Experiment #6

I. To study the generation of quadrature phase-shift keying (QPSK) modulated signal using arbitrary waveform generator, MATLAB, and IQ modulator.

II. Characterization of QPSK modulated signal constellation diagram, error vector magnitude (EVM), eye diagram, and channel power.

Experiment 6

Purpose: Generation of a BPSK/QPSK modulated signal using arbitrary waveform generator/MATLAB and IQ modulator.

Equipment and materials:

Equipment Required

i) N9010A Signal Analyzer/89601 Vector Signal Analysis Software with Oscilloscope (Digitizer)
ii) AFG3021B Function Generator (2 set)
iii) DPO2024 Oscilloscope, 200 MHz
iv) ME1100 dream-catcher training kit

Accessories Required

i) A PC with MATLAB/LABVIEW
ii) 2 × BNC(m)-to-BNC(m) coaxial cable, 1.0 m
iii) 4 × SMA(m)-to-BNC(m) coaxial cable, 1.0 m
iv) 3 × SMA(m)-to-SMA(m) coaxial cable, 0.18 m
v) 3 × USB cable

Procedure:

Creating I and Q Baseband Signals using MATLAB/Labview

1) Make the following connections

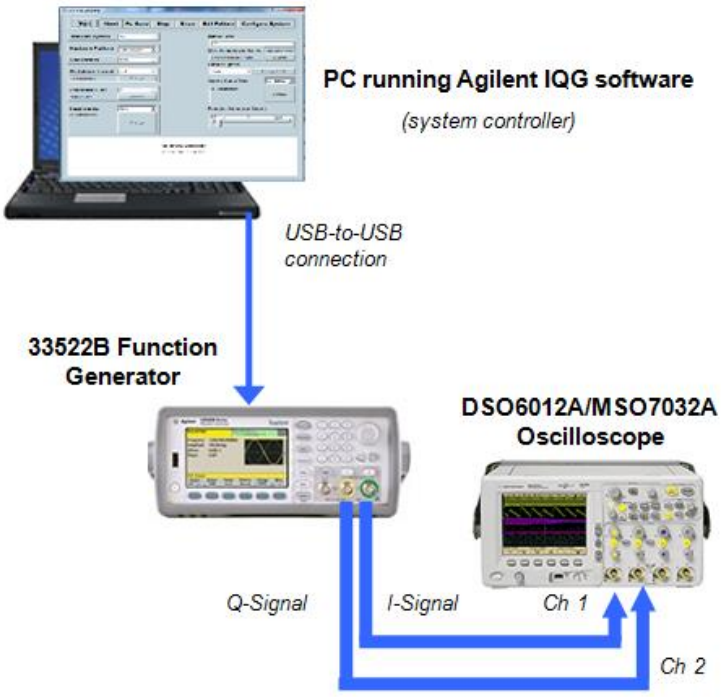

Figure 1.1 – Setup for I and Q Baseband Signal Upload and Verification

2) Use the following steps for generating PN Sequence in Matlab:

%Construct a PN object

h = commsrc.pn('GenPoly', [1 0 0 0 0 1 1], ...

'InitialStates', [0 0 0 0 0 1], ...

'CurrentStates', [0 0 0 0 0 1], ...

'Mask', [0 0 0 0 0 1], ...

'NumBitsOut', N);

%Reset (to the initial shift register state values)

reset(h);

%Output N PN bits

set(h, 'NumBitsOut', N);

bits=generate(h);

% upsample the generated bits by factor 8 or 16 using function 'upsample'.

% Design a Root raised cosine filter using 'Filter builder' app of Matlab. Filter object will be saved in matlab workspace.

% Pass the upsampled bits through filter using function 'step'.

%Save the filtered signal to an excel sheet using function 'xlswrite'.

%Use this excel sheet with Waveform downloader tool to download the signal into function generator.

%For details of Generator polynomial ('GenPoly'), please refer to theory of PN sequence generation and Matlab help on 'commsrc.pn'.

3) Download the generated IQ waveforms into the function generators.

4) Verify the generated IQ waveform with the oscilloscope. Figure 2 shows a sample of the measured IQ waveform using the oscilloscope.

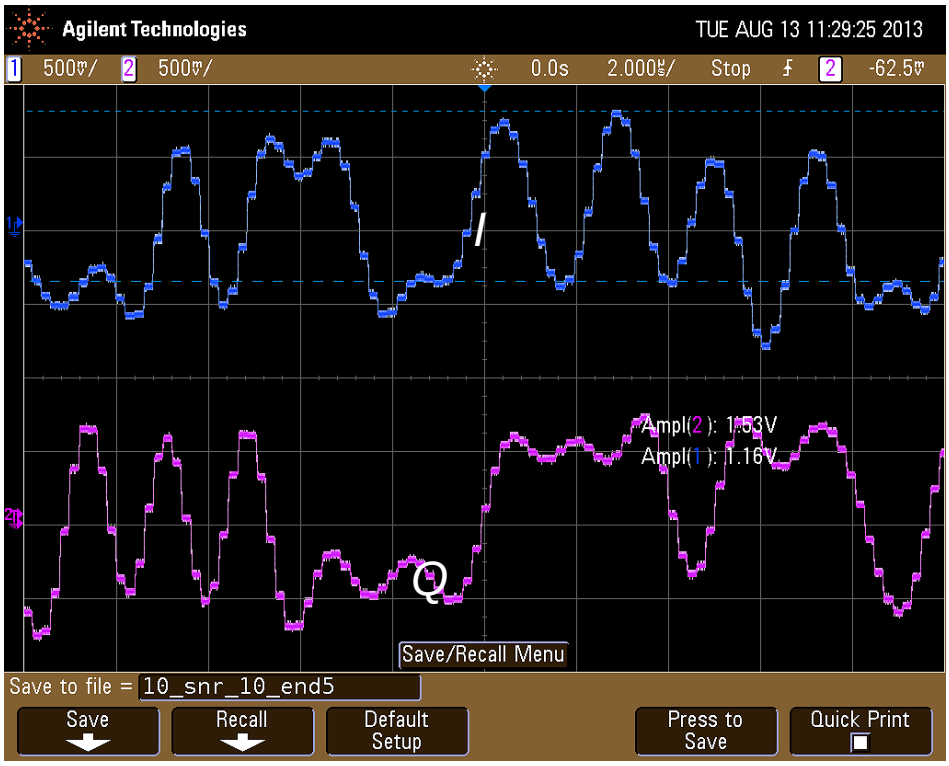

Figure 1.2 – Measured IQ Waveform in the Oscilloscope

5) In the oscilloscope, use **[Quick Meas]** to measure the amplitude of the IQ signals.

   Amplitude of the I signal = _____ V

   Amplitude of the Q signal = _____ V

Displaying the IQ Modulated RF Spectrum in the signal analyzer

1) Make the following connections on the IQ modulator in the ME1100 training kit.
Connect the **Output** ports (I and Q) of both function generator to the **I** and **Q** inputs of the IQ modulator. At the rear panel of the function generator, connect the **10 MHz OUT** terminal to the **Input** port of the 10 MHz Preamp. Next, connect the **Output** port of the 10 MHz Preamp to the **LO** port of the IQ modulator via a low pass filter.

   Use a jumper cable to connect the **RF** output of the IQ modulator to **the input of signal analyser.**

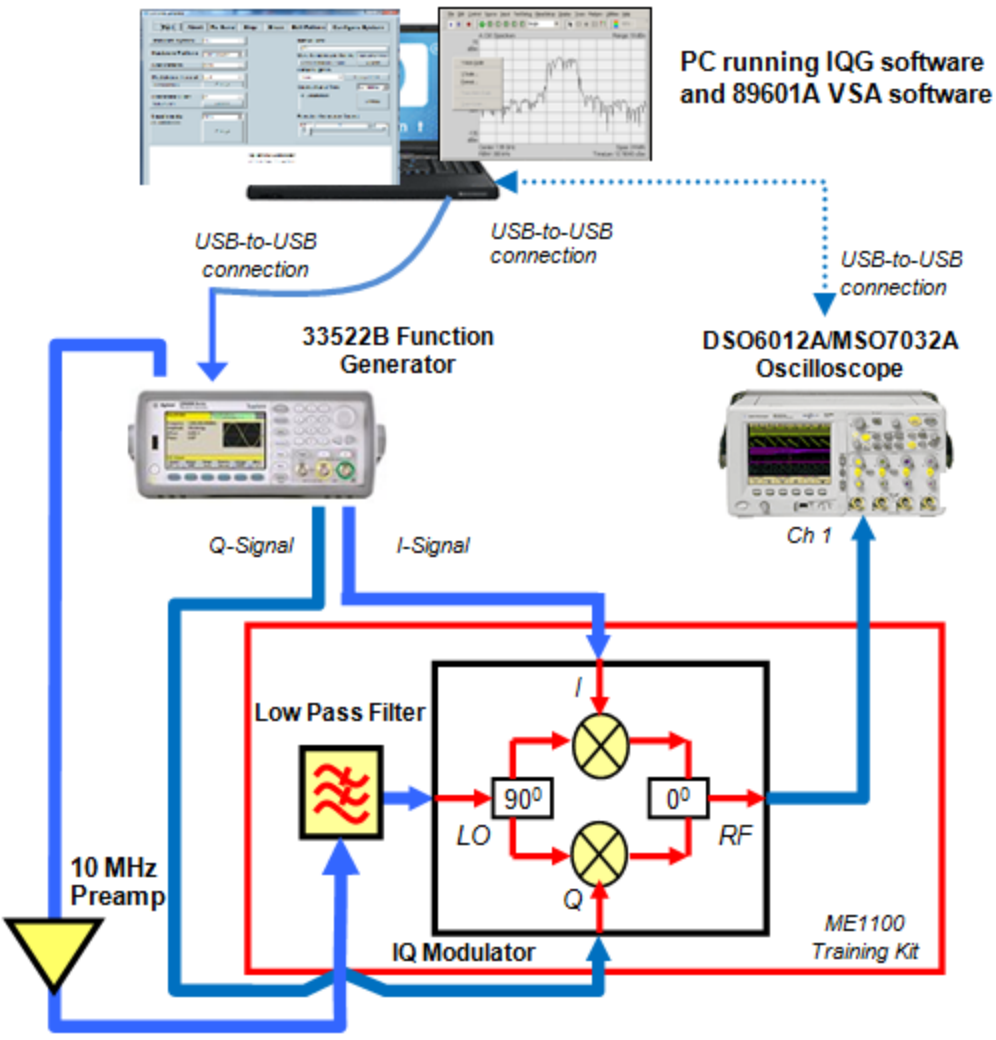

Figure 1.3 – Test Setup for Displaying the Modulated Baseband Signal