53210A Universal Counter Comprehensive Demo Guide

Summary: This comprehensive guide features the 53220A and 53230A universal counters. Each section of the demo guide is made to stand by itself, meaning you do not have to do all the steps and you can do them in any order. The demo sections are as follows:

1. Initial Setup
2. Making basic frequency and period measurements
3. Using histograms and trend charts
4. Using math
5. Using statistics
6. Appendix A: Demoing channel 2

Equipment: 53210A Universal Counter, 33522A or 33521A FG/AWG, and 1 BNC cable.

Conventions: hard keys are **bold** and soft keys are underlined

Comprehensive Demo Guide

1. Initial setup

a. Turn-on the 53210A and 3352xA. Connect the BNC cable to chan 1 of the 53210A and chan 1 of the 3352xA.

b. On the 3352xA:

i. Press **Chan1** → Output Load → Set to High Z to match the counter input impedance. Press Output On.

ii. Press **Parameters** → Frequency use the key pad to enter **10** and press MHz.

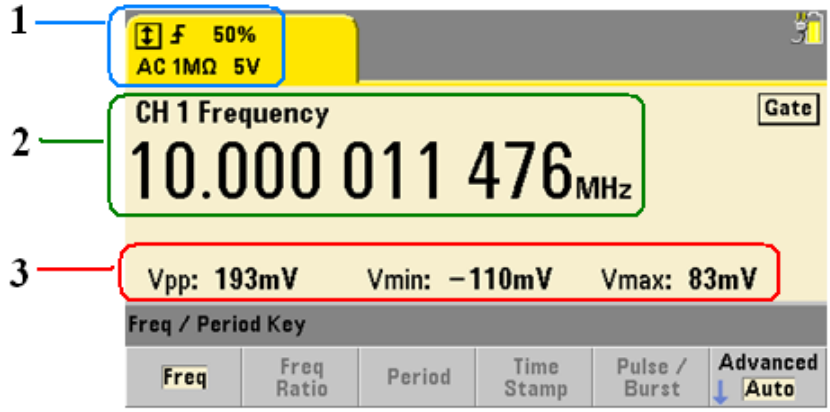
The 3352xA is now outputting a 10 MHz sine wave.

2. Making basic frequency and period measurements

a. Ensure you have completed step 1 the "Initial setup".

The 53210A will automatically start making frequency measurements. Making frequency measurements is the most common use of counters by our customers so that is why its turn-on default state is making frequency measurements. You should see a display like the screen shot in figure 1.

Figure 1. Default frequency measurement (you will only see 9 digits of resolution on 53210A)



From figure 1:

- 1 → Input conditioning settings: positive edge trigger, trigger at 50% amplitude point of edge, AC coupled, input Z 1M (other choice 50), input voltage range 5V (other choice 50V)
- 2 → Channel 1 frequency measurement (11 shown, 53210A will only have 9 digits of resolution)
- 3 → Amplitude measurements

b. On the 53210A:

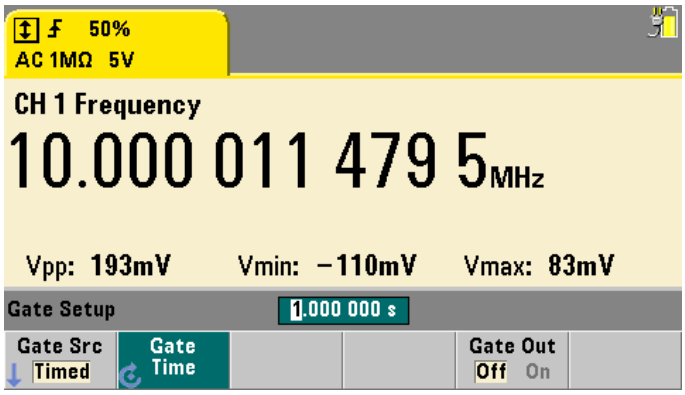
i. Press **Gate**. Above the Gate softkey menu you can see the current gate time is 100 ms (default value)

The gate time is the measurement window of the counter. Each frequency measurement you see on the display is the averaged value (actually we employ a more sophisticated confidential algorithm) of all the measurements made in that 100 ms gate time. The higher gate time means more resolution but lower measurement speed. The lower the gate time the more measurement speed but less resolution.

ii. Press Gate Time → **Shift** → **1** (from key pad) → Seconds

The gate time is now set for 1 second. Notice we are now getting 10 digits of resolution, the max resolution for the 53210A. Screen shot shown below in figure 2.

Figure 2. 12 digit resolution (53210A will only show 10 digits)



iii. Change the gate time to 1 us

This is the min gate time. Notice we only get 5 digits of resolution.

iv. Press → **Freq Period** → Period to get the period measurement

Simple frequency measurements at various gate times are what the majority of our customers will use the 53200 series of counters for.

3. Histograms and trend charts

These are two real fun features that can really catch the eye of counter users. Our older family of counters could not do this because they did not have the display for it or the memory. Histograms and Trend charts are a great way to create a quick interesting demo at a show.

a. If the 3352xA is not in its "Initial setup" condition (step 1), press → **System** → Store/Recall → Set to Defaults. Go back to step 1 and complete the "Initial setup"

b. On the 3352xA:

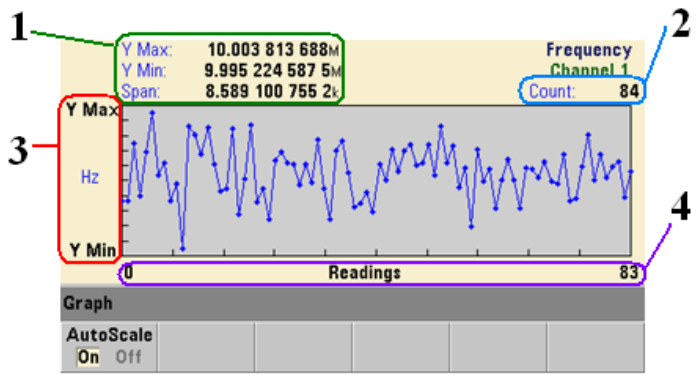
i. Press **Modulate** → Type → FM → Shape → More → Noise. Press Freq Dev use key pad to enter **300** and press kHz. Press Bandwidth use key pad to enter **10** and press kHz. Press Modulate On to turn on the modulation.

The 3352xA is now outputting a 10 MHz carrier with 10 KHz of Gaussian noise on it.

c. On the 53210A, Press **Utility** → Store/Recall → Set to Defaults. The 53210A is now in its default state

d. Press **Graph** → Trand Chart. The display should look like the one in Figure 3.

Figure 3. Trend chart



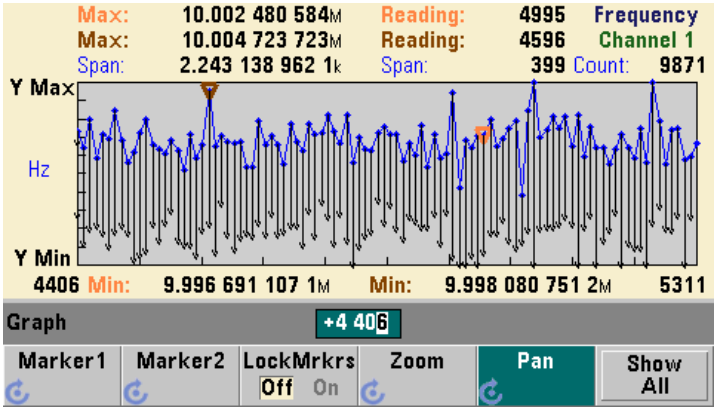
From the figure:

- 1 → 'Y Max' is the highest valued measurement (in this case frequency), 'Y Min' is the lowest valued measurement, and 'Span' is the difference between Y Max and Y Min
- 2 → 'Count' number of stored measurements. 'Frequency' is the measurement we are making
- 3 → 'Y Max' and 'Y Min' is the max and min bounds of the chart. If 'AutoScale' is on (default) the bounds are set automatically. You can turn it off to set the bounds manually

- 4 → 'Readings' the range of readings the trend chart displays (default up to 100)

e. Press Zoom & Markers. The Marker1, Marker2, Zoom, and Pan controls allow you to analyze and move through the readings.

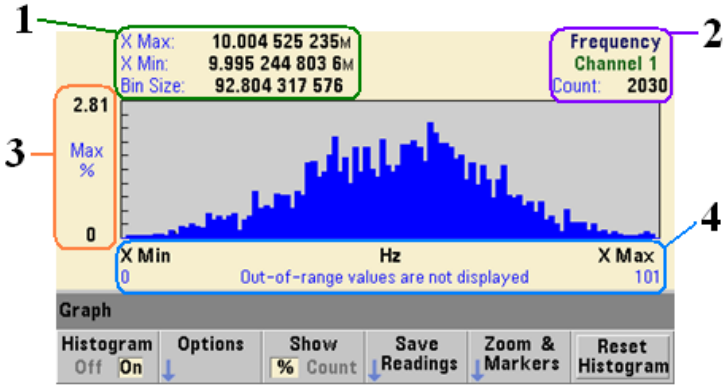
Below in figure 4 is an example data log of almost 10 K readings. Using the "Pan" and "Zoom" functions we choose to view about 900 readings. Using the Markers we were able to get the Max and Min readings within a chunk of readings. We also get the frequency span and readings span between the two markers. If you can, let the trend chart run for a while and then try out some of the data analysis features just mentioned.



Now we will check out the Histogram view

f. Press **Graph** → Histogram. This will bring up the histogram graphing functionality. Below in figure 4 is a screen shot of the 53210A histogram feature.

Figure 4. Histogram



From the figure:

- 1 → 'X Max' is the highest valued measurement (in this case frequency), 'X Min' is the lowest valued measurement, and 'Bin Size' is the measurement range (width) of each 'stack' in the histogram. For instance the Bin Size in the figure is 92.8 since we are making frequency measurements that means each bin or stack is 92.8 Hz wide.
- 2 → 'Count' number of measurements in Histogram. 'Frequency' is the measurement we are making

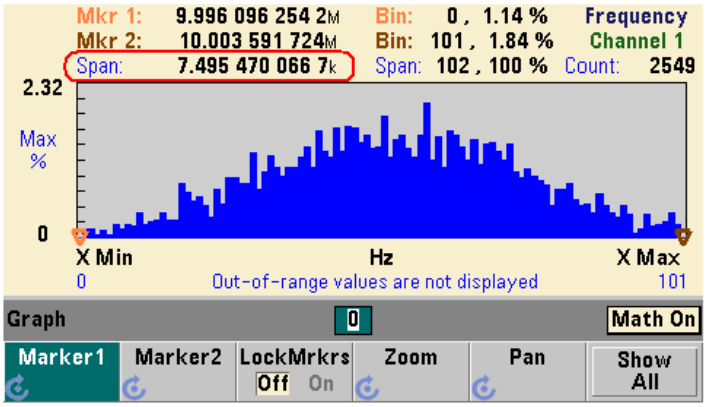
- 3 → Displays percentage of measurements at a given frequency. This can be changed to 'Count' instead of '%'
- 4 → The measurement range of the x-axis (in this case frequency). Notice out of range readings are not displayed.

Notice in the figure that after >2000 readings the Gaussian shape of the input signal from the 3352xA is taking shape (remember we configured it for FM with noise at 10 KHz BW). This is a great way to demo the 53210A at a show because customers who test time bases or oscillators know Gaussian distribution and will appreciated this feature.

a. Press Zoom & Markers. The Marker1, Marker2, Zoom, and Pan controls allow you to analyze and move through the readings.
b. In figure 5 below the markers were placed on the farthest measurement on the left and right side of the curve.

Notice the span value (frequency range between markers) at the top circled in red at 7.5 KHz. This is what we would expect since the FM noise bandwidth of the input signal is 10 KHz (the span would be closer to 10 KHz if we would have set a shorter gate time)

Figure 5. Histogram using markers



4. Using math

When doing time base checks or oscillator testing the +/- tolerance range of the test is not based on Hz but instead parts per million (PPM). Often the PPM conversion is done in the customer's software, but using the Math function in the 53200 series we can do it on the instrument.

a. If the 3352xA is not in its "Initial setup" condition (step 1), press → **System** → Store/Recall → Set to Defaults. Go back to step 1 and complete the "Initial setup"
b. On the 532xxA:
   i. Press **Utility** → Store/Recall → Set to Defaults. The 53210A is now in its default state
   ii. Press **Math** → Null/Scale.

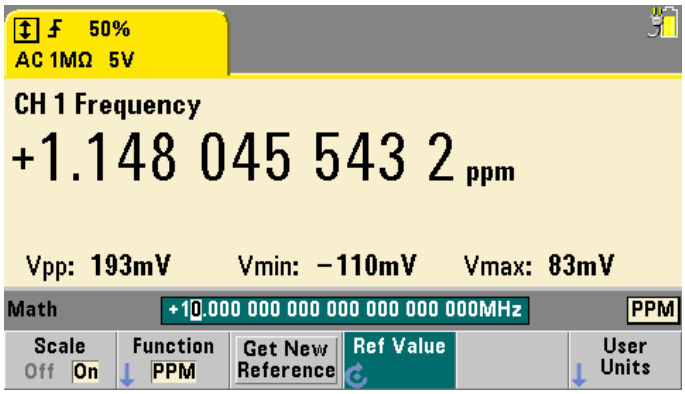
The scale function lets you compare the measured value to a reference value you set

iii. Press Ref Value → **Shift** → **10** (on number keypad) → Mega. Our reference value is 10 MHz

iv. Press Function → PPM → Scale On

The 53210A is now displaying how many PPM the measured value is from 10 MHz, see the screen shot in figure 5.

Figure 5. Scaling in PPM



v. Press Function. Check out some of the other scaling features: Null (difference in Hz), percentage (PCT), PPM, parts per billion (PPB), Mx-B

5. Using Statistics

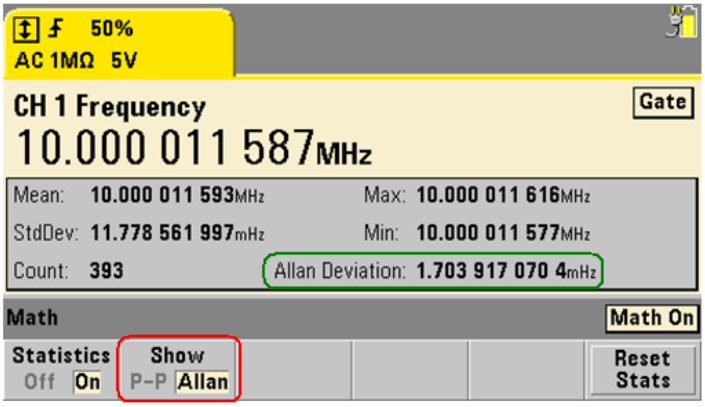
a. If the 3352xA is not in its "Initial setup" condition (step 1), press → **System** → Store/Recall → Set to Defaults. Go back to step 1 and complete the "Initial setup"

The 3352xA is now outputting a 10 MHz sine wave.

b. On the 53210A, Press **Utility** → Store/Recall → Set to Defaults. The 53210A is now in its default state

c. Press **Math** → Statistics → Statistics On. You should see a display like shown in the screen shot figure 6

Figure 6. Statistics (Allen Deviation not on 53210A only Pk to Pk)



The 532xxA is now making the following freq measurements: current, mean, min, max, standard dev, and Pk to Pk.

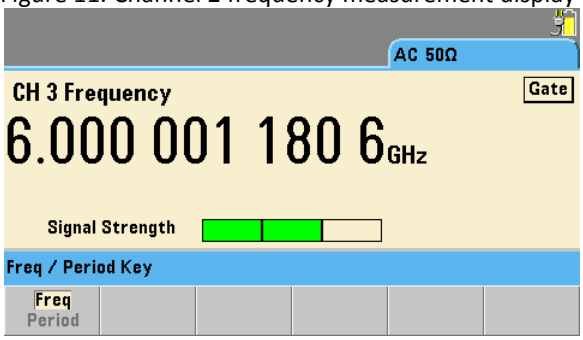
d. The Peak to Peak statistic is nothing more than the span or difference of max and min.

Appendix A: Demoing channel 2

Chan 2 with option 106 the input frequency range is 100 MHz to 6 GHz, with option 115 the input frequency range is 300 MHz to 15 GHz. A good Agilent signal generator to use to show channel 2 is our MXG signal generator product line, N518xA. Of course any RF/Microwave source will work. The following is general run through on setting up a channel 2 measurement:

- Using an RF/Microwave cable with an SMA or N-Type connector (depending on the 532xxA connector type) connect the output of the signal source to the counter channel 2 input. It is not recommended that you use a BNC cable for frequencies above 500 MHz.
- Set the signal source to a desired frequency level that falls within the 53210A's channel 2 frequency range. Set the output power to 0 dBm and turn the output on.
- On the 53210A, press **Chan 2** button and the 53210A will start making a frequency measurement on channel 2. The display should look like figure 11 (note on 53210A will be channel 2).

Figure 11. Channel 2 frequency measurement display (note on 53210A will be channel 2)



Notice that we have 11 digits of resolution using the default gate time (100 ms). This is the same as chan 1 and 2 on the 53220A and 53230A. If we were to change the gate time to 1 s we would see 12 digits of resolution just like chan 1 and 2 on the 53220A and 53230A. The resolution for chan 3 is the same as the resolution for chan 1 and 2. Unlike chan 1 and 2, chan 3 cannot measure the input amplitude. Under the frequency measurement in figure 11, you can see a gauge that gives you a general idea of the input signal strength. This is helpful to ensure chan 3 is not damaged by too high input power. Also it allows you to spot input signal that are too low. If the signal power is real low it will affect the accuracy of the measurement.