



Identifying Asynchronous Digital Cross-talk

By: Hewlett-Packard Company

Purpose:

In this hands-on exercise, the frequency spectrum of system “noise” on a TTL clock signal will be analyzed using the Fast Fourier Transform math function of the HP54542A digitizing oscilloscope.

Equipment:

- HP 54520-Series Oscilloscope
- HP 54720-66506 Application Training board

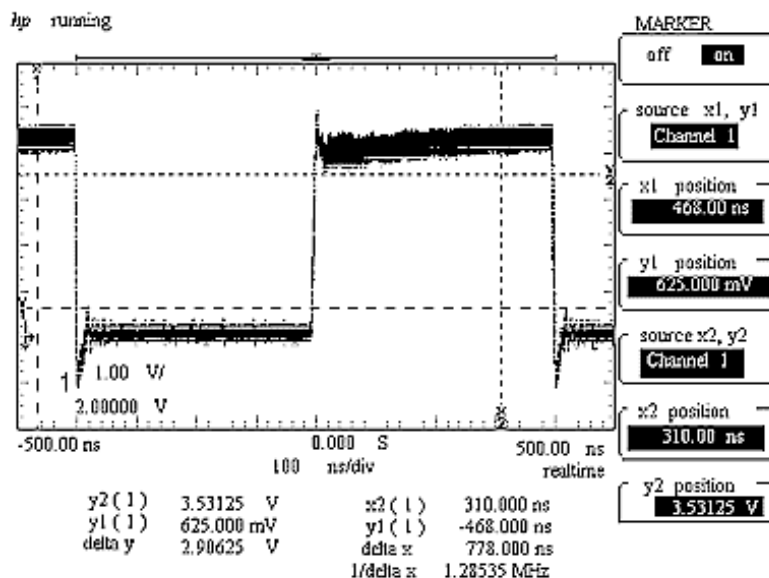
1. Using a 10:1 scope probe, connect channel 1 to TP2 (system clock) on the **DDT demo board**. Connect the probe's ground clip to one the test points labeled “G#”.
2. Load the scope setup from the disk file.
 - a. Press the **[blue shift key]** and then press **[Disk]**.
 - b. Select the **load scope** soft key and then select **SET**.
 - c. Turn the general entry knob to select setup from file **[LAB2A.SET]**.
 - d. Press **execute**.
3. To observe worst-case cross-talk, select the infinite persistence mode in the **[Display]** menu.
4. Using the delta V/t markers, measure the worst-case cross-talk.

Hint: Use the **y1** & **y2** markers in the **[Markers]** menu.

$V_{\text{high min}}$ _____

$V_{\text{low max}}$ _____

Note: These measurements should then be compared with device manufacturer's worst-case input threshold specifications.





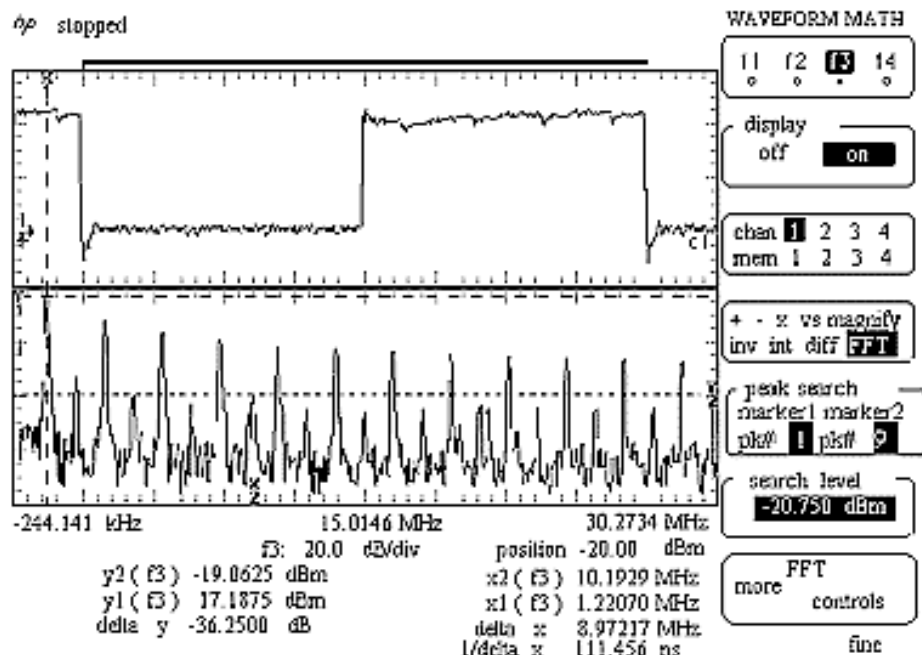
5. To observe the frequency spectrum of this waveform, load disk setup file [LAB2B.SET] as described in step #2.
6. Select the [Math/FFT] menu and then turn-on the FFT by pressing the **display - on** softkey. After an FFT has been computed and displayed, press the [Stop/Single] key.
7. Use the peak search markers and search level in the [Wform Math] menu to perform automatic frequency component measurements.
 - a. Press the **search level** softkey and adjust the level such that the horizontal marker is above the FFT display noise floor, but below most of the odd and even harmonic peaks.
 - b. Press the **peak search** softkey and rotate the knob to adjust **peak search marker #1** until the vertical marker is positioned on the peak of the fundamental frequency of this signal.

The fundamental frequency is the highest peak near the left side of the screen.

Notice that the marker will “jump” from one frequency component to the next as you rotate the knob. Peaks that are below the search level marker will be “masked out”.

Record the reading of the $X_1(f_3)$ marker.

freqfund = _____



8. Visually identify the largest cross-talk component.

Hint: The odd and even harmonics of the fundamental should decrease in amplitude as the frequency increases (peaks decrease in height from left to right on-screen). Also, amplitudes of non-harmonic peaks should be substantially below the odd and even harmonic peaks. To find cross-talk components, look for any apparent violations of this predicted behavior. The odd harmonics follow this behavior as predicted. However, it appears as though one of the even harmonics near 10 MHz increases in amplitude relative to the previous even harmonic (MHz). Actually, this even harmonic is not in violation of the predicted behavior. There is a cross-talk component very close to the 10 MHz harmonic that is almost “riding” on top of the 10 MHz harmonic.

9. Now use the automatic peak search markers again to measure the frequency of the largest cross-talk component.



- Press the **search level** softkey and ensure that the search level marker is below the cross-talk peak that you have visually identified. If not, then re-adjust the level.
- Press the **peak search** softkey two times to highlight **peak search marker #2**.
- Using the knob, position **peak search marker #2** until it lands on the peak of the cross-talk component that you have already visually identified. Record the reading of the $X_2(f_3)$ marker.

freq_{cross-talk} = _____

