

## PCM Lab procedure

Use the following procedure.

### 1. Modulation (Use PCM ENCODER Module)

- (a) Select  $A_4$ -law companding using the on-board COMP jumper.
- (b) Make sure the on-board switch SW2 has left switch DOWN and the right switch UP (left switch is 2 and right switch is 1 when you see the numbers upside down).
- (c) Connect 8.333 kHz TTL SAMPLE CLOCK to (PCM) CLK.
- (d) Select the front toggle switch to 4-bit LINEAR.
- (e) Connect  $V_{in}$  to Gnd located under VARIABLE DC.
- (f) Connect the frame synchronization signal FS to Channel 1-A and also to TRIG (located under SCOPE SELECTOR). Make sure the TRIG is connected to the oscilloscope EXT. TRIG.
- (g) Set the oscilloscope Trigger source to Ext. and also use SINGLE SEQ mode to look at the results.
- (h) Connect PCM DATA to Channel 2-A. You will a result similar to Figure 3 of the PCM-Encoding handout.
- (i) Now change the front toggle switch to 4-bit COMPAND, 7-bit LINEAR. And look at the PCM signal. Document these results. Press SINGLE SEQ each time to look at the waveforms.
- (j) Look at the Spectrum of these PCM signals. Set Start Freq. to 0 Hz and Span to 50 kHz on the spectrum analyzer. Use AUTO SCALE if you are unable to see the entire height of the spectrum. Document these results. Notice the changes in the spectrum.
- (k) Now use a different voltage as input instead of GND. Make sure the input is with in  $\pm 2$ , by looking at the value on the oscilloscope. Notice the change in PCM data. Document your results for two other voltage values, one positive and other negative.
- (l) Now change the on-board COMP jumper to  $\mu_4$ -law companding and repeat the procedure.

### 2. Demodulation (Use PCM DECODER Module)

- (a) Make sure the on-board switch SW2 has left switch DOWN and the right switch UP (left switch is 2 and right switch is 1 when you see the numbers upside down).
- (b) Select  $A_4$ -law companding using the on-board COMP jumper (make sure PCM ENCODER Module is using the same law).
- (c) Connect 8.333 kHz TTL SAMPLE CLOCK to CLK.

- (d) Select the front toggle switch to 4-bit LINEAR (again make sure PCM ENCODER Module is using the setting).
- (e) Select the front toggle FS SELECT switch to EXT FS and connect to FS of PCM ENCODER.
- (f) Connect PCM DATA to PCM ENCODER's PCM DATA.
- (g) Connect  $V_{out}$  to Channel 2-B. Also connect DC voltage to Channel 2-A and look at the output. They should be the same value.
- (h) Now instead of DC Voltage use SYNC. MESSAGE located on the PCM ENCODER as the input  $V_{in}$ .
- (i) Look at the PCM DATA signal, and the output  $V_{out}$  of PCM DECODER, you should see a quantized signal of the same frequency as the SYNC. MESSAGE. Document these results.
- (j) Now change the front toggle switch of both PCM ENCODER and PCM DECODER Modules to 4-bit COMPAND, 7-bit LINEAR. Document the results.
- (k) Look at the results when PCM ENCODER and PCM DECODER Modules are not set to the same encoding schemes, for example Select 4-bit COMPAND on PCM ENCODER and select 4-bit LINEAR or 7-bit LINEAR. Try other combinations and look at the outputs.
- (l) Try changing the on-board COMP jumper to  $\mu_4$ -law companding and see if your results vary.