wire antenna in place of RP-SMA

Here are some design guidelines to help ensure antenna performance:

- Never place the antenna close to metallic objects.
- In the overall design, ensure that wiring and other components are not placed near the antenna.
- Do not place the antenna in a metallic or metalized plastic enclosure.
- Keep plastic enclosures 1cm or more from the antenna in any direction.

## ADDITIONAL FLASH MEMORY (Optional)

The Silicon Labs Transceiver ICs (Si1000 and Si1002) have an embedded 64kB of flash. Additional memory (1MB) can be mounted on the module (as an option) to enable Over The Air (OTA) programming capability.

This is a custom solution as an option for all part numbers.

**ABSOLUTE MAXIMUM RATINGS**

Description	MeshConnect™ Sub-G Module		Unit
	Min	Max	
Power Supply Voltage (VDD)	-0.3	3.6	VDC
Voltage on any I/O Line	-0.3	VDD + 0.3	VDC
RF Input Power	–	10	dBm
Storage Temperature Range	-40	125	°C
Reflow Soldering Temperature	–	260	°C

**Note:** Exceeding the maximum ratings may cause permanent damage to the module or devices.

**RECOMMENDED (OPERATING CONDITIONS)**

Description	MeshConnect™ Sub-G Module			Unit
	Min	Typ	Max	
Power Supply Voltage (VDD)	1.8/2.7*	3.3	3.6	V
Input Frequency	863	–	870	MHz
Input Frequency	902	–	928	MHz
Ambient Temperature Range	-40	25	85	°C

**Note:** \* 2.7v is the min voltage if an additional memory IC was placed on the module.

**DC CHARACTERISTICS** (@ 25°C, VDD = 3.6V, ZICM0xxxP2 TX power max)

Description	MeshConnect™ Sub-G Module			Unit
	Min	Typ	Max	
Transmit Mode Current	–	90	–	mA
Receive Mode Current	–	24	–	mA
Sleep Mode Current	–	TBD	–	µA

**DC CHARACTERISTICS** (@ 25°C, VDD = 3.6V, ZICM0xxxP0 TX power max)

Description	MeshConnect™ Sub-G Module			Unit
	Min	Typ	Max	
Transmit Mode Current	–	35	–	mA
Receive Mode Current	–	24	–	mA
Sleep Mode Current	–	TBD	–	µA

**RF CHARACTERISTICS** (@ 25°C, VDD = 3.6V, ZICM0xxxP2)

Description	MeshConnect™ Sub-G Module			Unit
	Min	Typ	Max	
<b>General Characteristics</b>				
RF Frequency Range	863	–	928	MHz
<b>Transmitter</b>				
Maximum Output Power	–	19	–	dBm
Minimum Output Power	–	-5	–	dBm
FSK Error	TBD	–	TBD	%
Carrier Offset	TBD	–	TBD	KHz
Deviation	–	75	–	KHz
<b>Receiver</b>				
Sensitivity (1% PER, 156kbps)	–	-99	TBD	dBm
Saturation (maximum input level)	–	–	10	dBm

**RF CHARACTERISTICS** (@ 25°C, VDD = 3.6V, ZICM0xxxP0)

Description	MeshConnect™ Sub-G Module			Unit
	Min	Typ	Max	
<b>General Characteristics</b>				
RF Frequency Range	863	–	928	MHz
<b>Transmitter</b>				
Maximum Output Power	–	12	–	dBm
Minimum Output Power	–	-12	–	dBm
FSK Error	TBD	–	TBD	%
Carrier Offset	TBD	–	TBD	KHz
Deviation	–	75	–	KHz
<b>Receiver</b>				
Sensitivity (1% PER, 156kbps)	–	-99	TBD	dBm
Saturation (maximum input level)	–	–	10	dBm

**PIN SIGNALS I/O PORT CONFIGURATION**

MeshConnect module has 56 edge I/O interfaces for connection to the user’s host board. The MeshConnect Module Dimensions shows the layout of the 56 edge castellations.

**MeshConnect I/O PIN ASSIGNMENTS**

Number	Name	Notes
1	GND	
2	GND	
3	GND	
4	GND	
5	GND	
6	GND	
7	GND	
8	NC	
9	ANTA	Available: Not used for any module functionality
10	GPIO0	Available: Not used for any module functionality
11	GPIO2	Available: Not used for any module functionality
12	P0.7/IREF	Must be connected to SDN for SNAP firmware
13	P0.6/ CNVSTR	Used as Chip Select for Memory on CEL Eval. Board
14	P0.5/RXD	UART TXD
15	P0.4/TXD	UART RXD
16	WP	Write Protect Pin of Memory Chip on Module
17	NC	
18	GND	
19	GND	
20	NC	
21	NC	
22	NC	
23	P0.3	Used as Chip Select for Memory IC on the CEL Module
24	P0.2	Memory IC MISO signal pin
25	P0.1	Must be connected to NIRQ for SNAP firmware
26	P0.0	Memory IC Clock Signal
27	GND	
28	VCC	
29	RST/C2CK	Debug Clock
30	P2.7/C2D	Debug Data
31	P2.6	GPIO connected to Buzzer on CEL Eval Board
32	P2.5	GPIO connected to Switch 3 on CEL Eval board
33	P2.4	GPIO connected to LED3 on CEL Eval board
34	P2.3	GPIO connected to Switch 2 on CEL Eval Board



**MeshConnect I/O PIN ASSIGNMENTS** (Continued)

Number	Name	Notes
35	NC	
36	NC	
37	GND	
38	GND	
39	GND	
40	GND	
41	GND	
42	P2.2	GPIO connected to LED2 on CEL Eval board
43	P2.1	GPIO connected to Switch 1 on CEL Eval Board
44	P2.0	GPIO connected to LED1 on CEL Eval board
45	P1.7	GPIO connected to Switch 0 on CEL Eval Board
46	P1.6	GPIO connected to LED0 on CEL Eval board
47	P1.5	Memory IC MOSI
48	NIRQ	External Interrupt Request
49	SDN	Radio Shutdown (Active High)
50	GND	
51	GND	
52	GND	
53	GND	
54	GND	
55	GND	
56	GND	

**SOFTWARE/FIRMWARE**

The Sub-G modules support the following software:

- Synapse SNAP Embedded Firmware
- Wireless M-Bus (868MHz Only)
- Silicon Labs EZMac
- CEL Protocol

The MeshConnect Sub-G Development Kit provides a guide on how to access the Si100x IC and utilize the Silicon Labs software development environment. It also provides a set of demo applications to conduct several tests. Below is the list of the demo software features:

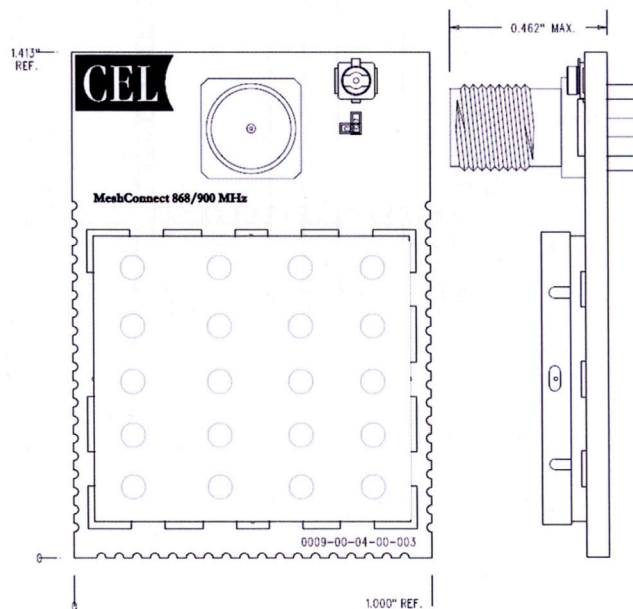
**SOFTWARE/FIRMWARE** (Continued)

- Self Healing (Orphan handling)
- Point-to-Point network formation
- Point-to-Multipoint (Star) network formation
- Self Healing (Orphan handling)
- Point-to-Point network formation
- Point-to-Multipoint (Star) network formation
- ACK
- Wakeup Modes (Si100X) – most likely software will just use one of the wakeup modes
- Frequency Hopping
- Unicast Addressing using 16-bit device IDs
- Broadcast Addressing
- Packet Forwarding (Master node only)
- Forwarding Table Aging (Master node only)
- Promiscuous Mode (TBD – later release)
- Listen Before Talk (LBT)
- RSSI
- Packet Filtering
- Pairing/Joining
- Network Synchronization through beacon messages to coordinate sleep/wake cycles
  - Master node needs to send out beacon as well as figure out when to go to sleep and when to wake up
  - End node wakes up and looks for beacon to figure out when to go to sleep and wake up
- Command line interface for debug/testing/configuration
- Push buttons for Range or PER packet test on a Eval board
- Save configuration to flash
- Save configuration to external flash
- Over-the-air programming of the image to another device (TBD – later release)
- Low Battery detection

**MODULE DIMENSIONS**

**MeshConnect™** Sub-G Module with U.FL Connector for external antenna

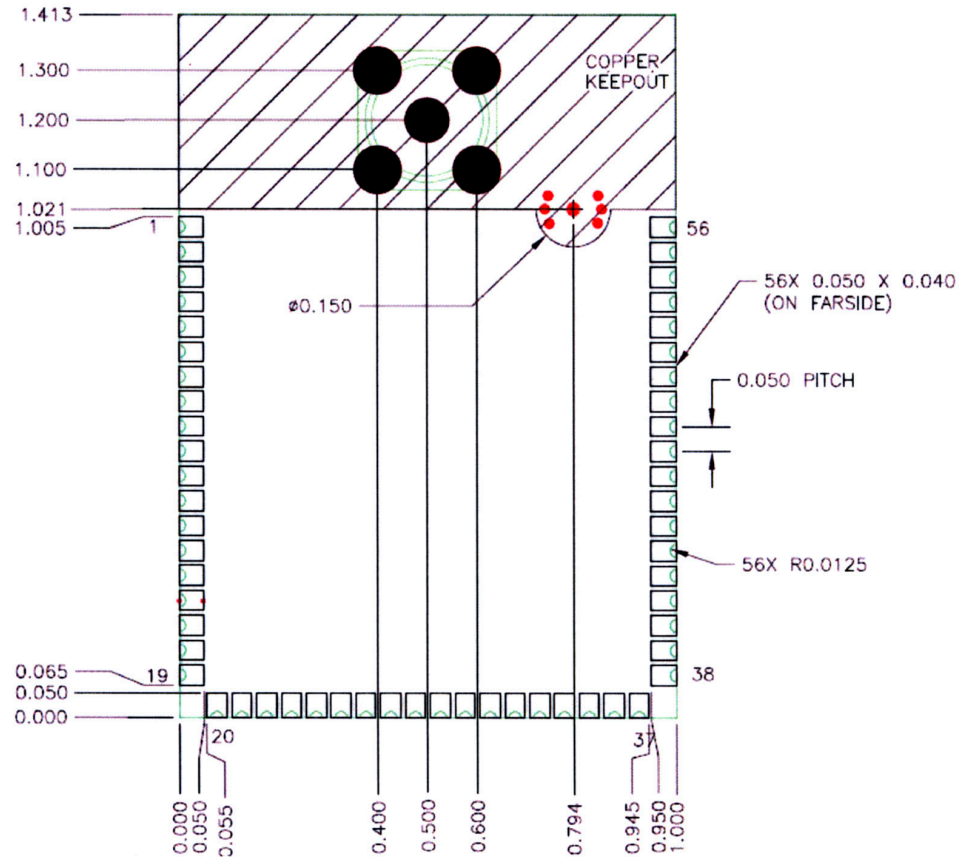
**MeshConnect™** Sub-G Module with RPSMA Connector for external Antenna



For layout recommendation for optimum antenna performance, refer to Antenna section in this document.

## MODULE LAND FOOTPRINT

**Note:** Unless otherwise specified. Dimensions are in Inches [mm].



## EVALUATION BOARD

CEL provides an Evaluation board to allow easy testing of the Module. The Evaluation board provides power via:

- AA cell batteries
- USB
- AC Adapter regulated down to 3.3VDC
- External Lab Power Supply (A jumper is also provided for the purposes of monitoring the DC current of the module under various modes of operation).

Also included on the evaluation board are four momentary push button switches and four LEDs, a piezo buzzer, a potentiometer, and a SPI memory IC. The peripherals are connected to GPIO of the module (see notes in Pin definitions) through slide switches. If the user would want to connect user specific circuits to the GPIO, slide switches can be used to disconnect the evaluation board peripherals.

The purpose of the evaluation board is to demonstrate simple applications of using GPIO, communicating with the device and also allow flexibility for user specific needs.

## PROCESSING

### Recommended Reflow Profile

Parameters Values	
Ramp up rate (from Tsoakmax to Tpeak)	3°/sec max
Minimum Soak Temperature	150°C
Maximum Soak Temperature	200°C
Soak Time	60-120 sec
TLiquidus	217°C
Time above TL	60-150 sec
Tpeak	250°C
Time within 5° of Tpeak	20-30 sec
Time from 25° to Tpeak	8 min max
Ramp down rate	6°C/sec max

Achieve the brightest possible solder fillets with a good shape and low contact angle.

### Pb-Free Soldering Paste

Use of “No Clean” soldering paste is strongly recommended, as it does not require cleaning after the soldering process.

**Note:** The quality of solder joints on the castellations (‘half vias’) where they contact the host board should meet the appropriate IPC Specification. See the latest **IPC-A-610** “Acceptability of Electronic Assemblies, section 8.2.4 Castellated Terminations.”

### Cleaning

In general, cleaning the populated modules is strongly discouraged. Residuals under the module cannot be easily removed with any cleaning process.

- Cleaning with water can lead to capillary effects where water is absorbed into the gap between the host board and the module. The combination of soldering flux residuals and encapsulated water could lead to short circuits between neighboring pads. Water could also damage any stickers or labels.
- Cleaning with alcohol or a similar organic solvent will likely flood soldering flux residuals into the two housings, which is not accessible for post-washing inspection. The solvent could also damage any stickers or labels.
- Ultrasonic cleaning could damage the module permanently.

The best approach is to consider using a “no clean” soldering paste and eliminate the post-soldering cleaning step.

### Optical Inspection

After soldering the Module to the host board, consider optical inspection to check the following:

- Proper alignment and centering of the module over the pads.
- Proper solder joints on all pads.
- Excessive solder or contacts to neighboring pads, or vias.

### Repeating Reflow Soldering

Only a single reflow soldering process is encouraged for host boards.

### Wave Soldering

If a wave soldering process is required on the host boards due to the presence of leaded components, only a single wave soldering process is encouraged.

## PROCESSING *(Continued)*

### Hand Soldering

Hand soldering is possible. Use a soldering iron temperature setting equivalent to 350°C, follow IPC recommendations/ reference document IPC-7711.

### Rework

The MeshConnect Module can be unsoldered from the host board. Use of a hot air rework tool and hot plate for pre-heating from underneath is recommended. Avoid overheating.

**Warning** Never attempt a rework on the module itself, e.g. replacing individual components. Such actions will terminate warranty coverage.

### Additional Grounding

Attempts to improve module or system grounding by soldering braids, wires, or cables onto the module RF shield cover is done at the customer's own risk. The numerous ground pins at the module perimeter should be sufficient for optimum immunity to external RF interference.

## AGENCY CERTIFICATIONS

### FCC Compliance Statement (Part 15.19) Section 7.15 of RSS-GEN

This device complies with Part 15 of the 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.

### Warning (Part 15.21)

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

### 20 cm Separation Distance

To comply with FCC/IC RF exposure limits for general population / uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

### OEM Responsibility to the FCC Rules and Regulations

The MeshConnect Module has been certified per FCC Part 15 rules for integration into products without further testing or certification. To fulfill the FCC certification requirements, the OEM of the MeshConnect Module must ensure that the information provided on the MeshConnect Label is placed on the outside of the final product. The MeshConnect Module is labeled with its own FCC ID Number. If the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: W7Z-ICP0" or "Contains FCC ID: W7Z-ICP0"

The OEM of the MeshConnect Module must only use the approved antenna, (PCB Trace Antenna) that has been certified with this module. The OEM of the MeshConnect Module must test their final product configuration to comply with Unintentional Radiator Limits before declaring FCC compliance per Part 15 of the FCC rules.

**AGENCY CERTIFICATIONS** *(Continued)*

**IC Certification — Industry Canada Statement**

The term "IC" before the certification / registration number only signifies that the Industry Canada technical specifications were met.

**Section 14 of RSS-210**

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population. Consult Safety Code 6, obtainable from Health Canada's website: <http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/99ehd-dhm237/index-eng.php>

**CE Certification — Europe**

The MeshConnect 868MHz RF modules has been tested and certified for use in the European Union.

**OEM Responsibility to the European Union Compliance Rules**

If the MeshConnect module is to be incorporated into a product, the OEM must verify compliance of the final product to the European Harmonized EMC and Low-Voltage / Safety Standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive.

The manufacturer must maintain the user's guide and adhere to the settings described in the manual for maintaining European Union Compliance. If any of the specifications are exceeded in the final product, the OEM is required to make a submission to the notified body for compliance testing.

**OEM Labeling Requirements**

The `CE' mark must be placed on the OEM product in a visible location.

The CE mark shall consist of the initials "CE" with the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be adhered to.
- The CE mark must be a minimum of 5mm in height
- The CE marking must be affixed visibly, legibly, and indelibly. Since the 2400 - 2483.5 MHz band is not harmonized by a few countries throughout Europe, the Restriction sign must be placed to the right of the "CE" marking as shown in the picture



**SHIPMENT, HANDLING, AND STORAGE**

**Shipment**

The MeshConnect Modules are delivered in trays of 28.

**Handling**

The MeshConnect Modules are designed and packaged to be processed in an automated assembly line.

**Warning** The MeshConnect Modules contain highly sensitive electronic circuitry. Handling without proper ESD protection may destroy or damage the module permanently.

**Warning** According to JEDEC ISP, the MeshConnect Modules are moisture-sensitive devices. Appropriate handling instructions and precautions are summarized in Section 2.1. Read carefully to prevent permanent damage due to moisture intake.

**Moisture Sensitivity Level (MSL)**

MSL 3, per J-STD-033

**Storage**

Storage/shelf life in sealed bags is 12 months at <40°C and <90% relative humidity.

**REFERENCES & REVISION HISTORY**

Previous Versions	Changes to Current Version	Page(s)
0008-00-07-00-000 (Issue ES) December 7, 2010	Initial preliminary datasheet.	N/A

**Disclaimer**

- The information in this document is current as of the published date. The information is subject to change without notice. For actual design-in, refer to the latest publications of CEL data sheets or data books, etc., for the most up-to-date specifications of CEL products. Not all products and/or types are available in every country. Please check with an CEL sales representative for availability and additional information.
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- While CEL endeavors to enhance the quality, reliability and safety of CEL products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in CEL products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment and anti-failure features.