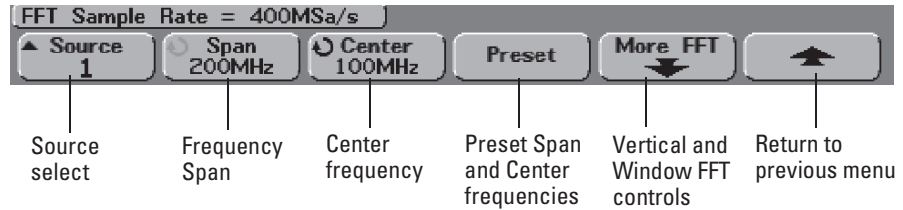


FFT Operation

- 1 Press the **Math** key, press the **FFT** softkey, then press the **Settings** softkey to display the FFT menu.



Source selects the source for the FFT. The source can be any analog channel, or math functions $1 + 2$, $1 - 2$, and $1 * 2$.

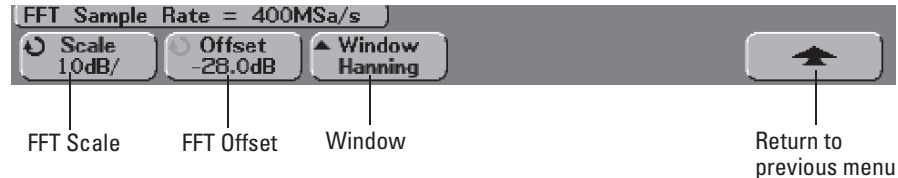
Span sets the overall width of the FFT spectrum that you see on the display (left graticule to right graticule). Divide span by 10 to calculate the number of Hertz per division. It is possible to set Span above the maximum available frequency, in which case the displayed spectrum will not take up the whole screen. Press the **Span** softkey, then turn the Entry knob to set the desired frequency span of the display.

Center sets the FFT spectrum frequency represented at the center graticule on the display. It is possible to set the Center to values below half the span or above the maximum available frequency, in which case the displayed spectrum will not take up the whole screen. Press the **Center** softkey, then turn the Entry knob to set the desired center frequency of the display.

Preset sets the frequency Span and Center to values that will cause the entire available spectrum to be displayed. The maximum available frequency is half the effective FFT sample rate, which is a function of the time per division setting. The current FFT sample rate is displayed above the softkeys.

Making Measurements
FFT Measurement

- 2 Press the More FFT softkey to display additional FFT settings.



Scale allows you to set your own vertical scale factors for FFT expressed in dB/div (decibels/division). Press the **Scale** softkey, then turn the Entry knob to rescale your math function.

Offset allows you to set your own offset for the FFT. The offset value is in dB and is represented by the center graticule of the display. Press the **Offset** softkey, then turn the Entry knob to change the offset of your math function.

Scale and offset considerations

If you do not manually change the FFT scale or offset settings, when you turn the horizontal sweep speed knob, the span and center frequency settings will automatically change to allow optimum viewing of the full spectrum. If you do manually set scale or offset, turning the sweep speed knob will not change the span or center frequency settings, allowing you see better detail around a specific frequency. Pressing the FFT **Preset** softkey will automatically rescale the waveform and span and center will again automatically track the horizontal sweep speed setting.

Window selects a window to apply to your FFT input signal:

Hanning - window for making accurate frequency measurements or for resolving two frequencies that are close together.

Flat Top - window for making accurate amplitude measurements of frequency peaks.

Rectangular - good frequency resolution and amplitude accuracy, but use only where there will be no leakage effects. Use on self-windowing waveforms such as pseudo-random noise, impulses, sine bursts, and decaying sinusoids.

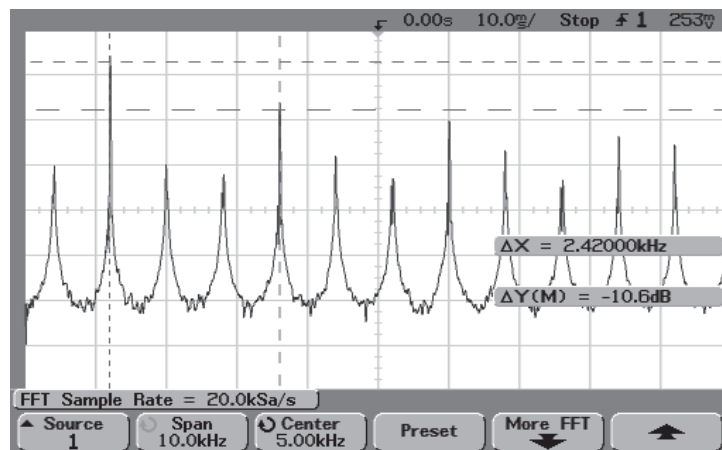
- 3 To make cursors measurements, press the **Cursors** key and set the **Source** softkey to **Math**.

Use the X1 and X2 cursors to measure frequency values and difference between two frequency values (ΔX). Use the Y1 and Y2 cursors to measure amplitude in dB and difference in amplitude (ΔY).

- 4 To make other measurements, press the **Quick Meas** key and set the **Source** softkey to **Math**.

You can make peak-to-peak, maximum, minimum, and average dB measurements on the FFT waveform. You can also find the frequency value at the first occurrence of the waveform maximum by using the X at Max measurement.

The following FFT spectrum was obtained by connecting the front panel Probe Comp signal (~1.2 kHz from 54620-series) to channel 1. Set sweep speed to 10 ms/div, vertical sensitivity to 1 V/div, Units/div to 10 dB, Offset to -28.0 dB, Center frequency to 5.00 kHz, frequency Span to 10.0 kHz, and window to Hanning.



FFT measurements

FFT Measurement Hints

It is easiest to view FFTs with Vectors set to On. The Vector display mode is set in the Display menu.

The number of points acquired for the FFT record 2048 and when frequency span is at maximum, all points are displayed. Once the FFT spectrum is displayed, the frequency span and center frequency controls are used much like the controls of a spectrum analyzer to examine the frequency of interest in greater detail. Place the desired part of the waveform at the center of the screen and decrease frequency span to increase the display resolution. As frequency span is decreased, the number of points shown is reduced, and the display is magnified.

Making Measurements

FFT Measurement

FFT Measurement Hints - Continued

While the FFT spectrum is displayed, use the **Math** and **Cursors** keys to switch between measurement functions and frequency domain controls in FFT menu.

Decreasing the effective sampling rate by selecting a slower sweep speed will increase the low frequency resolution of the FFT display and also increase the chance that an alias will be displayed. The resolution of the FFT is one-half of the effective sample rate divided by the number of points in the FFT. The actual resolution of the display will not be this fine as the shape of the window will be the actual limiting factor in the FFTs ability to resolve two closely spaced frequencies. A good way to test the ability of the FFT to resolve two closely spaced frequencies is to examine the sidebands of an amplitude modulated sine wave. For example, at 2 MSa/s effective sampling rate, a 1 MHz AM signal can be resolved to 2 kHz. Increasing the effective sampling rate to 4 MSa/s increases the resolution to 5 kHz for a set 2048 point FFT.

For the best vertical accuracy on peak measurements:

- Make sure the probe attenuation is set correctly. The probe attenuation is set from the Channel menu if the operand is a channel.
- Set the source sensitivity so that the input signal is near full screen, but not clipped.
- Use the Flat Top window.
- Set the FFT sensitivity to a sensitive range, such as 2 dB/division.

For best frequency accuracy on peaks:

- Use the Hanning window.
- Use Cursors to place an X cursor on the frequency of interest.
- Adjust frequency span for better cursor placement.
- Return to the Cursors menu to fine tune the X cursor.

For more information on the use of window please refer to Agilent Application Note 243, "The Fundamentals of Signal Analysis" Chapter III, Section 5 (Agilent part number 5952-8898.) Additional information can be obtained from "Spectrum and Network Measurements" by Robert A. Witte, in Chapter 4 (Agilent part number 5960-5718).