

VERA-P173 Antenna Reference Design

Topic :	VERA-P173 antenna reference design	
	UBX-17061097	Confidential – For Internal Use
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Date :	2017-11-09	
To :	Application engineer	

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1 Scope

This document defines the essential specifications necessary to implement the VERA-P173 antenna reference designs. The information contained herein and its references should be sufficient to guide a skilled person in an attempt to implement the design on a host carrier. It will provide the designer with PCB layout details and expected performance specifications.

The document supports a connector-based designs for the use of external antennas (one for each antenna pin of the module)

2 FCC/IC ID reference

Model	FCC ID	IC ID
VERA-P173	XPYVERAP173	TBD

Table 1: FCC and IC ID

3 General description and requirements

VERA-P173 antenna reference design module provides two RF interfaces for connecting the external antennas. Antenna ports **ANT1** and **ANT2** have a nominal characteristic impedance of 50Ω and must be connected to the related antenna through a 50Ω transmission line to allow proper impedance matching along the RF path; a bad termination of the pin may result in poor performance or even damage to the RF section of the module.

For optimal antenna performance in multi-radio mode, the isolation between the antennas must be maximized; the designer must follow the requirements specified in Table 2 and Table 3 to ensure good performance.

Item	Requirements	Remarks
Impedance	50 Ω nominal characteristic impedance	The impedance of the antenna RF connection must match the 50 Ω impedance of the ANTx pin.
Frequency Range	5850 - 5925 MHz	For 802.11p.
Return Loss	$S_{11} < -13$ dB (VSWR < 1.5:1) Abs. Max.	The Return loss or the S_{11} , as the VSWR, refers to the amount of reflected power, measuring how well the primary antenna RF connection matches the 50 Ω characteristic impedance of the ANTx pin. The impedance of the antenna termination must match as much as possible the 50 Ω nominal impedance of the ANTx pin over the operating frequency range thus, maximizing the amount of the power transferred to the antenna.
Efficiency	> -1.5 dB (> 70%) recommended > -3.0 dB (> 50%) acceptable	The radiation efficiency is the ratio of the radiated power to the power delivered to the antenna input. The efficiency is a measure of how well an antenna receives or transmits.

Table 2: Summary of antenna interface requirements

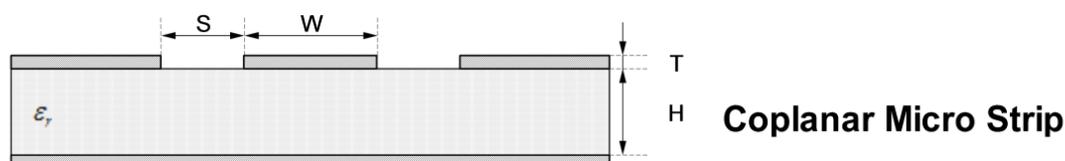
Item	Requirements	Remarks
Isolation (in-band)	$ S_{21} > 50$ dB recommended $ S_{21} > 43$ dB minimum	The antenna to antenna isolation is the loss between the primary and the secondary antenna; high isolation results from low coupled antennas.
Isolation (out-of-band)	$ S_{21} > 35$ dB recommended $ S_{21} > 30$ dB acceptable	Out-of-band isolation is evaluated in the band of the aggressor to ensure that the transmitting signal from the other radio is sufficiently attenuated by the receiving antenna to avoid saturation and intermodulation effects at the receiver's port.

Table 3: Summary of antenna isolation requirements

4 Reference design of RF path

The reference design of the 50 Ω path to connect the modules antenna pins with a SMA connector is displayed in Figure 1 and the dimensions concerning the board stack-up (Table 4) are specified in Table 5. An SMA connector is used to mount the antenna from Table 6.

PCB Layer	Material	Thickness
Solder mask top	General LPI solder mask	20 μ m
Top	Copper Foil	35 μ m
Dielectric	Pre-preg	600 μ m
L2	Copper Foil	35 μ m
Dielectric	Core	240 μ m
L3	Copper Foil	35 μ m
Dielectric	Pre-preg	600 μ m
Bottom	Copper Foil	35 μ m
Solder mask bottom	Generic LPI Soldermask	20 μ m

Table 4: Stack-up of VERA-P1-EVK with standard FR4 substrate ($\epsilon_r = 4.6$)

Figure 1: Coplanar waveguide with ground dimension specification

Item	Value
S	400 μm
W	900 μm
T	35 μm
H	600 μm
Spacing between ANT1 and ANT2 waveguides	16 mm

Table 5: Coplanar waveguide with ground specification

5 Antenna

The module has been approved for use with any dipole antenna with less or equal to 6 dBi peak gain. An example of an approved antenna is listed in Table 6.

Model name	Manufacturer and description	Gain [dBi] (peak)
TD.10.5113	Taoglas, Dipole Terminal Antenna SMA Connector	5.88 dBi

Table 6: Approved antenna example