RAD Engineering
BLM VME J2 Backplane

Printed Circuit Board
Trace Impedance Measurements

February 8, 2005

Test Equipment Used

- RAD Engineering VME J2 Backplane
- Scope: HP 54825A Infinium Oscilloscope 500MHz 2 Ga/s
- Probes: HP 1160A Probes (500 MHz, 10 Meg Ohm, 9pf)
- Pulse Generator: HP 8131A, 500 MHz
- Assortment of Fixed Resistors / Variable

Input Pulse Parameters

- ⇨ Input pulse has a 850ps rise time.
- ⇨ Pulse Period 500μs, Pulse High width 10μs.
- ⇨ Pulse Level High = 5.00V
- ⇨ Pulse Level Low = 0.20V
- ⇨ Pulse Generator output terminated with a 52.5 Ohm and a 1.00 K Ohm series resistor to make a current source.

Initial Impedance Measurements

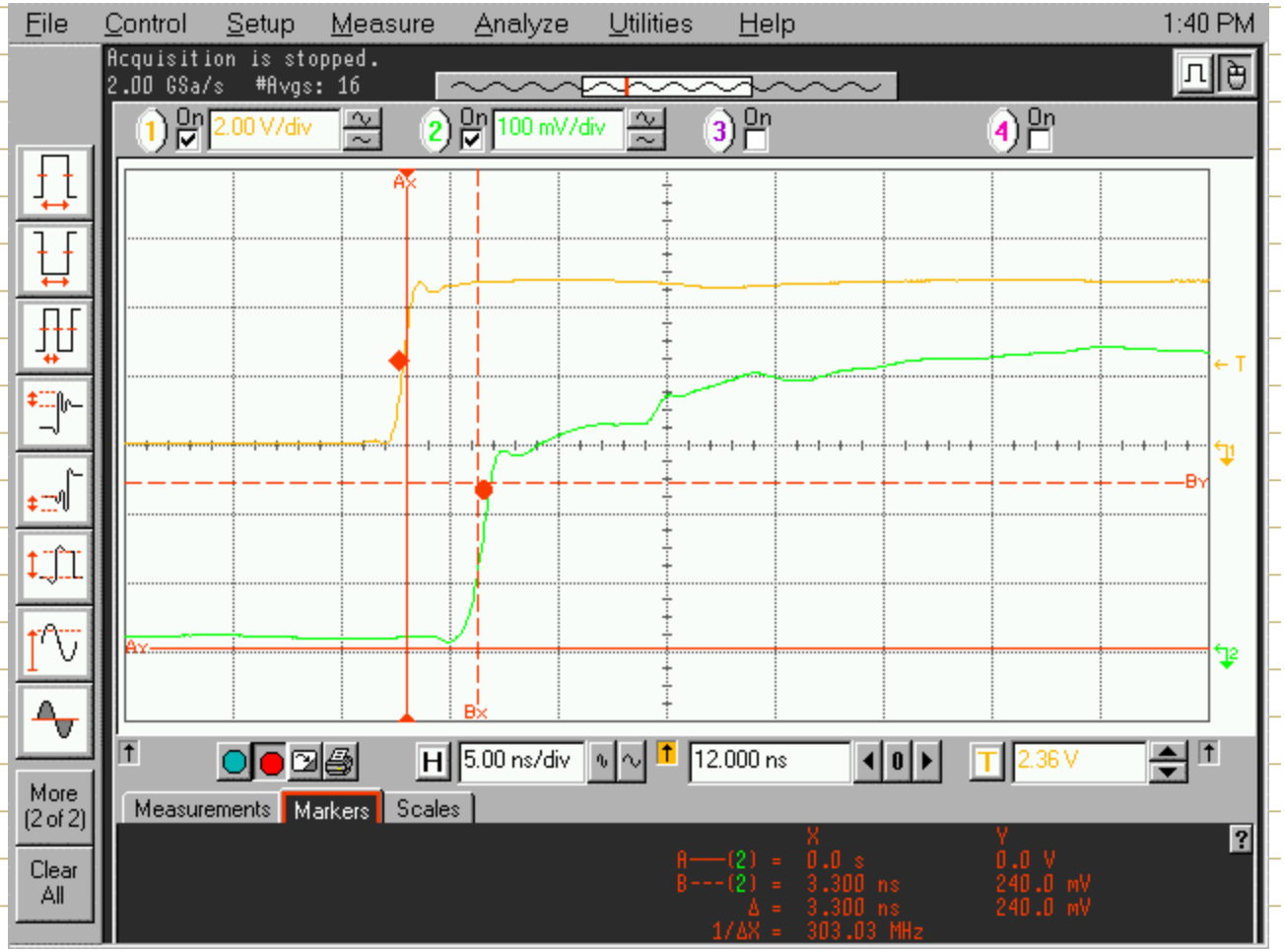
- Impedance measurements were carried out on the following backplane traces.
- Row A pins 17 (Signal) and 18 (Gnd).
- Row B pins 11 (Signal) and 12 (Gnd).
- Row C pins 29 (Signal) and 30 (Gnd)
- **Notes:** The A and C-Rows are the BLM Control Bus. B-Row is the standard VME J2 pinout.
- The A and C-Row traces are on outer signal layers. The B-Row traces are on an inner signal layer.

Impedance Row A pins

File Name:

impA_100.TIF

Trace terminated in 100 ohm resistor.



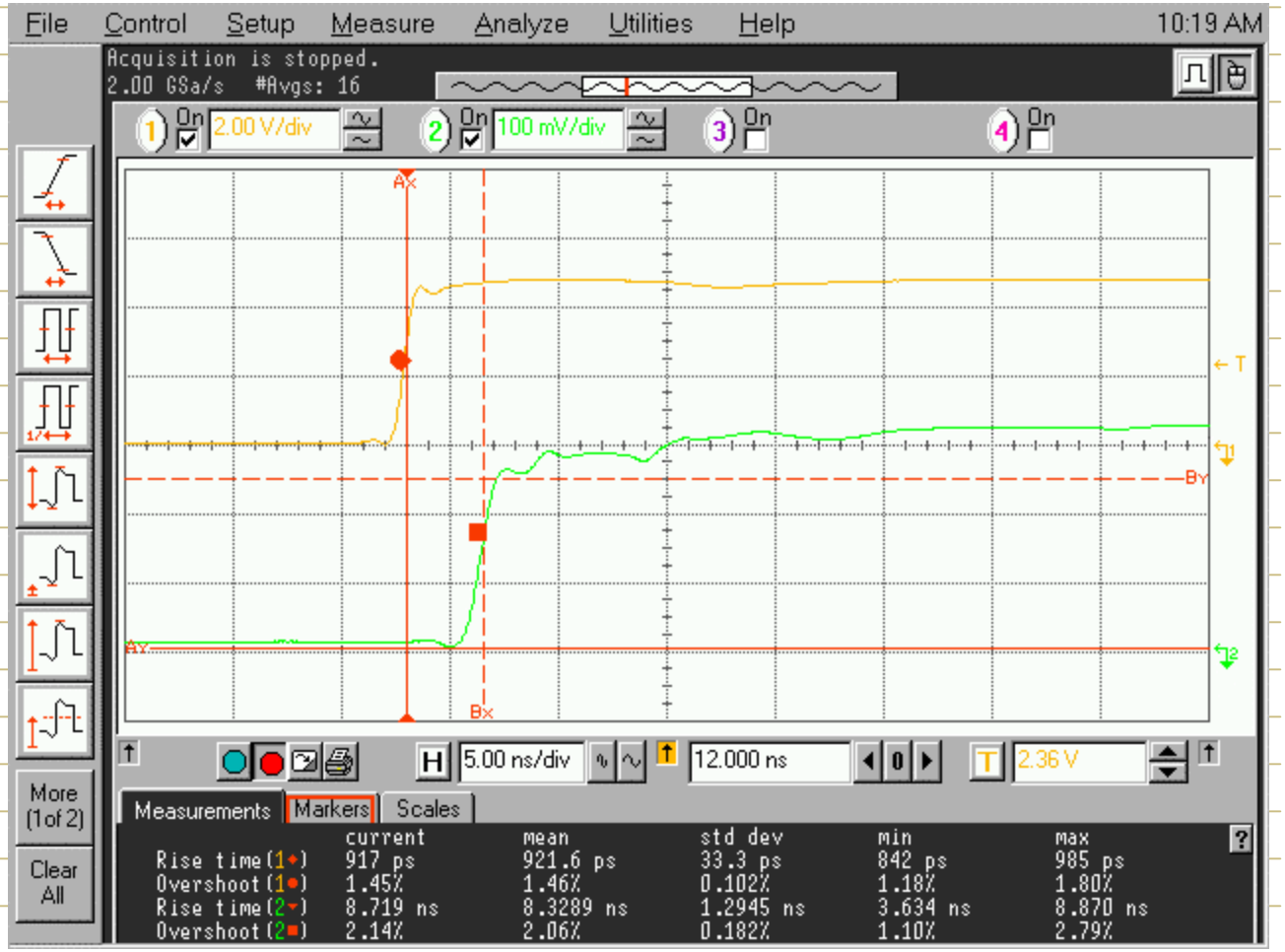
Impedance Row A pins

File Name:

impA_073.TIF

Trace terminated in 72.7 ohm resistor.

(70 Ohms - Stephen Request)



Impedance Row A pins

File Name:

impA_056.TIF

Trace terminated in 56.5 ohm resistor.

Impedance Row A pins

File Name:

impA_042.TIF

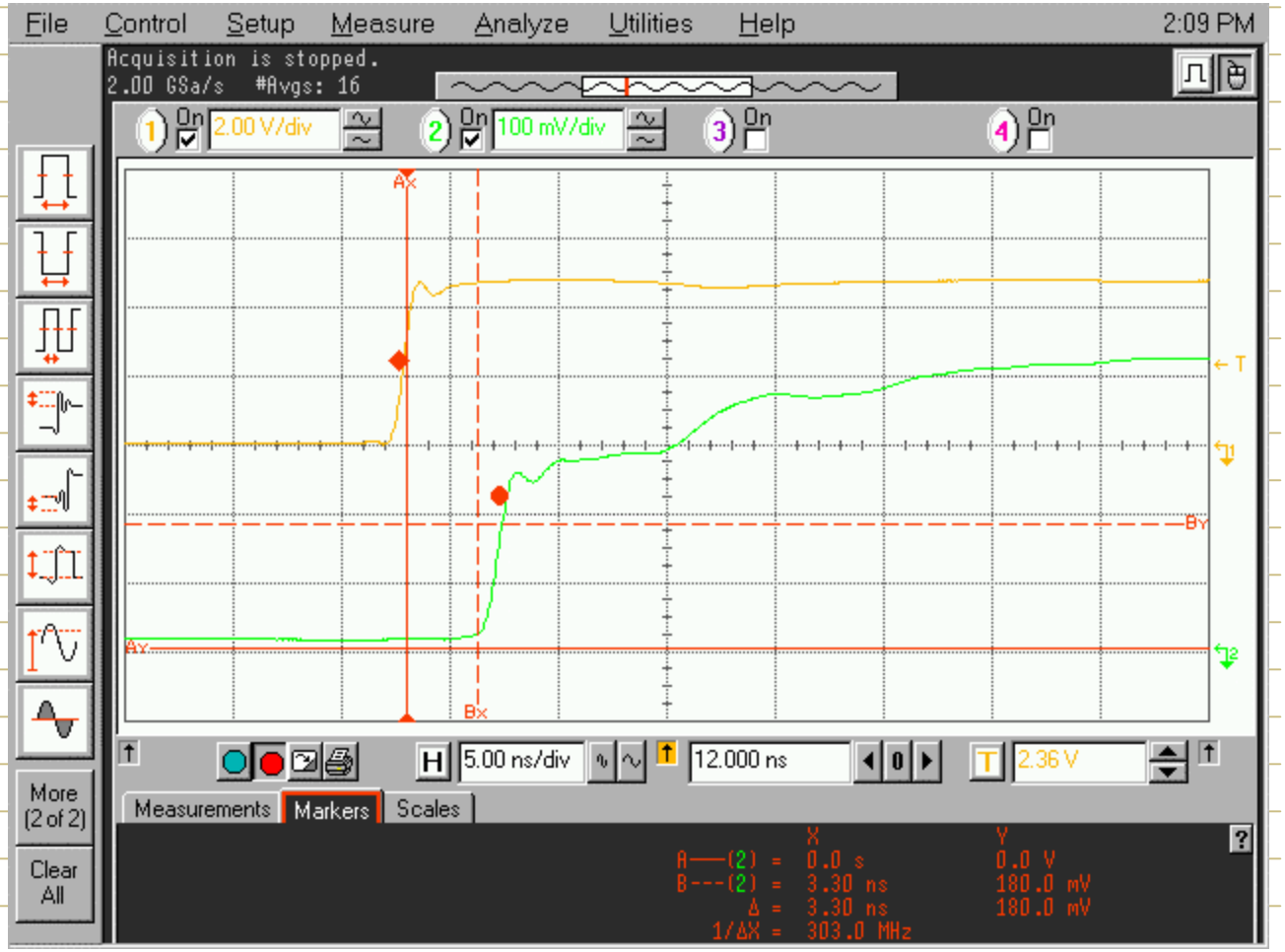
Trace terminated in 42 ohm resistor.

Impedance Row B pins

File Name:

impB_100.TIF

Trace terminated in 100 ohm resistor.



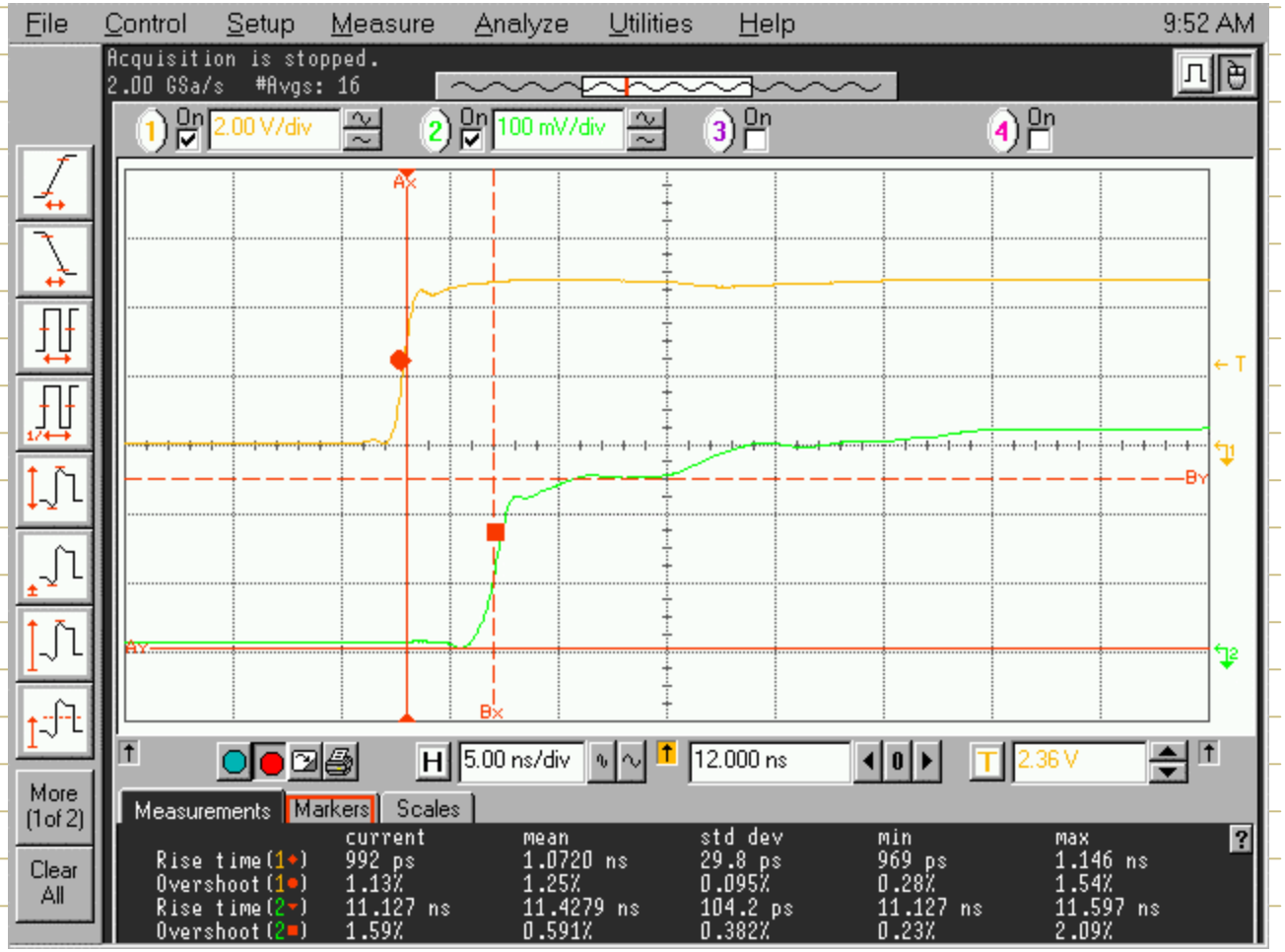
Impedance Row B pins

File Name:

impB_073.TIF

Trace terminated in 72.7 ohm resistor.

(70 Ohms - Stephen Request)



Impedance Row B pins

File Name:

impA_044.TIF

Trace terminated in 44.2 ohm resistor.

Impedance Row B pins

File Name:

impA_022.TIF

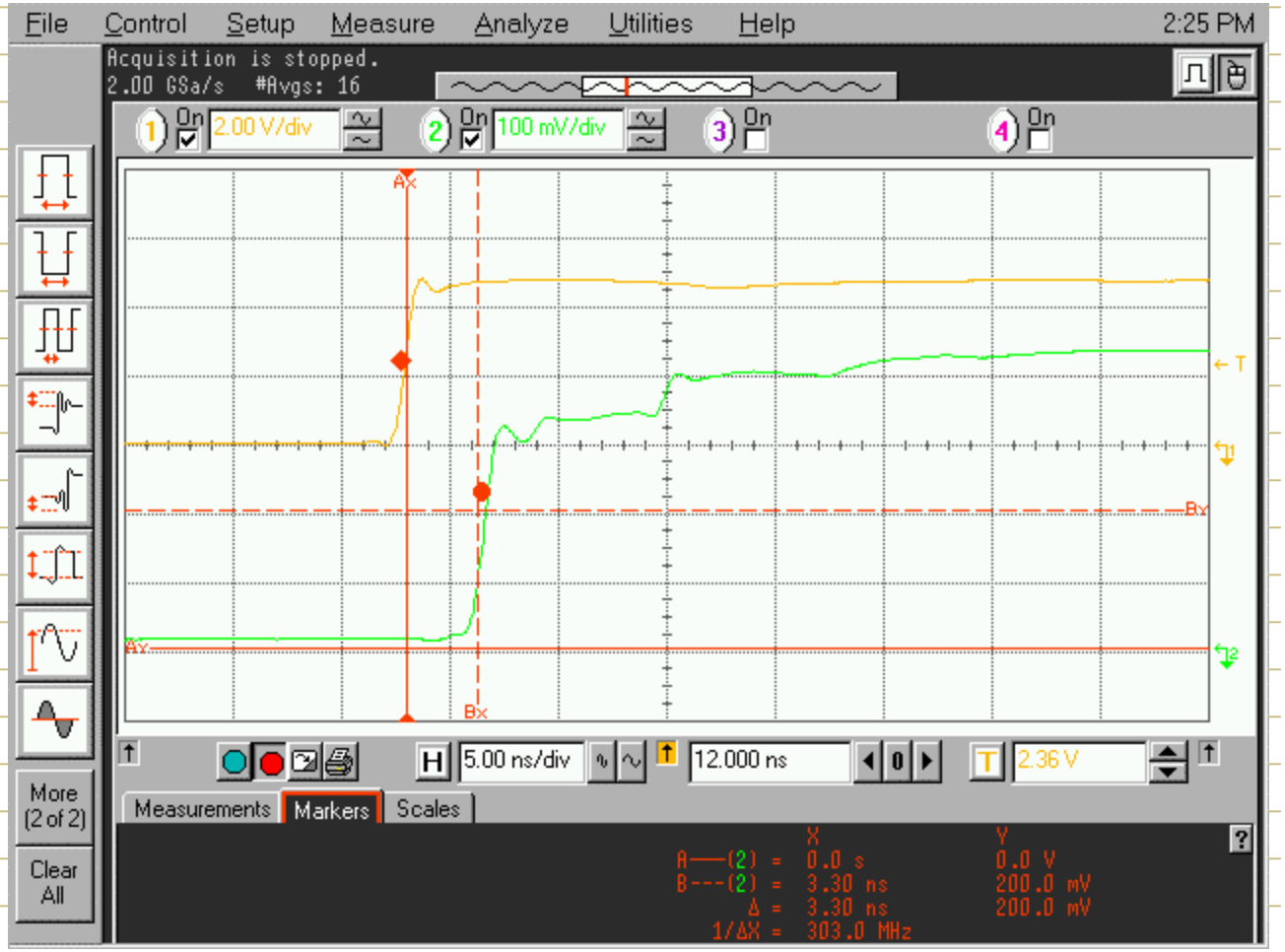
Trace terminated in 22 ohm resistor.

Impedance Row C pins

File Name:

impC_100.TIF

Trace terminated in 100 ohm resistor.



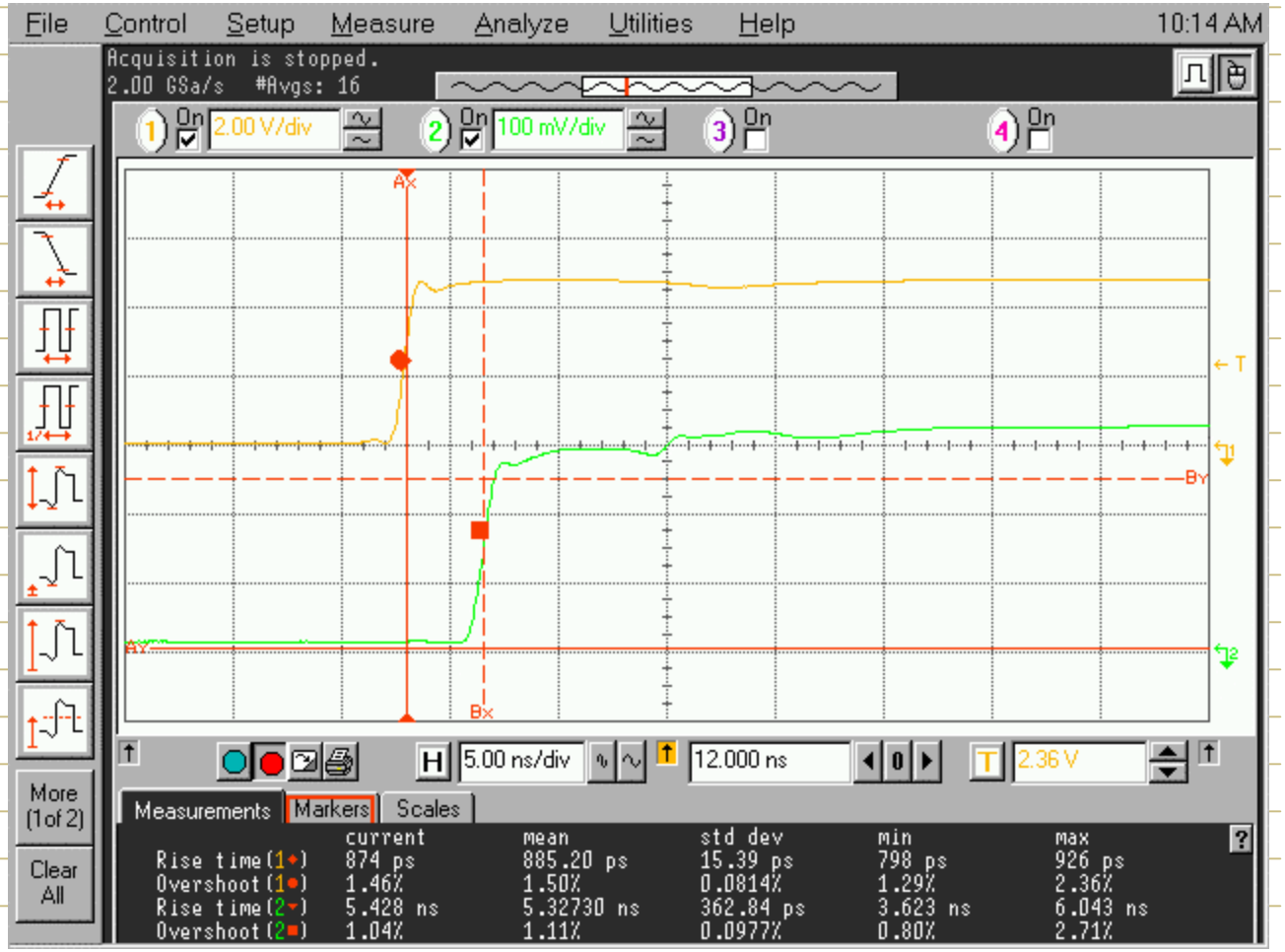
Impedance Row C pins

File Name:

impC_073.TIF

Trace terminated in 72.7 ohm resistor.

(70 Ohms - Stephen Request)



Impedance Row C pins

File Name:

impC_060.TIF

Trace terminated in 60 ohm resistor.

Impedance Row C pins

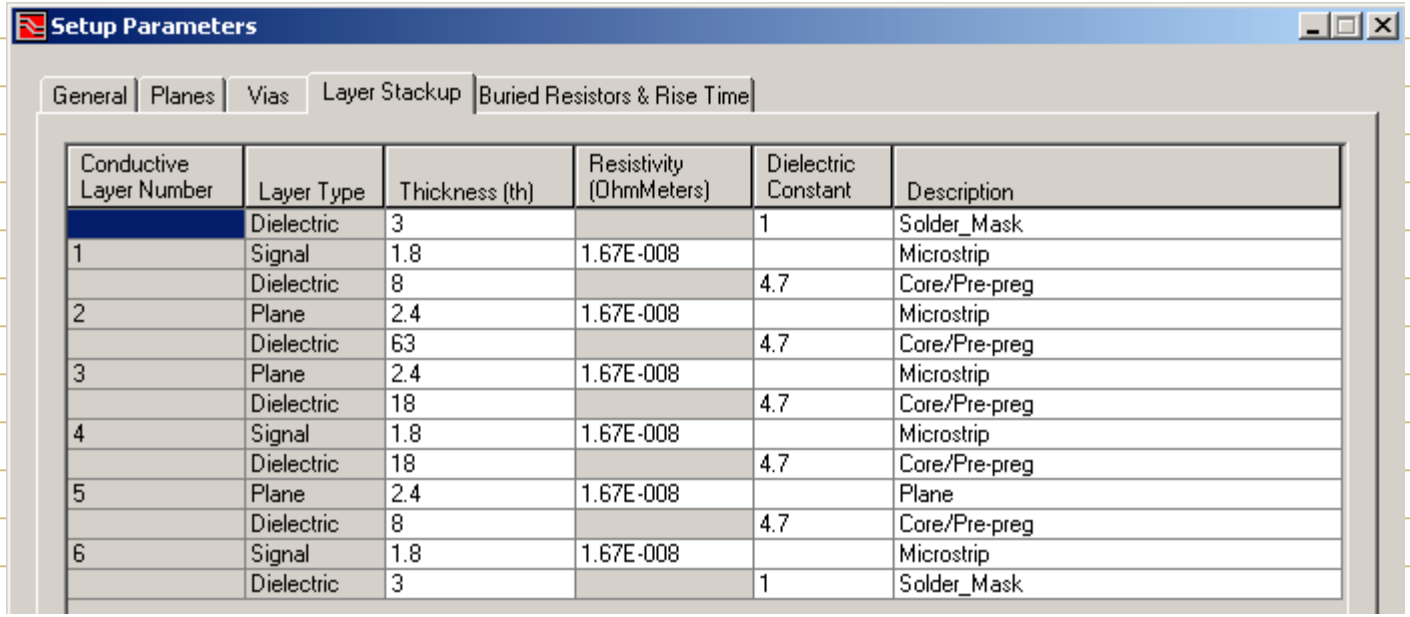
File Name:

impA_042.TIF

Trace terminated in 42 ohm resistor.

RAD Backplane Design Checks

- ⇨ Use the layer stack/thickness numbers from the RAD fabrication drawing and create a model of the backplane in Veribest.
- ⇨ This would allow the Veribest PCB software to estimate an impedance for each trace layer.

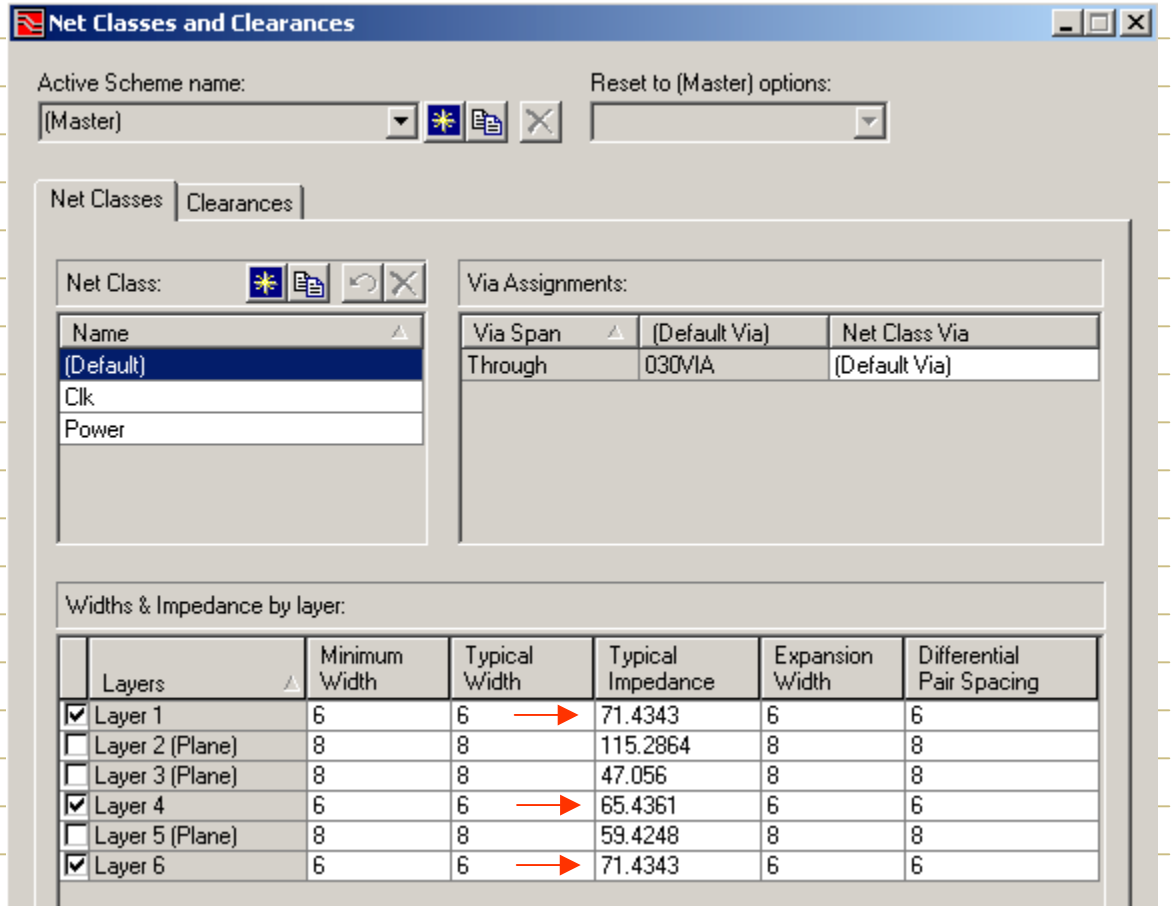


Conductive Layer Number	Layer Type	Thickness (th)	Resistivity (OhmMeters)	Dielectric Constant	Description
	Dielectric	3		1	Solder_Mask
1	Signal	1.8	1.67E-008		Microstrip
	Dielectric	8		4.7	Core/Pre-preg
2	Plane	2.4	1.67E-008		Microstrip
	Dielectric	63		4.7	Core/Pre-preg
3	Plane	2.4	1.67E-008		Microstrip
	Dielectric	18		4.7	Core/Pre-preg
4	Signal	1.8	1.67E-008		Microstrip
	Dielectric	18		4.7	Core/Pre-preg
5	Plane	2.4	1.67E-008		Plane
	Dielectric	8		4.7	Core/Pre-preg
6	Signal	1.8	1.67E-008		Microstrip
	Dielectric	3		1	Solder_Mask

RAD Backplane Design Checks

- Measure PCB trace width from RAD Gerber Files.
- All three signal layers use 6 mil (0.006”) traces.

- **Veribest Estimates:**
- Row A (Layer1) = 71.43 Ohms
- Row B (Layer4) = 65.44 Ohms
- Row C (Layer6) = 71.43 Ohms



RAD Backplane Design Checks

- ⇨ Use microstrip design equation from "Motorola MECL System Design Handbook" to estimate trace impedance.

$$Zo' = \frac{87}{\sqrt{e_r + 1.41}} \ln\left(\frac{5.98h}{0.8w + t}\right)$$

  - ⇨ Assume e_r = 4.7
  - ⇨ *Zo'* = 69.7 Ohms

- ⇨ Use stripline design equation from the same reference to estimate B-Row trace impedance.

$$Zo' = \frac{60}{\sqrt{e_r}} \ln\left(\frac{4b}{0.67\pi w(0.8 + \frac{t}{w})}\right)$$

  - ⇨ Assume e_r = 4.7
  - ⇨ *Zo'* = 64.7 Ohms

e_r = Dielectric Constant of G-10, FR-4, etc
h = Trace height above ground plane
w = Trace width, t = Trace thickness
b = For stripline, distance between ground planes

Additional Impedance Measurements

- At the previous meeting (2/01/05) there was a request to measure the trace impedance of other manufacturers VME backplanes.
- To make more measurements, backplanes with removable termination networks would need to be found.
- Four additional VME J1 & J2 backplanes were located and measurements completed.

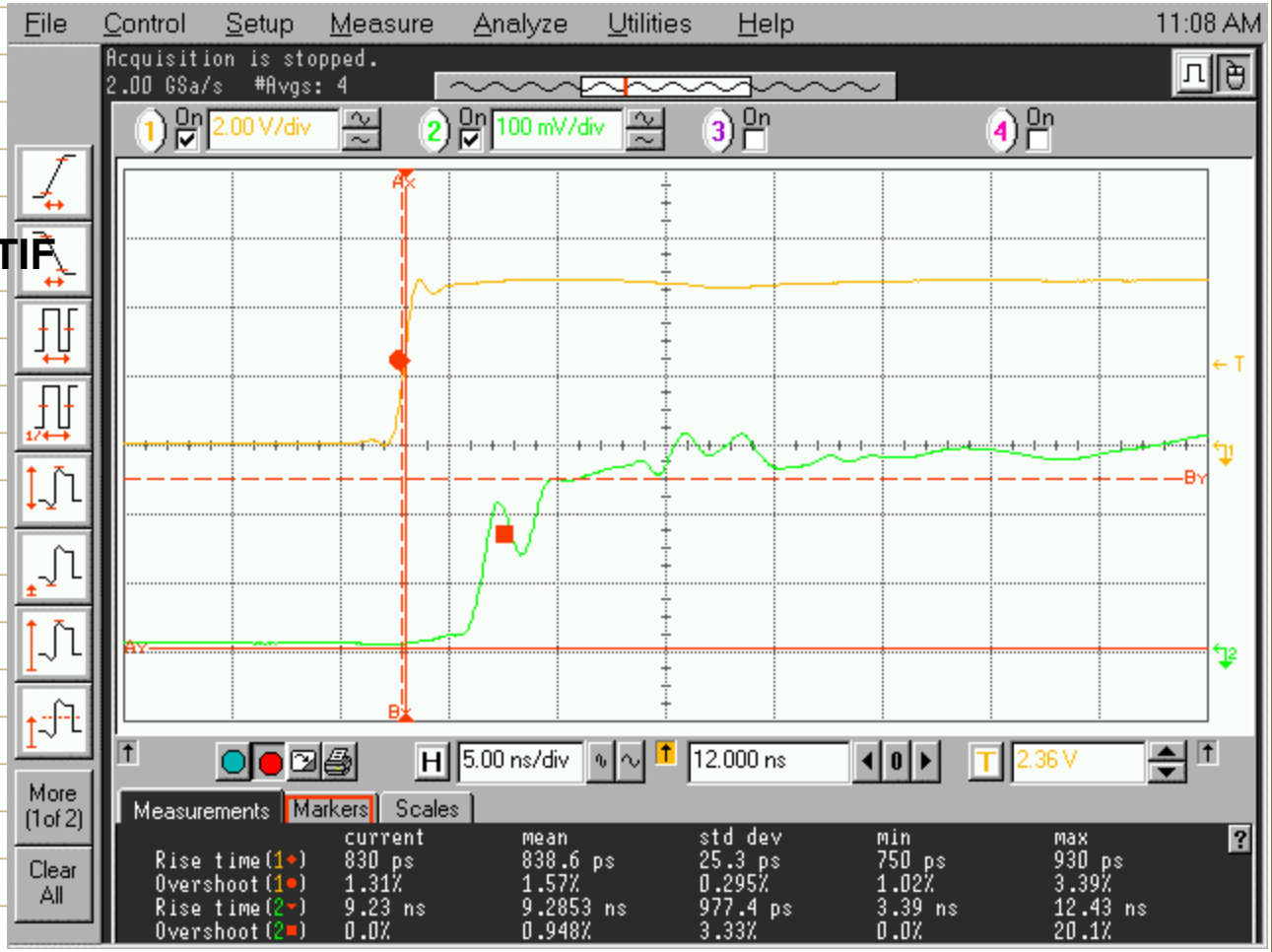
Bicc-Vero VME J2 Backplane

File Name:

BIC2_impB_065.TIF

Trace terminated in 65.3 ohm resistor.

Row B pins 11 (Signal) and 12 (Gnd).



Nasty looking signal, measurements probably not valid. (Tom Z.)

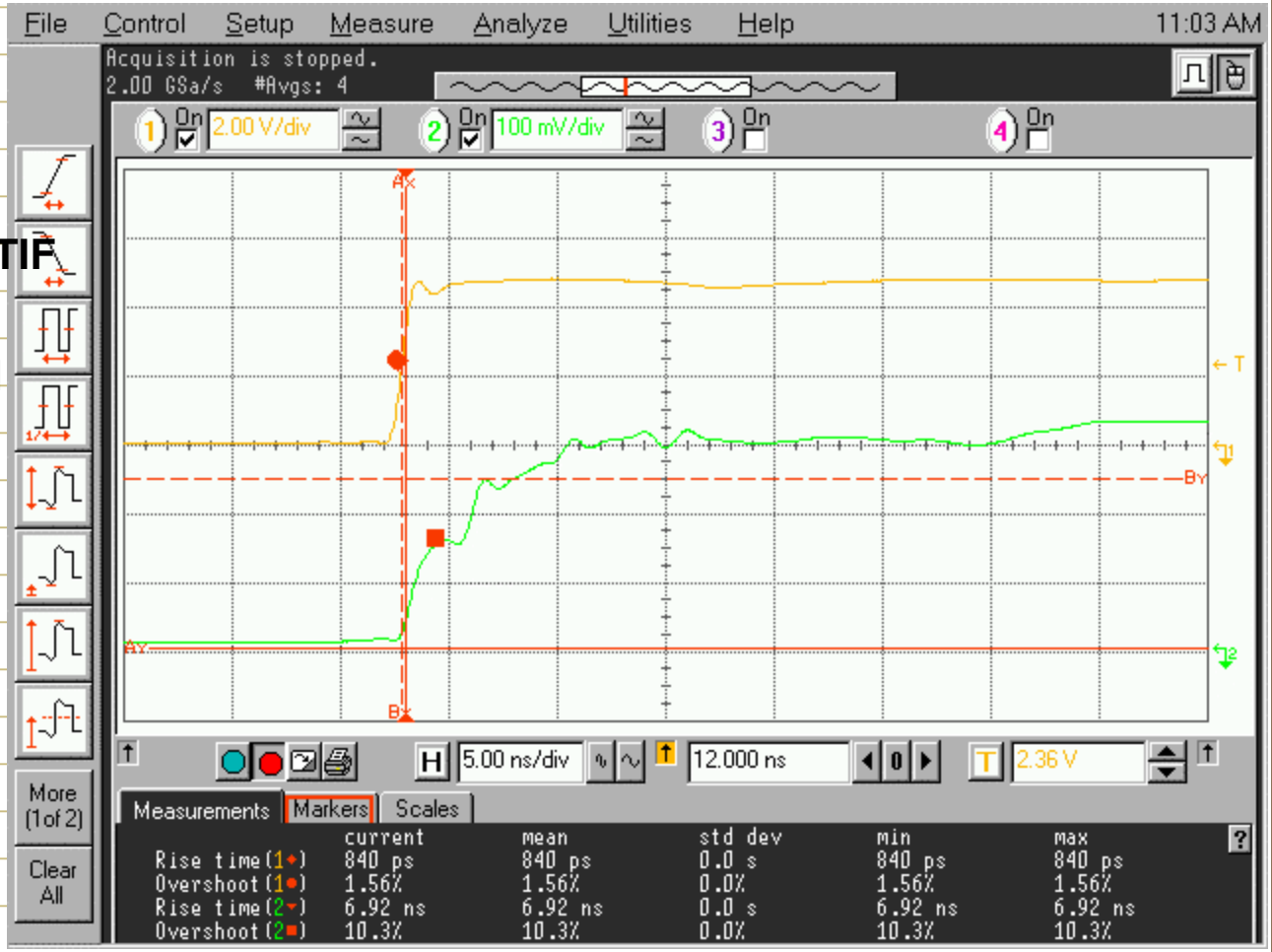
Bicc-Vero VME J2 Backplane

File Name:

BIC2_impB_070.TIF

Trace terminated in 70.2 ohm resistor.

Row B pins 11 (Signal) and 12 (Gnd).



Measurement probably not valid. (Tom Z.) - (18pf cap added)

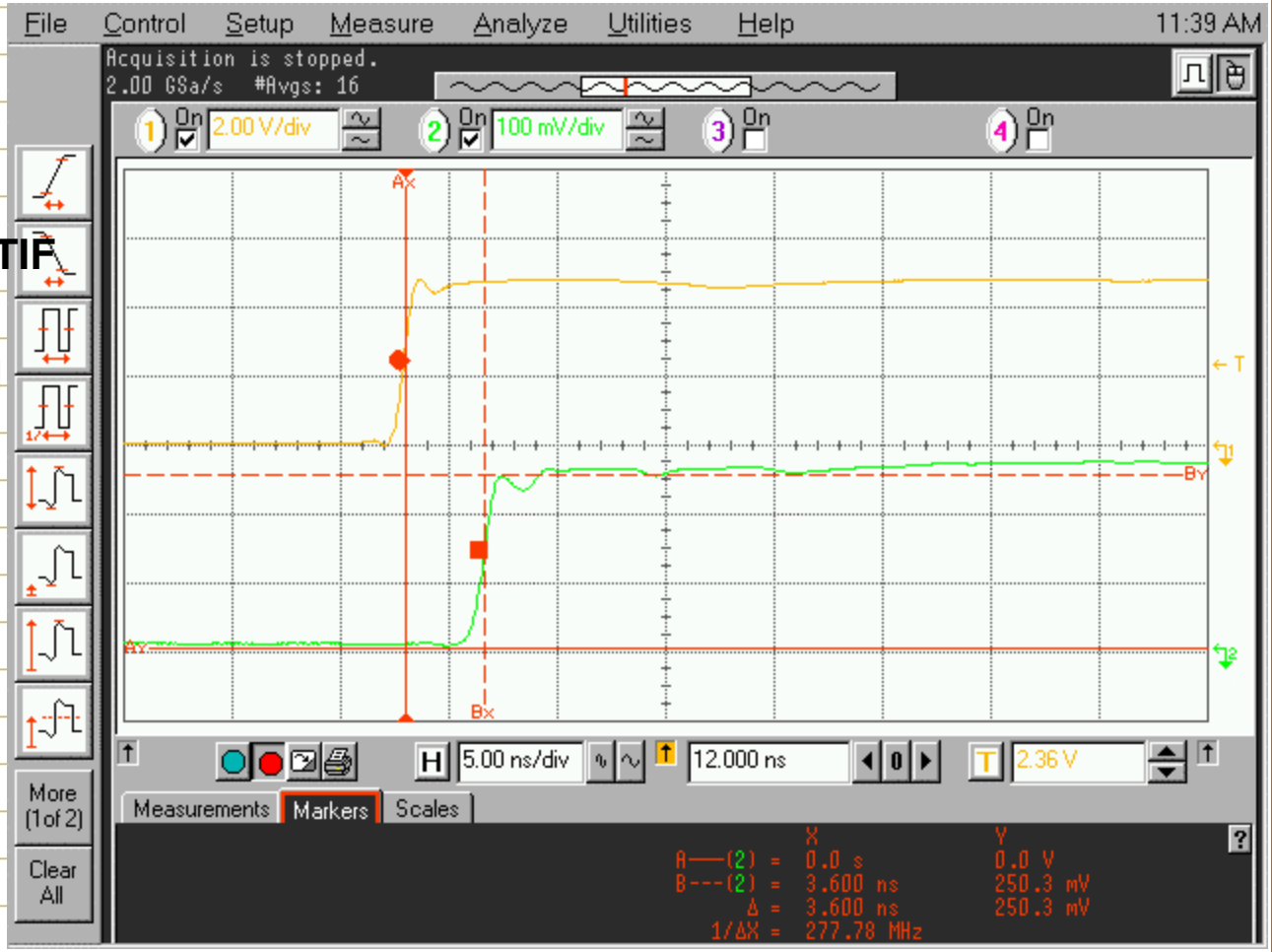
Bicc-Vero VME J1 Backplane

File Name:

BIC1_impA_060.TIF

Trace terminated in 60.4 ohm resistor.

Row A pins 8 (Signal) and 9 (Gnd).



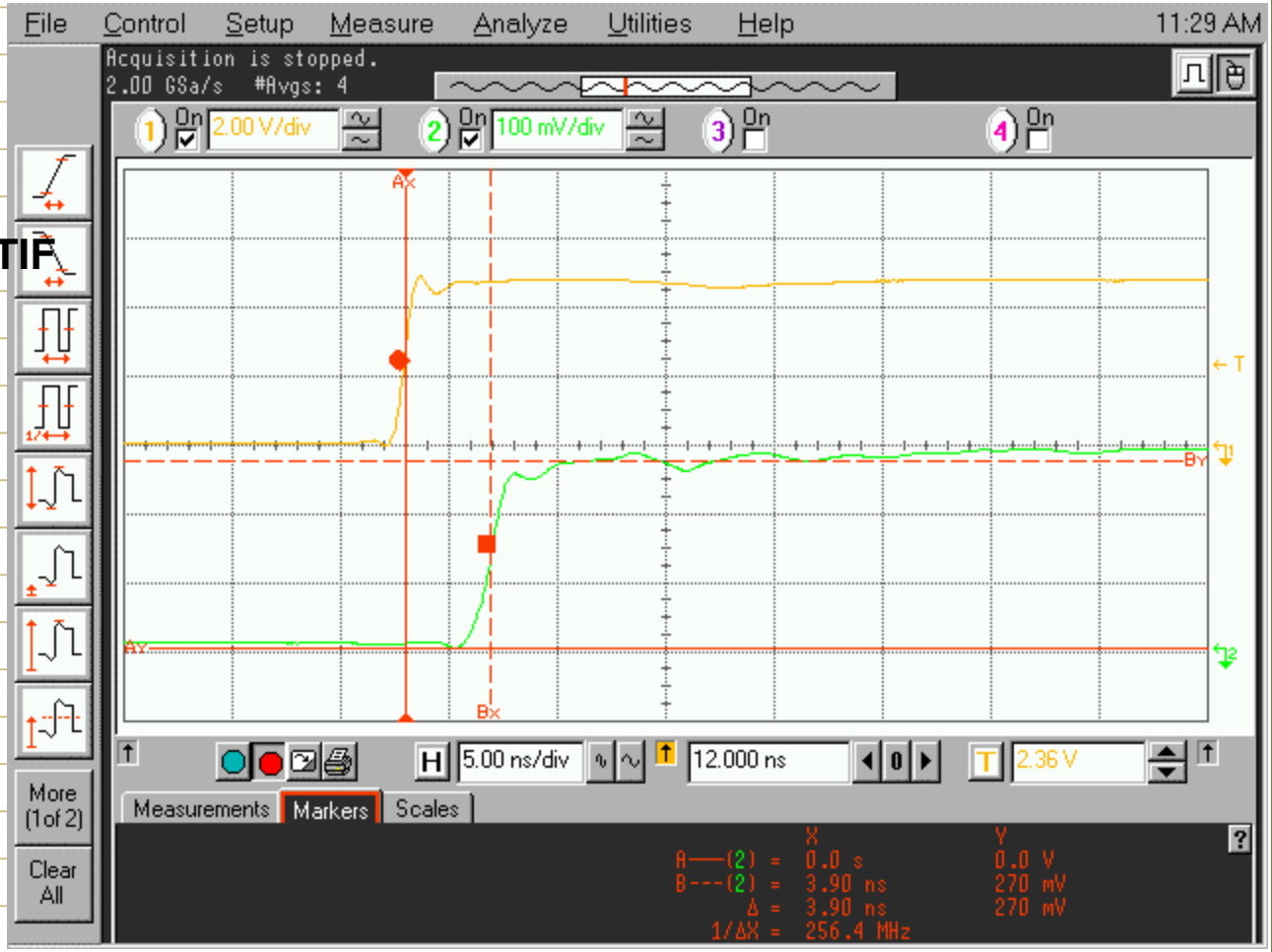
Bicc-Vero VME J1 Backplane

File Name:

BIC1_impB_064.TIF

Trace terminated in 64.4 ohm resistor.

Row B pins 19 (Signal) and 20 (Gnd).



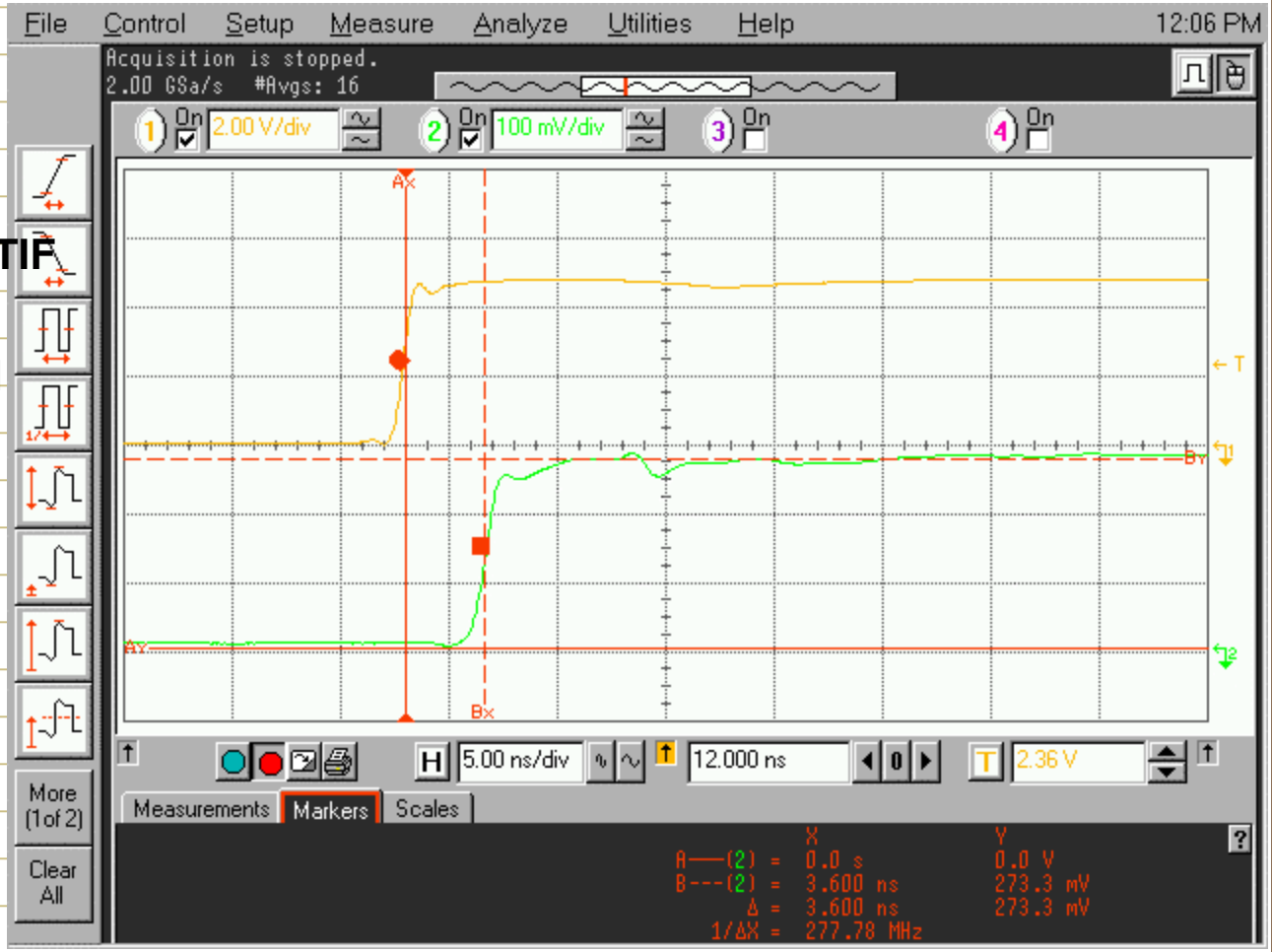
Bicc-Vero VME J1 Backplane

File Name:

BIC1_impC_063.TIF

Trace terminated in 63.4 ohm resistor.

Row C pins 8 (Signal) and 9 (Gnd).



Schroff VME J1 Backplane

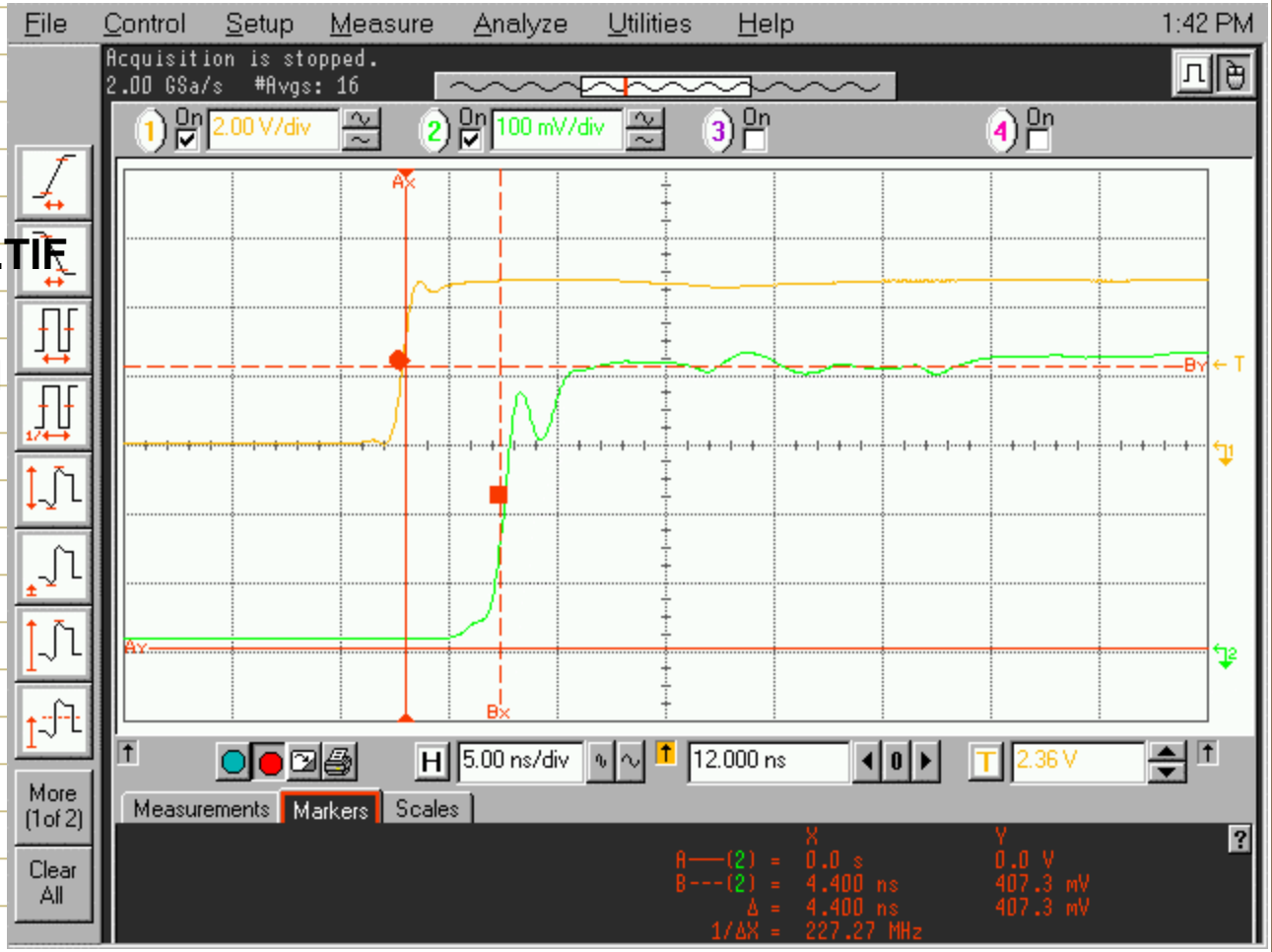
(Older Model, Wire Wrap Length Pins on Connectors)

File Name:

SCF1_impA_098.TIF

Trace terminated in 97.7 ohm resistor.

Row A pins 8 (Signal) and 9 (Gnd).



Schroff VME J1 Backplane

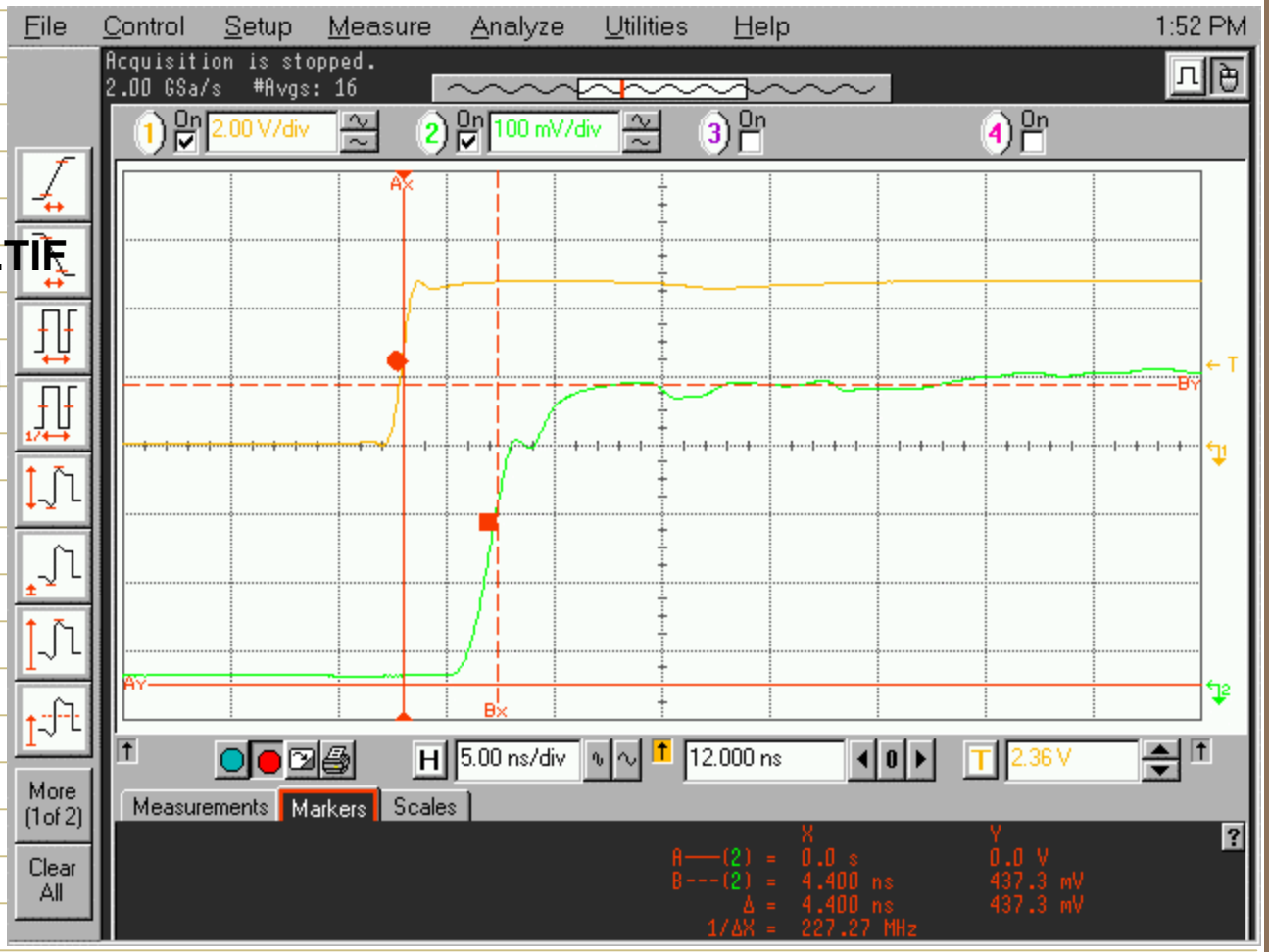
(Older Model, Wire Wrap Length Pins on Connectors)

File Name:

SCF1_impB_106.TIF

Trace terminated in 105.8 ohm resistor.

Row B pins 19 (Signal) and 20 (Gnd).



Schroff VME J1 Backplane

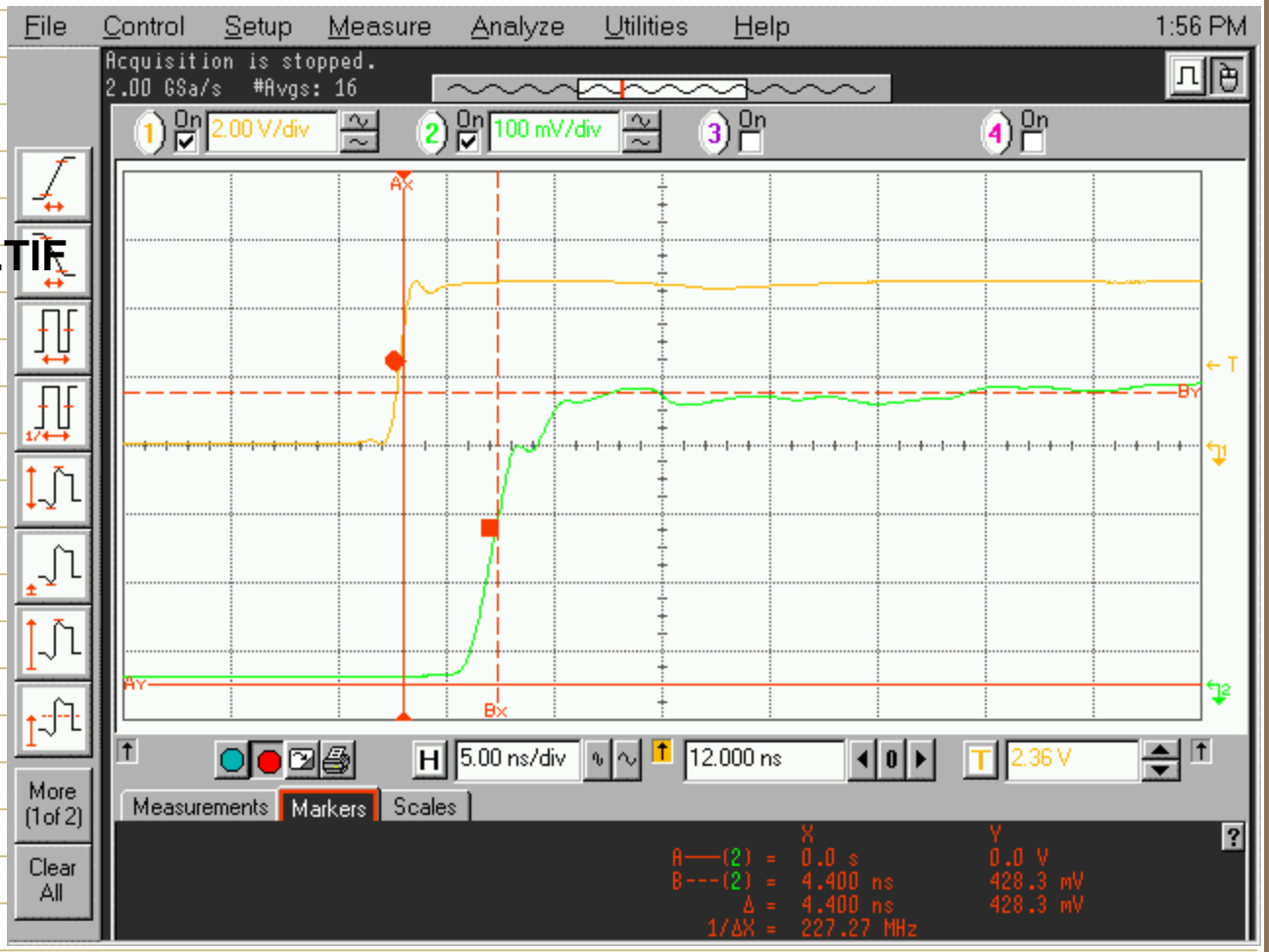
(Older Model, Wire Wrap Length Pins on Connectors)

File Name:

SCF1_impC_100.TIF

Trace terminated in 100.6 ohm resistor.

Row C pins 8 (Signal) and 9 (Gnd).



Schroff VME J1 Backplane

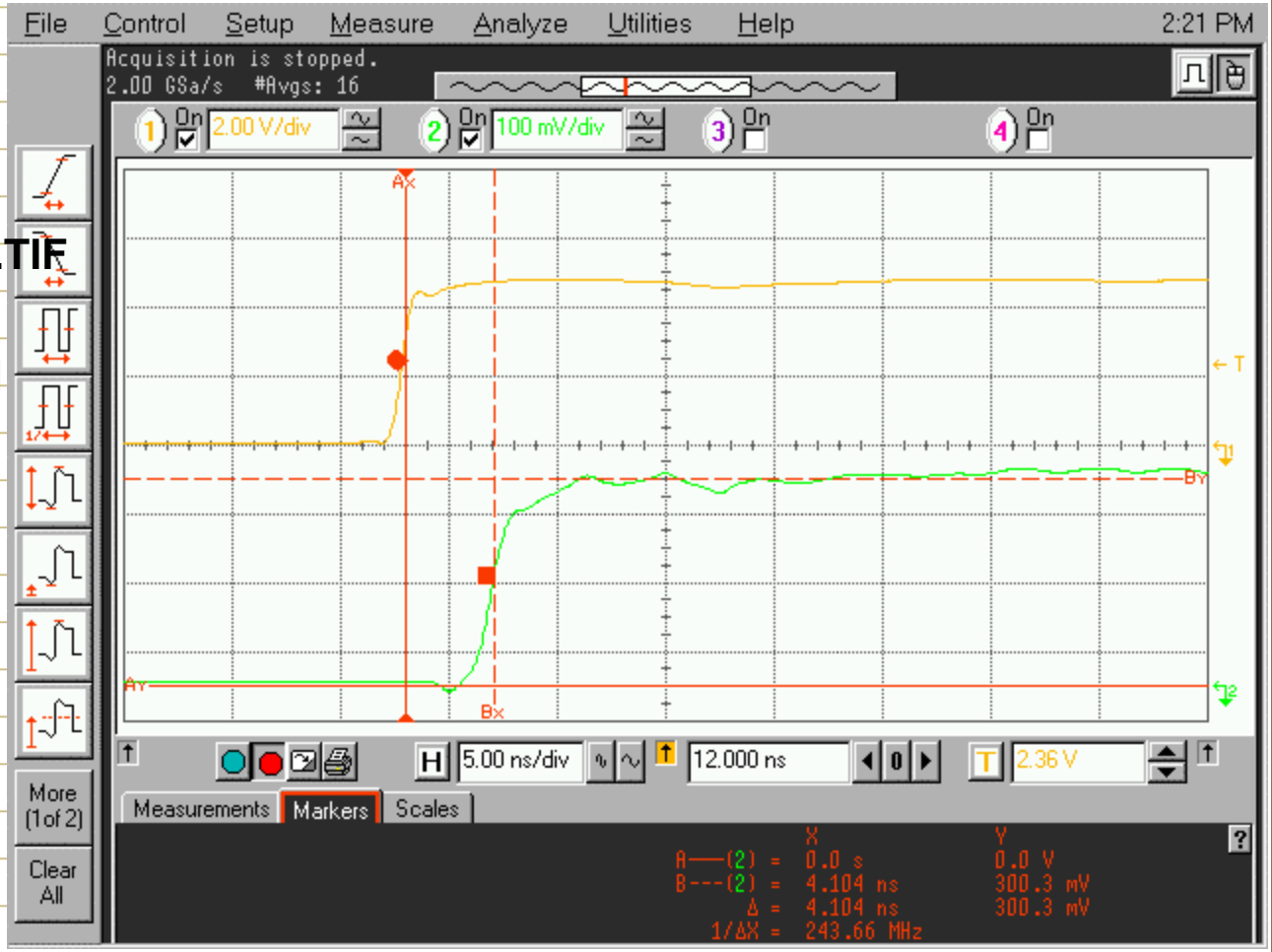
(Model 60800-390, 20-Slots)

File Name:

SHF1_impA_071.TIF

Trace terminated in 71.3 ohm resistor.

Row A pins 8 (Signal) and 9 (Gnd).



Schroff VME J1 Backplane

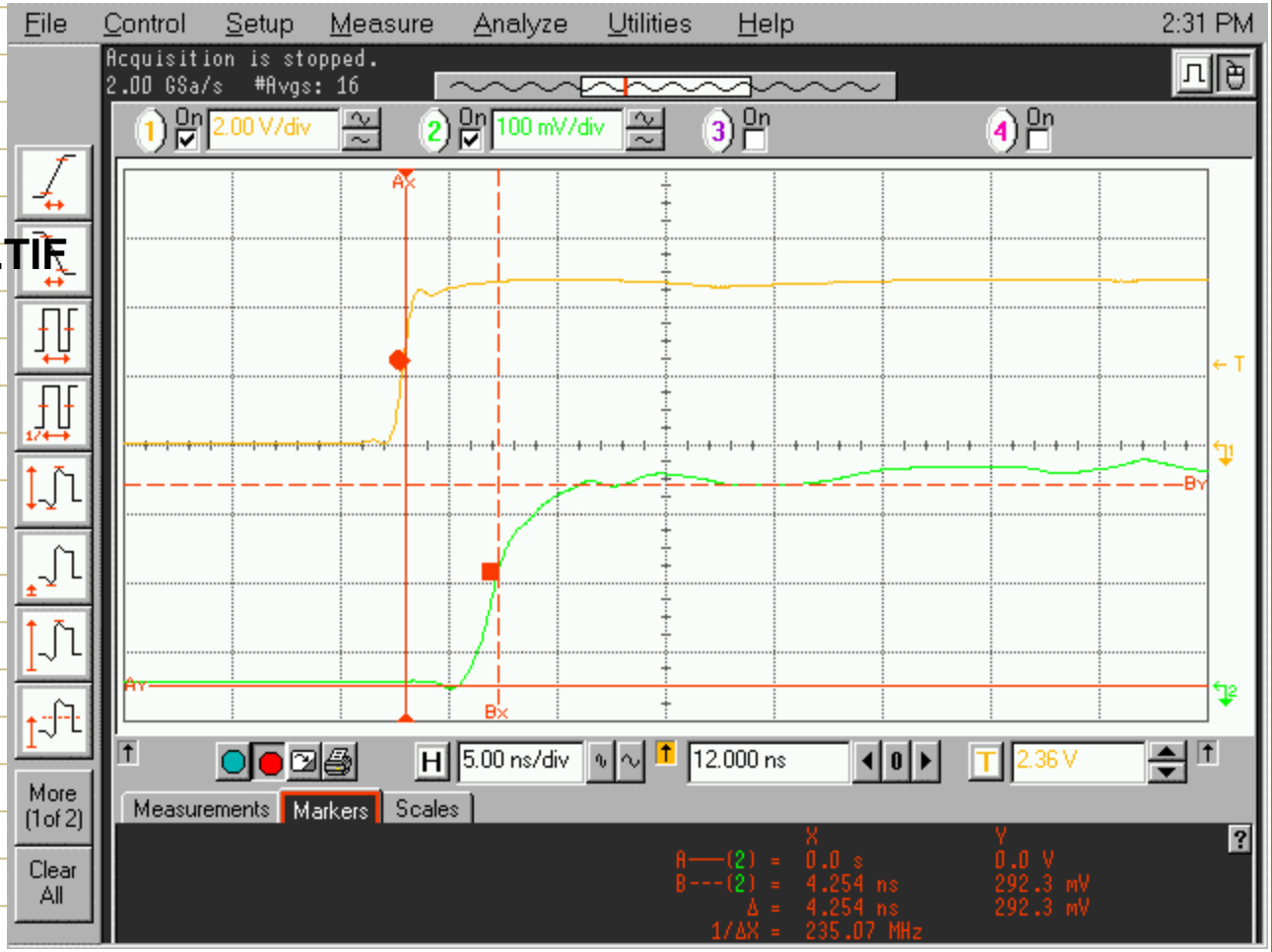
(Model 60800-390, 20-Slots)

File Name:

SHF1_impB_072.TIF

Trace terminated in 72.4 ohm resistor.

Row B pins 19 (Signal) and 20 (Gnd).



Schroff VME J1 Backplane

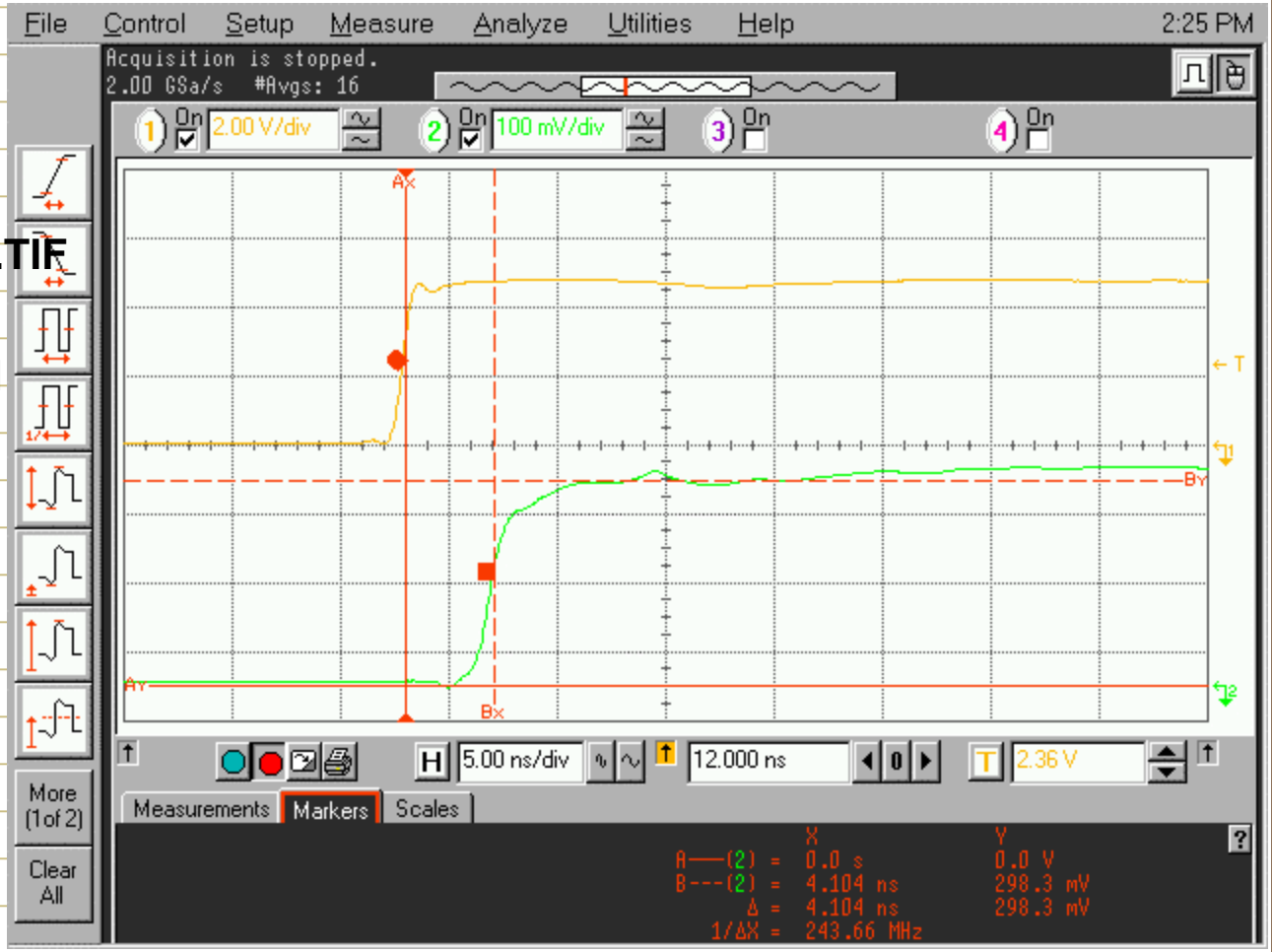
(Model 60800-390, 20-Slots)

File Name:

SHF1_impC_072.TIF

Trace terminated in 72.1 ohm resistor.

Row C pins 8 (Signal) and 9 (Gnd).



Summary, Other Backplanes

- ⇨ Bicc-Vero VME J2 Backplane
- ⇨ Avg. Impedance = ???
- ⇨ Bicc-Vero VME J1 Backplane
- ⇨ Avg. Impedance = 63.1 Ohms
- ⇨ Schroff VME J1 Backplane (Older Model, Wire Wrap Pins)
- ⇨ Avg. Impedance = 101.4 Ohms
- ⇨ Schroff VME J1 Backplane (Model 60800-390, 20-Slot)
- ⇨ Avg. Impedance = 71.9 Ohms

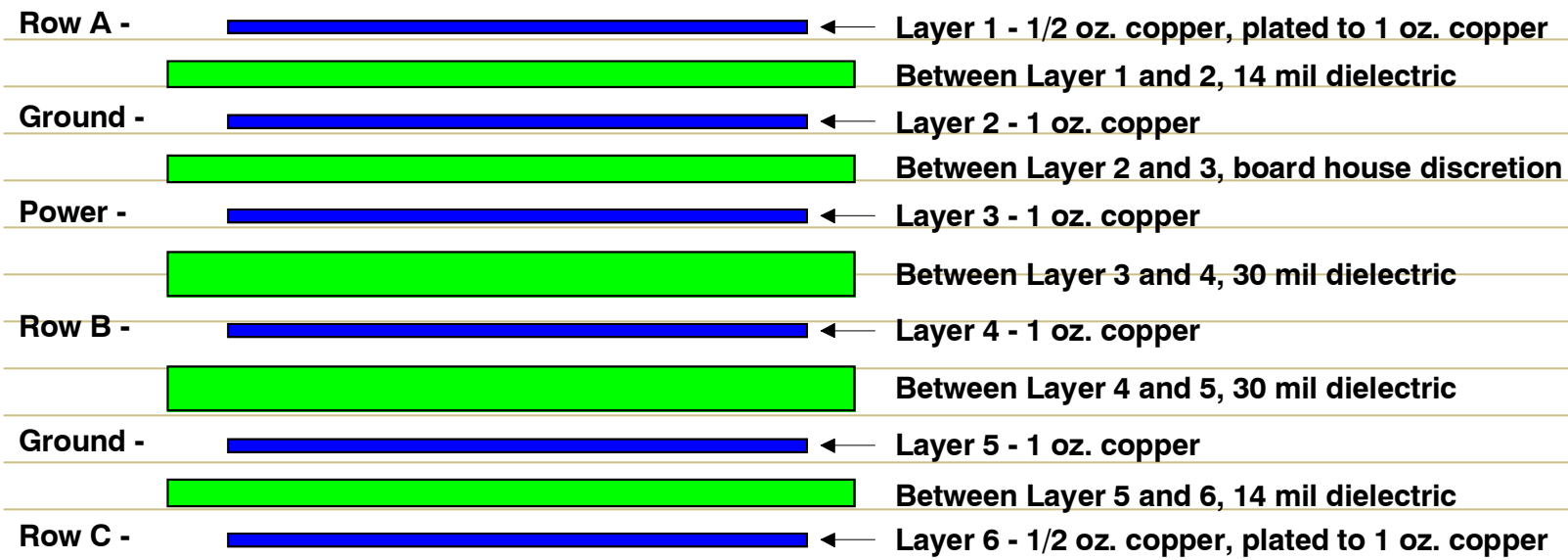
RAD Engineering
BLM VME J2 Backplane

Updated Information for Production Backplanes

February 15, 2005

Production Backplane Layer Stack

- ⇨ Prototype Backplane Trace Impedance was Low
- ⇨ RAD Engineering Proposed Different Layer Stack for Production Backplanes
- ⇨ Still 6 mil trace, Impedance 90 Ohms +\- 10%
- ⇨ Overall thickness the same at 0.125” +\- .005”



Production Backplane Impedance

- The estimated impedance for the old layer stack was approximately, ???
- Estimate Prototype Backplane:
- A & C Rows = 69.7 Ω , B Row = 64.7 Ω
- The estimated impedance for the new layer stack would be approximately, ???
- Estimate Production Backplane:
- A & C Rows = 90.8 Ω , B Row = 79.7 Ω

Production Backplane Impedance

- Measured Impedance of Prototype Backplane:
- Prototype A & C Rows = 56-60 Ohms
- Prototype B Row = 44 Ohms
- If the addition of the ground isolation islands, connectors, etc. lowers the estimated impedance by the same amount as on the two prototypes we should end up with a trace impedance of approximately...
- Production A & C Rows = 77 Ohms
- Production B Row = 60 Ohms