



Alliance Support Partners, Inc.

TERADYNE

Journey of an Instrument NSF

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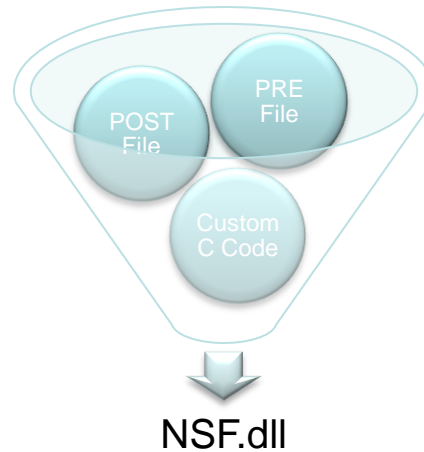
Teradyne Users Group 2009



Introduction

- Alliance Support Partners, Inc. (ASP)
 - Located in Northern California
 - A proud member of Teradyne Support Network since 2004
 - Delivered over 200 TPS on S9 platform since then
- The Project
 - Rehost from L200 to S9 Platform using TPSCS
 - Two NSFs - Timer Counter (TIMEMS) and IEEE
 - 5 New Non-Standard Instruments
 - VM2164 Timer Counter
 - Amrel DC Power Supply (IEEE)
 - Behlman AC Power Supply (IEEE)
 - NI Synchro / Resolver (IEEE)



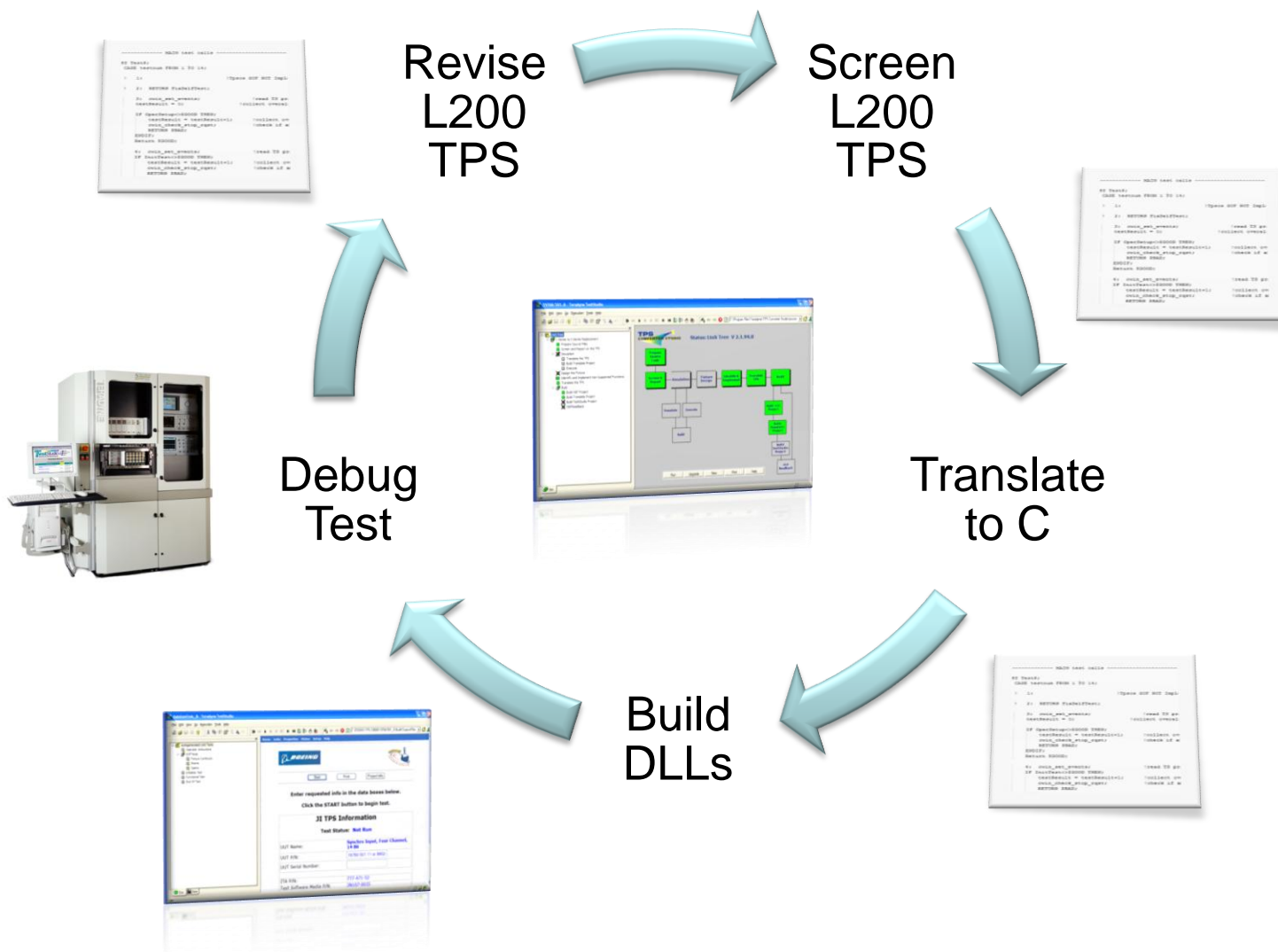


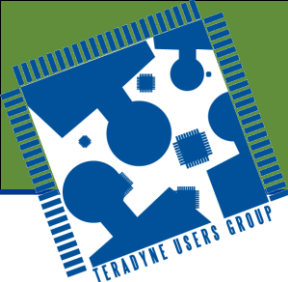
Using the Timer Counter NSF to take a closer look at how to create and test an NSF in Converter Studio

NSF - THE CREATION



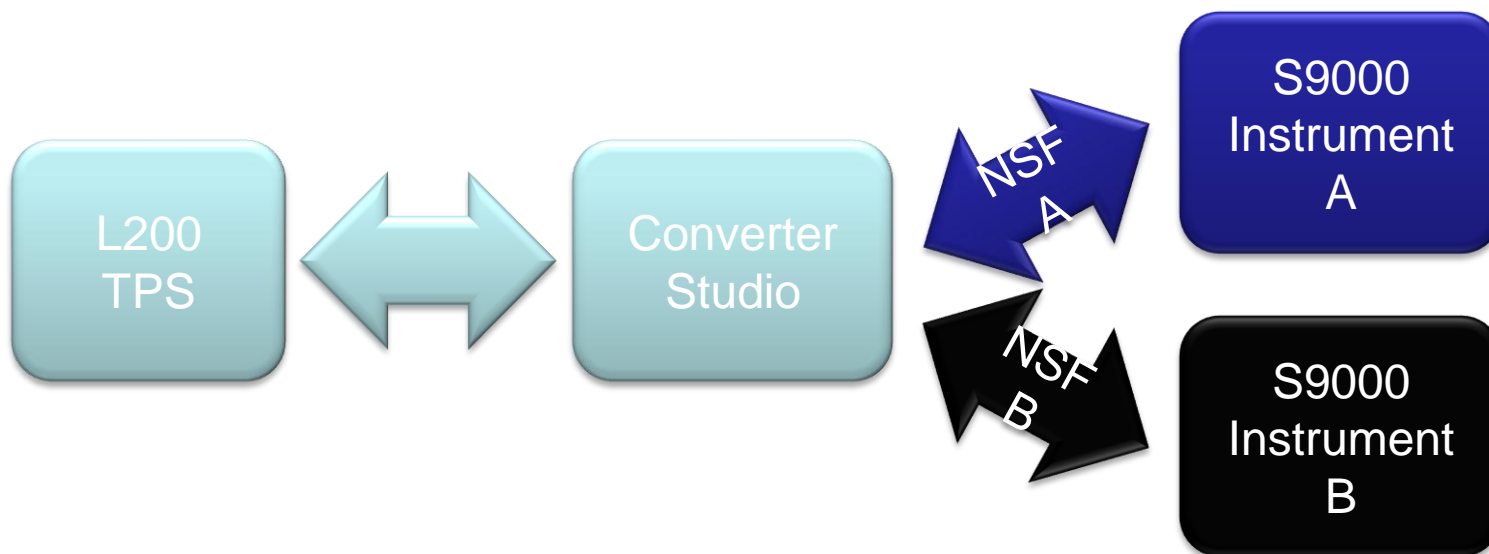
Converter Studio Process

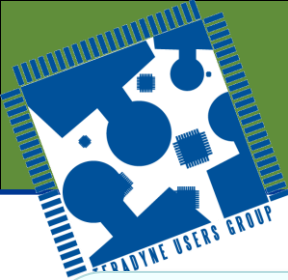




Instrument Interchangeability

- Allows instrument interchangeability without changing L200 TPS code
- Instrument NSF
 - Maintains Traceability
 - Reduces Complexity of Re-hosting





NSF Architecture in Converter Studio

Call appropriate function in Custom Code; **created by NSF Developer**

Communicates with specific instrument; **Created by NSF Developer**

Converter Studio

PRE / POST Code

Custom Code

Instrument

Implements the L200 NSF function call; is called when TPS is run; Created by Converter Studio by compiling Pre, Post, and Custom Code

NSF.dll

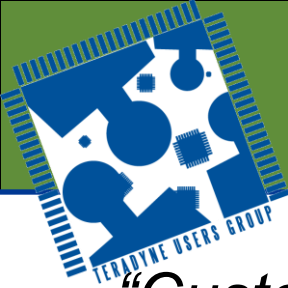
NSF CUSTOM IMPLEMENTATION FOLDER

C:\FODMS\TPS-S9000\TIMERCOUNTER_TESTBENCH\Identify

Browse...

NON-SUPPORTED FUNCTIONS LIST (☒)

FUNCTION NAME	CATEGORY	IMPLEMENTATIONS
NSFReset	USER	USR_NsfReset
NSFTestLevelClose	USER	USR_NsfTestLevelClose
NSFTestLevelInit	USER	USR_NsfTestLevelInit
NSFTPSLevelClose	USER	TER_SpectrumClose
NSFTPSLevelInit	USER	TER_SpectrumInit
read_dcpower	MISC_HW	TER_hpe66000
read_meter	ANALOG_HW	TER_hpe1412
read_timems	MISC_HW	USR_vtvm2164
set_dcpower	MISC_HW	TER_hpe66000
set_dcv	ANALOG_HW	TER_ke240x
set_meter	ANALOG_HW	TER_hpe1412
set_timems	MISC_HW	USR_vtvm2164
test_timems	MISC_HW	none
TOTAL FUNCTIONS		none
		TER_hpe1420
		USR_vtvm2164



Timer Counter NSF

“Customer needs to utilize the L200 PRECOUNT keywords and instrument capability which is not supported by standard S9000 configuration.”

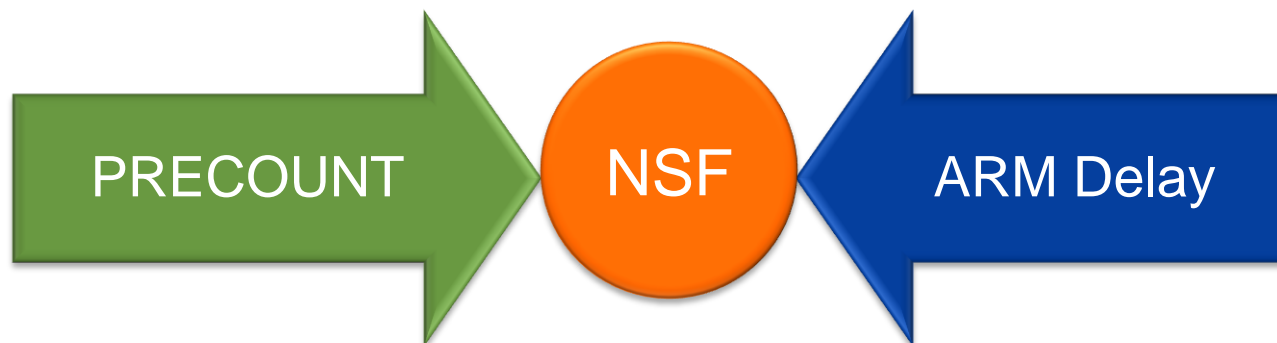
Agilent E1420

- 200 MHz Frequency
- 9-digit Resolution
- 2 ns (200 ps w/ averaging)



VTI VM2164

- 200 MHz Frequency
- 9-digit Resolution
- 1 nS (100 ps w/ averaging)
- 200 Readings per Second
- **Arm Delay (PRECOUNT)**





Writing Counter Timer NSF

- SET TIMEMS
 - Configures the Timer Counter Instrument
- READ TIMEMS
 - Reads the Timer Counter Measurement
- PRECOUNT
 - Option in SET TIMEMS
 - Provides delay after Counter Arm Condition



Integrate Into Converter Studio



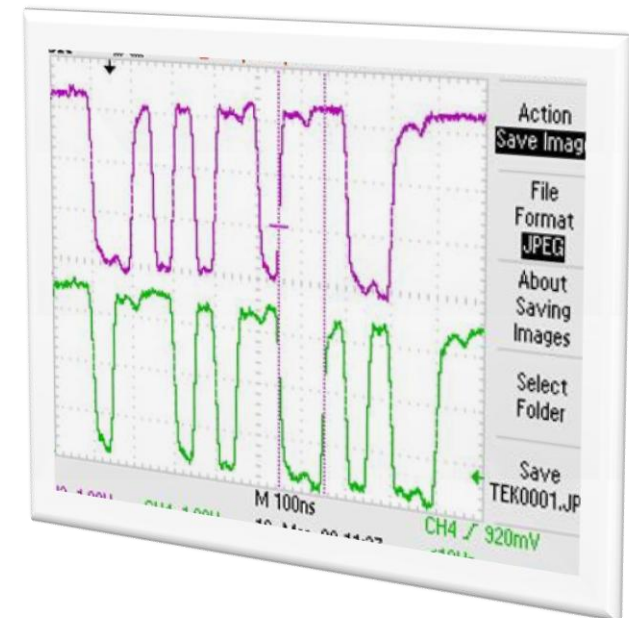
Setup: Build NSF Project

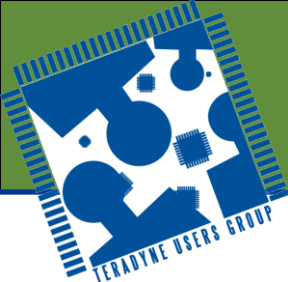
DIRECTORIES, FILES, OPTIONS SELECTION	
PROJECT ADE TYPE	<input type="radio"/> VC++ Project (VC++ 6.0) <input type="radio"/> .Net Project (VC++ 7.0) <input checked="" type="radio"/> CVI Project
SOURCE CODE DIRECTORY	C:\FODMS\TPS-S9000\19760-501_JI\Identify_Implement
SOURCE FILES	<div>C Source Files</div> <div>CShellANALOG_HW.c CShellIEEE.c CShellMISC_HW.c CShellNewError.c CShellNewUtil.c CShellUSER.c</div>
	<div>Header Files</div> <div>CShellNew.def CShellNew.h CShellNewError.h CShellNewGlobals.h CShellNewOutput.h Version.h</div>
BUILD OPTION	<input checked="" type="radio"/> Release Mode <input type="radio"/> Debug Mode
PROJECT LOCATION	C:\FODMS\TPS-S9000\19760-501_JI\Build\Build_NSF_Project Browse...
PROJECT NAME	NSF_JI
NSF BUILD FOLDERS SELECTION (<input type="checkbox"/>)	
ADDITIONAL FOLDERS AND FILES SELECTION (<input checked="" type="checkbox"/>)	
ADDITIONAL INCLUDE DIRECTORIES	\USR_Vtvm2164 Browse...
ADDITIONAL LINKED LIBRARIES	\USR_Vtvm2164\USR_Vtvm2164.lib Browse...
ADDITIONAL SOURCE FILES	Browse...
<div>OK Cancel Apply Print Help</div>	



Testing and Debugging NSF

- NI Spy Capture
 - Verifies high level calls generate correct low level instrument commands
- Simultaneous Scope on Timer Counter Inputs
 - Verifies correct signal input
- L200 Test Bench
 - Written entirely in L200 Code
 - Use M9 and SCPM
 - No test fixture required





Reflections on Development Process

- Implementing NSF in DLL was very helpful
 - Debugging
 - Updating NSF w/o reconverting project
- Using existing NSF as template not efficient
 - Differences between old and new instrument
 - Traceability not as important as expected
- Test bench written in L200 has advantages
 - Verifies Custom Code
 - Verifies Pre / Post Code
 - Verifies the way in which functions are called



Resolving issues that arise integrating NSF and new instruments
Into customer application.

NSF – SPEED BUMPS



Real World Issues

- Now that the NSF is written and “working” how does it fare when we run the converted TPS?
- Issues Encountered with Timer Counter
 - Order of Operations Issue
 - Counter Overflow Issue
 - Precount Issue
 - Signal Quality Issue



Order of Operations Issue

- **Problem:** Instrument unexpectedly loses configuration
- **Root Cause:** Order of commands sent to instrument
- **Solution:** Send commands in correct order
- **Complicating Issues:**
 - Misunderstanding of documentation
 - No feedback from instrument



Overflow Issue

- **Problem:** measurements periodically return incorrect results
- **Root Cause:** Instrument HW Bug
- **Solution:** Fix in SW by initializing twice
- **Complicating Factors**
 - Occurs infrequently
 - No test case that covered this scenario



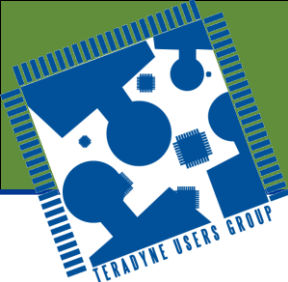
PRECOUNT Issue

- **Problem:** TIMEMS measurements using the PRECOUNT option returning unstable results
- **Root Cause:** Instrument not meeting spec
- **Solution:** Vendor to ECO instrument
- **Complicating Factors**
 - No test case to verify instrument meeting spec
 - Difficult to verify instrument configured properly



Signal Integrity Issue

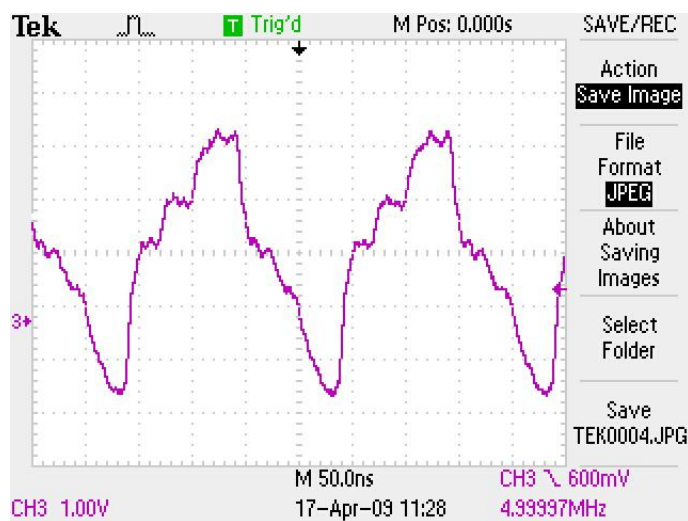
- **Problem:** Readings fail and vary across systems
- **Root Cause:** Impedance mismatching causes signal reflection though SCPM
 - L200 has a digital switch matrix
 - S9000 has an analog switch matrix
- **Complicating Issues:**
 - Requires external signal analysis w/ Scope
 - Trial and error



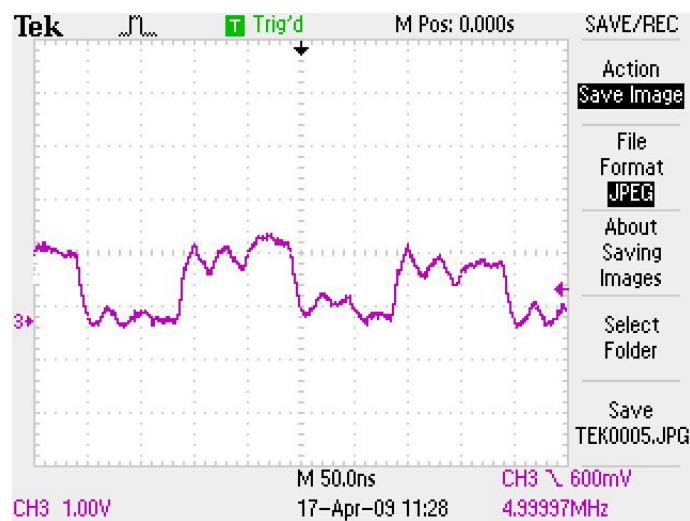
Signal Integrity Solution - 50 Ω Input

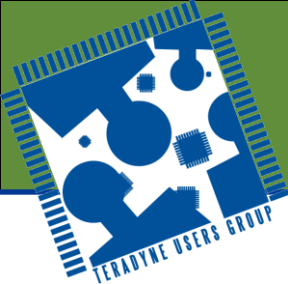
- NSF Keyword: "SOURCE EXT50"
- Use 50 Ω Input Impedance on Counter Timer
- Cleans Up Signal, But Loads it Down

Without 50 Ohm Input Impedance



With 50Ohm Input Impedance



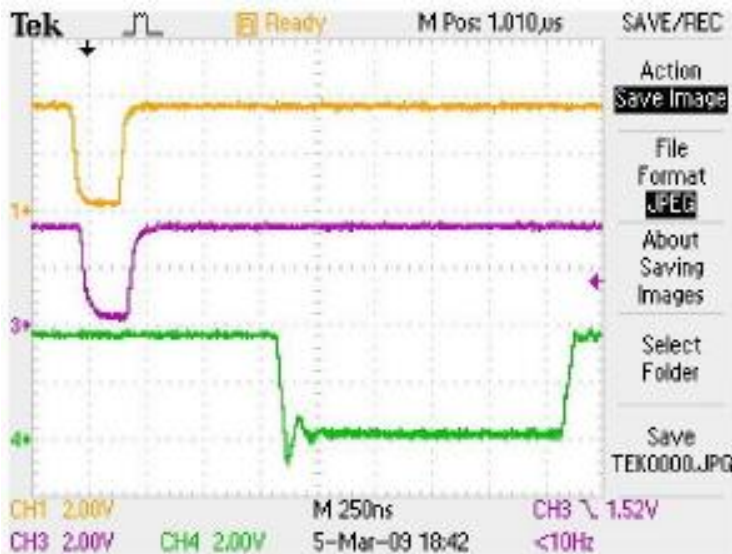


Ideal Solution – Signal Buffer

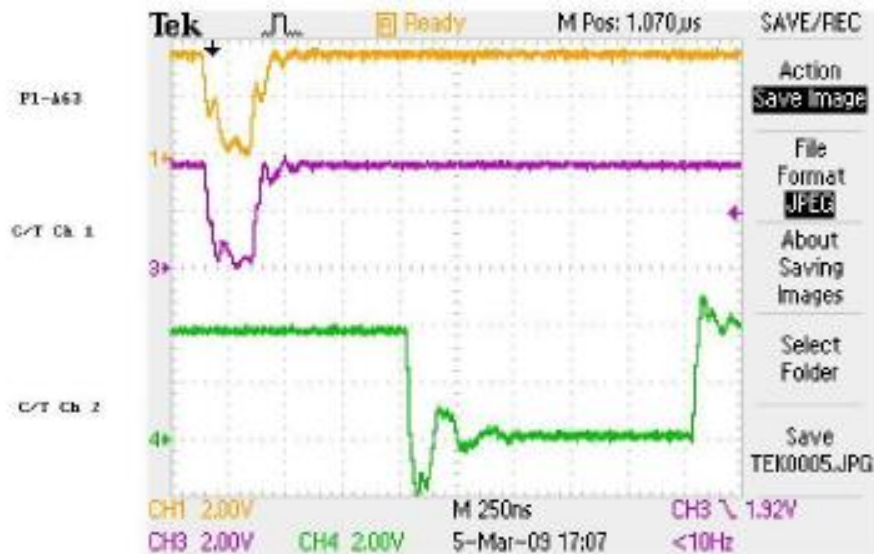
- Custom Buffering in Fixture OR
- Off the Shelf Signal Buffer Matrix



With ASP Analog Signal Buffer (SBX36)



Original Signal (No Buffering)

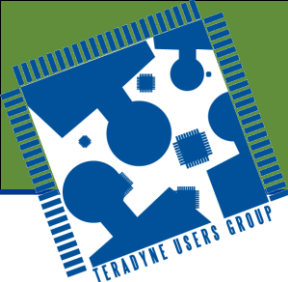




IEEE NSF

- Amrel DC Power Supply
 - Negative Voltage Programming Issue
 - SLOW Ramp Up Issue
 - No Response Issue
- NAI Synchro-Resolver
 - Instrument Not Functioning





Enhance Existing NSF

- Add on to existing NSFs for debugging
- For example:
 - Enhance SET JUMPER to include debug print of TxConnections

A screenshot of a Windows-style window titled "ConsoleWin". The window has a blue title bar with standard minimize, maximize, and close buttons. The main area is a text field with a light beige background, displaying the following text:

```
THE SPEC LIMITS ARE:      -100.00000  TO      100.00000 MICROAMPS
Disconnecting Jumper 1|0
Disconnecting Jumper 2|0
Connecting Jumper 1|0 - Pin /A6 to /LOAD2_2 (/19790-501_DCO/Configuration/VXI Test Syste
Connecting Jumper 2|0 - Pin /LOAD2_1 to /C7 (/19790-501_DCO/Configuration/VXI Test Syste
Disconnecting Jumper 1|0
Disconnecting Jumper 2|0
PAR 3.4.11:  BITE TEST
PASSED FTS PAR 3.4.11.1:
      PIN P1-A73 IS IN LOGIC HI STATE
LIMITS ARE FROM 2.5 VOLTS TO 5.25 VOLTS
Connecting Jumper 3|0 - Pin /J1P35 to /GND_PIN (/19790-501_DCO/Configuration/VXI Test Sy
```

The text is wrapped and matches the content of the adjacent code block. The window includes a horizontal scrollbar at the bottom.

```
THE SPEC LIMITS ARE:      -100.00000  TO      100.00000 MICROAMPS
Disconnecting Jumper 1|0
Disconnecting Jumper 2|0
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LIMITS ARE FROM 2.5 VOLTS TO 5.25 VOLTS
Connecting Jumper 3|0 - Pin /J1P35 to /GND_PIN (/19790-501_DCO/Configuration/VXI Test Sy
```



“Some people will never learn anything because they understand everything too soon.”

Alexander Pope (1688 – 1744)

To that extent, we certainly learned a lot from this project.

NSF – LOOKING BACK





Lessons Learned

- Writing a good Instrument NSF is a lot of work!
 - Requires a lot of coding and attention to details
 - Requires developing rigorous test cases
 - Requires significant amount of hardware integration work
- Hardware may not behave the same even if it is claimed to be compatible
- Hardware may not work per its datasheet
- Analog Switching is a big problem for signal quality



Q & A

