

Embedded Multi-Protocol IOT Module**DESCRIPTION**

The ZB3212F6R4SP2 ZigBee, Thread, Bluetooth Smart Mini Modules feature the Silicon Labs EFR32MG12 single chip transceiver. These devices are footprint-compatible with CEL's existing line of ZigBee-, Thread-, and Bluetooth-based modules, allowing for fast and simple performance upgrades via drop-in compatible hardware.

The ZB3212F6R4SP2 Mini Modules are fully certified standalone solutions for designers looking to take advantage of the robustness of the Silicon Labs EmberZNet PRO™ stack while having the flexibility to interface to Bluetooth Smart-enabled devices previously deployed in the field. These modules eliminate design risk and significantly reduce time-to-market for a multitude of IoT applications.

These EFR32-based devices are compatible with Silicon Labs' Simplicity Studio development environment which includes an eclipse-based IDE, documentation, debug, energy management tools, and flashing tools. Simplicity Studio supports a multitude of sample applications for many common uses of the EFR32, accelerating the development proof-of-concept designs and demos.

**KEY FEATURES**

- Multi-Protocol Support in a Single Device:
 - ZigBee 3.0, Thread, Bluetooth Smart 5.0
- Enhanced Memory
 - 1MB Flash
 - 256kB SRAM
- Up to 24 Analog/Digital GPIOs, including SPI, USART, I2C, 12b ADC, iDAC, Comparators and Timers
- Radiated Output power up to 20dBm
- Two Antenna Configurations
 - Integrated PCB Trace Antenna
 - External Antenna Connections via 50Ω RF Castellated Port for development
- Mini Footprint: 0.940" x 0.655" (23.9 x 16.6mm)
- Footprint-compatible with CEL's Bluetooth, ZigBee, and Thread Module Family, Allowing for Fast and Simple Performance Upgrades
- ZB3212F6R4SP2-1 Variant FCC, IC, Certified* for Usage Throughout North America and Canada

* Official FCC & IC certifications are in process and pending final approval by the respective governmental bodies.

APPLICATIONS

- Connected Home & Appliances
- Building Control & Automation
- Lighting
- Security
- Wireless Sensor Networks
- Wireless Audio & Video
- Remote Health and Wellness Monitoring
- General IoT Wireless Networking

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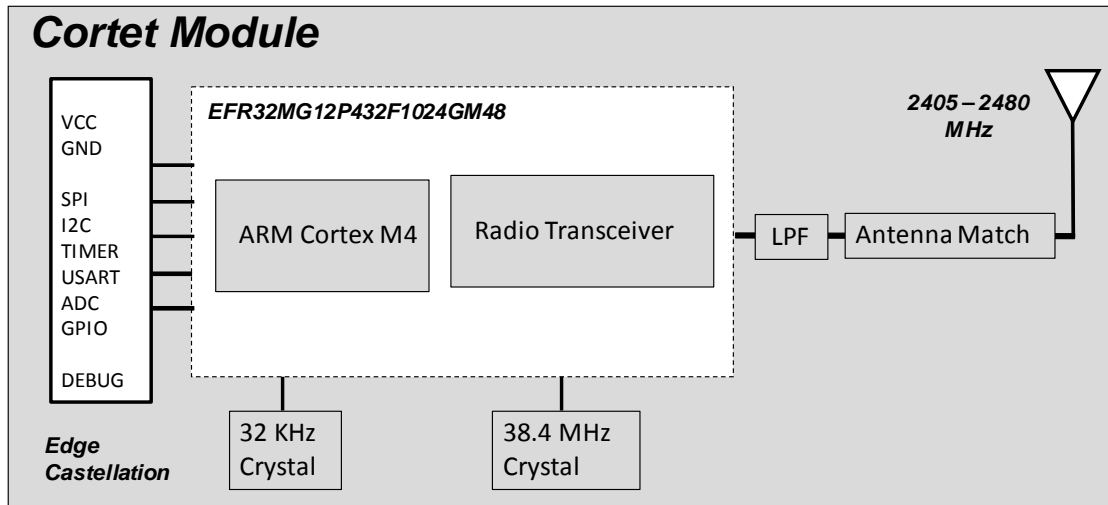
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BLOCK DIAGRAM



ORDERING INFORMATION

Order Number	Description	Min/Multiple
ZB3212F6R4SP2-1-R	Zigbee/Thread/BT Smart Module, EFR32MG12P433F1024GM48-C0 single chip transceiver + MCU (1MB flash, 256kB RAM), Trace Antenna	600
ZB3212F6R4SP2-1C-R	Zigbee/Thread/BT Smart Module, EFR32MG12P433F1024GM48-C0 single chip transceiver + MCU (1MB flash, 256kB RAM), Castellation Pin for External Antenna. <i>NOT FCC OR IC CERTIFIED. END USER MUST CERTIFY BEFORE PLACING ON THE MARKET.</i>	600

ANTENNA

The Cortet Mini Modules include an integrated Printed Circuit Board (PCB) trace antenna certified for FCC & IC requirements. An optional configuration which uses a castellation pin on the module allows the user to connect to an external antenna however this implementation would require certification by the end user and may not use the CEL FCC ID number on the label. The PCB antenna employs a topology that is compact and highly efficient. To maximize range, an adequate ground plane must be provided on the host PCB. Correctly positioned, the ground plane on the host PCB will contribute significantly to the antenna performance.

For optimum antenna performance, the Cortet Mini Module should be mounted with the PCB trace antenna overhanging the edge of the host board and ideally in the upper left corner of the host board so that free space is left of the module as opposed to additional pcb and components. To further improve performance, a ground plane may be placed on the host board under the module, up to the antenna but not extending under the antenna (a minimum of 1.5" x 1.5" is recommended). The installation of an uninterrupted ground plane on a layer directly beneath the module will also allow traces to be routed under the layer. Refer to the application note *Mini Modules Hardware Design Guidelines* for more details. CEL can assist with your PCB layout.

The following are some design guidelines to help ensure optimal antenna performance:

- The antenna portion of the Mini Module should hang over the host board so that there is not any additional PCB under the antenna.
- Never place the antenna close to metallic objects
- In the final assembly, 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 a minimum of 1cm away from the antenna in any direction

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

ABSOLUTE MAXIMUM RATINGS

Description	Min	Max	Unit
Power Supply Voltage	0	3.8	V
Voltage on any 5V Tolerant IO Line	-0.3	Min of 5.25 and VDD+2	V
Voltage on any non-5V Tolerant IO Line	-0.3	VDD+0.3	V
RF Input Power	-	10	dBm
Storage Temperature	-50	150	°C
Reflow Soldering Temperature	-	260	°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
	Power Supply Voltage	2.4	3.3	3.8	V
	Frequency	2405		2480	MHz
	Ambient Temperature Range	-40		85	°C

DC CHARACTERISTICS

(@ 3.3VDC and 25°C unless otherwise specified)

Item	Condition	Min	Nom	Max	Unit
Tx Mode: 2.4 GHz 19.5 dBm ¹	Continuously Modulated Carrier		120		mA
Tx Mode: 2.4 GHz 10 dBm ¹	Continuously Modulated Carrier		55		mA
Tx Mode: 2.4 GHz 0 dBm ¹	Continuously Modulated Carrier		18		mA

Rx mode	802.15.4		12		mA
	Bluetooth Smart		12		mA

Sleep Modes	EM1 all peripherals disabled		65		μA/MHz
	EM2 deep sleep mode		2.8		μA
	EM3 stop mode		2.7		μA
	EM4 Hibernate mode		0.62		μA

1. Power referenced at the IC output.

RF CHARACTERISTICS**TRANSMITTER**

Item	Condition	Nom	Unit
Maximum Radiated TX Power	3.8 V supply	20	dBm
Minimum TX Power	Power Setting -20 or less	-25	dBm
Frequency Range		2400 - 2483.5	MHz

The RF performance reported above assumes a default supply voltage of 3.3V unless otherwise noted.

RECEIVER

Item	Condition	Nom	Unit
1% PER 802.15.4	250kbps	-101	dBm
1 % PER Sensitivity	2Mbps 2GFSK signal	-89.2	dBm
0.1 % BER Sensitivity	250kbps 2GFSK signal	-99.1	dBm
Frequency Range		2400 - 2483.5	MHz

I/O PIN ASSIGNMENTS

Refer to the STM32 datasheet for pin functionality details.

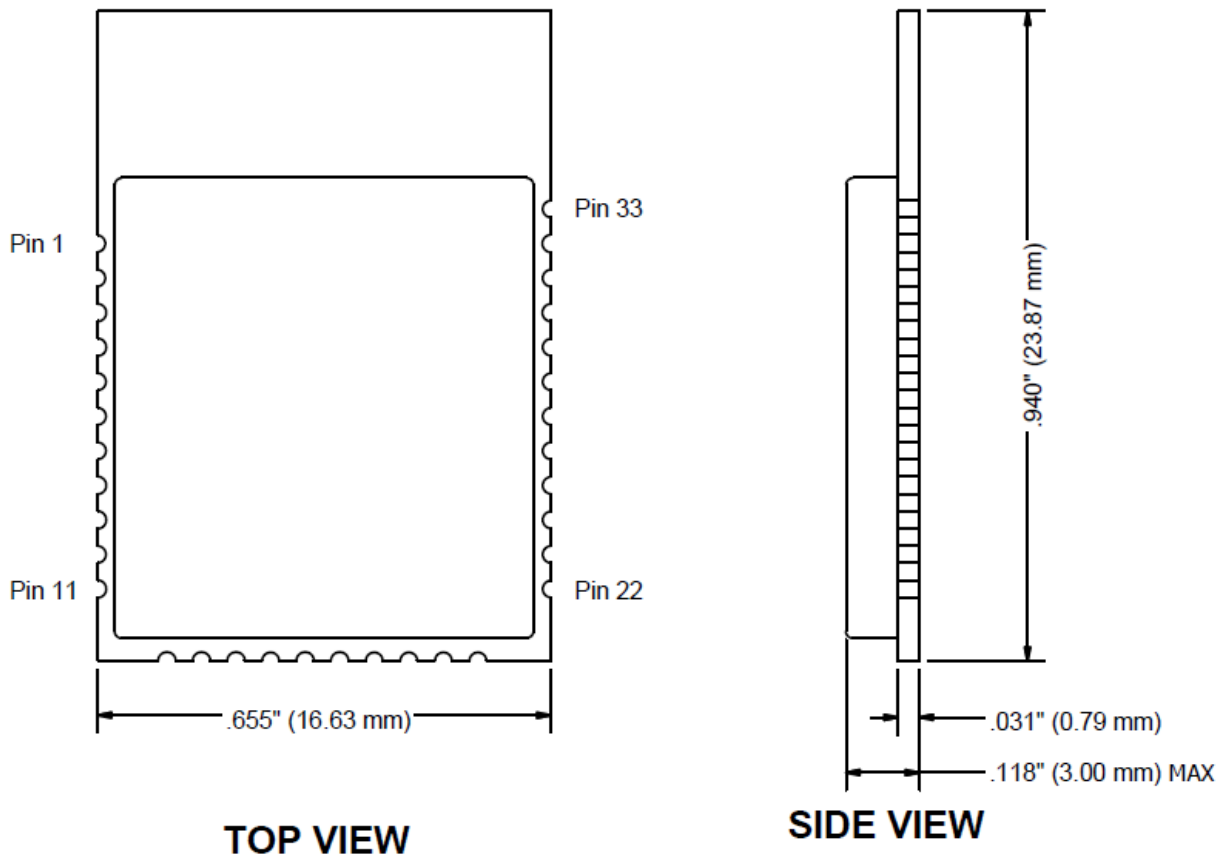
Module Pin Number	Pin Name	Notes
1, 2, 12, 31, 33	GND	
3	PA0	
4	Reset	
5	PA1	
6	PA2	
7	PA3	
8	PA5/US0_SCLK/CTS	
9	PB11/US0_CS/RTS	
10	PB12/US1_TX	
11	PB13/Wake/US1_RX/I2C0_SDA	
13	VCC	Input power to the module.
14	PC6/I2C0_SCL/US1_CLK	
15	PC7/US1_CS	
16	PC8	
17	PC9	
18	PC10/	
19	PC11/I2C0_SDA/US0_TX	
20	PF4/I2C0_SCL/US0_RX	
21	PF0/JTCK/SWCLK	
22	PF2/JTDO/SWO	
23	PF3/JTDI	
24	PF1/JTMS/SWDIO	
25	PF5	
26	PF6/APBY/APAX	Could be A/D or GPIO
27	PF7	
28	PD13/APCY/APDX	Could be A/D or GPIO
29	PD14/APDY/APCX	Could be A/D or GPIO
30	PD15/APCY/APDX	Could be A/D or GPIO
32	RF OUT	Castellation Pin for External Antenna

CEL MINI MODULE COMPATIBILITY

The geometry of the land pattern and location of the RF castellations is identical to CEL's ZICM35x family of ZigBee/Thread and B1010 Bluetooth Smart Mini Modules. The digital and analog mapping to develop a drop-in compatible solution is described below:

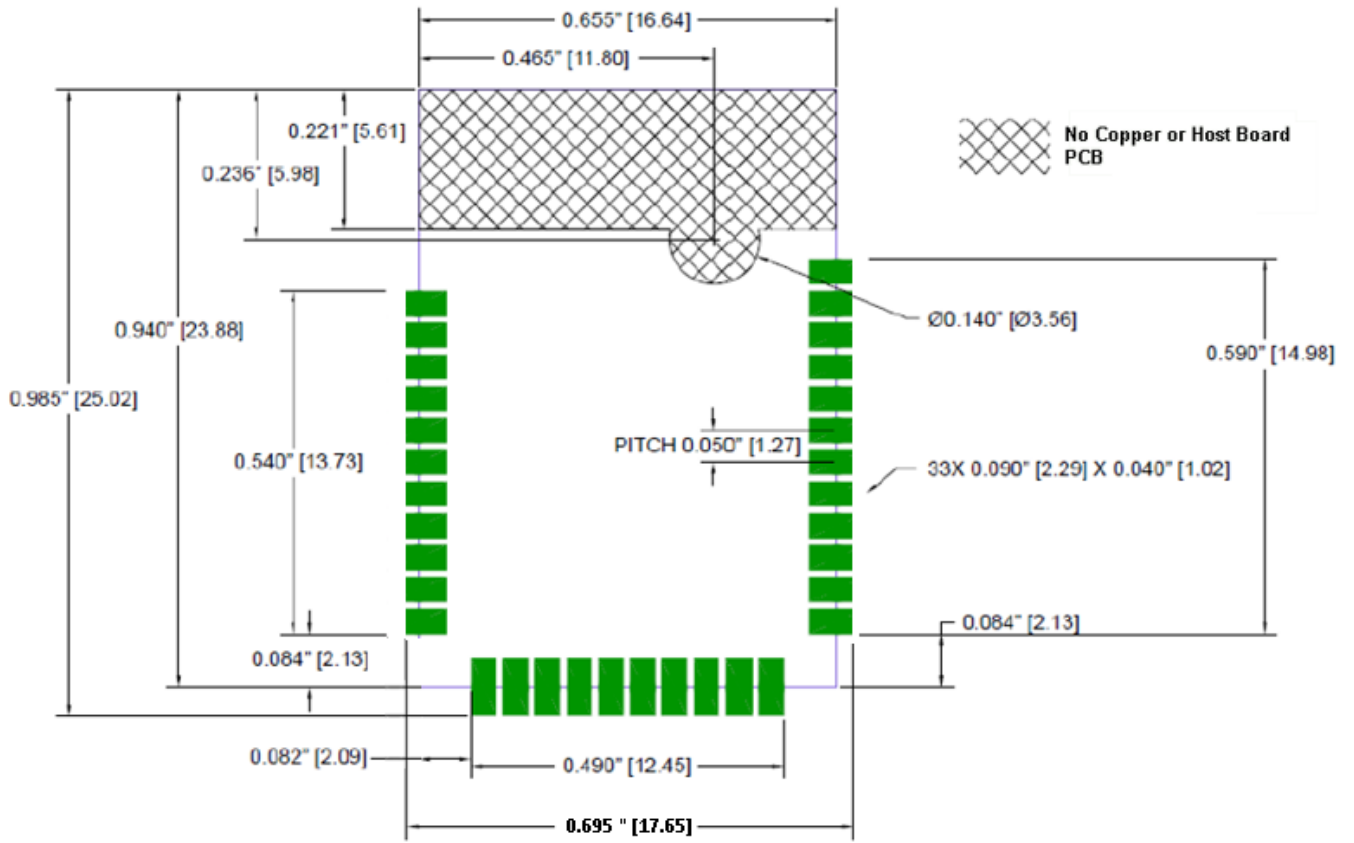
Pin #	Function	ZICM35x	B1010	ZB3212F6R4SP2
4	Reset	RESET	N/C	RESET
7	Wake	PA7	WAKE	PA3
8, 9, 19, 20	Serial Controller 1	UART/SPI/I2C	Two wire UART/I2C	USART/I2C
10, 11, 14, 15	Serial Controller 2	SPI/I2C	I2C	SPI/I2C
16, 17, 21, 22, 23, 24, 27	Debug & Programming	Debug & Programming	Debug & Programming	Debug & Programming
28, 30	ADC	PB7, PB5	AIO[1], AIO[2]	PD13, PD15
29	Timer	PB6	PIO[11]	PD14

MODULE DIMENSIONS



Note: All dimensions are $\pm .005$ in (0.12 mm) unless otherwise specified

MODULE LAND FOOTPRINT



Note: Refer to the Antenna section in this document for layout recommendations which will yield optimal antenna performance.

PROCESSING

Recommended Reflow Profile

Parameter Values	
Ramp Up Rate (from T_{soakmax} to T_{peak})	3°/sec max
Minimum Soak Temperature	150°C
Maximum Soak Temperature	200°C
Soak Time	60-120 sec
T_{Liquidus}	217°C
Time above T_{Liquidus}	60-150 sec
T_{peak}	250°C
Time within 5° of T_{peak}	20-30 sec
Time from 25° to T_{peak}	8 min max
Ramp Down Rate	6°C/sec max

Pb-Free Solder 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 Castellated Terminations Section in the latest IPC-A-610 Acceptability of Electronic Assemblies document.*

Cleaning

In general, cleaning the populated module 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” solder 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.

Hand Soldering

Hand soldering is possible. When using a soldering iron, follow IPC recommendations (reference document *IPC-7711*).

Rework

The Cortet module can be unsoldered from the host board. Use of a hot air rework tool should be programmable and the solder joint and module should not exceed the maximum peak reflow temperature of 250°C.

Caution

If temperature ramps exceed the reflow temperature profile, module and component damage may occur due to thermal shock. Avoid overheating.

Warning

Never attempt a rework on the module itself (i.e., replacing individual components); such actions will terminate warranty coverage.

Additional Grounding

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

AGENCY CERTIFICATIONS

NOTE: Certifications are in process and pending final approval

FCC Compliance Statement Part 15.19, Section 7.15 of RSS-GEN

This device complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS Standards. Operation is subject to the following two conditions:

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

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.

Warning (Part 15.21)

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

20cm 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 20cm from all persons and must not be operated in conjunction with any other antenna or transmitter.

OEM Responsibility to the FCC and IC Rules and Regulations

The Cortet Mini Module has been certified per FCC Part 15 Rules and to Industry Canada license exempt RSS Standards for integration into products without further testing or certification. To fulfill the FCC and IC certification requirements, the OEM of the Cortet Module must ensure that the information provided on the Cortet label is placed on the outside of the final product. The Cortet Mini Module is labeled with its own FCC ID number and IC ID number. If the FCC ID and the IC ID are 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. The exterior label can use wording such as the following

"Contains Transmitter Module FCC ID: W7Z-WB4343S"

"Contains Transmitter Module IC: 8254A-WB4343S"

The OEM of the Cortet Mini Module may only use the approved antennas (PCB Trace Antenna) that have been certified with this module. The OEM of the Cortet Mini Module must test their final product configuration to comply with Unintentional Radiator Limits before declaring FCC Compliance per Part 15 of the FCC Rules.

IC Certification — Industry Canada Statement

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

Certification IC — Déclaration d'Industrie Canada

Le terme "IC" devant le numéro de certification/d'enregistrement signifie seulement que les spécifications techniques Industrie Canada ont été respectées.

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/radio_guide-lignes_direct-eng.php

L'article 14 du CNR-210

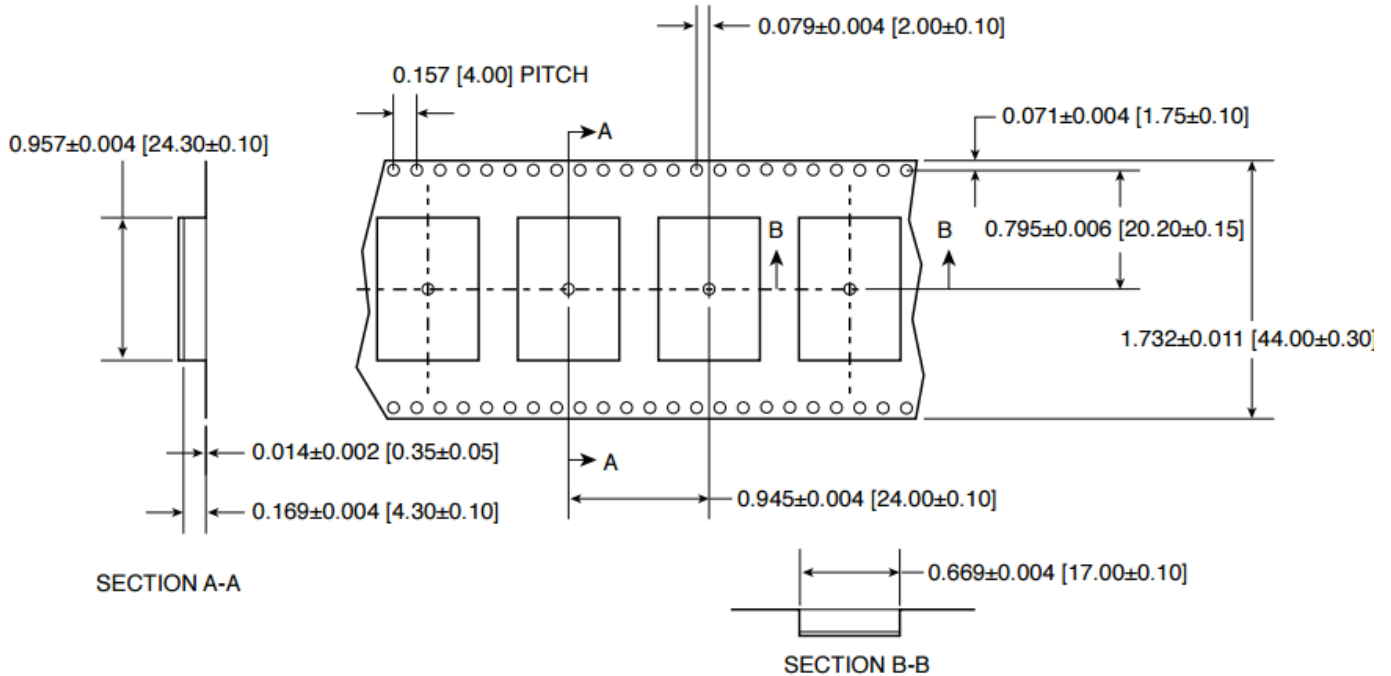
Le programme d'installation de cet équipement radio doit s'assurer que l'antenne est située ou orientée de telle sorte qu'il ne pas émettre de champ RF au-delà des limites de Santé Canada pour la population générale. Consulter le Code de sécurité 6, disponible sur le site Web de Santé Canada: http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php

SHIPMENT, HANDLING AND STORAGE

Shipment

The Cortet modules are delivered in reels of 600 units. The reel diameter is 12.992 inches (330mm).

Tape and Reel Dimensions
Measurements are in inches [mm]



Handling

The Cortet modules are designed and packaged to be processed in an automated assembly line.

Warning

The Cortet modules contain highly sensitive electronic circuitry. Handling without proper ESD protection may destroy or damage the module permanently.

Warning

The Cortet modules are moisture-sensitive devices. Appropriate handling instructions and precautions are summarized in J-STD-033. 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.

QUALITY

CEL modules offer the highest quality at competitive prices. Our modules are manufactured in compliance with the IPC-A-610 specification, Class II. Our modules go through JESD22 qualification processes which includes high temperature operating life tests, mechanical shock, temperature cycling, humidity and reflow testing.

CEL builds the quality into our products, giving our customers confidence when integrating our products into their systems.

REVISION HISTORY

Previous Versions	Changes to Current Version	Page(s)
0020-00-07-00-000 (Issue A) September 2017	Initial Preliminary Data Sheet	N/A

DISCLAIMER

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For more information about CEL Cortet products and solutions, visit our website at cortet.cel.com.

TECHNICAL ASSISTANCE

For Technical Assistance, visit cortet.cel.com/tech-support.