Report Title: *Transmitting and Receiving a Signal Using Patch Antennas.*
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Description: *The task is an experiment where two patch antennas were used to transmit and receive a QPSK modulated signal, generated using the SMW and then demodulated on the FSW.*
Objective: - *To transmit a QPSK modulated signal generated on the SMW using a patch antenna, and to demodulate the signal on the FSW.*

1. Experimental Setup & Procedure

Figure 1 shows the setup of the experiment.

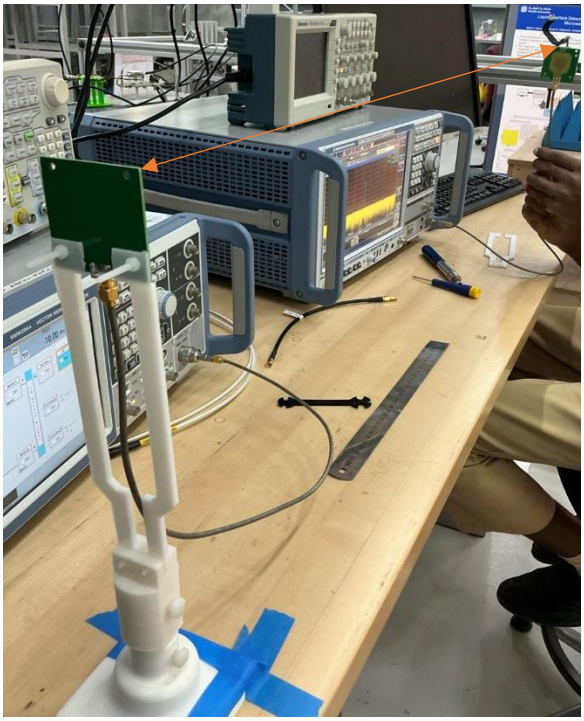

Figure 1. Experimental setup

Equipment:

*Signal generator (SMW200A)
*Signal and spectrum analyzer (FSW)
*Vector network analyzer (VNA)
*SMA cables
*(2) Patch antennas
*Antenna holder

Procedures:

1) Firstly, the VNA was used to plot the log scale of the magnitude of s_{22} parameter versus the frequency. The frequency at which the antenna resonates or transfer maximum power is the frequency at which the absolute minimum of the plot occurs. The VNA plot is shown in figure 2 and the obtained frequency is, $f = 5.804$ GHz.

2) The patch antenna was suspended to the antenna holder, as shown in figure 1 and the antenna holder was taped to the table. The distance between the two antennas is d = 88 cm.

3) Using SMA cables, the transmitting antenna was connected to the SMW, and the receiving antenna was connected to the FSW.

4) The SMW was configured to generate a QPSK modulated signal, with a symbol rate of **100ksym/s**. The data source is the **patter 1001**, and the filter used is a **root raised cosine** with a roll off factor of **0.25**. The RF carrier signal has a center frequency of **5.804 GHz** and a power level of **-10 dBm**. Figure 3 shows the preview of the generated signal on the SMW.

Figure 2. VNA plot, log scale of the magnitude of s_{22} parameter versus the frequency.

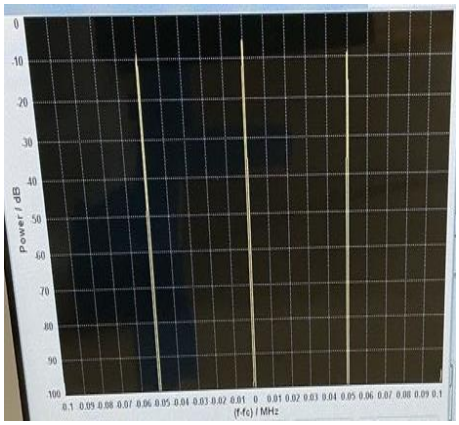

Figure 3. A preview of the generated signal on the SMW.

2. Results

The received signal in the FSW is shown in figure 4. The power of the received signal is around -55 dBm. The theorical calculation of the received signal power using the Friss equation is given below. There is only a slight deviation of the practical result from the theoretically calculated result.

$$P_r^{[dBm]} = P_t^{[dBm]} + G_r^{[dBi]} + G_t^{[dBi]} + 20 \times \log\left(\frac{\lambda}{4\pi d}\right)$$

$$P_r^{[dBm]} = -10dBm + 0 + 0 + 20 \times \log\left(\frac{3 \times 10^8}{(5.804 \times 10^9)4\pi(0.88)}\right)$$

$$P_r^{[dBm]} = -56.61\ dBm$$

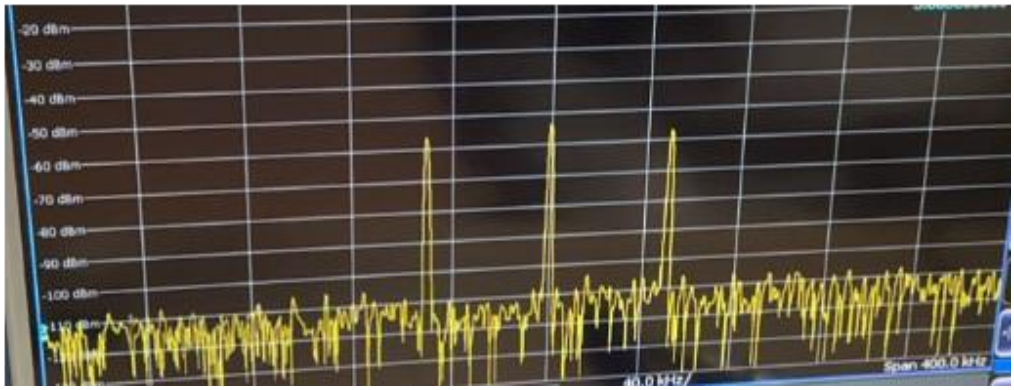

Figure 4. Received signal on the FSW.