JODY-W1 antenna reference design

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1 Scope

This document defines the essential specifications necessary to implement the JODY-W1 antenna reference designs. It is part of the equipment certification application issued to FCC and IC. 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
JODY-W164-03A	XPYJODYW164	8595A-JODYW164
JODY-W164-07A	XPYJODYW164-07A	8595A- JODYW16407A

Table 1: FCC and IC IDs for different models of JODY-W1 series

3 General description and requirements

JODY-W1 series module provides three RF interfaces for connecting the external antennas. Antenna ports ANT0 and ANT1 have a nominal characteristic impedance of 50 Ω and must be connected to the related antenna through a 50 Ω 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.

The ANT2 antenna port is not used on the JODY-W164-03A and JODY-W164-07A modules.

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 Antenna pins.
Frequency Range	2400 - 2500 MHz 5150 - 5850 MHz	For 802.11b/g/n and Bluetooth. For 802.11a/n/ac.
Return Loss	S_{11} < -10 dB (VSWR < 2:1) recommended S_{11} < -6 dB (VSWR < 3:1) acceptable	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 antenna pins. The impedance of the antenna termination must match as much as possible the 50 Ω nominal impedance of antenna pins over the operating frequency range, to maximize the amount of 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 antenna input: the efficiency is a measure of how well an antenna receives or transmits.
Maximum Gain		The maximum antenna gain must not exceed the value specified in type approval documentation to comply with regulatory agencies radiation exposure limits.

Table 2: Summary of antenna interface requirements

Item	Requirements	Remarks
Isolation (in-band)	S_{21} > 25 dB recommended S_{21} > 20 dB acceptable	The antenna to antenna isolation is the S_{21} parameter between the two antennas in the band of operation.
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 effect at the receiver's port.
Envelope Correlation Coefficient (ECC)	ECC < 0.1 recommended ECC < 0.5 acceptable	The ECC parameter correlates the far field parameters between antennas in the same system. A low ECC parameter is fundamental to improve performance in MIMO-based systems.

Table 3: Summary of MIMO and Wi-Fi/Bluetooth coexistence 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. The specification can be found in Table 4. The two coplanar ground planes beside the signal trace should be connected to the lower ground plane using vias (illustrated in Figure 2). It is recommended that this vias are placed with a maximum distance of 0.5 mm to the coplanar ground edge and a maximum pitch of 2 mm. The top side should be coated with generic LPI solder stop mask. The antenna traces should have a minimum distance of 20 mm, preferably more, to ensure the required antenna to antenna isolation.

The SMA connector is used to mount an antenna. For Bluetooth and Wi-Fi operation in the 2.4 GHz band and Wi-Fi operation in the 5 GHz band, the module has been tested and approved for use with antennas up to 2 dBi antenna gain.

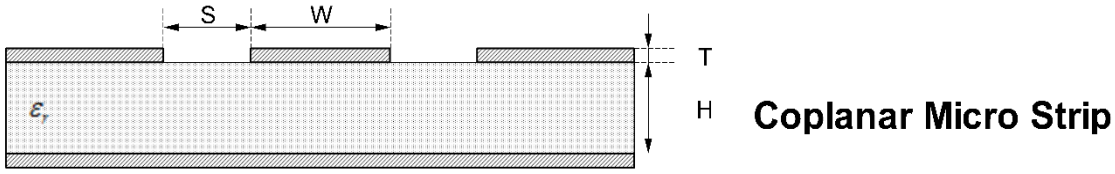

Figure 1: Coplanar micro-strip dimension specification

Item	Value
S	300 µm
W	650 µm
T	35 µm
H	400 µm
ε_r	4.3

Table 4: Coplanar micro-strip specification

The mechanical dimensions and position of the components are specified in Figure 2. The layers beneath the 'top layer' have the same dimensions and are filled with ground. No RF traces are routed in those layers.

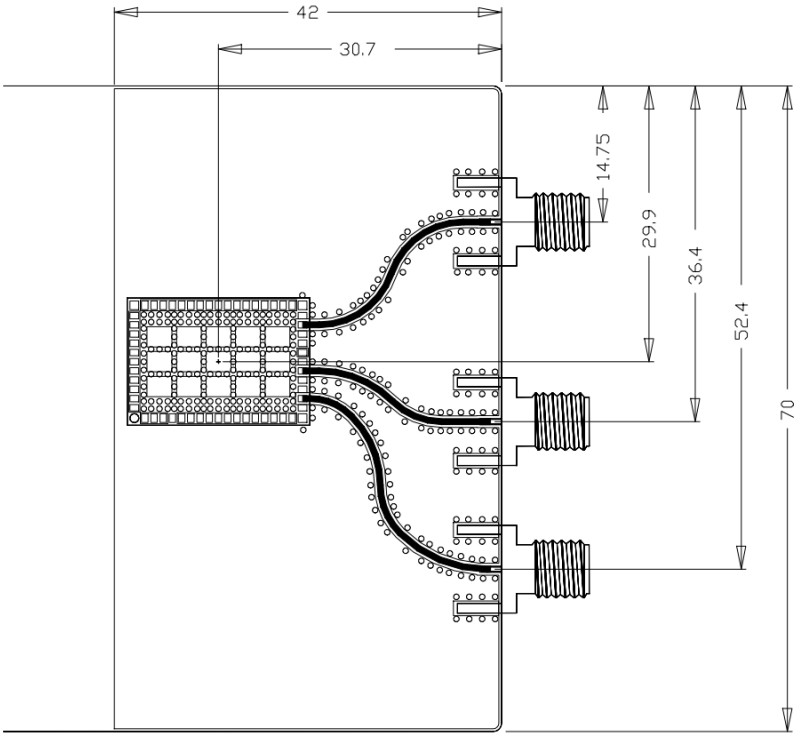

Figure 2: Mechanical dimensions of JODY-W1 antenna reference design, top layer. Antenna ports from top to bottom: ANT1, ANT0, ANT2.

The ANT2 antenna port is not used on the JODY-W164-A modules.