



lumenradio MLE-N2 Radio Module Integration User Guide

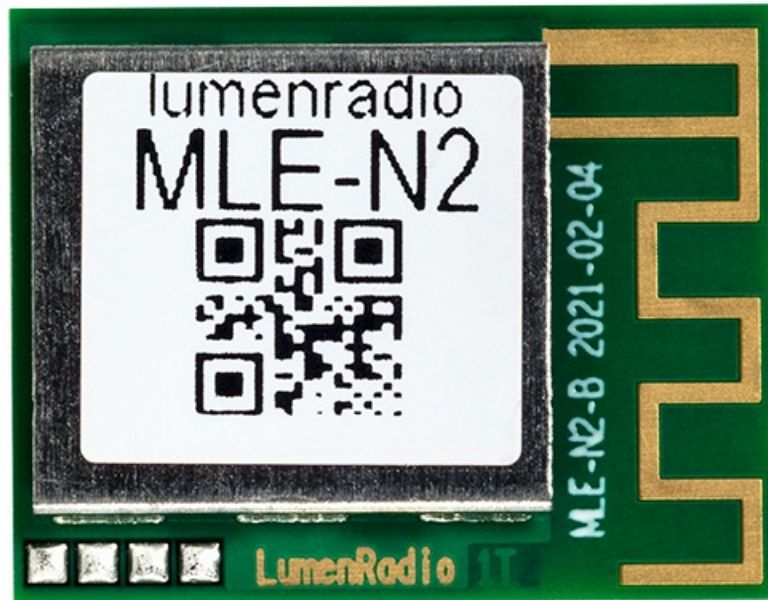
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lumenradio MLE-N2 Radio Module Integration



Product Information

Specifications

- **Absolute Maximum Ratings:**
 - **Supply Voltage:** -0.3V to 3.9V
 - **Operating Temperature:** -40°C to +85°C
 - **Input Voltage (VDD \leq 3.6V):** -40 to VDD+0.3V
 - **Input Voltage (VDD > 3.6V):** -40 to 3.9V
 - **Ground Pad Voltage:** 0.0V to +10V
 - **Storage Temperature:** -40°C to +125°C
 - **RF Input Power:** 1mW
 - **ESD All Pins, Human Body Model:** 1
- **Operating Temperature Range:** -40°C to +85°C
- **Power Supply:**
 - **Supply Voltage:** 1.7V to 3.6V
 - **Supply Current:** 150mA to 250mA
 - **Supply Rise Time:** 100ms (0V to 3.7V)
- **Digital I/O Pins:**
 - **Input Voltage Logic Low:** 0V to 0.3 * VDD
 - **Input Voltage Logic High:** 0.7 * VDD to VDD
 - **Output Voltage Logic Low:** 0V to VDD-0.4V
 - **Output Voltage Logic High:** VDD-0.4V to VDD
- **RF Performance:**
 - **Operating Frequency Range:** 2402MHz to 2480MHz
 - **Receiver Sensitivity (0.1% BER):** -96dBm
 - **TX Output Power:** 8.1dBm

Product Usage Instructions

• Integration Guide

The LumenRadio MLE-N2 module is designed for easy integration into products without the need for an external antenna. Follow these steps for successful integration:

• Step 1: Pin Assignments

Refer to the provided pin assignment documentation to correctly connect the module within your product.

• Step 2: Layout Considerations

Ensure proper layout considerations are met to optimize performance and signal integrity. Follow guidelines provided in the integration guide.

Frequently Asked Questions (FAQ)

1. Q: Is the MLE-N2 module suitable for high-volume production?

A: Yes, the MLE-N2 module is designed for high-volume production, offering cost efficiency and industrial-grade quality.

2. Q: What is the operating temperature range of the MLE-N2 module?

A: The MLE-N2 module can operate within a temperature range of -40°C to +85°C.

3. Q: Where can I find mechanical design files for the MLE-N2 module?

A: Mechanical design files in .stp and .dxf format are available for download on the LumenRadio online support page dedicated to the MLE-N2 module.

MLE-N2 radio module integration guide

Product Description

- The LumenRadio MLE-N2 (Mira Low Energy) module is a small size, cost efficient, industrial grade, multi-standard radio module, designed for high volume production of products without the need of an external antenna.
- MLE-N2 is based on the Nordic Semiconductor nRF52840 and features a powerful ARM Cortex M4 microcontroller with a dual radio for Bluetooth-based protocols and 802.15.4-based protocols. MLE-N2 is optimized for low-energy applications built on MiraOS and the MiraMesh radio stack.
- The MiraOS, MSS (Multi-Standard Support) feature allows concurrent operation of MiraMesh and Bluetooth v5.0, as well as NFC. This feature provides reliable mesh networking through MiraMesh with concurrent support for easy commissioning, local control and user interaction (UX/UI) over Bluetooth v5.0/NFC using a smartphone or tablet. Ultra-low energy consumption allows for battery-powered products or energy harvesting operation. MLE-N2 is an SMD module and thanks to its small footprint it can easily be integrated into any product.

Features

- Based on Nordic Semiconductor nRF52840 chipset
- Up to 8dBm configurable transmit output power
- -95dBm receiver sensitivity
- 103dB link budget
- On board antenna

- NFC-A support
- -40 – +85 °C operating temperature
- ARM Cortex-M4F at 64MHz operation
- 1MB flash and 256kB RAM
- 1.7 VDC – 3.6 VDC operation
- AES 128-bit ECB/CCM/AAR hardware accelerator
- 12bit ADC, SPI, I2C, UART, PWM, USB 2.0, GPIO
- Pre certified for Europe (ETSI RED), US (FCC/CFR 47 Part 15 unlicensed modular transmitter approval), Canada (IC RSS)
- 19,0 x 15,2 x 2,2mm footprint

Specifications

- **Sensitivity:** -95dBm
- **Frequency band:** 2.45 GHz, ISM band (2402-2480 MHz)
- **Dimensions:** 19.0 mm x 15.2 mm
- **Supply voltage** 1.7 – 3.6V

MLE-N2 radio module integration guide

- **Sensitivity:** -95dBm
- **Frequency band:** 2.45 GHz, ISM band (2402-2480 MHz)
- **Dimensions:** 19.0 mm x 15.2 mm
- **Supply voltage** 1.7 – 3.6V

Absolute maximum ratings

Maximum ratings are the extreme limits to which the MLE-N2 module can be exposed for a limited amount of time without permanently damaging it. Exposure to absolute maximum ratings for prolonged periods of time may affect the reliability of the device.

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{DD}	Supply voltage	-0.3		3.9	V
T_A	Operating temperature	-40		85	°C
V_{IO}	IO Input voltage $V_{DD} \leq 3.6V$			$V_{DD} + 0.3$	V
V_{IO}	IO Input voltage $V_{DD} > 3.6V$			3.9	V
V_{SS}	Ground pad voltage			0.0	V
T_S	Storage temperature	-40		+125	°C
RF_{in}	RF input power			+10	dBm
ESD	ESD all pins, Human Body Model			1	kV

Operating temperature range

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_A	Operating temperature	-40		85	°C

Power supply

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{DD}	Supply voltage	1.7	3.3	3.6	V
I_{DD}	Supply current		150	250	mA
V_{RISE}	Supply rise time (0 V to 3.7 V)			100	ms

Digital I/O pins

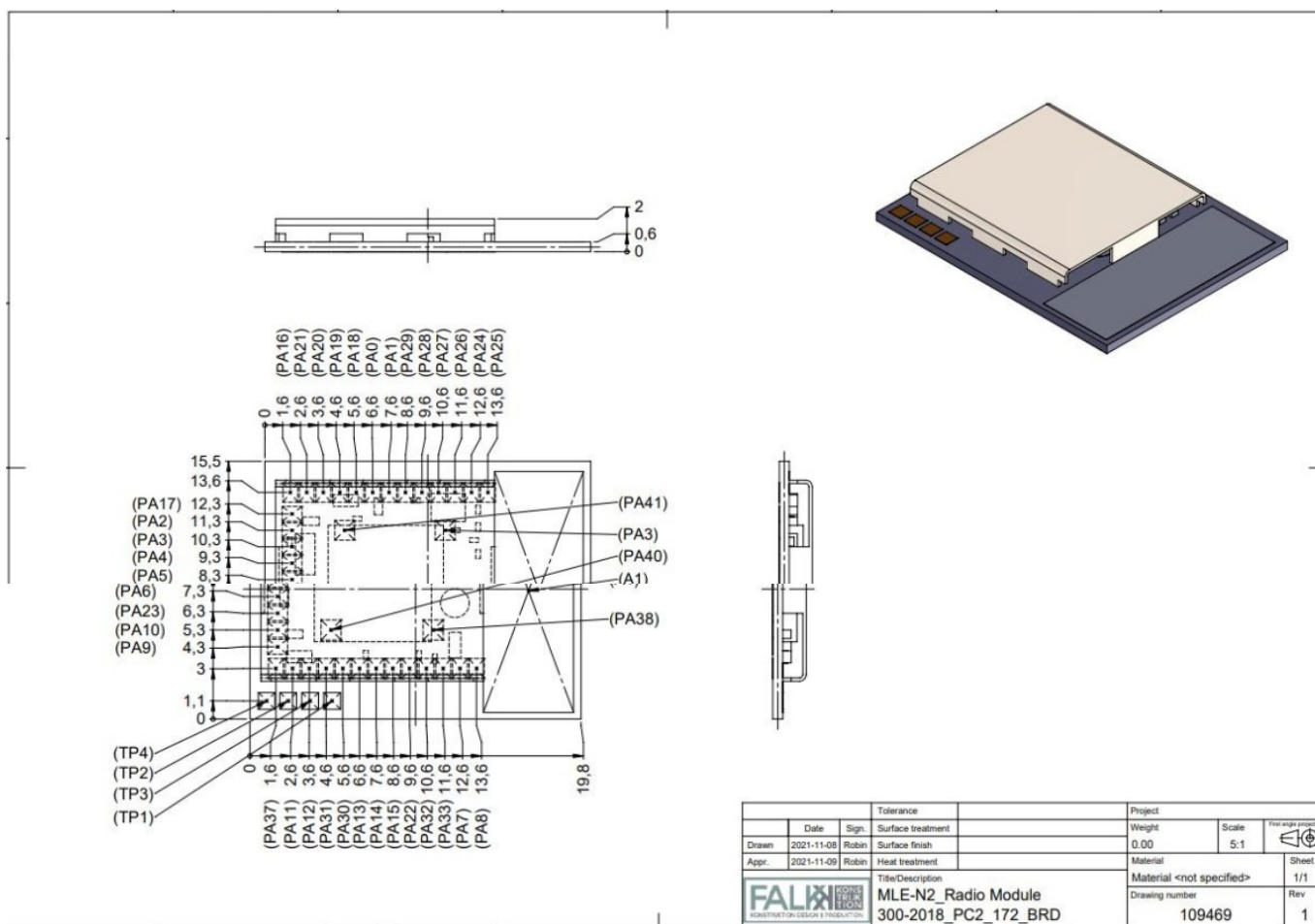
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{IL}	Input voltage logic low	0		$0.3 \cdot V_{DD}$	V
V_{IH}	Input voltage logic high	$0.7 \cdot V_{DD}$		V_{DD}	V
V_{OL}	Output voltage logic low	0		0.4	V
V_{OH}	Output voltage logic high	$V_{DD} - 0.4$		V_{DD}	V

RF Performance

RF performance below is valid at an ambient temperature of 25°C and a supply voltage of 3.3 V.

Symbol	Parameter	Min.	Typ.	Max.	Unit
f_{range}	Operating frequency range	2402		2480	MHz
RX_{sens}	Receiver sensitivity (0.1% BER)		-96		dBm
TX_{pout}	TX output power		8.1		dBm

Mechanical specification

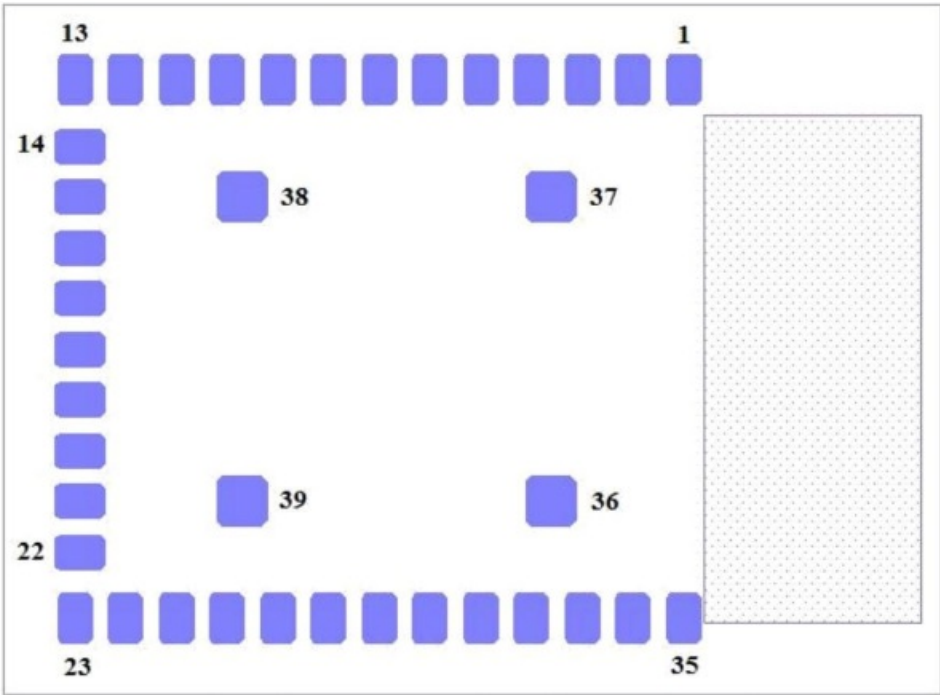


All dimensions in mm

Mechanical design files in .stp and .dxf format is available for download at the LumenRadio online support page

for the MLE-N2 module.

Pin assignments



Module seen from the top

MLE-N2 radio module integration guide

Pin number	nRF52840 pin name	Pin type	Description
P1	P1.11	Digital I/O	Low Frequency signals only
P2	P1.10	Digital I/O	Low Frequency signals only
P3	P1.12	Digital I/O	Low Frequency signals only
P4	P1.13	Digital I/O	Low Frequency signals only
P5	P1.14	Digital I/O	Low Frequency signals only
P6	P1.15	Digital I/O	Low Frequency signals only
P7	P0.03	Digital I/O, Analog Input	Low Frequency signals only
P8	P0.02	Digital I/O, Analog Input	Low Frequency signals only
P9	P0.28	Digital I/O, Analog Input	Low Frequency signals only
P10	P0.29	Digital I/O, Analog Input	Low Frequency signals only
P11	P0.31	Digital I/O, Analog Input	Low Frequency signals only
P12	P0.30	Digital I/O, Analog Input	Low Frequency signals only
P13	DCC1	Voltage output	Do not connect.
P14	P0.27	Digital I/O	

P15	P0.04	Digital I/O, Analog Input	
P16	P0.05	Digital I/O, Analog Input	
P17	P0.06	Digital I/O	
P18	P0.07	Digital I/O	
P19	P0.08	Digital I/O	
P20	P1.09	Digital I/O	
P21	P0.12	Digital I/O	
P22	P0.11	Digital I/O	
P23	VBUS	Voltage supply	5V supply if USB is used, else tie to ground.
P24	P0.19	Digital I/O	
P25	P0.21	Digital I/O	
P26	D-	Digital I/O	USB data
P27	D+	Digital I/O	USB data
P28	P0.18	Digital I/O	nRESET
P29	P0.22	Digital I/O	
P30	P0.23	Digital I/O	
P31	P1.00	Digital I/O	
P32	SWDIO	Digital I/O	Debug
P33	SWDCLK	Digital I/O	Debug
P34	P0.09 / NFC	Digital I/O	NFC
P35	P0.10 / NFC	Digital I/O	NFC
P36	VCC	Voltage supply	Main voltage supply.
P37	GND	GND	
P38	GND	GND	
P39	GND	GND	

For detailed information about pin functionality, see the Nordic Semiconductor nRF52840 product specification document.

Layout considerations

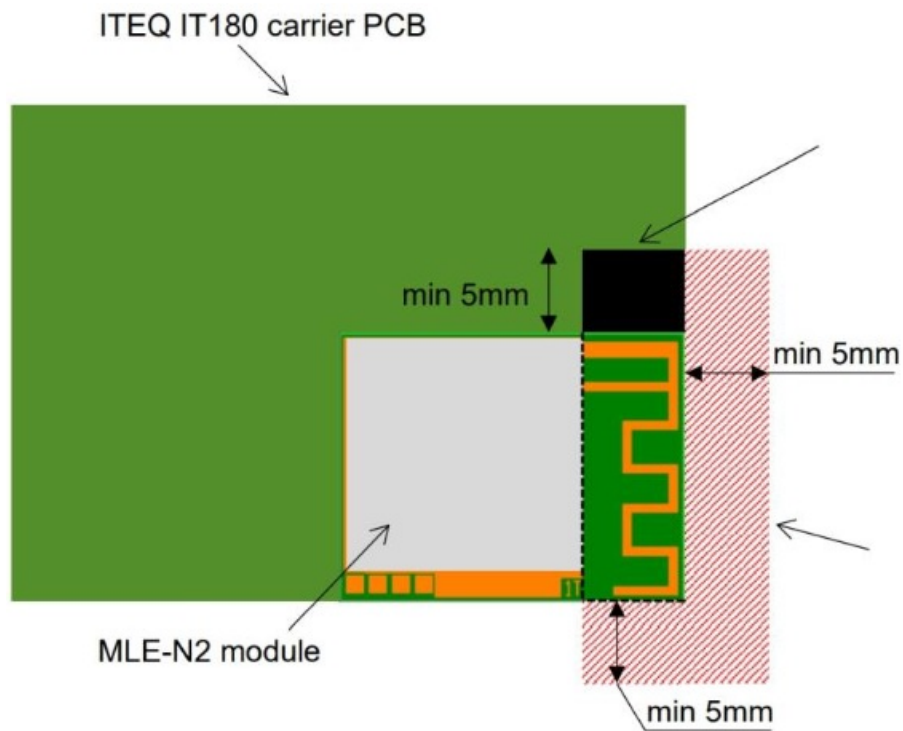
Electrical and mechanical design files are available for download at the LumenRadio online support page for the MLE-N2 module.

Antenna

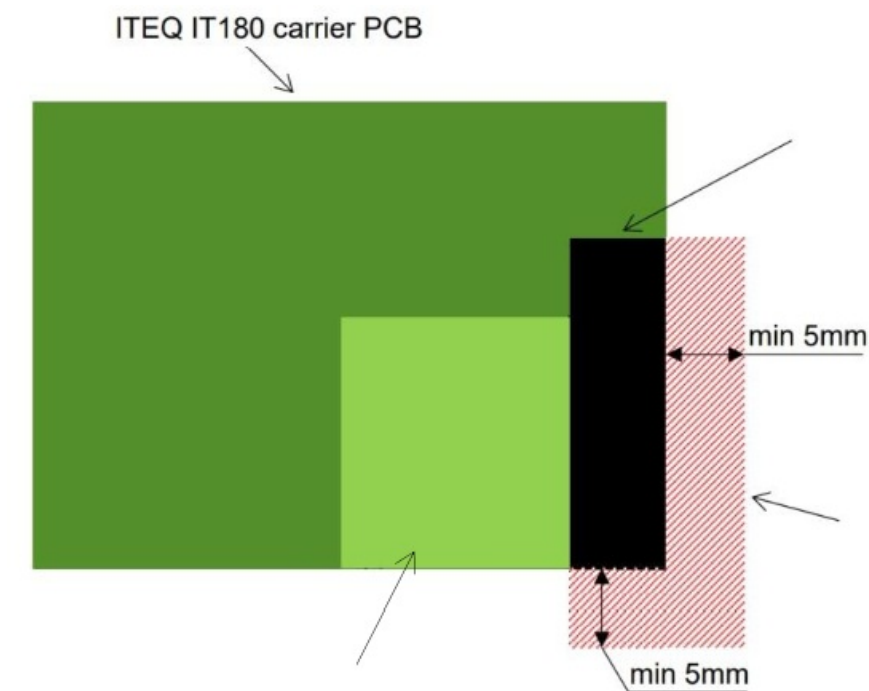
The MLE-N2 module has a built in highly effective inverted F antenna optimized for wall mount applications.

Layout considerations for the main board

For optimum performance of the MLE-N2 antenna the carrier board PCB should be designed so that following dimensions are met:



- lack Area is a carrier board clearance area. No components or traces/GND planes are allowed in this area. This area should be min 5mm wide from the board edge of MLE-N2 to the opposite board edge. Please note the orientation of the antenna and MLE-N2.
- Red diagonal striped area is a keep out area "air gap" from any solid objects or carrier board PCB material.

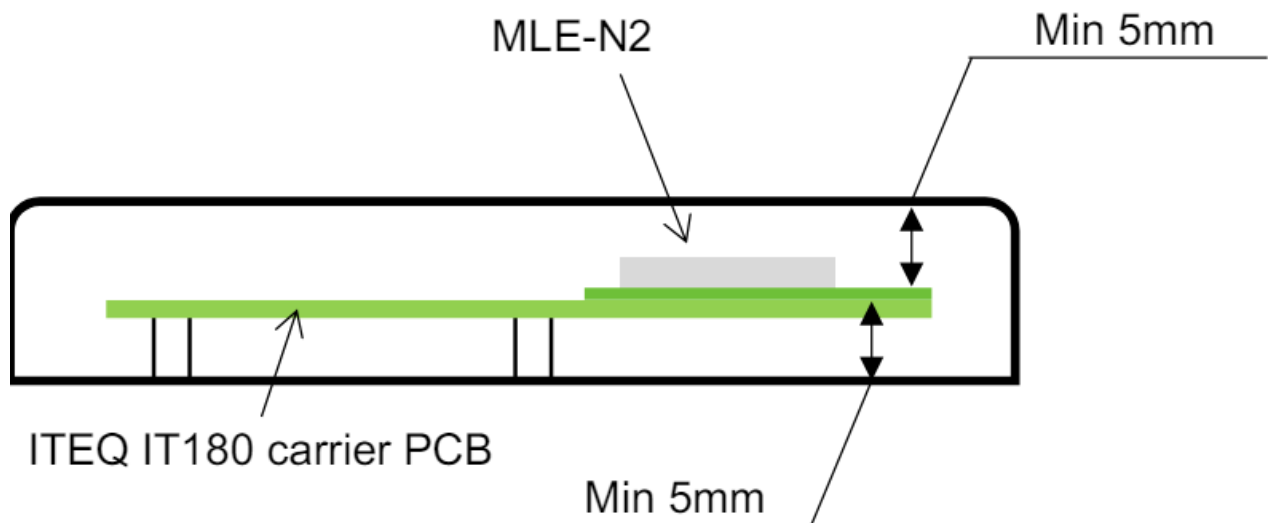


Top layer of carrier board PCB should be free from non-isolated GND planes, traces or vias.

- Black Area is a carrier board clearance area. No components or traces/GND planes are allowed in this area. This area should be min 5mm wide from the board edge of MLE-N2 to the opposite board edge.
- Red diagonal striped area is a keep out area "air gap" from any solid objects or carrier board PCB material.

Board design without MLE

Guidelines for mounting in enclosure



Min 5mm to solid objects under and above MLE-N2 antenna area. Note that carrier board thickness can be included in the total distance to solid objects under the antenna. I.e. for a 1.6mm carrier board standoffs needs to be min 3.4mm

Product Verification and Testing

Design Verification

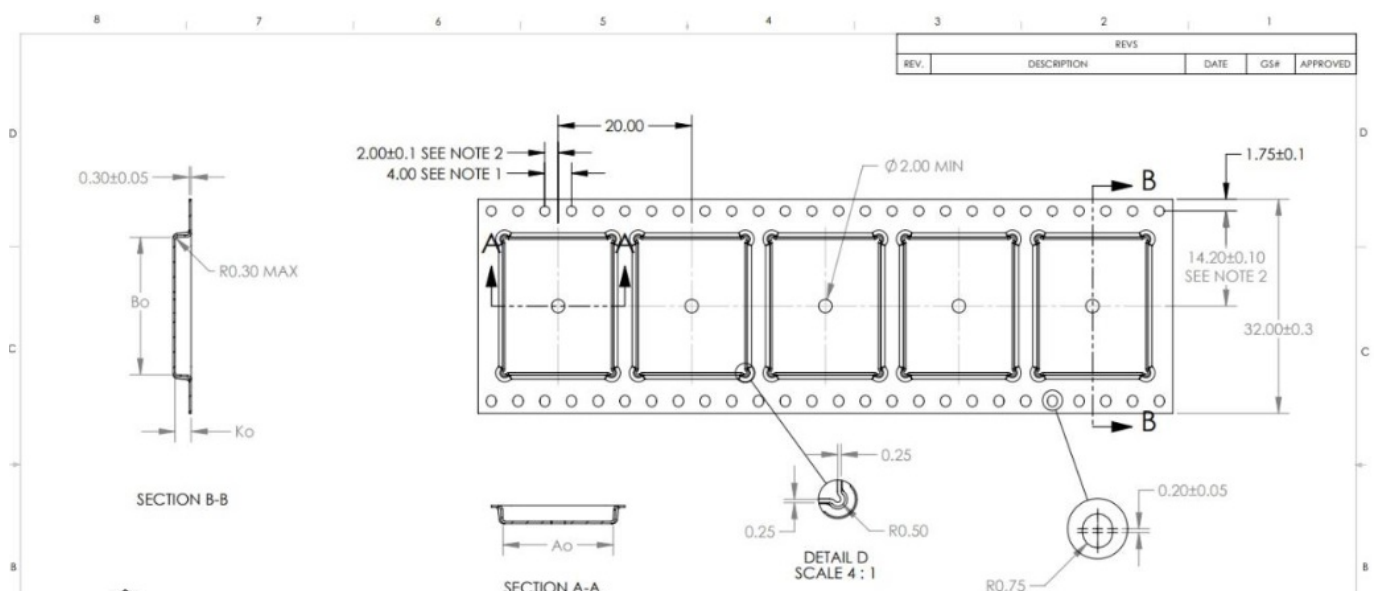
LumenRadio operates a full RF laboratory in Sweden and can offer design verification and testing services – please contact LumenRadio for advice (for contact information see section 9 “Contact and Ordering information”).

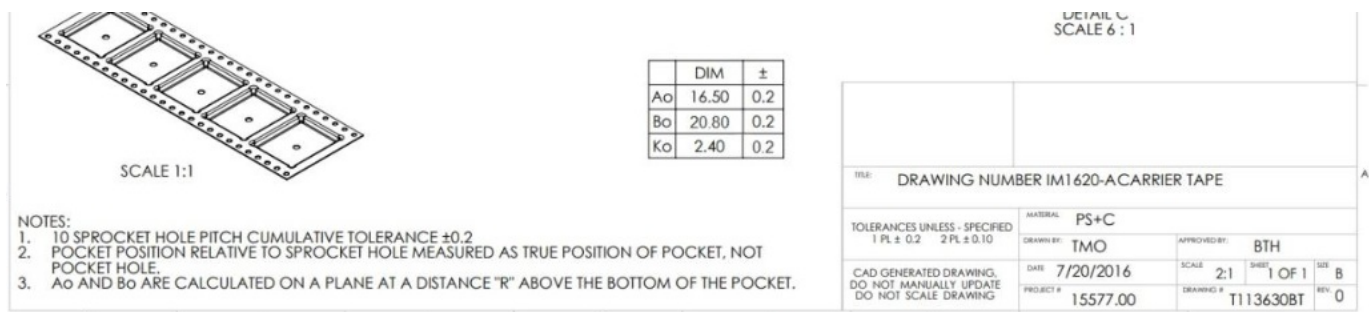
Production Testing

All mle-n2 modules are factory tested before being shipped. However, it is advised to perform some level of testing as part of your products overall test process. Please contact LumenRadio for product testing advice (for contact information see section 9 “Contact and Ordering information”).

MLE-N2 module Packaging

Carrier tape dimensions









Reel marking

Every reel has an identifier sticker booth on the reel and the reel package.

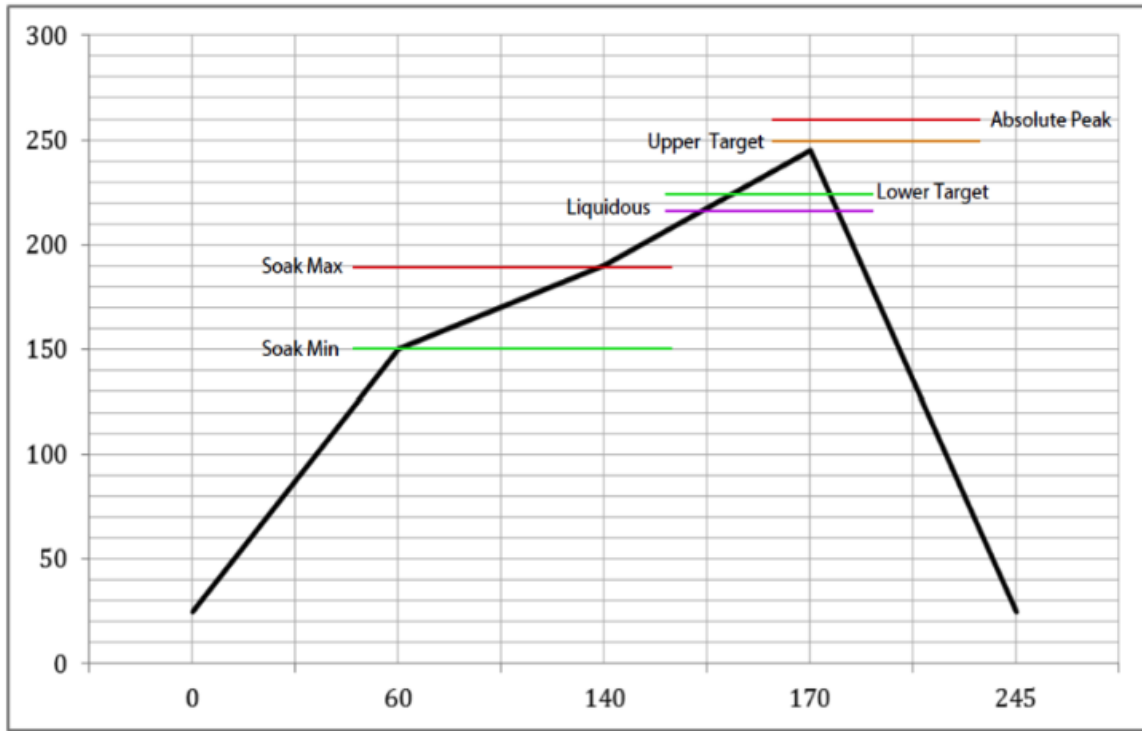


The identifier sticker contains the following information:

PRODUCT MLE-N2	SOFTWARE VERS. SW: XXXX		
PACKED DATE XXXX-XX-XX XX:XX:XX		QUANTITY XXX	
XXXXXXX (serial number)			
			
		FCC ID: XRSMLN201 IC ID: 8879A-MLEN201	
			

MLE-N2 reflow soldering specification

MLE-N2 is a surface mounted device (SMD) designed to be easily integrated into high-volume production lines including reflow soldering to a PCB. It is ultimately the responsibility of the customer to choose the appropriate solder paste and to ensure oven temperatures during reflow meet the requirements of the solder paste. The MLE-N2 module conforms to JSTD-020D1 standards for reflow temperatures.



Temperatures should not exceed the minimums or maximums presented in the table below.

Specification	Value	Unit
Temperature Inc./Dec. Rate (max)	3	°C / sec
Temperature Decrease rate (goal)	2-3	°C / sec
Soak Temp Increase rate (goal)	0.5 – 1.0	°C / sec
Flux Soak Period (min)	70	sec
Flux Soak Period (max)	120	sec
Flux Soak Temp (min)	150	°C
Flux Soak Temp (max)	190	°C
Time Above Liquidous (max)	70	sec
Time Above Liquidous (min)	50	sec
Time In Target Reflow Range (goal)	30	sec
Time At Absolute Peak (max)	5	sec
Liquidous Temperature (SAC305)	218	°C
Lower Target Reflow Temperature	225	°C
Upper Target Reflow Temperature	250	°C
Absolute Peak Temperature	260	°C

Compliance information

FCC information

MLE-N2 FCC ID: XRSMLN201**Federal Communication Commission Interference Statement**

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. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, 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 of the following measures:
 - Reorient 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.

FCC Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. 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, and
2. This device must accept any interference received, including interference that may cause undesired operation.

FCC Declaration of Conformity

We LumenRadio AB, Johan Willins Gatan 6, 41648 Gothenburg, Sweden, declare under our sole responsibility that Mira MLE-N2 comply with Part 15 of FCC Rules.

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2. The transmitter module may not be co-located with any other transmitter or antenna,

IMPORTANT NOTE:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labelling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20cm may be maintained between the antenna and users. The final end product must be labelled in a visible area with the following: "Contains FCC ID: XRSMLN201".

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter (MLE-N2) installed.

Industry Canada statement

IC: 8879A-MLEN201

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

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

Caution Exposure:

This device meets the exemption from the routine evaluation limits in section 2.5 of RSS102 and users can obtain Canadian information on RF exposure and compliance.

The final end product must be labelled in a visible area with the following:

- The Industry Canada certification label of a module shall be always clearly visible when installed in the host device, otherwise the host device must be labelled to display the Industry Canada certification number of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:
- **Contains transmitter module:** 8879A-MLEN201 where 8879A-MLEN201 is the module's certification number.

CE

Mira MLE-N2 comply with the Essential Requirements of RED (Radio Equipment Directive) of the European Union (2014/53/EU). Mira MLE-N2 meet the ETSI EN 300 328 V2.2.2 conformance standards for radio performance.

Other Compliances

For other local compliance regulations (CE, UL, CSA, SRRC, C-Tick, etc.) you are responsible as the product manufacturer to ensure all required compliance testing is completed. LumenRadio are happy to advise on compliance testing – please contact LumenRadio for details.

RoHS / REACH

The MLE-N2 module complies with directive 2011/65/EU, 2015/863/EU (RoHS) of the European Parliament and the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment. The MLE-N2 module modules do not contain the SVHC (Substance of Very High Concern), as defined by Directive EC/1907/2006 Article according to REACH Annex XVII.


Contact and Ordering information

- LumenRadio AB
- Johan Willins Gatan 6
- SE-416 48 Gothenburg
- **Sweden**
- **Phone:** +46 31 301 03 70
- www.lumenradio.com
- sales@lumenradio.com
- The LumenRadio support team can be reached through our support portal.






Product	Order Code
MLE-N2 module	800-8204

- LumenRadio AB
Johan Willins Gata 6 SE-416 68 Gothenburg Sweden
- www.lumenradio.com
- sales@lumenradio.com
- **Phone:** +46 31 301 03 70
- **Fax:** +46 31 301 03 80
- VAT reg. no: SE556761749201

Documents / Resources

	<p>lumenradio MLE-N2 Radio Module Integration [pdf] User Guide MLE-N2 Radio Module Integration, MLE-N2, Radio Module Integration, Module Integration</p>
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References

-  [Home - LumenRadio](#)
-  [Home - LumenRadio](#)
-  [Jira Service Management](#)
-  [Support - LumenRadio](#)
-  [nRF52840 - Bluetooth 5.3 SoC - nordicsemi.com](#)
- [User Manual](#)

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