VLBA Electronics Memo No. 129

National Radio Astronomy Observatory

VLBA Array Program

VLB Array Electronics Memo No. 129

VLBA Sampler Test Card

Ron Weimer

February 1992

Introduction:

I have constructed a card that makes testing of D121 VLBA samplers easier. I have been using it to bench check samplers before shipping or when they are thought to have problems. Since we sometimes have trouble isolating problems between the BBC, sampler and formatter, I thought it would be handy to have these same test cards available at the VLBA sites. We are sending a card out to each site. The purpose of this report is to describe what the card does and how to use it.

Card Description:

The card consists of 18 resistor networks, each of which forms a two bit digital to analog (D/A) converter. Since each sampler converts the BBC signals to two bit number streams, the D/A output should approximate the BBC signals. Each bit output is on two lines (true and complement) in order to drive a balanced line receiver in the formatter. I convert the signals single ended so that each sampler section has a + and - test point. There are eight sections in each sampler. This accounts for 16 of the D/A's. The other two can be used to monitor the one second sync pulse that is converted in the sampler also. Finally there are two test points for monitoring the 32 MHz clock that is also on the sampler output cable. Figure 1 is a schematic of a typical D/A circuit. Figure 2 is a drawing of the circuit board showing the location of the various test points. This is also marked on the test board but it is hard to read.

Use of Card:

The easiest way to use the card is to remove the 40 pin ribbon cable from the back of the sampler module. Note the orientation of the cable being removed so that it gets replaced in the same position. Then connect the test card to the sampler with the short ribbon cable jumper that we are sending along with the test card. Connect the clip lead to chassis ground. Figure 3 is a sketch of the back of the sampler module. Now hook a scope up to the SYNC - and SYNC + test points. Figure 4 shows a typical scope traces of these points. Your waveforms might not be as clean as this. Try limiting the bandwidth of the scope to 20 MHz or so. What you are expecting is a negative pulse on SYNC - and a positive pulse on SYNC +. Each should be approximately 30 nanoseconds wide. The pulse occurs once per second so it is not easy to view. This will check that the test card is hooked up right and the sampler is doing something.

Testing BBC - Noise:

There are two types of signals that can be used to look at the sampler outputs. The first is to use receiver noise thru the BBC's. This requires an active front end selected through the IF system. I suggest setting the BBC bandwidths to 62.5 KHz. Check the BBC power counters for good signal levels. Figure 5 shows some scope traces from the storage scope when noise was fed into the BCC's. An analog scope will not look as clean but should show four bright horizontal traces, each representing one of the code steps shown on figure 5. There will be multiple transitions between the code step levels. You may have to fiddle some with the scope sync and bandwidth limit to get a decent picture. All 16 of the USB, LSB, +, and - should look alike (assuming all four BBC's are set and have noise inputs).

Testing BBC - 10 KHz:

The second test is to generate 10 KHz signals out of the BBC units and look at the test points for a 10 KHz signal. Figures 6 and 7 show scope traces of this test output. Figure 6 are some single traces. Figure 7 is multiple traces showing the jitter of the phase of the 10 KHz signal. This would be close to what your scope picture should look like. Again note the 4 step levels. Also note the period of the waveform. It should be close to 100 microseconds.

The following procedure generates the 10 KHz signals and is adapted from Clint Janes writeup on doing pcal test of the D rack.

1. Select Base Band Converter (BBC) #1 as the reference source by connecting its front panel LO output to IF Distributor A external input 1. Using SCREENS, set MODULE/BBC #1 LO output to 700.00 MHz.

2. Distribute the 700.00 MHz to all BBCs by selecting the IF Distribute with MODULE/IFDIST. Set IFA input to EXTERNAL and IFA attenuation to 20 db. Total power and switch power numbers on IFDIST screen are not correct and should be ignored.

3. Select MODULE/BBC and establish a 10 KHz signal on each Lower Side Band (LSB) BBC output by setting the LO Frequency on BBC #2 through BBC #8 to 700.01 MHz, IF to

A, LSB and USB Bandwidth to 62.5 KHz, and gain control to Auto Level. (700.00 MHz - 700.01 MHz = 10 KHz LSB.) For this setup, Auto Level will seek a value around - 6 db that will AGC the BBC total power output to about 16,000 counts.

4. Connect scope to the LSB + and LSB - test point corresponding to BBC 2 thru 8. (Note any problems)

5. Set the LO of BBC1 to 700.02 MHz. This will generate a 10 KHz signal out of the USB outputs of BBC 2 through 8. Check USB test points for this signal.

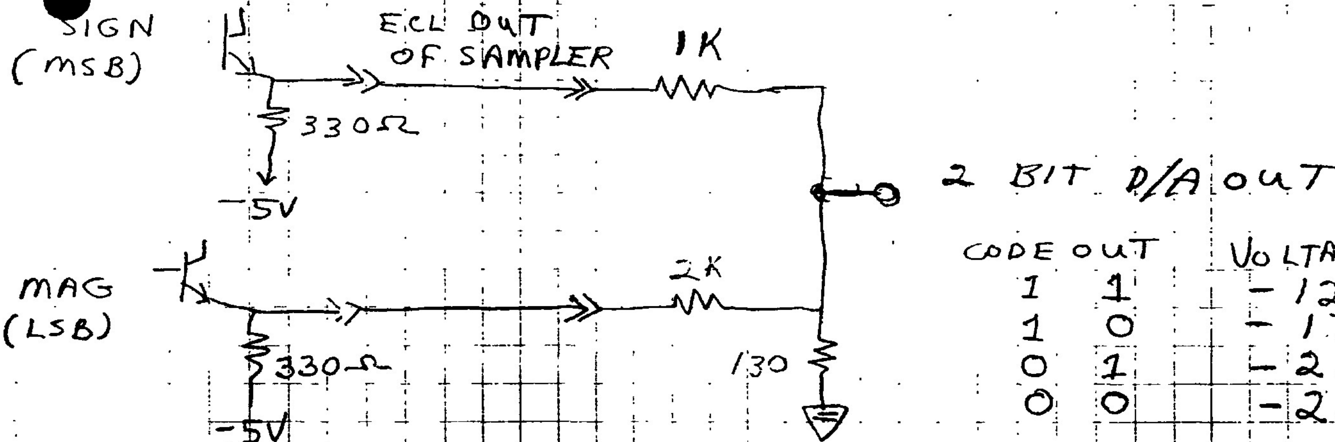
6. Finally - Check BBC1 by substituting one of the other BBCs LO signal into the IF Distributor input. Check both USB and LSB waveforms out of BBC 1.

You can adapt the above procedure to test single outputs that you suspect to be bad. You can also look at the 10 KHz out of the BBCs on their front panel monitor points. Figure 8 is a copy of a typical BBC output.

It should be noted that this does not check the cable from the Sampler to the A/D card. That would require removing the cover from the back of the D rack and substituting the cable in use for the short cable sent with the test card. Replace the cables carefully to ensure pin 1 to pin 1 orientation.

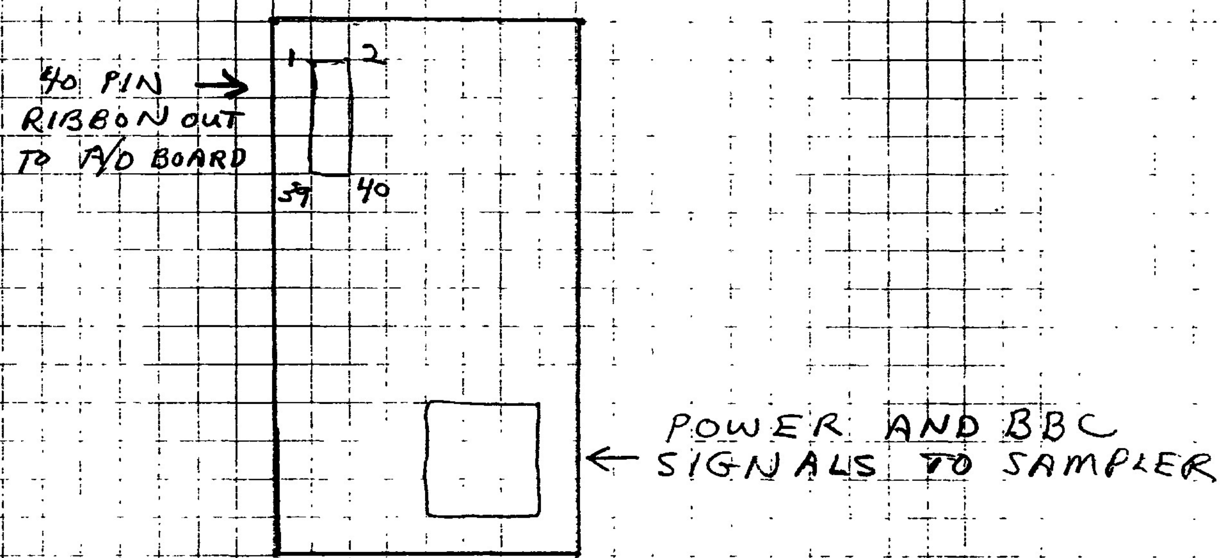
Conclusion:

I hope that these instructions will assist the station techs in using this test card. I suggest that the card be tried on a quiet electronics day to get a feeling for what is normal when things are working ok. Feel free to call for assistance.



CODE OUT		VOLTAGE (APPROX)
1	1	-120 mv
1	0	-170 mv
0	1	-230 mv
0	0	-280 mv
SIGN	MAG	

FIGURE 1



BACK VIEW
SAMPLER MODULE

FIGURE 3

REDUCE TO
5.000

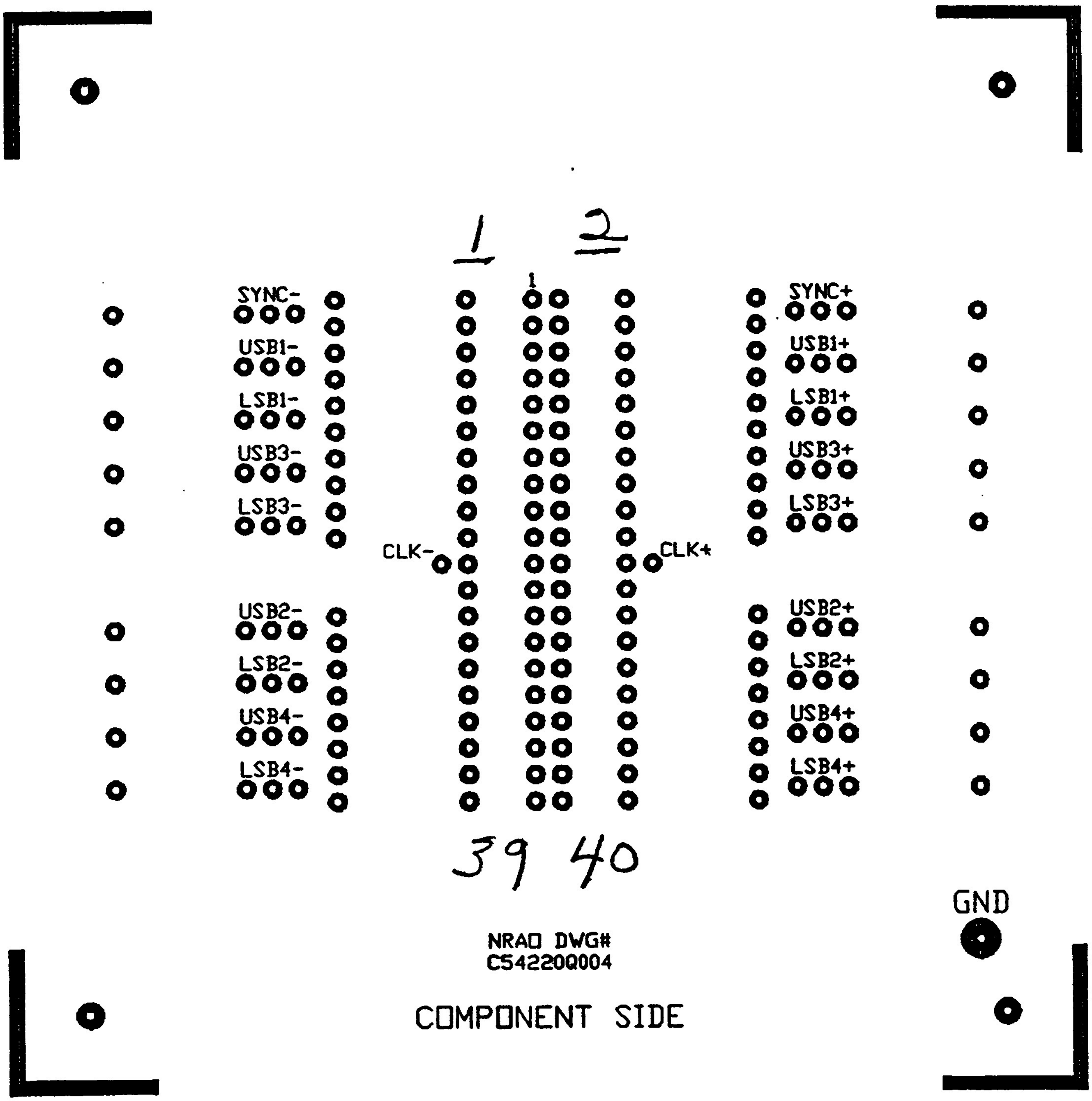


FIGURE 2

COMPONENT SIDE

SCALE 2/1

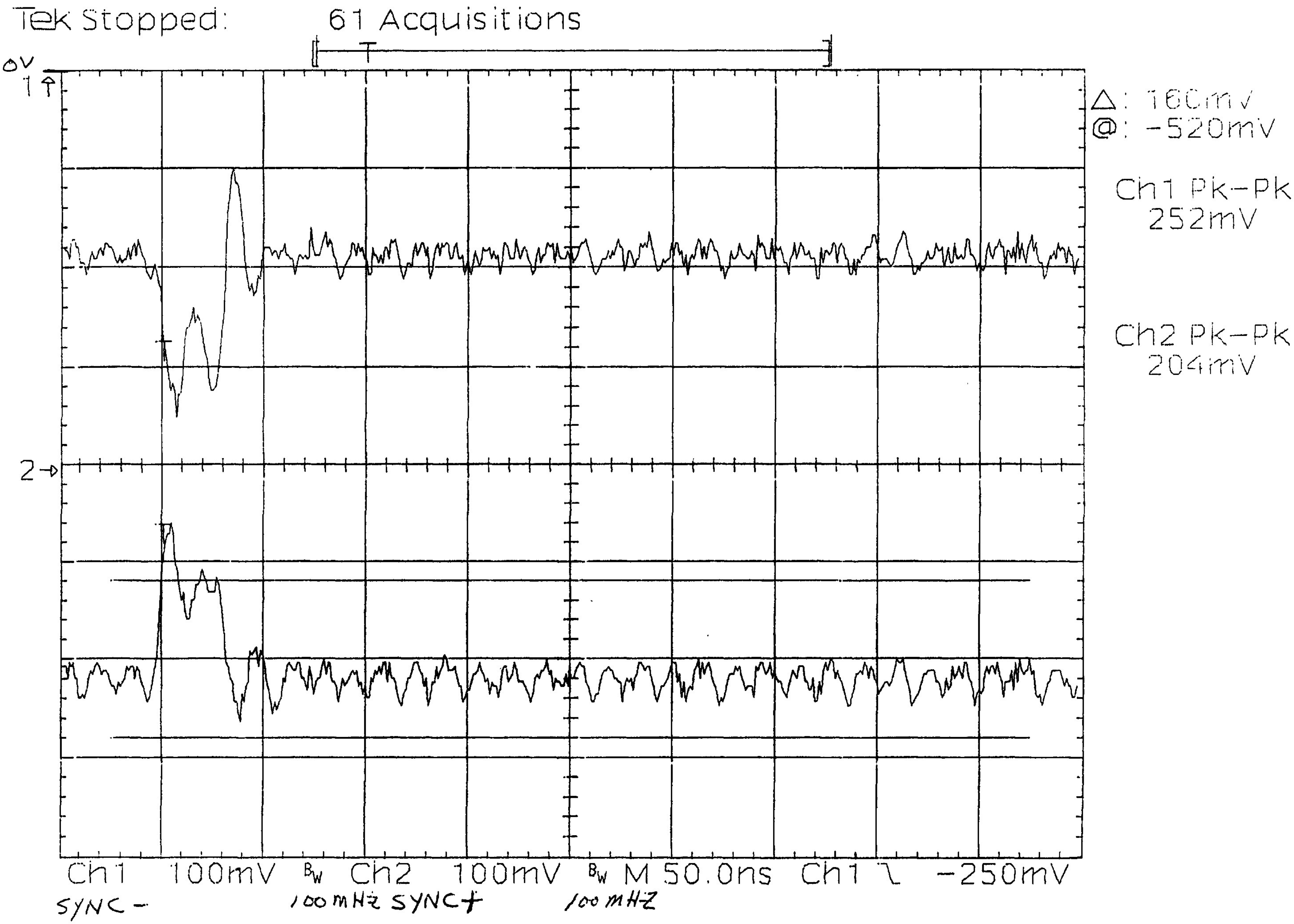

Tek Stopped: 61 Acquisitions
0V
1
2
Δ: 160mV
@: -520mV
Ch1 Pk-Pk
252mV
Ch2 Pk-Pk
204mV
Ch1 100mV BW Ch2 100mV BW M 50.0ns Ch1 -250mV
SYNC -
100 MHz SYNC +
100 MHZ

FIGURE 4

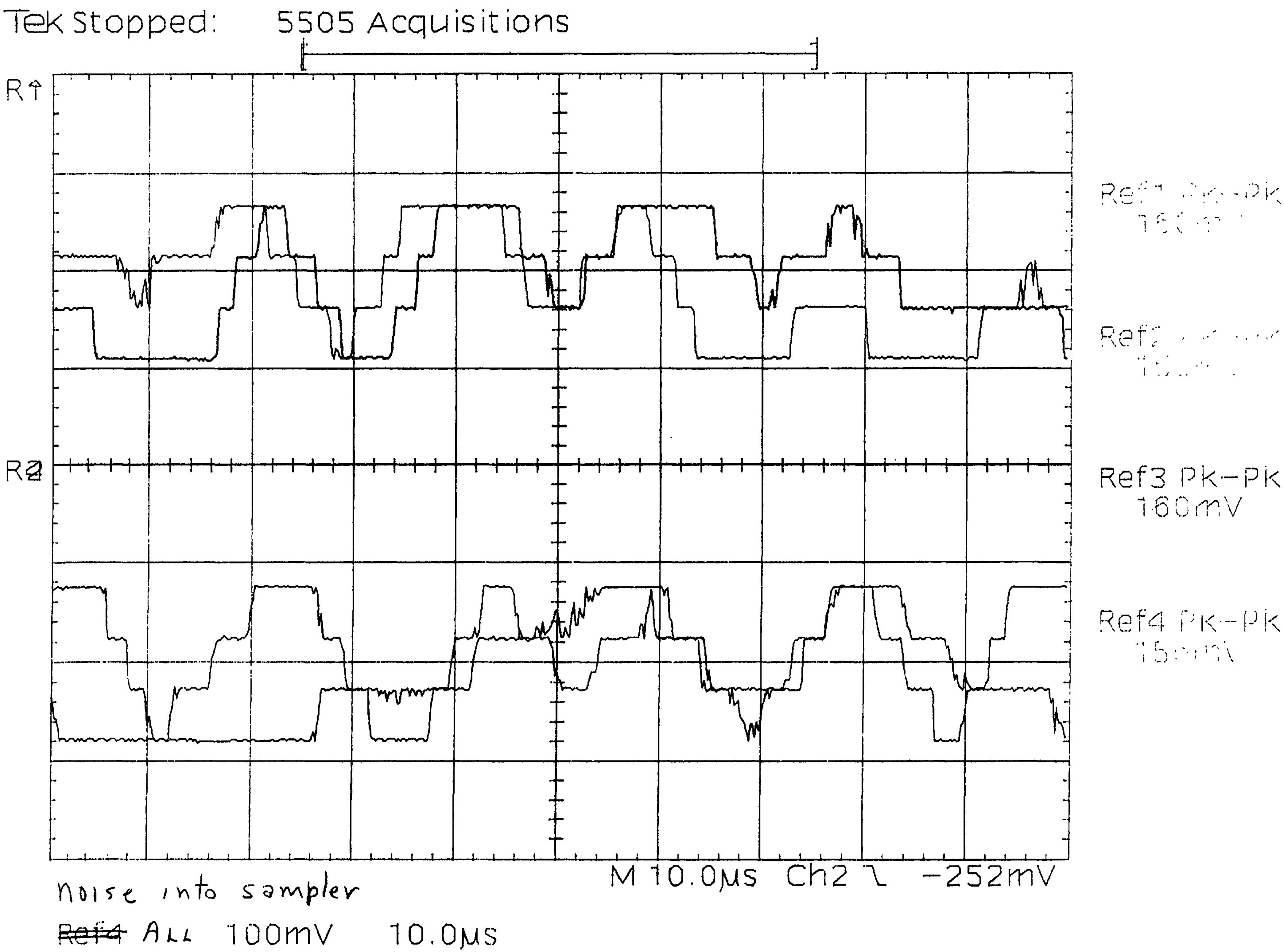
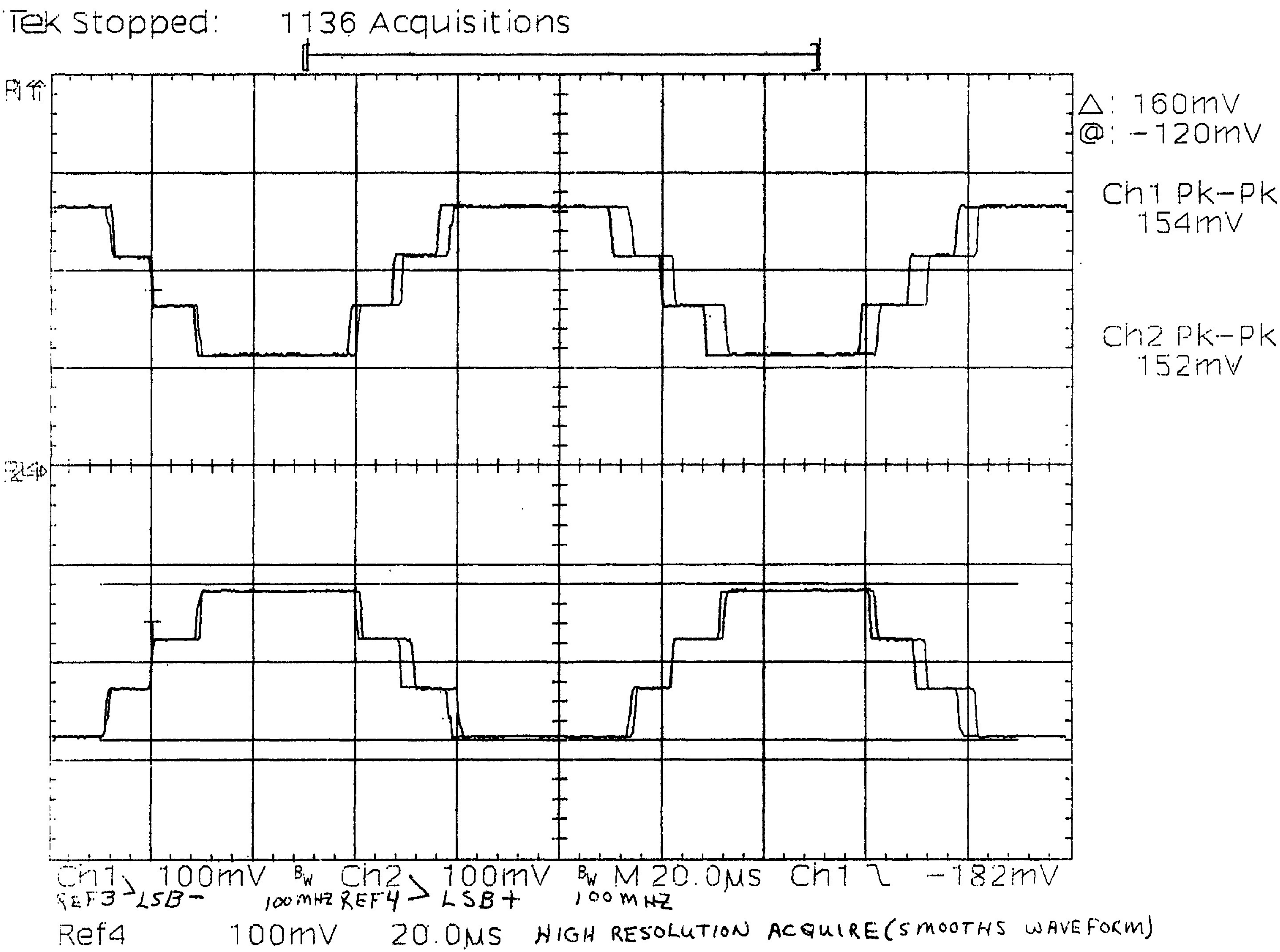

Tek Stopped: 5505 Acquisitions
R1
R2
Ref3 Pk-Pk
160mV
Ref4 Pk-Pk
M 10.0µs Ch2 ⌊ -252mV
noise into sampler
~~Ref4~~ ALL 100mV 10.0µs

FIGURE 5

FIGURE 6


Tek Stopped: 1136 Acquisitions
Δ: 160mV
@: -120mV
Ch1 Pk-Pk
154mV
Ch2 Pk-Pk
152mV
Ch1 100mV Bw Ch2 100mV Bw M 20.0ms Ch1 ⌊ -182mV
REF3 → LSB− 100 MHZ REF4 → LSB+ 100 MHZ
Ref4 100mV 20.0ms HIGH RESOLUTION ACQUIRE (SMOOTHS WAVEFORM)

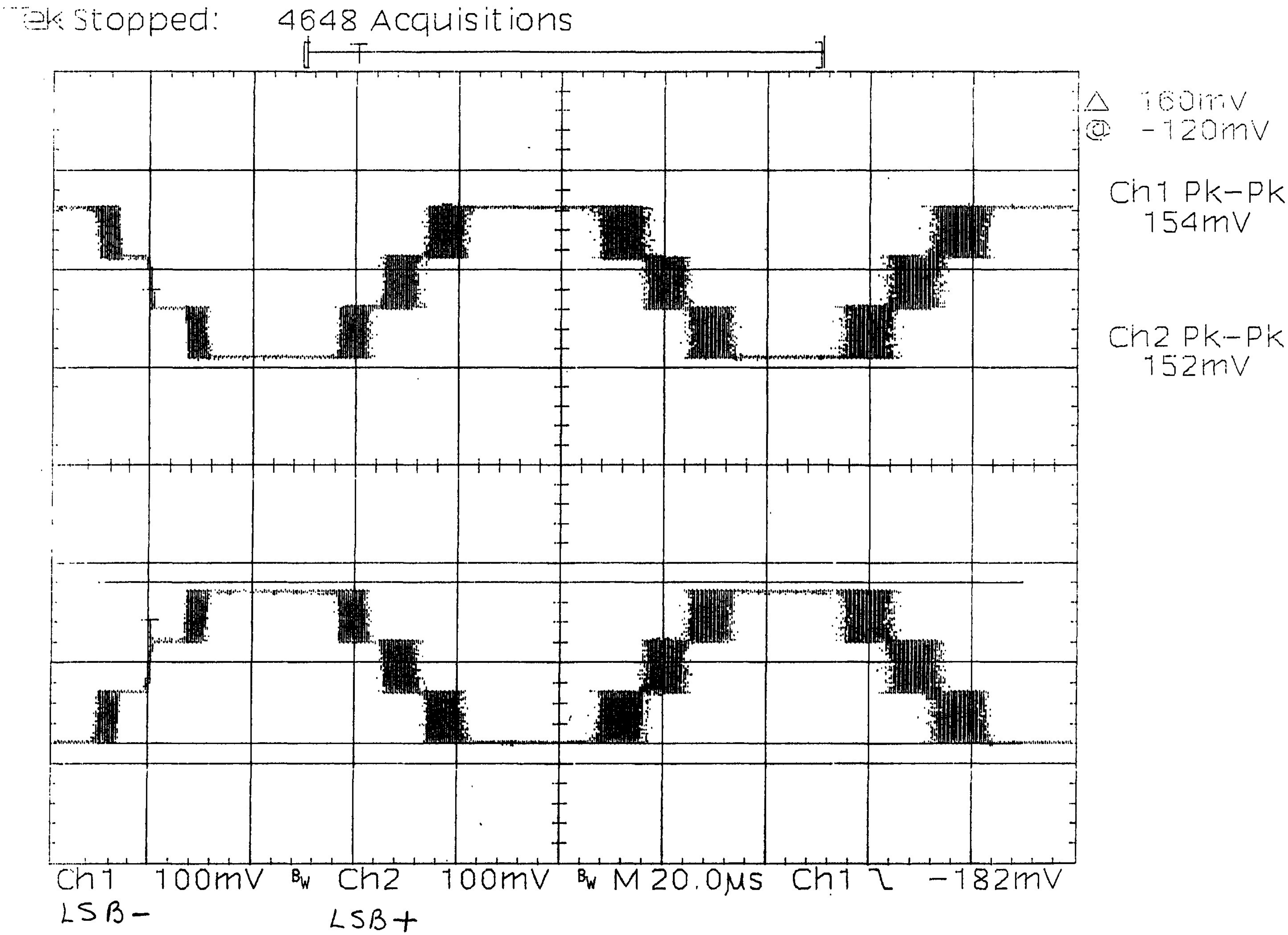
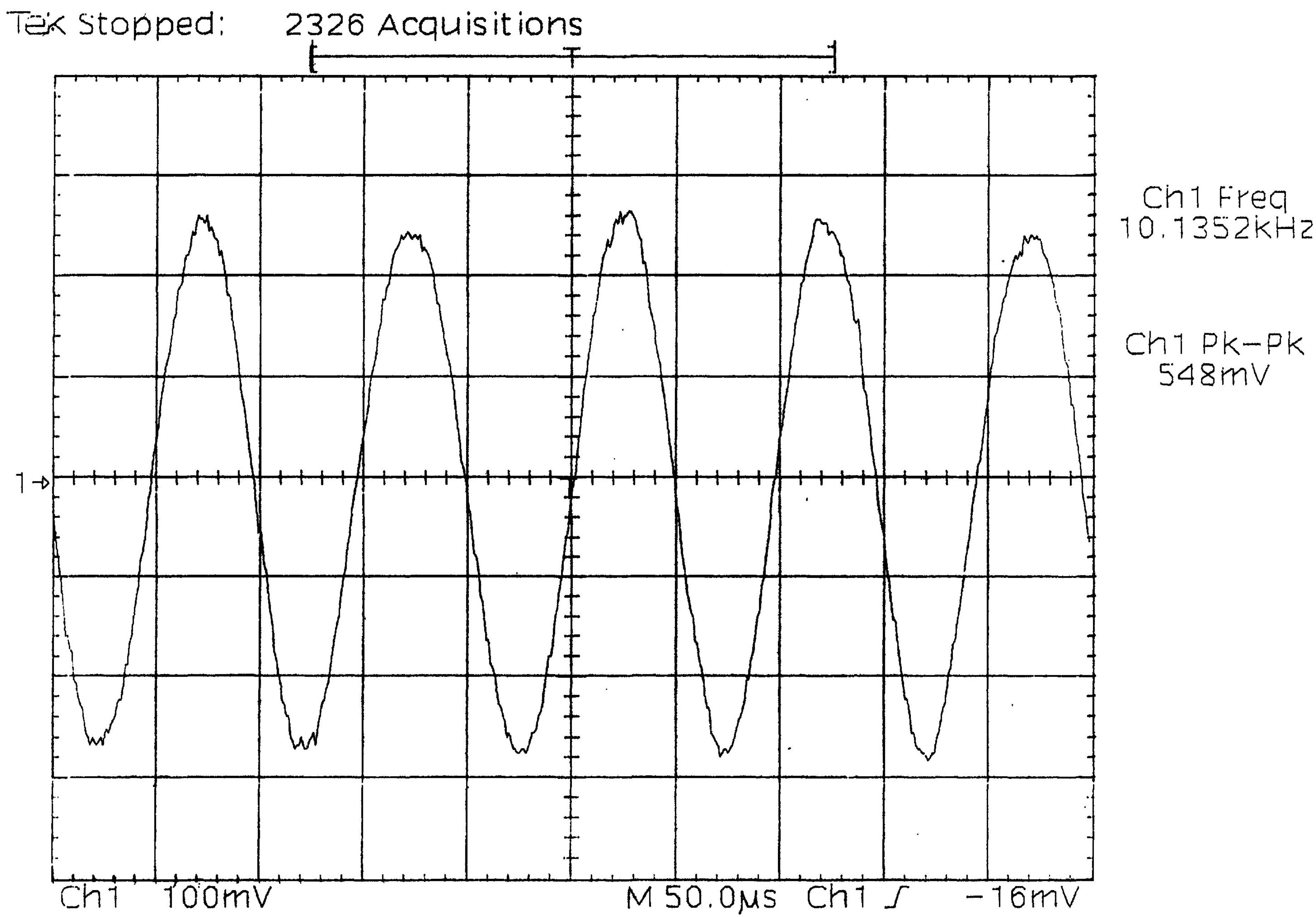

Tek Stopped: 4648 Acquisitions
Δ 160mV
@ -120mV
Ch1 Pk-Pk
154mV
Ch2 Pk-Pk
152mV
Ch1 100mV
Ch2 100mV
M 20.0μs Ch1 ℩ -182mV
LSB-
LSB+

FIGURE 7

FIGURE



Tek Stopped: 2326 Acquisitions
Ch1 Freq
10.1352kHz
Ch1 Pk-Pk
548mV
1→
Ch1 100mV
M 50.0µs Ch1 ∫ −16mV