

Title: T-Mobile F5688W Antenna Qualification report ed05  
Reference: 31006587

## 5.5 WIFI Combined Gain, FCC Gain and Beamforming Gain

We have calculated the WIFI Combined Gains, FCC Gains and Beamforming Gains with the measurements for all the antenna combinations.

- 1) The H & V results are sorted for each antenna in separate pages (e.g. 0\_2G4\_H&V)
- 2) The absolute gain of each antenna is calculated with these formulas (e.g. 0\_2G4\_Abs\_dB):

$$P_H = 10^{P_{HdBm}}$$

$$P_V = 10^{P_{VdBm}}$$

$$G_{ant} = 10 * \log(P_H + P_V)$$

- 3) Combined, FCC and BF gain are calculated for all combinations of the antennas

$$Combined\ Gain_{i\_antennas} = 10 * \log\left(\frac{10^{\frac{G_{anto}}{10}} + 10^{\frac{G_{ant1}}{10}} + 10^{\frac{G_{ant2}}{10}} + \dots + 10^{\frac{G_{ant_i}}{10}}}{Number\ of\ antennas}\right)$$

$$FCC\ Gain_{i\_antennas} = 10 * \log\left(\frac{\left(10^{\frac{G_{anto}}{20}} + 10^{\frac{G_{ant1}}{20}} + 10^{\frac{G_{ant2}}{20}} + \dots + 10^{\frac{G_{ant_i}}{20}}\right)^2}{Number\ of\ antennas}\right)$$

$$BF\ Gain_{i\_antennas} = FCC\ Gain_{i\_antennas} - Combined\ Gain_{i\_antennas}$$

Table 14: Calculated WIFI Combined Gain, FCC Gain and Beamforming Gain with the measurements

| WIFI2G4 @ 2437MHz                   |  | MIMO4x4    |
|-------------------------------------|--|------------|
|                                     |  | ANT0-1-2-3 |
| Uncorrelated Combined Gain          |  | 2.63       |
| Gain FCC (correlated Combined Gain) |  | 6.64       |
| BeamForming Gain                    |  | 4.01       |
| WIFI5G @ 5180MHz                    |  | MIMO4x4    |
|                                     |  | ANT0-1-2-3 |
| Uncorrelated Combined Gain          |  | 1.02       |
| Gain FCC (correlated Combined Gain) |  | 5.72       |
| BeamForming Gain                    |  | 4.70       |
| WIFI5G @ 5500MHz                    |  | MIMO4x4    |
|                                     |  | ANT0-1-2-3 |
| Uncorrelated Combined Gain          |  | 0.76       |
| Gain FCC (correlated Combined Gain) |  | 5.52       |
| BeamForming Gain                    |  | 4.76       |
| WIFI5G @ 5825MHz                    |  | MIMO4x4    |
|                                     |  | ANT0-1-2-3 |
| Uncorrelated Combined Gain          |  | 1.06       |
| Gain FCC (correlated Combined Gain) |  | 5.79       |
| BeamForming Gain                    |  | 4.73       |