

DESCRIPTION

The Powercast PCR91505-M is a RAIN UHF RFID Reader module. The module is intended to be integrated into other electronic product designs to enable RAIN RFID functionality. The reader module's air interface protocol adheres to EPCglobal® UHF Class 1 Gen 2/ISO 18000-63 RFID. It is designed to interface to other host systems via UART communication and is powered from externally applied 5V DC power. The RFID module communicates with and powers RFID tag devices. A Gen2 compliant tag device communicates back to the reader via RF backscattering. The reader operates in the 902-928MHz ISM frequency band. Operational power as well as communication is provided to the reader module using castellated hole solder connections. The module supports one antenna via the same style solder connection. The module supports an optional external RGB LED to display the status of the reader.

ORDERING OPTIONS

Part Number	PCR91505-M
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PRODUCT CONTENTS

The following items are included:

Quantity	Description
1	PCR91505-M RAIN RFID Reader Module

APPLICATIONS

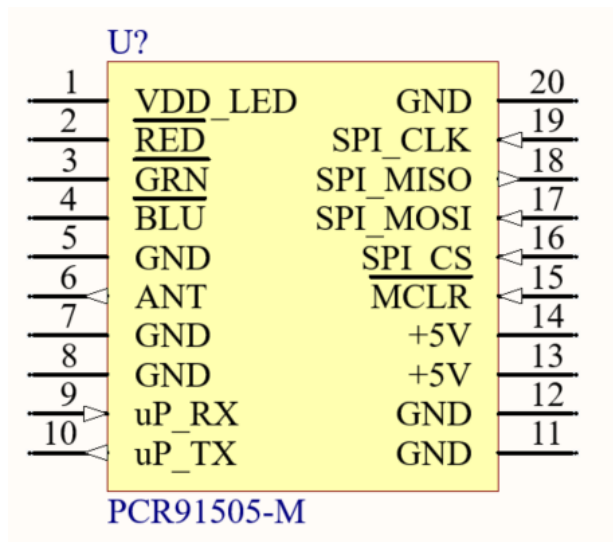
- Enable communication with and provide power to Gen2-compliant RFID tags, including:
 - Active tags
 - Battery-Assisted-Passive tags
 - Passive tags
- Perform inventory scanning of RFID tags within a specified location
- Execute access commands (e.g., read, write, update) on RFID tags



Powercast products and technology are covered by one or more patents with other patents pending. All patent and trademark information can be found at <http://www.powercastco.com/IP/>

SET-UP AND OPERATION

1. Mount the module in the desired location on a motherboard PCB with appropriate connection to a heat sink.
 - a. Ideally the motherboard will have a cutout under the module so that appropriate heatsinking can be connected directly to the bottom side of the module PCB.
 - b. Additional heatsinking can be connected to the module shield if desired.
2. Make the appropriate connections to the signals available at the castellated hole solder connections for 5VDC power, ground, UART communication, optional module MCU reset, and the optional RGB status LED.
3. Connect a 50ohm antenna to the antenna port which is also available on a castellated hole solder connection.
 - a. Reference the AUTHORIZED ANTENNAS listed in this manual.
4. Use the following UART settings:
 - a. Speed: 921600
 - b. Data: 8 bit
 - c. Parity: None
 - d. Stop bits: 1 bit
 - e. Flow control: none
5. Utilize the module's JSON protocol document to communicate with and control the reader module.



Module Pin Number	Signal	Description
1	VDD_LED	External status LED anode 3.3VDC power supply (if used)
2	nRED	External red status LED cathode (if used)
3	nGRN	External green status LED cathode (if used)
4	nBLU	External blue status LED cathode (if used)
5	GND	Ground
6	ANT	50ohm antenna connection
7	GND	Ground
8	GND	Ground
9	uP_RX	UART RX line. Connect to host TX line.
10	uP_TX	UART TX line. Connect to host RX line.
11	GND	Ground
12	GND	Ground
13	+5V	+5VDC power (2A)
14	+5V	+5VDC power (2A)
15	nMCLR	Module MCU reset (optional connection to force the module MCU into reset, utilize this reset if the module becomes unresponsive to the host)
16	SPI_CS	Not used
17	SPI_MOSI	Not used
18	SPI_MISO	Not used
19	SPI_CLK	Not used
20	GND	Ground

Contact Powercast for the module footprint and 3D model

The optional status LED connections indicate the following operating conditions:

LED Status	Description
Off	Device is not Powered
Blue	Initial power on and configuration sequence
Green	Inventory mode
Red	Powered on and RF output off due to over temperature
Yellow	System is in certification test mode and waiting for a command – CW, PRBS, etc.

SPECIFICATIONS

Item	Description
Frequency	Frequency Hopping: 902.75MHz to 927.25MHz; 914.75 MHz Center Frequency
RF Communication	EPCglobal® UHF Class 1 Gen 2 / ISO 18000-63 RFID
Power Output	+30dBm (1W) max
Approvals	United States - FCC ID: YESPCR91505-M Canada - IC ID: 8985A-PCR91505M
Digital Communication Interface	Serial UART, 921600 bps, 3.3V
Operating Temperature	-40°C to +60°C (+60°C can be increased with improved heatsinking and airflow)
Environment	Indoor or outdoor use with appropriate enclosure
Mounting	Solder connections are castellated holes. The PCB bottom must be connected to a heatsink with airflow. Additionally, the shield may be connected to a heatsink with airflow.
Power	5VDC/2A (+/- 350mV)
Dimensions	1.5" × 1.35" × 0.21"

Please Note: The PCR91505-M is EPC Gen 2 Compliant

SUPPORT

Technical support for Powercast products can be initiated through the following methods:

Website contact form: <http://www.powercastco.com/contact/>

Telephone: +1 412-455-5800

COMPLIANCE STATEMENTS

FCC

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.

Changes or modifications not expressly approved by Powercast could void the user's authority to operate the equipment. Use and maintain device only as specified in this manual.

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.

This transmitter module is authorized to be used in other devices only by OEM integrators under the following conditions:

1. The antenna(s) must be installed such that a minimum separation distance of 23cm is maintained between the radiator (antenna) & user's/nearby person's body at all times to meet FCC MPE requirement.
2. The transmitter module must not be co-located with any other antenna or transmitter.

However, the OEM integrator is still responsible for testing the end-product for any additional compliance requirements with this module installed. (i.e., digital device emissions, PC peripheral requirements, etc.)

IMPORTANT NOTE: In the event that these conditions cannot be met (for certain configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID number 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.

The OEM integrator must be made aware not to provide information to the end user regarding how to install or remove this RF module in the user manual of the end product.

USER MANUAL REQUIREMENT

The user manual for the end product must include the following information in a prominent location:

“To comply with FCC’s and IC’s RF radiation exposure requirements, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 23cm is maintained between the radiator (antenna) & user’s/nearby person’s body at all times and must not be co-located or operating in conjunction with any other antenna or transmitter.”

AND

The transmitting portion of this device carries with it the following two warnings:
“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”

AND

“Any changes or modifications to the transmitting module not expressly approved by Powercast could void the user’s authority to operate this equipment”

END PRODUCT LABELLING

The end product must be labeled with the following identification information in a visible area: “Contains Transmitter Module FCC ID: YESPCR91505-M” or “Contains FCC ID: YESPCR91505-M”

ISED

Under ISED Canada (IC) regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by ISED 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 (EIRP) is not more than that necessary for successful communication.

This radio transmitter IC ID: 8985A-PCR91505M has been approved by ISED Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

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.

To comply with 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 34 cm from all persons and must not be colocated or operating in conjunction with any other antenna or transmitter.

END PRODUCT LABELING

The final product must be labeled in a visible area with the following: “Contains Powercast PCR91505-M transmitting module IC: 8985A-PCR91505M”

Conformément à la réglementation ISED 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 ISED 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.

Le présent émetteur radio IC: 8985A-PCR91505M a été approuvé par ISED Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

Le fonctionnement de l'appareil est soumis aux deux conditions suivantes: 1. Cet appareil ne doit pas perturber les communications radio, et 2. cet appareil doit supporter toute perturbation, y compris les perturbations qui pourraient provoquer son dysfonctionnement.

Au but de conformer aux limites d'exposition RF pour la population générale (exposition non-contrôlée), les antennes utilisés doivent être installés à une distance d'au moins 34 cm de toute personne et ne doivent pas être installé en proximité ou utilisé en conjonction avec un autre antenne ou transmetteur.

Marquage sur l'étiquette du produit complet dans un endroit visible: "Contient le module émetteur Powercast PCR91505-M IC : 8985A-PCR91505M "

AUTHORIZED ANTENNAS

There are no trace antennas on the PCR91505-M module. This device has been designed to operate with the antennas listed below.

Installation permits the use of the following antennas:

Antenna Type	Manufacturer	Part Number	Max Gain
Circular Polarized Patch	Laird	PAR90209H	6 dBi
Linear Patch	Powercast	PAP-ANT-H1-915	6 dBi
Linear Dipole	Pasternack	PE51OM1013	3 dBi

With reduced output power (27dBm conducted max):

Antenna Type	Manufacturer	Part Number	Max Gain
Linear Yagi	Pasternack	PE51YA1009	9 dBi

Antennas may be internal or external to the device. On a PCB antenna connections must be routed via a 50ohm transmission line trace. Cable connections must be made via a 50ohm coax cable.

FCC MODULAR CERTIFICATION CONSIDERATIONS

Powercast has obtained FCC modular certification for the PCR91505-M module and meets all parts of FCC Part 15.212 and FCC Part 15.247. This means that the module can be installed in different end-use products by another equipment manufacturer.

The module can be operated with an equivalent antenna as listed in the FCC filing, as long as it has equal or lower gain than the antenna listed. Equivalent antennas must be of the same general type (e.g. dipole, circularly polarized patch, etc.), and must have similar in-band and out-of-band characteristics (consult specification sheet for cutoff frequencies).

If the antenna is of a different type or has higher gain than those listed in the modules' FCC filing, a class II permissive change must be requested from the FCC.

A host using a module component that has a modular grant can:

1. Be marketed and sold with the module built inside that does not have to be end-user accessible/ replaceable, or
2. Be end-user plug-and- play replaceable.

In addition, a host product is required to comply with all applicable FCC equipment authorizations, regulations, requirements and equipment functions not associated with the RFID module portion. For example, compliance must be demonstrated to regulations for other transmitter components within the host product, to requirements for unintentional radiators (Part 15B), and to additional authorization requirements for the non-transmitter functions on the transmitter module (for example, incidental transmissions while in receive mode or radiation due to digital logic functions).

To ensure compliance with all non-transmitter functions, the host manufacturer is responsible for ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that after the module is installed and operational the host continues to be compliant with Part 15B unintentional radiator requirements. Since this may depend on the details of how the module is integrated with the host, we will provide guidance to the host manufacturer for compliance with Part 15B requirements.

INTEGRATION GUIDELINES

This module's FCC certification is only valid when the manufacturer/integrator adheres to the specific trace reference design dimensions provided in this integration instruction. Any deviations from these specific dimensions, even if still within the guidelines provided, will trigger the need for additional testing and authorization under a Class II Permissive Change.

The PCR91505-M is designed for 50 Ohm impedance-controlled RF connections. The RF output of this module must be routed to the antenna/connector via 1 of 2 approved example trace designs.

PCB stack ups can vary depending on the PCB manufacturer. The host device manufacturer should consult their PCB manufacturer for the most accurate stack up information. In order for each trace design to maintain a 50 Ohm impedance and compliance, the stack up of the host device must be the same as the stack up on the corresponding example trace design PCB.

Passive impedance matching networks are allowed, if necessary. Layer transitions, branches, stubs, and RF test pads are not permitted unless expressly shown.

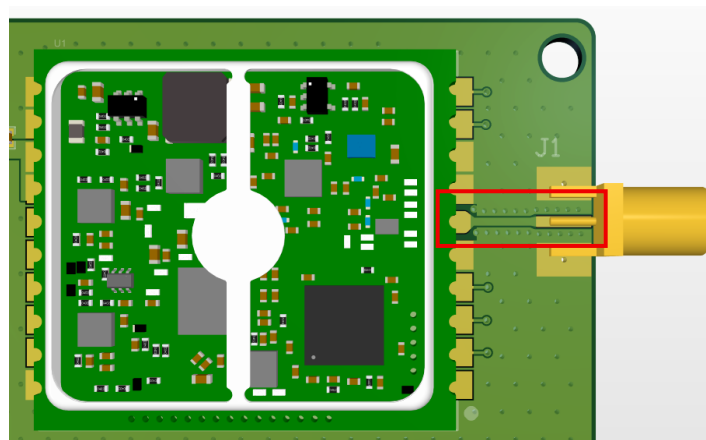
Below are the tested example trace design layouts:

Option 1: 4-layer coplanar waveguide

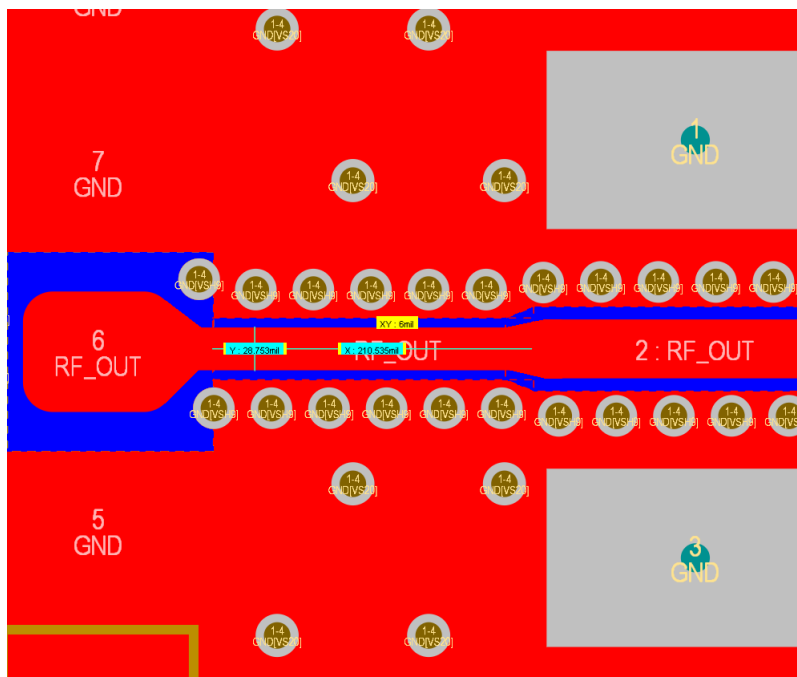
#	Name	Material	Type	Wei...	Thickne...	Dk	Df
	Top Overlay		Overlay				
	Top Solder	Solder Resist	Solder Mask		0.4mil	3.5	
1	Top Layer		Signal	1oz	1.4mil		
	Dielectric 2	7628	Prepreg		8.284mil	4.4	0.02
2	Layer 1	CF-004	Signal	1/2oz	0.598mil		
	Dielectric 1	FR-4	Core		41.929mil	4.6	
3	Layer 2	CF-004	Signal	1/2oz	0.598mil		
	Dielectric 3	7628	Prepreg		8.284mil	4.4	0.02
4	Bottom Layer		Signal	1oz	1.4mil		
	Bottom Solder	Solder Resist	Solder Mask		0.4mil	3.5	
	Bottom Overlay		Overlay				

Tested PCB Stack up

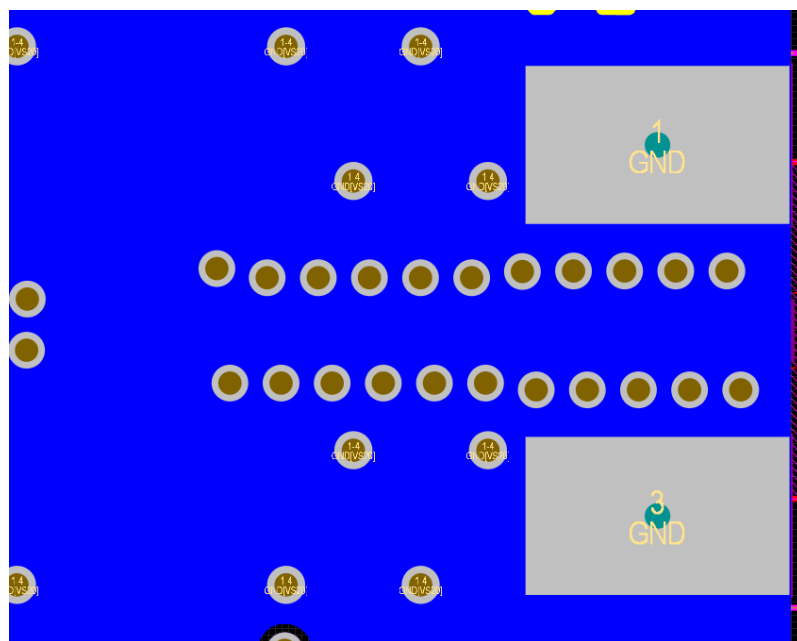
The above figures show details for the tested PCB stack up, including materials, dielectric constants, and layer heights. The trace width is 28.752mil, trace ground clearance is 6mil, and trace impedance is 50 Ohms. Note that in this layout, the middle two layers are removed from underneath the RF trace and only the Top and Bottom layer are utilized.



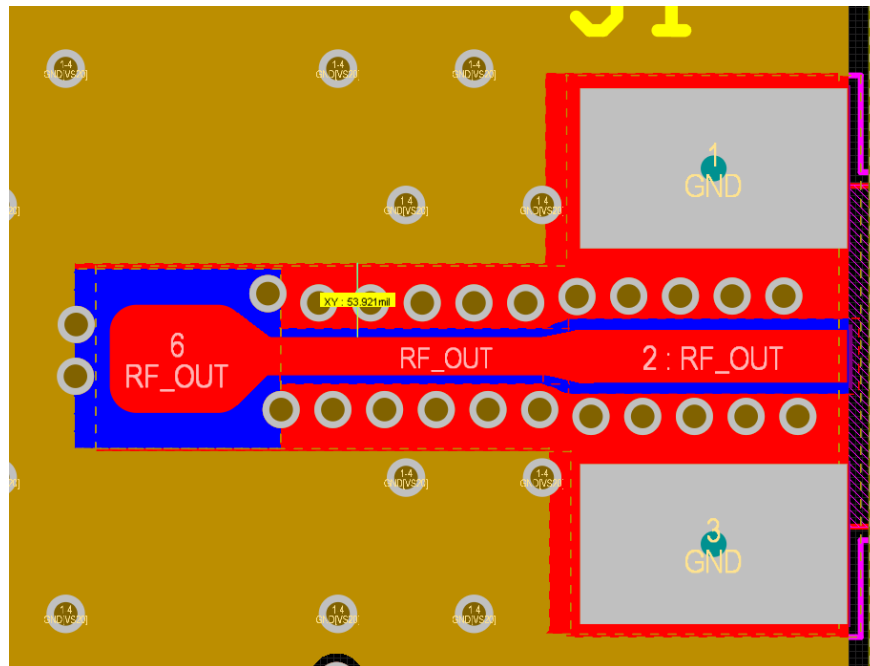
3D Rendering of Tested Layout (RF Trace in Red Box)



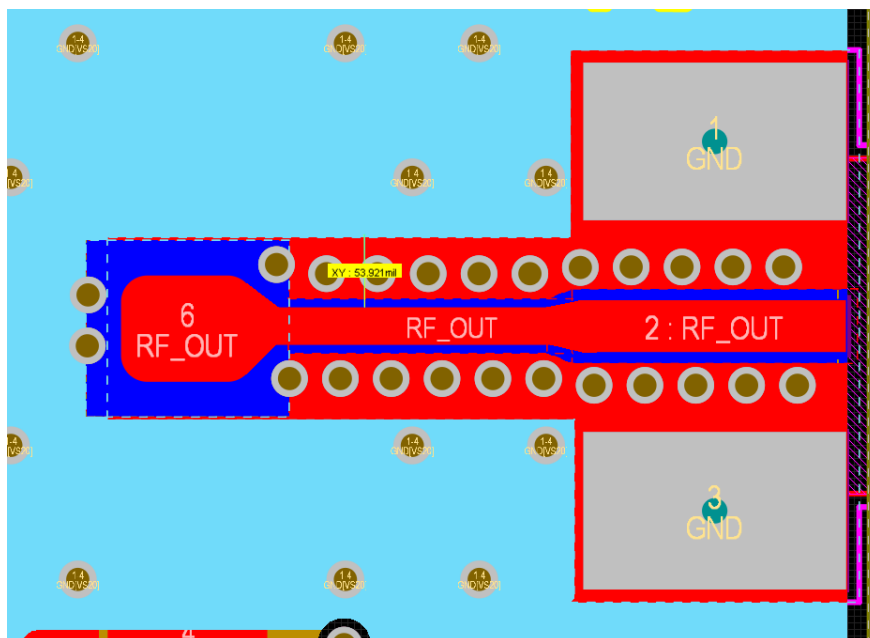
2D Top Layout of RF Trace (Width, Length, and Ground Clearance Measurement Included)



2D Bottom Layout of RF Trace



2D Top Middle Layout of RF Trace (Ground Clearance Measurement Included)

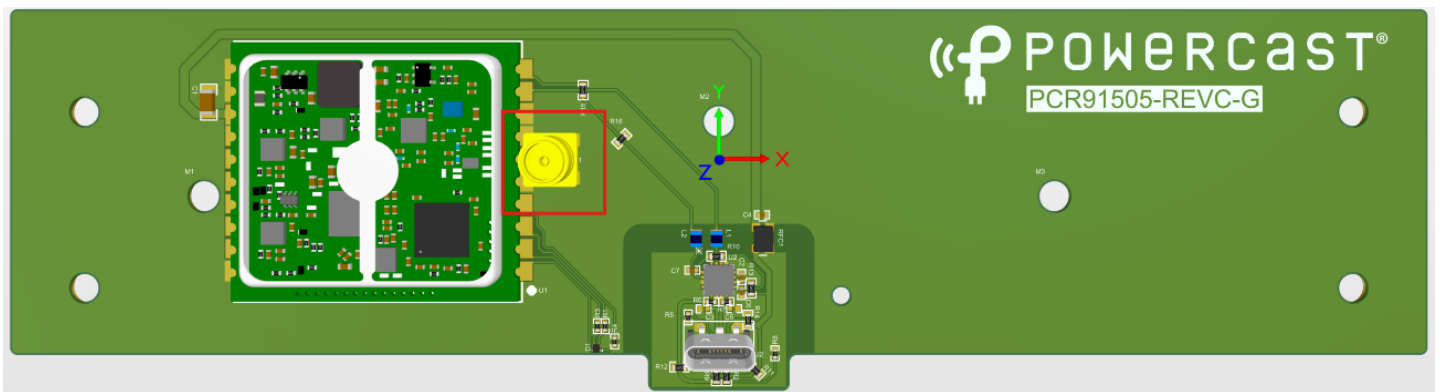


2D Bottom Middle Layout of RF Trace (Ground Clearance Measurement Included)

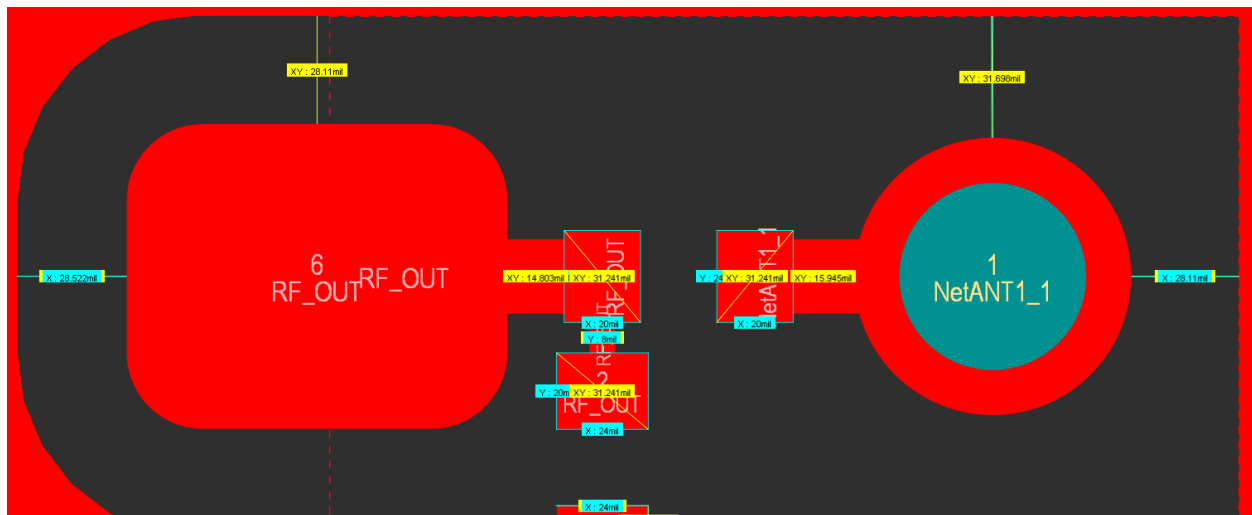
Option 2: 2-layer coplanar waveguide

#	Name	Material	Type	Wei...	Thickne...	Dk	Df
	Top Overlay		Overlay				
	Top Solder	Solder Resist	Solder Mask		0.4mil	3.5	
1	Top Layer	CF-004	Signal	1oz	1.378mil		
	Dielectric 3	PP-006	Prepreg		9.843mil	4.8	0.02
2	Aluminum	Aluminum	Signal	3oz	51.181mil		

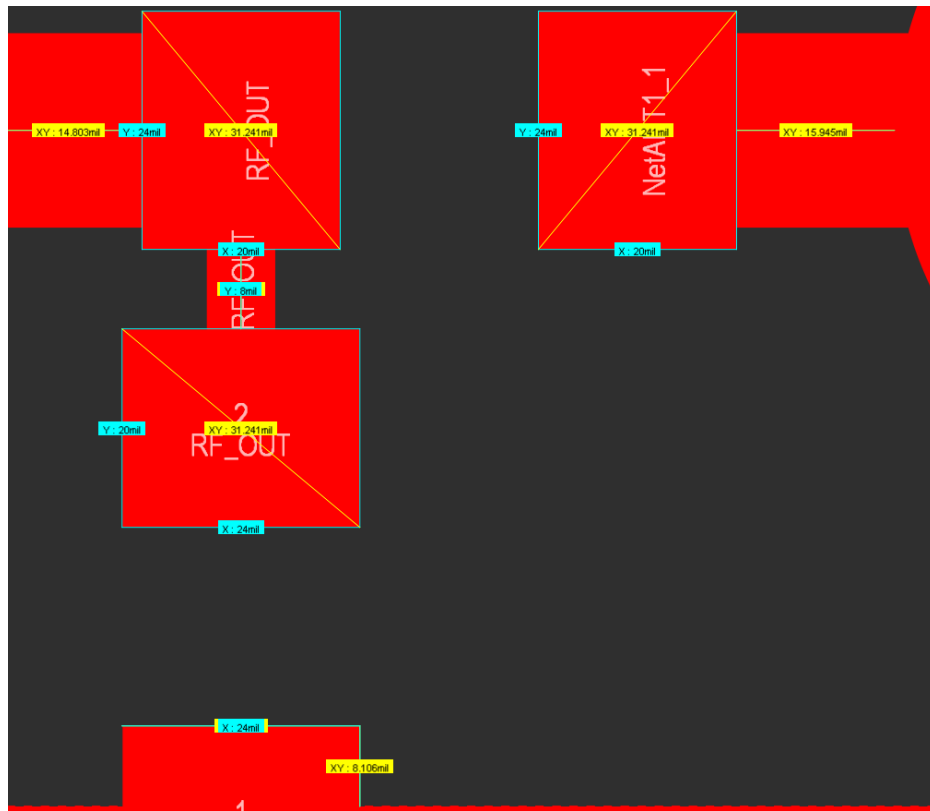
The above figures show details for the tested PCB stack up, including materials, dielectric constants, and layer heights. Measurements for pads, clearance, and traces are shown below. Note this trace design features footprints for a series and a shunt 0402 passive element. Only the series element was used to tune the trace.



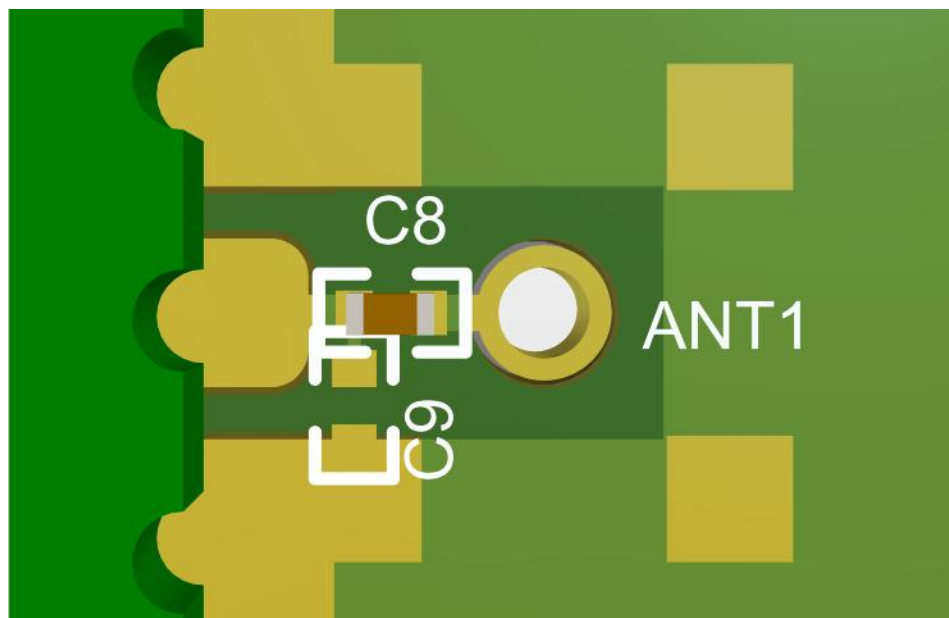
3D Rendering of Tested Layout (RF Trace in Red Box)



2D Top Layout of RF Trace (Width and Length of Pads, and Ground Clearance Measurement Included)



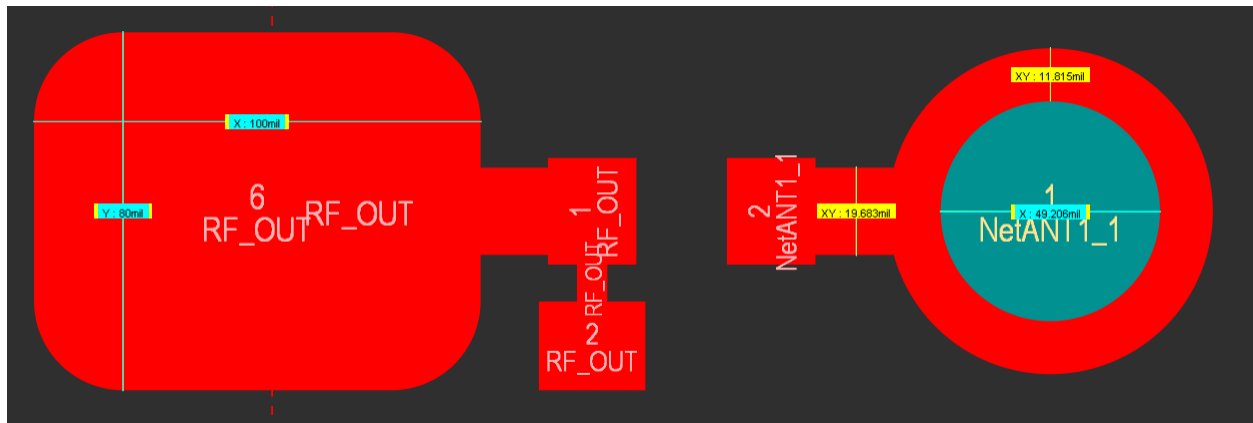
2D Top Layout of RF Trace (Width and Length of Pads and Length of Traces Measurement Included)



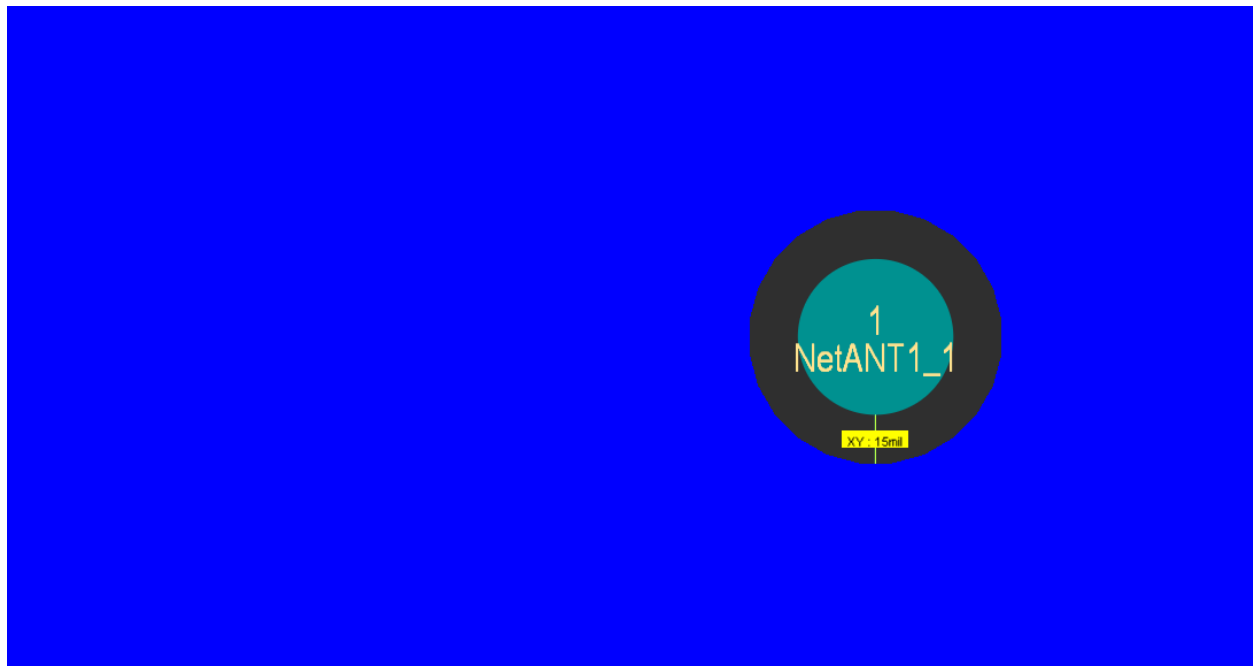
3D Rendering of RF Trace with SMA removed

PCR91505-M

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2D Top Layout of RF Trace (Width and Length of Pads, Hole and Annular Ring of Via, and Width of Traces Measurement Included)



2D Bottom Layout of RF Trace (Via Hole Ground Clearance Measurement Included)

The above figures demonstrate the 2 layouts of the PCR91505-M feeding the CON-SMA-EDGE-S SMA connector and the SMA-J-P-H-ST-TH1, respectively. Note that host device connectors must be permanently attached to the host device and the antenna of choice or unique. Follow the selected RF connector's PCB layout guidelines to ensure an adequate impedance match and compliance. If the RF connector is accessible to the end user, then, in accordance with Section 15.203 of the FCC's Rules, it must be of a unique type to disable connection of a non-permissible antenna.

Please note, the above "AUTHORIZED ANTENNAS" section highlights the antenna types permitted for use with this module. If the host device manufacturer is not using the exact antenna models listed, the host device manufacturer must use an antenna of the same type and of equal or lower gain. In doing so, please consult the respective antenna's datasheet to ensure gain, radiation pattern, and impedance are consistent and compliant.

To validate a layout design, measure and verify the conducted RF power out of the module and transmission line to ensure it is consistent with the specification. Furthermore, measure and verify the peak gain of the antenna of choice. The host device manufacturer is responsible for complying to FCC specifications.

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Powercast warrants its products in accordance with Powercast's standard warranty available at www.powercastco.com/terms-conditions



Powercast Corporation

620 Alpha Drive, Suite 1
Pittsburgh, PA, USA 15238
www.powercastco.com
contact@powercastco.com
+1 (412)-455-5800