Question(s):

1) **Could you explain whether antenna topology has some influence on WLAN calibration process?**
2) **Will I get different calibration results if the module is connected to a chip antenna vs. board antenna?**

Answer:

The calibration for output power is dependent on load impedance as seen by the FEM output to be 50 ohms. If the impedance looking into the antenna (either chip or PCB) is equal the incident power to the antenna would be the same. **Note**: attached files vswr1.pdf and DG303-111.pdf are Return Loss vs. VSWR tables. This is also related to maximum power transfer theorem where $Z_{source} = Z_{load}$ for maximum power transfer.

Therefore, the return loss of each antenna is equal. **Note**: as return loss approaches a large number (say 40 dB) and VSWR approaches 1, the impedance looking into the antenna approaches 50 ohms.

Antenna Theory

The output power of the chip antenna vs. the PCB antenna would be controlled by the antenna gain parameter. See attached TI app notes *slyt296*, *swra161b*, *swra092b*, and article *PCBvsTrace_ant.pdf* for more explanation.

The antenna specification describing the input impedance of the antenna (which is the impedance seen by the FEM of the WL1xxx solution) is described by either: 1) definitions for VSWR, or 2) Return Loss Parameters.

VSWR: is Voltage Standing Wave Ratio - **standing wave ratio** (**SWR**) is the ratio of the amplitude of a partial standing wave at an antinode (maximum) to the amplitude at an adjacent node (minimum), in an electrical transmission line. The SWR is usually defined as a voltage ratio called the **VSWR**, for *voltage standing wave ratio*. For example, the VSWR value of 1.2:1 denotes a maximum standing wave amplitude that is 1.2 times greater than the minimum standing wave value. Reference the following Wikipedia link http://en.wikipedia.org/wiki/VSWR.

Return Loss: **return loss** or **reflection loss** is the loss of signal power resulting from the reflection caused at a discontinuity in a transmission line This discontinuity can be a mismatch with the terminating load or with a device inserted in the line. It is usually expressed as a ratio in decibels (dB); where *RL*(dB) is the return loss in dB, P_i is the incident power and P_r is the reflected power. (Return loss is expressed as the ratio of Pi / Pr in dB)

$$\Gamma = \frac{VSWR - 1}{VSWR + 1} \qquad RL = -20\log\left[\frac{VSWR - 1}{VSWR + 1}\right] \qquad ML = -10\log\left\{1 - \left[\frac{VSWR - 1}{VSWR + 1}\right]^2\right\}$$

$$VSWR = \frac{1 + \Gamma}{1 - \Gamma} \qquad RL = -20\log(\Gamma) \qquad ML = -10\log(1 - \Gamma^2)$$

$$\Gamma = 10^{\frac{-RL}{20}} \qquad VSWR = \frac{1 + 10^{\frac{-RL}{20}}}{1 - 10^{\frac{-RL}{20}}} \qquad ML = -10\log\left[1 - \left(10^{\frac{-RL}{20}}\right)^2\right]$$

Where Γ is the reflection coefficient.

The reflection coefficient can be given by the equations below, where Z_S is the impedance toward the source, Z_L is the impedance toward the load:

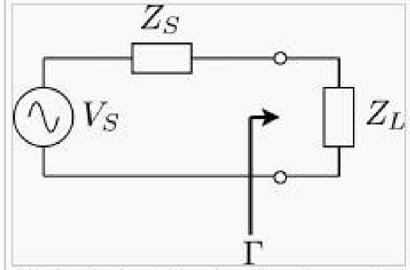
$$\Gamma = \frac{Z_L - Z_S}{Z_L + Z_S}$$

Notice that a negative reflection coefficient means that the reflected wave receives a 180°, or π, phase shift.

The absolute magnitude (designated by vertical bars) of the reflection coefficient can be calculated from the standing wave ratio, *SWR*:

$$|\Gamma| = \frac{SWR - 1}{SWR + 1}$$

The reflection coefficient is displayed graphically using a Smith chart.



Simple circuit configuration showing measurement location of reflection coefficient.