**Direct Synthesis of Carrier Signal upto 6 GHz**

The zcu111 can directly synthesize (without external RF source) carrier signal of frequency upto its maximum sampling rate 6.144 GHz, alongside with its images. As an example, when we set carrier frequency to be 4.7 GHz, we will measure three spikes at the output as shown below: 4.7 GHz, 1.4 GHz, 7.6 GHz.

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| C:\Users\Richard\Desktop\QICK\ppt\2023_物理年會\poster\photos\dds_spectrum.png |
| spike 1 @ 0 \* 6.144 GHz + 4.7 GHz 4.7 GHz, spike 2 @ 1 \* 6.144 GHz – 4.7 GHz 1.4 GHz, spike 3 @ 2 \* 6.144 GHz – 4.7 GHz 7.6 GHz |

The images of the carrier signal results from the action of zero-order-hold operation of DAC (see the section Sampling & Re-construction). With proper filters and amplifiers, we can generate high frequency qubit tone with sufficient power using just zcu111 and without external RF source.