VN310 RF Modem

User Manual

TABLE OF CONTENTS

1. Purpose and audience 2
2. Pin-out and interface summary 2
3. Serial and SPI interfacing with VN310 4
4. VN310 Power Supply Considerations 6
4.1. Key Specifications 6
4.2. Electrical Characteristics 6
4.3. External Anetnna Specifications and Installation Requirements 7
5. VN310 Mechanical Drawings 8
6. Regulatory Labeling and Notices 11

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1. PURPOSE AND AUDIENCE

The purpose of this document is to define the VN310 radio's connectivity options. It also aims to provide the necessary data to achieve hardware integration of the VN310 with a customer's external application processor.

An external processing entity can communicate with the VN310 using either a UART interface (utilizing UART2) or an SPI interface. The UART1 port is dedicated to serial firmware download.

By definition the VN310 is essentially a small radio module, approximately 1.1"W x 1.4"L, that is pre-loaded with the ISA100.11a communications stack. The small form factor enables the radio to be used in a variety of applications. The VN310-I and the VN310-H are identical from a hardware perspective and differ only by the pre-loaded factory firmware.

2. PIN-OUT AND INTERFACE SUMMARY

Refer to the block diagram in Figure 1 for the following section.

The VN310 radio module uses the Freescale MC13224 SoC.

The transmit path utilizes a PA (power amplifier) to increase the power output of the VN310 module to a maximum output power at the antenna connector of +17 dBm, with a nominal operating power level of +10 dBm. The transmit power variation vs. temperature is no greater than +/- 3 dB over the industrial temperature range of -40 deg. C to +85 deg. C. A Digital-to-Analog converter (DAC) is used to vary the bias voltage on the power amplifier to adjust its power and also to maintain the optimum output power vs. current consumption. Power tuneability is accomplished by varying the PA bias via the DAC.

The advantages of a radio module with adjustable power output are the following:

1. Ability to increase power output to +17 dBm in applications where battery consumption is not critical or applicable.

2. Enables the unit to be configured for different regulatory certification needs, especially locations that require reduced power, such as Europe, Japan, and China.

3. Provides greater power level consistency, for systems where symmetrical links are more critical.

The design of the RF section of the unit uses additional transmit components:

1. Dual LPFs to reduce harmonic output and spurious output for regulatory compliance, such as FCC, R&TTE, and Japanese certifications.

2. Balun to match the differential output of the radio SoC to the single ended transmit circuits.

3. Tx / Rx switch to select the transmit / receive RF path.

4. An antenna matching circuit, to ensure a 50 ohm driving source impedance into the antenna connector. The matching will maximize power output and minimize return loss.

As shown in the block diagram, the receive path utilizes the same Tx / Rx switch and antenna matching network. The receive path is passive without any additional amplification.

The Freescale SoC is clocked at 24 MHz using a 20 ppm crystal to maintain frequency stability. A 32.768 kHz real-time clock IC is utilized to maintain SoC clocking operation during low power / standby modes. An additional external flash memory IC (serial) with a 512 KB capacity is utilized for additional data storage. To improve reliability, a separate hardware watchdog timer is used to reset the radio if the GPIO stops communicating with the watchdog for more than 10 seconds. Note, this time can be adjusted to optimize performance.

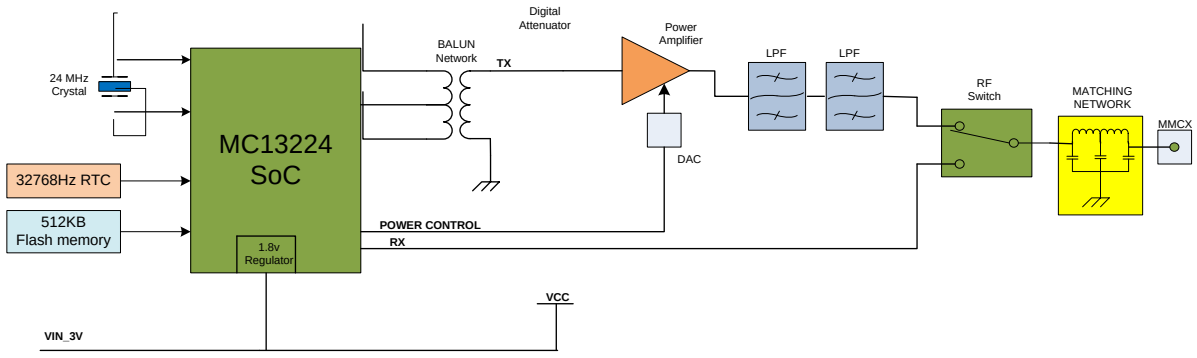


Figure 1. VN310 Functional Block Diagram

Figure 2 presents the physical location of the pins on the VN310, and Table 1 presents the VN310 pin descriptions.

Note: For minimum battery consumption, all unused GPIOs should be left unconnected.

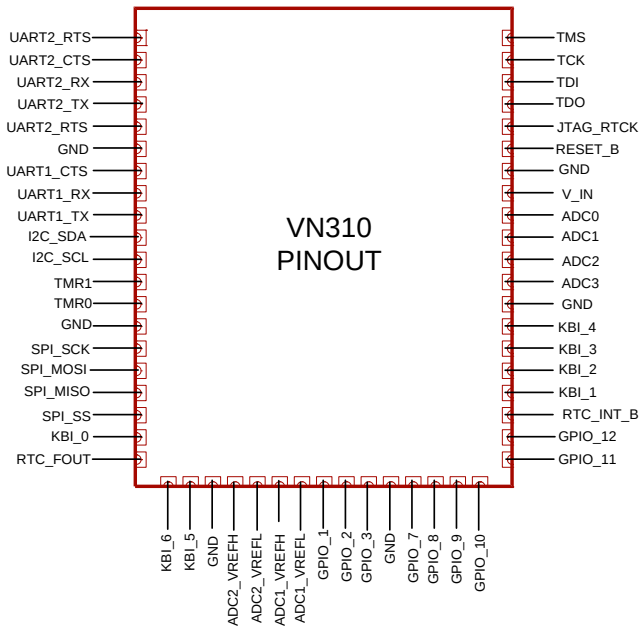


Figure 2. VN310 Pinout

Table 1. VN310 Pin Definitions

No.	Name	Description	Type	Dir	Comments
1	UART2-CTS	UART2 Clear to Send	DIG	I	Standard UART communication with flow control. Connect this to UART-RTS of application processor.
2	UART2-RTS	UART2 Request to Send	DIG	O	Standard UART communication with flow control. Connect this to UART-CTS of application processor.
3	UART2-RXD	UART2 Receive Data	DIG	I	Standard UART communication with flow control. Connect this to UART-TXD of application processor.
4	UART2-TXD	UART2 Transmit Data	DIG	O	Standard UART communication with flow control. Connect this UART-RXD of application processor.
5	UART1-RTS	UART1 Request to Send	DIG	I	Not Used
6	GND	Ground	N/A	N/A	

No.	Name	Description	Type	Dir	Comments
7	UART1-CTS	UART1 Clear to Send	DIG	O	Not Used
8	UART1-RXD	UART1 Receive Data	DIG	I	Standard UART communication. Used for upgrading the firmware of the VN310. TTL<-> RS232 level shifters should be employed when connecting to RS232 port.
9	UART1-TXD	UART1 Transmit Data	DIG	O	Standard UART communication. Used for upgrading the firmware of the VN220. TTL<-> RS232 level shifters should be employed when connecting to RS232 port.
10	I2C-SDA	I2C bus DATA	DIG	I/O	Not Used
11	I2C-SCL	I2C bus CLOCK	DIG	I/O	Not Used
12	TMR1	Timer 1 I/O	DIG	O	READY signal used to wake up the application processor.
13	TMR0	Timer 0 I/O	DIG	I/O	Not Used
14	GND	Ground	N/A	N/A	
15	SPI-SCK	SPI Clock	DIG	O	Standard SPI Communication
16	SPI-MOSI	SPI Data Out	DIG	O	Standard SPI Communication
17	SPI-MISO	SPI Data In	DIG	I	Standard SPI Communication
18	SPI-SS	SPI Slave Select	DIG	O	Standard SPI Communication
19	KBI0	RTC clock out enable / Keyboard interface pin 0	DIG	O	Not Used
20	RTC-FOUT	32768Hz RTC clock out	DIG	O	Not Used
21	KBI6	Keyboard interface pin 6	DIG	I	Used for Wakeup & Status (Provisioning) button. Holding this pin low for 10 seconds causes the radio to return to the factory defaults state and scan for a provisioning device.
22	KBI5	Keyboard interface pin 5	DIG	I/O	Not Used
23	GND	Ground	N/A	N/A	
24	ADC2-VREFH	ADC2 reference, high pin	Analog	I	Set ADC2-VREFH to Low and ADC2-VREFL to High and power the VN220 for a few seconds to erase the flash. After erasing the flash, set the ADC2-VREFH to High and ADC2-VREFL to Low. **WARNING: this operation will erase the Bootloader and all manufacturing and non-volatile data!**
25	ADC2-VREFL	ADC2 reference, low pin	Analog	I	See the comments for ADC2-VREFH.
26	ADC1-VREFH	ADC1 reference, high pin	Analog	I	Not Used
27	ADC1-VREFL	ADC1 reference, low pin	Analog	I	Not Used
28	GPIO1	GPIO	DIG	O	Used for output gain control.
29	GPIO2	GPIO	DIG	O	Used for output gain control.
30	GPIO3	GPIO	DIG	O	Used for output gain control.
31	GND	Ground	N/A	N/A	
32	GPIO7	GPIO	DIG	I/O	Not Used
33	GPIO8	GPIO	DIG	I/O	Not Used

No.	Name	Description	Type	Dir	Comments
34	GPIO9	GPIO	DIG	I/O	Not Used
35	GPIO10	GPIO	DIG	I/O	Not Used
36	GPIO11	GPIO	DIG	I/O	Not Used
37	GPIO12	GPIO	DIG	I/O	Not Used
38	RTC-INT-B	RTC wake-up interrupt / Keyboard interface pin 7	DIG	O	Not Used
39	KBI1	Keyboard interface pin 1	DIG	I	Used as boot switch in order to boot different firmware images based on the position of the switch (future functionality). At present, this pin should be held HIGH.
40	KBI2	Keyboard interface pin 2	DIG	I/O	Not Used
41	KBI3	Keyboard interface pin 3	DIG	I/O	Not Used
42	KBI4	Keyboard interface pin 4	DIG	I	WKU signal. Used by the application processor to wake up the VN210 processor.
43	GND	Ground	N/A	N/A	
44	ADC3	ADC pin 3	Analog	I	Not Used
45	ADC2	ADC pin 2	Analog	I	Not Used
46	ADC1	ADC pin 1	Analog	I	Not Used
47	ADC0	ADC pin 0	Analog	I	Reserved for future functionality. At present this pin should be held HIGH.
48	Vin	Supply Voltage	N/A	I	See Note.
49	GND	Ground	N/A	N/A	
50	RESET	RESET pin	DIG	I	Reset pin of the VN310. LOW to reset and HIGH to run.
51	JTAG-RTCK	JTAG Return Clock	DIG	O	Standard JTAG interface.
52	JTAG-TDO	JTAG Test Data Output	DIG	O	Standard JTAG interface
53	JTAG-TDI	JTAG Test Data Input	DIG	I	Standard JTAG interface
54	JTAG-TCK	JTAG Test Data Input	DIG	I	Standard JTAG interface
55	JTAG-TMS	JTAG Test Mode Select	DIG	I	Standard JTAG interface

Note: In the default configuration, the radio is powered from the LDO U13 (PN: MCP1802T-3002I-OT). R29 will be depopulated. Contact CDS engineering for more information.

3. SERIAL AND SPI INTERFACING WITH VN310

The following figures indicate the correct UART and SPI pin connectivity between the VN310 and an external application processor.

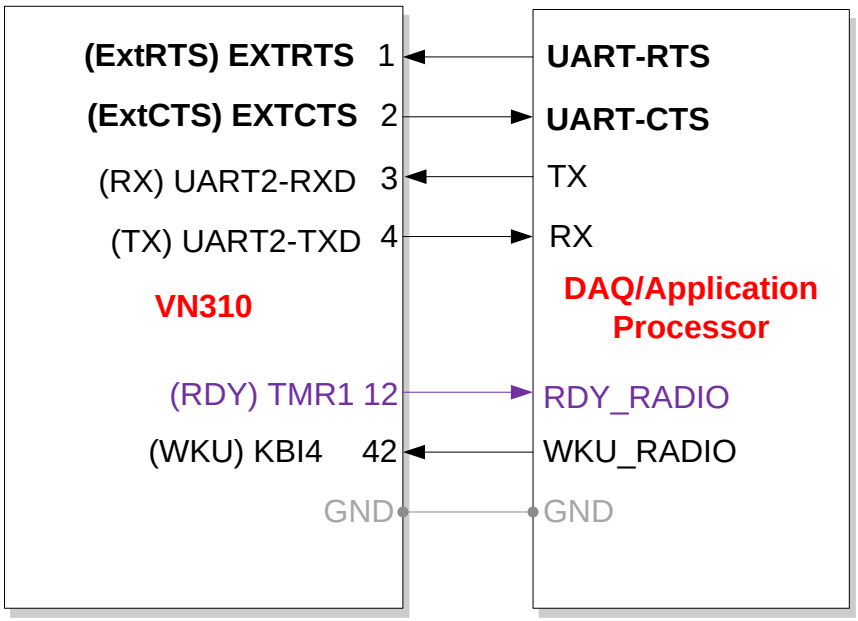


Figure 3. Interfacing with the VN310 using UART Based Communication

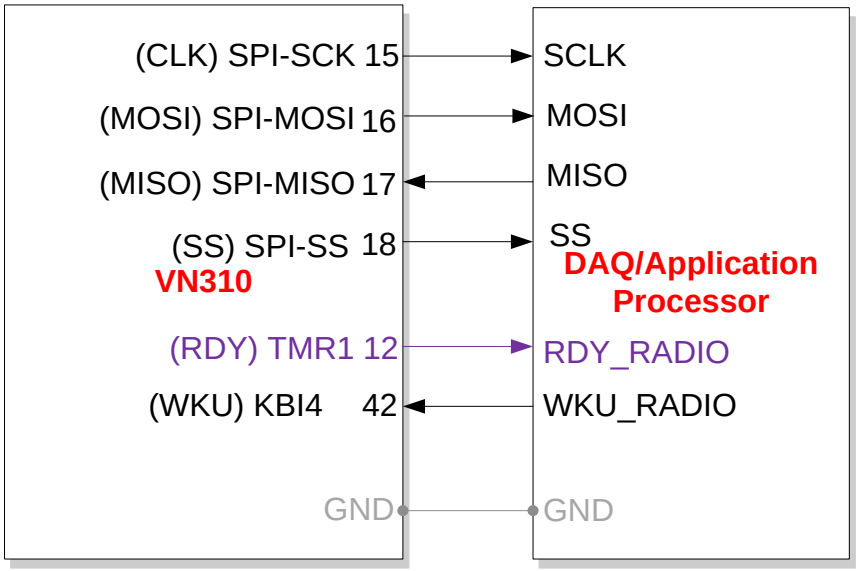


Figure 4. Interfacing with the VN310 using SPI Based Communication

Connect the RDY pin only if the full wakeup communication mode is desired.

4. VN310 POWER SUPPLY CONSIDERATIONS

4.1. KEY SPECIFICATIONS

Table 2. Key Specifications

Parameter	Min	Typ	Max	Units	Comment
Supply Voltage (3V regulated supply)	2.94	3.0	3.06	V	
Voltage on any digital I/O	-0.3	Vcc	Vcc + .02 V	V	
RF Output Level	0	+10	+17	dBm	Output power at antenna connector
Storage Temp Range (Max)	-40		+85	˚C	
Operating Temp Range (Max)	-40		+85	˚C	

4.2. ELECTRICAL CHARACTERISTICS

Table 3. Electrical Characteristics

Parameter	Min	Typ	Max	Units	Comments
Voltage on analog pins	0	3.0	Vcc	V	
Voltage supply noise			200	mVpp	50Hz – 15MHz
Peak current			124	mA	TX mode, maximum output power
Operating relative humidity	10		90	%RH	Non condensing
Transmit current			67 124	mA mA	At 10 dBm At 17 dBm
Receive current [1)]		21	27	mA	
Hibernate current [2)]		15		µA	
Output High-level Voltage (IOH = 5 mA) (All digital outputs)	80% Vcc		Vcc	V	
Output Low Voltage (IOL = -5 mA) (All digital outputs)	0		20% Vcc	V	
Input Low Voltage (All digital inputs)	0		30% Vcc	V	

Input High-level Voltage (all digital inputs)	70% Vcc	Vcc	V
Input hysteresis (all digital inputs)	0.06 Vcc		V

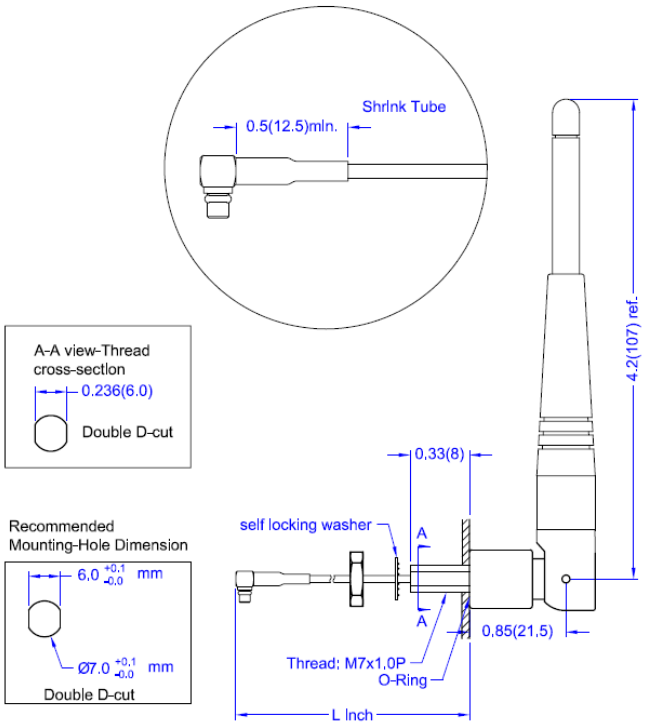
Notes:

1) All RAM active, Reference oscillator on (24 MHz) at 1.2 VDC, Radio RX on (receiving data), Reference clock available to all peripherals, ADC1 available but inactive, CPU on at 2 MHz (DCD).
2) External 32 kHz crystal oscillator on, CPU off (stop mode), wake-up from RTI timer or external request, Radio off, ADCs not available.

For additional information please consult the VersaNode 310 datasheet.

4.3. EXTERNAL ANTENNA SPECIFICATIONS AND INSTALLASTION REQUIREMENTS

Antenna Specification



Electrical Properties:

Frequency Range:	2.4~2.5 GHz
Impedance:	50Ω nominal
VSWR:	<2.0:1
Gain:	*2.0 dBi
Radiation:	Omni
Polarization:	Vertical

*Gain is measured under no flying lead.

Mechanical Properties:

Cable:	M17/93-RG178; Harbour Industries Standard length L=5 Inches,
Cable Length:	or to be specified. R/A MMCX Plug(male);
Connector:	Nearson 25-03M-TGG
Material;	Polyurethene(Black); BASF
Overmold;	Polyurethene(Black); BASF and
Swivel:	Polycarbonate(Black); Bayer
Operation Temp.;	-20°C to +65°C
Storage Temp.:	-30°C to +75°C

Connector Interface

MMCX Plug Right Angle (RMM)

TITLE	2.4GHz Fixed Mount Swivel Antenna - 181 Model	DATE 021805	SHEET 1 of 2
UNIT In.(mm)	DWG. NO. S181FL - RMM - 2450S		
SCALE none	NEARSON		

Antenna Installation requirements-*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.*

5. VN310 MECHANICAL DRAWINGS

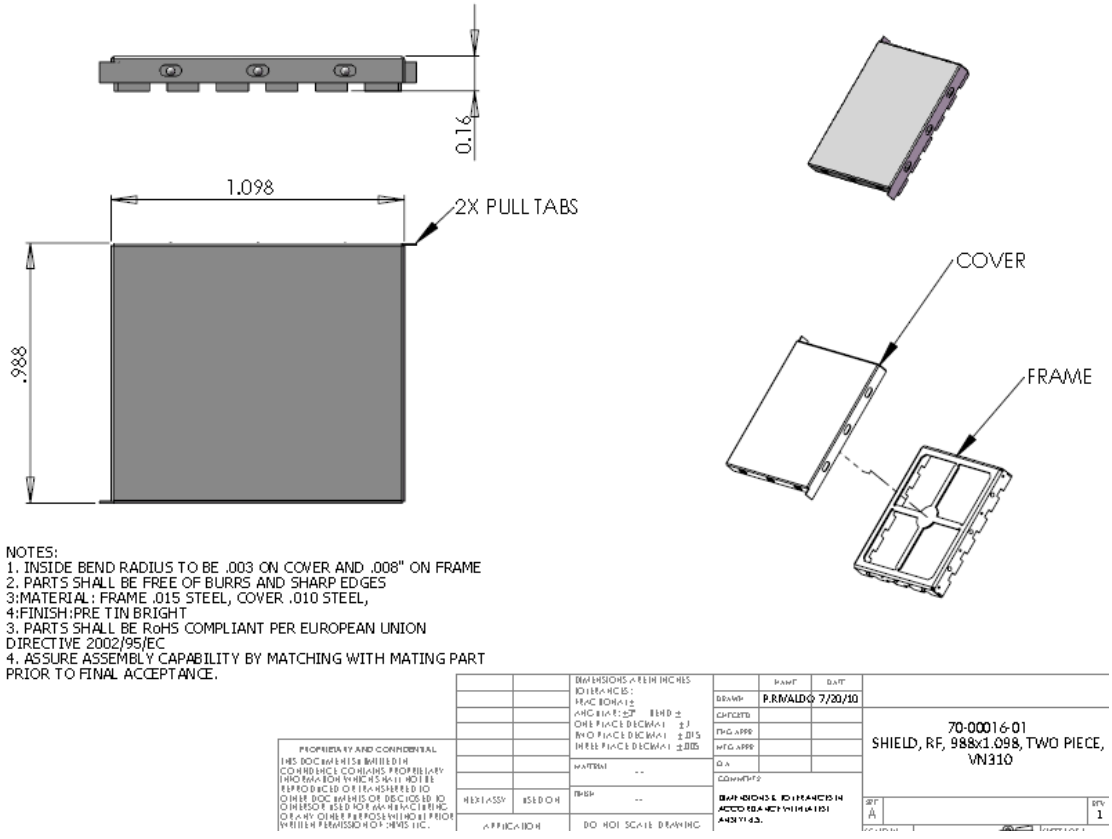


Figure 5. Shield

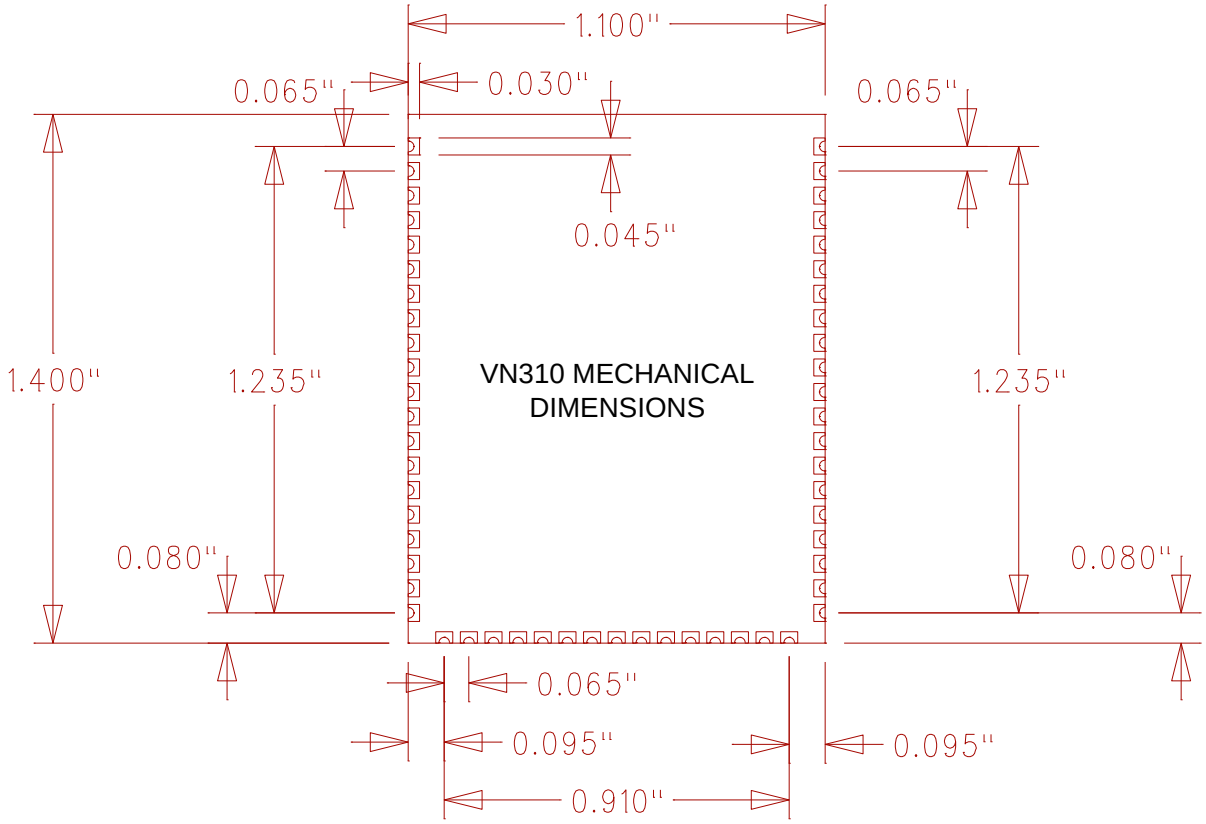


Figure 6. Outline Drawing

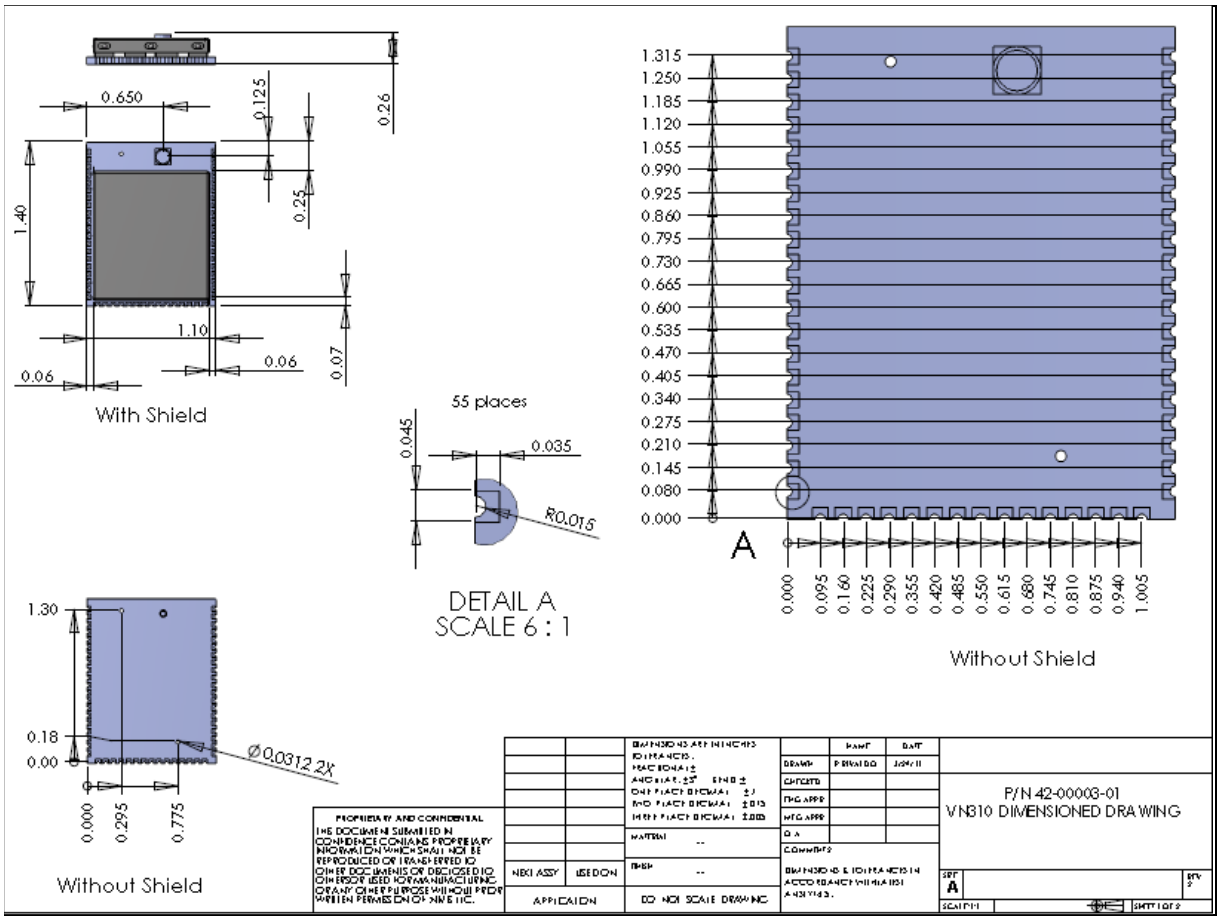


Figure 7. Dimension Drawing

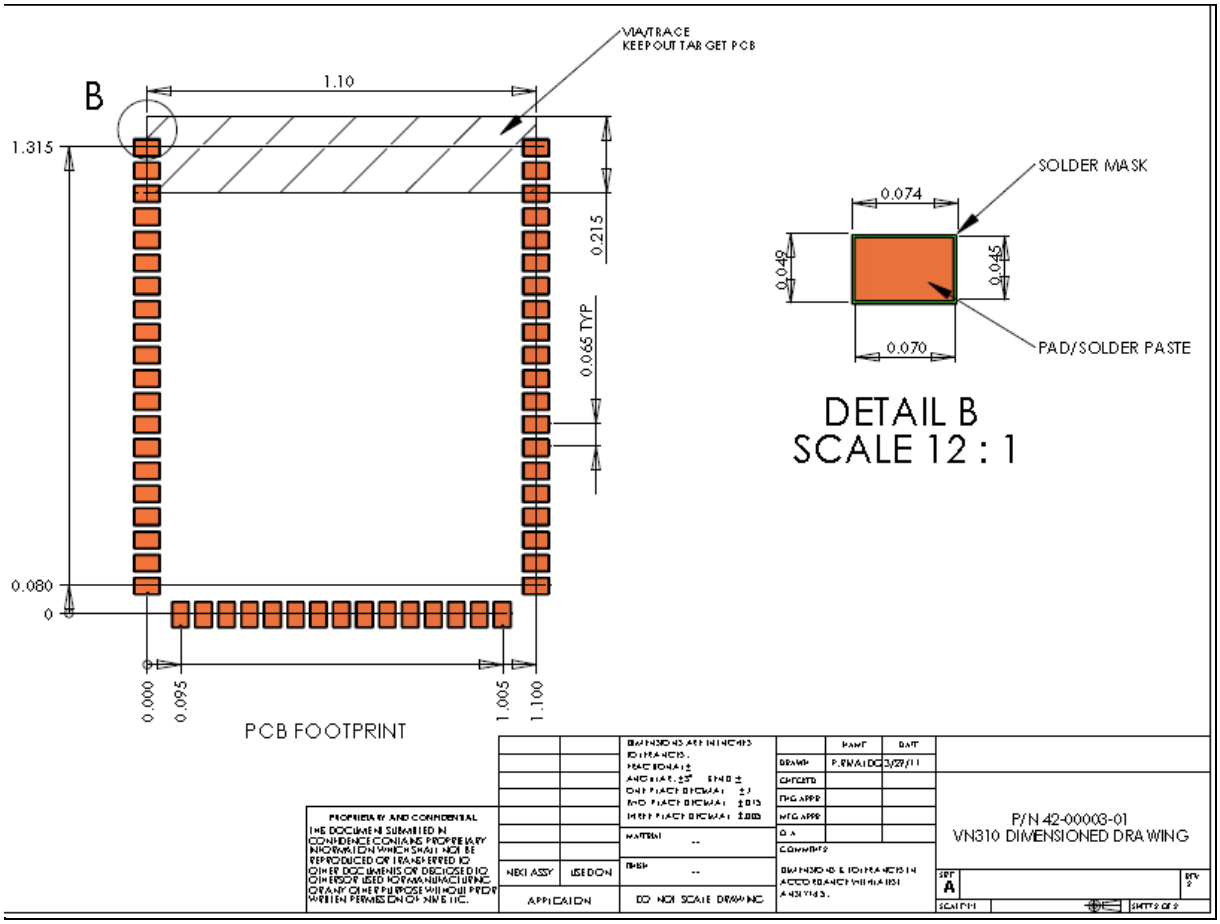


Figure 8. Recommended Footprint

6. REGULATORY LABELING AND NOTICES

FCC Notice-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.

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 or more 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.

Warning: Modifications to this equipment not expressly approved by manufacturer will void the user's authority to operate the equipment!

The VN310 RF 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 VN310 RF Module must ensure that the information provided on the VN310 RF Module label is placed on the outside of the final product. The VN310 RF 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: 2AKZ5-CDSVN310" or

"Contains FCC ID: 2AKZ5-CDSVN310"

IC RSS-210 Notice- 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.