REPLACING NVRAM IN TEKTRONIX 11000 SERIES PLUGINS

A **N**on **V**olatile **R**andom **A**ccess **M**emory (NVRAM) integrated circuit in Tektronix 11000 series plugins remembers information such as serial number and control settings. It contains a lithium battery that eventually dies. Rated lifetime is 10 years, but 25-30 years is common. The date code (format: YYWW) indicates when the part was manufactured. When it fails, there are several problems:

1. "Serial Sum" diagnostic failure at turn-on (loss of the plugin's serial number).

2. Calibration routine runs at every turn on even though the plugin has not been removed from the mainframe.

3. Failure to retain V/Div, Offset, Probe calibration, etc. after power is turned off.

4. Serial number is not displayed on screen in Mainframe's Utility Menu (Select "Ident")

There may be other failures directly caused by the NVRAM failure, so multiple failure codes should not discourage you. They may just be lost information from the last probe attached. These failures should be cleared by recycling the power on the mainframe after replacing the NVRAM.

Other than these failures, the plugin will operate normally once the diagnostic error codes are cleared by exiting the diagnostic screen. If the oscilloscope shows no failures after Enhanced Calibration, operation is fully calibrated except for transient response in the 11A52.

To avoid these recurring and annoying problems, the NVRAM must be replaced **and** the plug in serial number must be written into the NVRAM.

The NVRAM is identified as a Dallas Semiconductor 1220Y and is the tallest, thickest chip on the board. It has 24 pins. This NVRAM can be replaced with Dallas 1220AD-200, which is currently still in production and will have a battery that should last 25 years. Unsolder and remove the Dallas NVRAM. I recommend that the replacement NVRAM be socketed with a Mill-Max 110-41-624-41-001000 socket, available from Mouser Electronics and other suppliers

The procedure to replace the NVRAM and install a serial number is the same for the 11A16, 11A32, 11A33, 11A34, 11A71, and 11A72 plugins, except for 12 additional constants required by the 11A52.

Note: The 12 calibration constants for 11A52 high frequency transient response cannot be set using an 11300 series mainframe. This is apparently due to a failure of the plugin design group and the 11300 series design group to communicate in spite of the fact that the two groups were contiguous and had the same manager.

When given a choice, do not use an 11401 main frame for setting the 11A52 high frequency calibration constants as the 11401 bandwidth is not quite adequate to adjust the 11A52 properly, although you can probably come pretty close. The DSA601 mainframe can be used as well as the 11402 and 11403.

For all plugins, you must enter a serial number into the NVRAM using an 11000 series mainframe, a personal computer and either an RS232C cable or GPIB cable connected between them.

WRITING THE SERIAL NUMBER INTO NVRAM

IMPORTANT: Both 11400 main frame and plugin jumpers need to be installed to write the serial numbers or the 11A52 high frequency calibration constants into NVRAM. The 11300 series mainframes do not have a "Cal Lock" jumper but still allow the serial number to be written.

The relevant plugin jumper is J611, (J400 on 11A71). For writing the plugin serial number and the 11A52 calibration constants, J611 needs to be in the "horizontal position". (In the 11A71, this is the two pins toward the instrument top.) For normal operation the jumper is set to the "vertical position" (bottom in 11A71).

The mainframe jumper on 11400 series mainframes is located on the large bottom board in the front of the instrument. Remove the mainframe bottom cover. The jumper, labeled "Cal Lock", is located about 1" away from the board's (left to right) center on the CRT side of the instrument and centered in the front to back dimension of the bottom board. There are just two pins, there is no third pin to hold the jumper during normal operation. If the jumper is missing, one has to be stolen from some two pin shorting socket, preferably from another instrument such as a plugin not in use. You may also use an alligator clip. Be careful.

Establish communications between the mainframe and a personal computer with GPIB or an RS232 port using either Hypertext support (Win XP or earlier) or a modem capable of RS-232-C support. For Hyperterminal on Win XP and earlier Windows computers: START > All Programs > Accessories > Communications > Hyper Terminal. Use a normal RS-232-C cable. Do not use a Null Modem cable.

The 11403A I have is set to the following
Baudrate: 19200
Echo: On
Stop bits: 1
Parity: Even
Flag: Hard
Delay: 0
EOL String: CR/LF
Verbose: On
Debug: On

Some PC modems may need a lower baudrate (*e.g.* 4800 or less). Whichever baudrate you choose must be the same in both the computer and the mainframe.

Into the computer, type: UID? LEF then hit ENTER if the plugin is in the left hole, UID? CEN or UID? RIG if the plug in is in one of the other two holes. The mainframe should respond with the serial number of the plugin located in the specified hole. If you have replaced the NVRAM, if the number returned is not the serial number of the instrument, or it is gibberish, you will have to enter a serial number.

To query the serial number:
`UID? LEF` returns the Left plugin serial number
`UID? CEN` returns the Center plugin serial number
`UID? RIG` returns the Right plugin serial number

`UID?` `MAI` returns the mainframe serial number

Examples to enter the serial number:
```
UID LEF:"B010525"
UID CEN:"B061532"
UID RIG:"B120518"
```

UID means User IDentification. Use the serial number for your plugin printed on the top plugin rail.
Notice that there is no space between : and "

The full words, `LEFT`, `CENTER`, or `RIGHT` are also acceptable in place of LEF, CEN or RIG.

If your plugin is anything except an 11A52, you are done. Replace the jumpers to their original postions.

The mainframe will read the new serial number and invoke calibration at the next turn on.

11A52 HIGH FREQUENCY CALIBRATION CONSTANTS

The 11A32 and 11A34 use a single pot per channel to manually set the high frequency transient response.
The 11A71 and 11A72, I think, have all manual transient response adjustments. The 11A52 does not use
pots for high frequency adjust. Instead, the two high frequency adjustment voltages (one per channel) are
driven by the D/A converter (digital to analog converter), S/H (sample and hold) farm, and processor.
The voltage is set differently by the processor for each channel and for each of the M377 step gains:
50mV/div, 20mV/div, 10mV/div, 5mV/div, 2mV/div, and 1mV/div to optimize transient response.

With a bad or unprogrammed NVRAM, the 11A52 fails **HFadj Cksum** at turn on and the high frequency
transient response will be poor unless these 12 additional calibration constants (cal constants) are all set.
The information for the voltages is held along with the other cal constants in the NVRAM.

The 11A52 CH 1 cal constants known to me are:

```
 1: unknown
 2: unknown
 3: unknown
 4: unknown
 5: unknown
 6: unknown
 7:  VAR Gain characterization?
 8:  VAR Gain characterization?
 9:  VAR Gain characterization?
10:  VAR Gain characterization?
11:  Off Centering?
12:  Off Centering?
13:   1 mV dc balance
14:   2 mV dc balance
15:   5 mV dc balance
16: 10 mV dc balance
17: 20 mV dc balance
```

18: 50 mV dc balance
26: VAR Gain sensitivity
28:   1 mV/div gain
29:   2 mV/div gain
30:   5 mV/div gain
31: 10 mV/div gain
32: 20 mV/div gain
33: 50 mV/div gain
34: X1   atten gain
35: X10   atten gain
36: X100 atten gain (probably just the other X10 attenuator as two X10 attenuators are cascaded)
37: 100 MHz BWL gain (20MHz BWL gain is the reference setting)
38: Full BWL gain (20MHz BWL gain is the reference setting)
39: OFFSET X100 attn gain
40: OFFSET   X10 attn gain

53: HFAdj at   1mV/div (11A52 only) (HFAdj means High Frequency Adjust)
54: HFAdj at   2mV/div (11A52 only)
55: HFAdj at   5mV/div (11A52 only)
56: HFAdj at 10mV/div (11A52 only)
57: HFAdj at 20mV/div (11A52 only)
58: HFAdj at 50mV/div (11A52 only)

All cal constants for Channel 2 are 128 higher. For example, CH 2 HFAdj at 50mV/div is cal constant 186.

Except for the 11A52 HFAdj cal constants, you will **not** have to set any of these numbers. They are all set by the calibration cycle. They are reset at turn on (with a new NVRAM, or a change in plugin location) or whenever you press Enhanced Accuracy, assuming the instrument has warmed up. All of this is very automatic and should not be of concern to you.

You do, however, have to set the serial number of the plugin in the NVRAM. See above.

SETTING THE TWELVE 11A52 CALIBRATION CONSTANTS

For optimum transient response in the 11A52, every M377 preamplifier gain setting sensitivity has a different HFAdj associated with it. For example, 58 is for CH1 (*i.e.* input 1) at 50mV/div. 184 is for CH2 at 10mV/div. See the Table below for a full list. The random number assigned when the NVRAM is replaced will result in bad transient response, particularly from 10mV/div to 10V/div. The effect is seen in frequencies above 100MHz and for about the first two nanoseconds of the transient response.

Transient response for the plugin must be set for the 1mV to 50mV/div settings on each channel. The 11A52 reuses the 10mV, 20mV and 50mV settings for 100mV through 10V.   1mV/div, 2mV/div and 5mV/div are used only on those sensitive settings.

To clear the HFAdj chksum error, and obtain good high frequency/transient response, you must enter all six cal constants for each channel.

HIGH FREQUENCY CALIBRATION CONSTANT COMMANDS

Query examples	Description
CCAL? 58	Returns present value of cal constant 58 of the center plugin. 58 is the cal constant for CH 1 (*i.e.* input 1) at 50mV/div HFAdj pin in volts delivered to the M377 (165-2129-xx) preamplifier. Add 128 to 58 = 186 to get CH 2 at 50mV/div.
RCAL? 58	Returns Cal constant 58 for the Right plugin (CH1, 50mV/div)
RCAL? 186	Returns Cal constant 186 for the Right plugin (CH2, 50mV/div)
LCAL? 56	Returns Cal constant 56 for the Left plugin (CH1, 10mV/div)

Command examples	Description
CHC1 SENS:.05	Sets the Channel 1 of the Center plugin to 50mV/div. CH means Channel, or input. C1 means Center plugin hole, CH1 (*i.e.* input 1).
CHR2 SENS:5E-2	Sets the Channel 2 of the Right plugin to 50mV/div. As you can see, scientific notation works as well as fixed point

To adjust transient response of Channel 1 of the center plugin at 50mV/div, use a TD pulser to observe transient response. Set the CH 1 V/div to 50mV/div using either the mainframe front panel control (easier) or by using the computer interface (takes time). Query the present value of cal constant 58:

CCA? 58	The value should be between -1 and +1. Adjust the transient response by changing the value between -1 and +1 by typing in a voltage. The **effect will be observed only at the oscilloscope's faster sweep speeds, *i.e.* 2ns/div.** More positive numbers increase the transient response peaking.

Important: When changing the HFAdj cal settings, the 11A52 processor has to actually invoke that cal constant in order to make the voltage change. This means that when you, for example, set the CH 1 transient response for 50mV/div by changing cal constant 58, you must then manually select a different V/div setting (*e.g.* 20mV/div) and then return to 50mV/div to see the cal constant and transient response change actually take place.

CCAL 58:-.4	Sets CH1 HFAdj to -0.4V at 50mV/div for the Center plugin
RCAL 185:4E-1	Sets CH2 HFAdj to 0.4V at 20mV/div for the plugin in the Right plugin compartment.

Adjust the 1mV/div to 50mV/div transient responses for both channels. You must use an appropriate coaxial attenuator between the TD pulser and the 11A52 input to be sure the signal remains entirely on screen. 2mV/div and 1mV/div are slower than the other sensitivities, and the adjustment will have less effect at these sensitivities. A setting of +1V will not be uncommon at 1mV/div and 2mV/div.

DEFLECTION FACTORS AND ASSOCIATED ADDRESS TABLE

Deflection Factor	CH1 Cal Address	CH2 Cal Address
50mV/div	58	186
20mV/div	57	185
10mV/div	56	184
5mV/div	55	183
2mV/div	54	182
1mV/div	53	181

That should do it.

Return the plugin J611 jumper to the vertical position. Return the mainframe Cal Lock jumper to the disconnected state.

With 12 new HFAdj cal constants and a new serial number, the instrument will probably come up without errors. If there are probe related errors, they can be eliminated by putting a level 2 probe (one which tells the plugin its offset and attenuation ratio with a small pin next to the BNC connector) on the front panel with the instrument running and then removing it. Simply recycling the power may also do this.

You can check that the serial number is correct by pressing the mainframe front panel "UTILITY" button and touching the "Ident" part of the screen. All the serial numbers and firmware versions should be shown.

ADDENDUM
PROGRAMMING THE 11K SERIES PLUGINS REMOTELY

Knowledge of these commands is not necessary for replacement of the NVRAM or 11A52 high frequency calibration constants. They are given here as a quick tutorial.

Programming the 11A32, 34, 52, and 72 is fairly straight forward. Sending the mainframe the following example commands has the following result. The 11A71 and 11A72 do not respond to BW or IMP commands as they do not have changeable bandwidth or input impedance.

c

There is a space after the channel number, but none after the colon. The commands are not case sensitive. The 11A32, 11A52 and 11A72 do not have a channel 3 or channel 4.

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