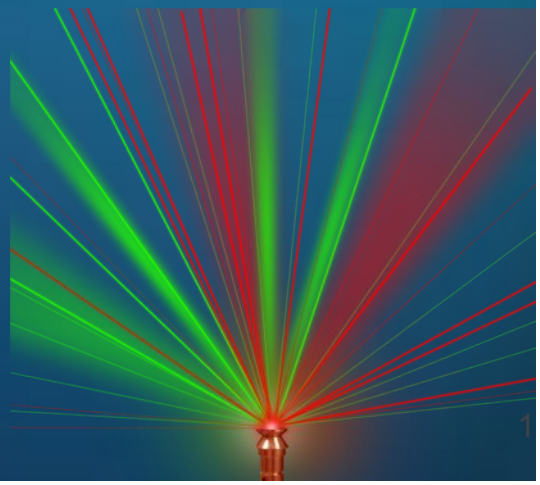
Tektronix

Enhancements in Real-Time Multi-Channel Detection Capability

2018 PDV CONFERENCE



Agenda

- Introduction
- Newest Generation Tek Acquisition Technology
- High/Ultra Performance O/E
- De-embedding Channel Effects

Newest Generation Acquisition Technology

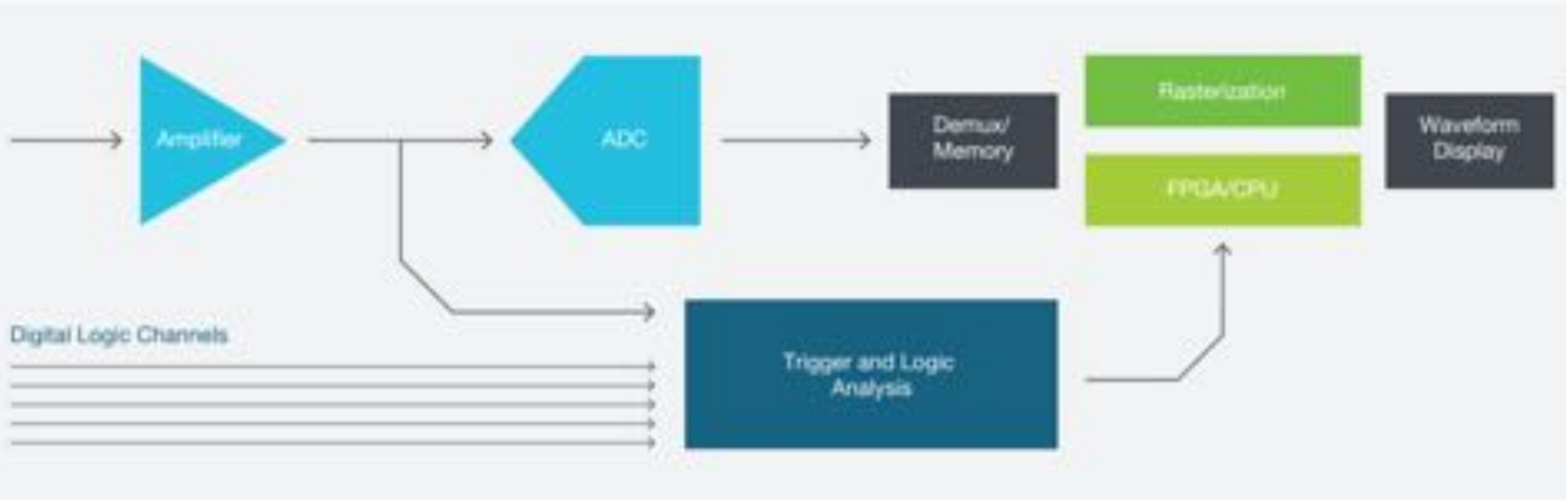
5 Series MSO and Low Profile

TWO FORM FACTORS, SAME GREAT PERFORMANCE

Same high performance 12-bit oscilloscope, same programmatic command set making it easy to transition from bench to system applications

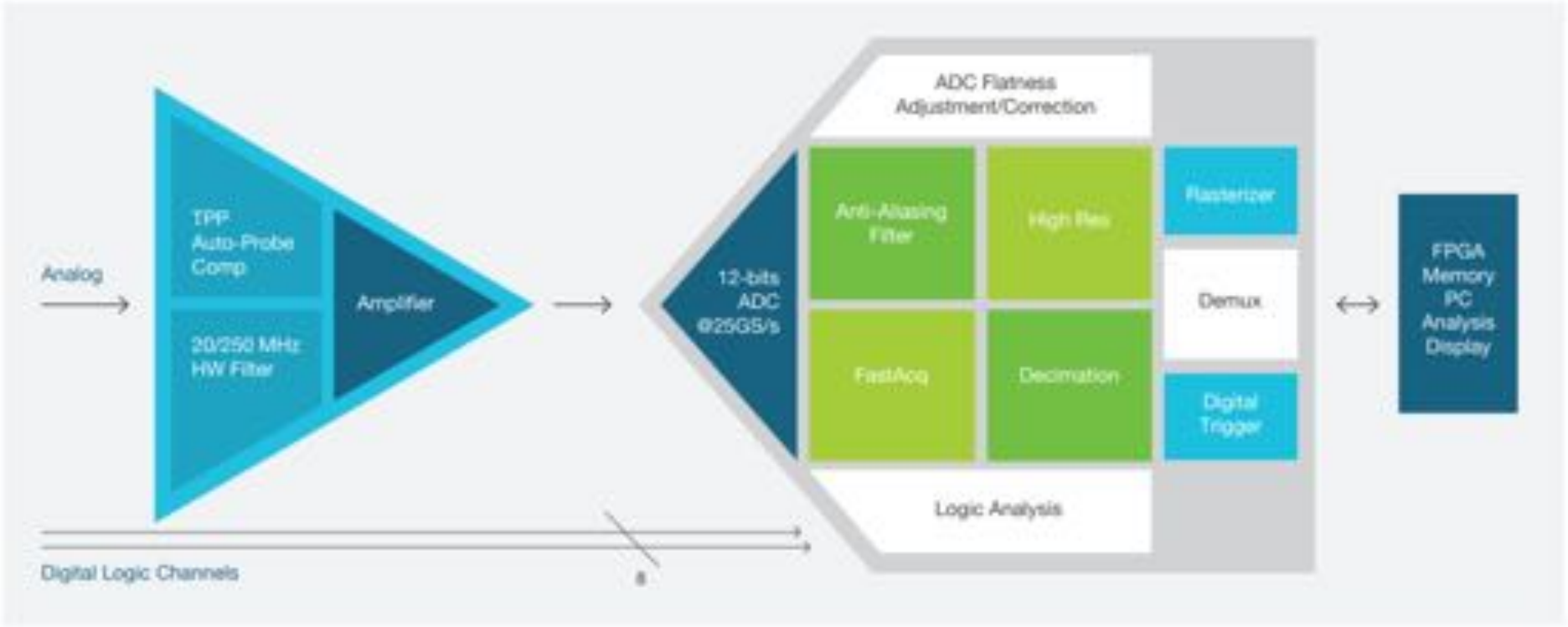
Signal Integrity

CONVENTIONAL OSCILLOSCOPE ARCHITECTURE



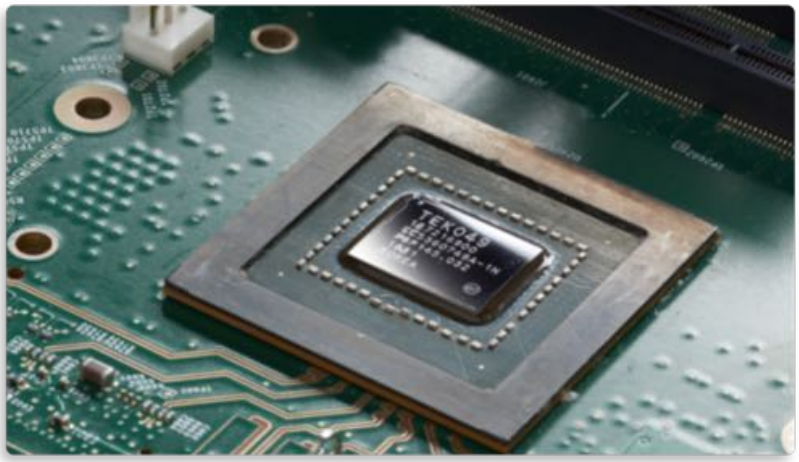
Improved Signal Integrity

NEW TEKTRONIX SIGNAL PATH



Improved Signal Integrity

NEW CUSTOM TEKTRONIX ASIC TECHNOLOGY

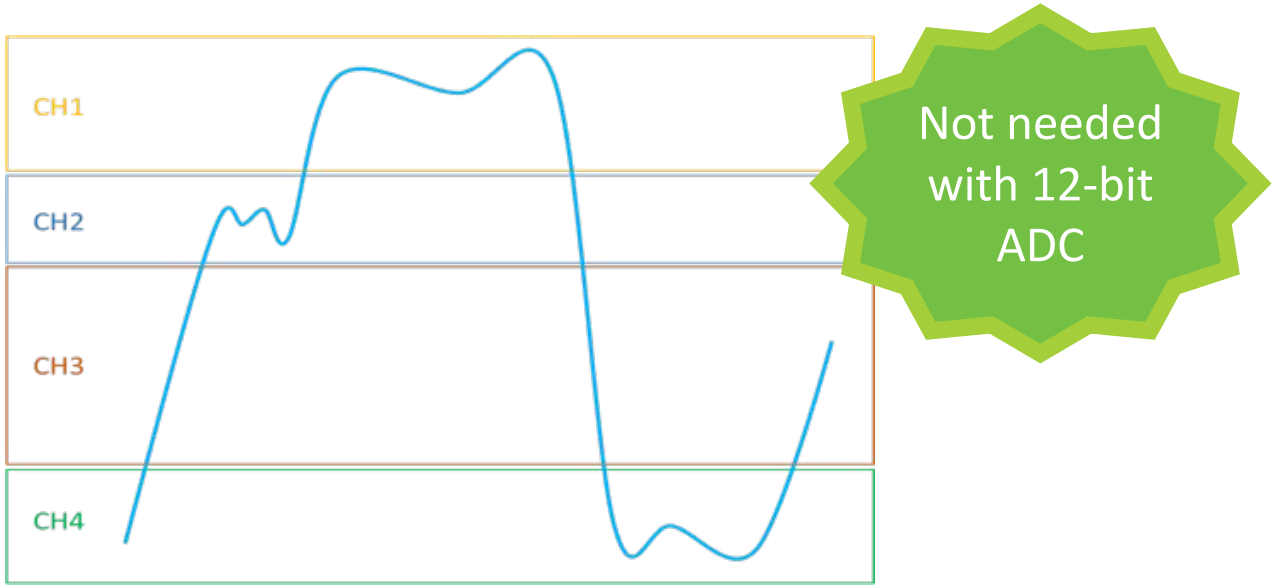


- New Custom Tektronix ASIC
- 25GS/s Sample Rate per chip
  6.25GS/s per FlexChannel™ input
- 12-bit Analog to Digital Convertor (ADC)
  - 4,096 digitizing levels 16x More Resolution over 8-bit ADCs
- Advanced Integration in one chip
  - Trigger Circuitry *New Digital Trigger*
  - FlexChannels (can be one analog channel or 8 digital channel)
  - Demux

Signal Integrity

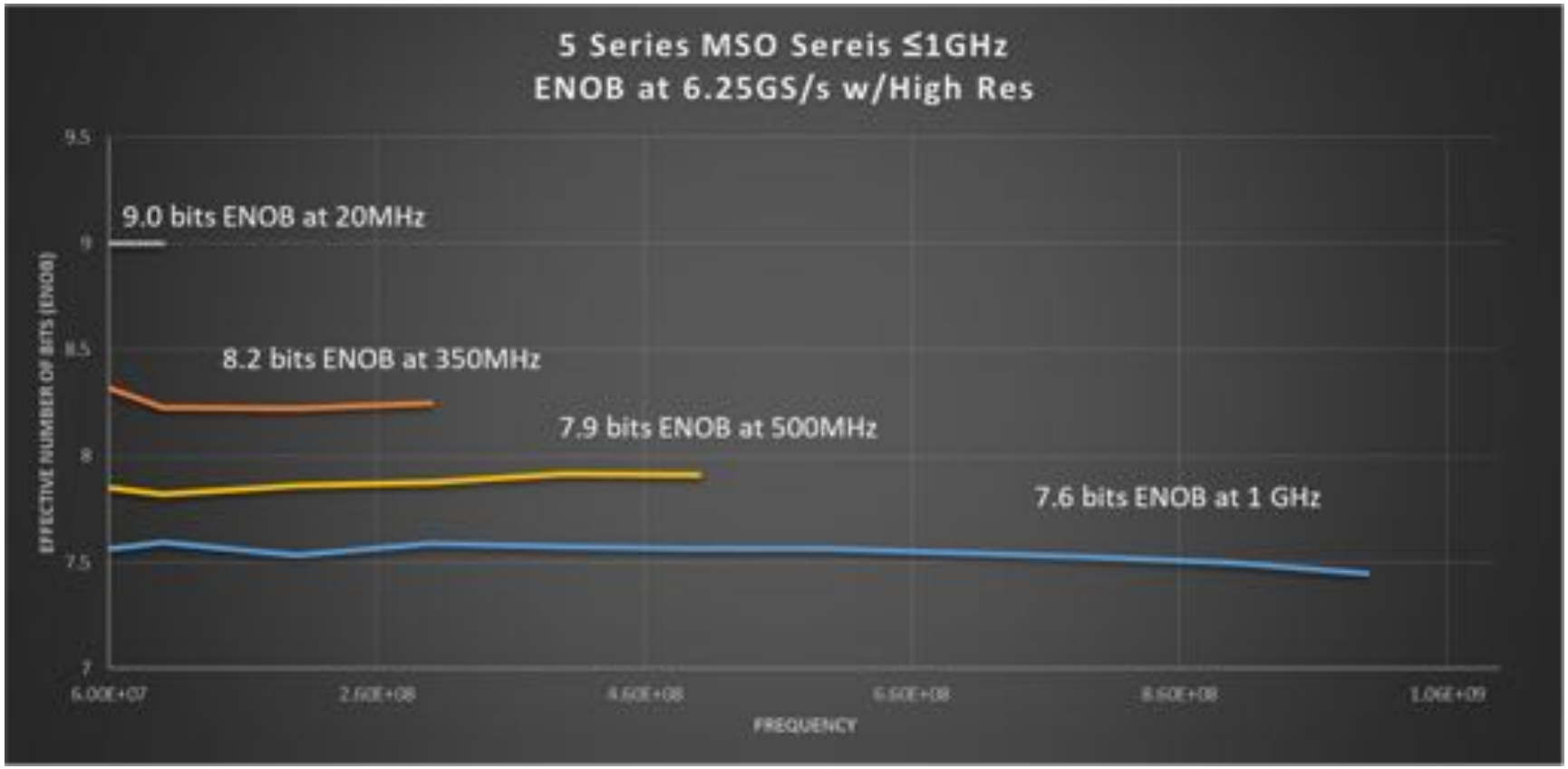
WHY PEOPLE STITCH SIGNALS TOGETHER

- To view small signals riding on large signals, you need high dynamic range. Traditional 8-bit scopes don't have enough, so users will often break up the signal into multiple channels.
- Using 4+ channels to capture a single signal, using different gain/ offset/ position and overdriving the input, they capture then combine the data and 'stitch' it back together



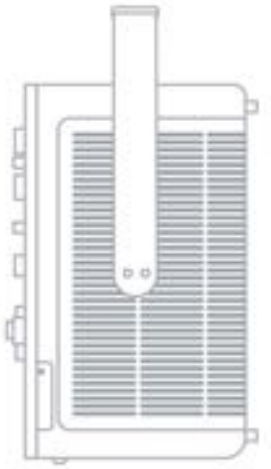
Signal Integrity

DRIVES IMPROVEMENTS IN EFFECTIVE NUMBER OF BITS (ENOB)



Signal Integrity

IMPROVED HORIZONTAL TIME BASE



- Clock is more accurate, designed from the Tektronix 70K-SX Series
- *Improves* Effective Number of Bits (ENOB)
- *Improves* Delta Time Accuracy (DTA)
- *Improves* Trigger functionality
- *6x Better* Sample Jitter (aperture uncertainty)
  - MSO/DPO5000B: 3ps
  - 5 Series MSO: <450fs

Extreme Channel Density

5 SERIES MSO LOW PROFILE

5 Series MSO Low Profile	MSO58LP
Bandwidth	1 GHz
Maximum Analog Channels / Digital Channels	8 Analog / 64 (op. in blocks of 8)
Sample Rate (all Analog or Digital)	6.25 GS/s
Standard Record Length (all A&D ch.)	125 Mpts
Waveform Capture Rate	> 500,000 wfms/s
ADC Resolution	12 bits
Effective Number of Bits (ENOB)	7.6 bits @ 1 GHz with High Res
Aux Trig Input	±5 Vrms, 50Ω SMA
Arbitrary/Function Generator	Up to 50 MHz (opt.)
Operating System	Closed Linux
System Programming Integration Tools	MATLAB, NI LabVIEW, IVI-C, IVI-COM, LXI, Python and more
Remote Access	Easy Internet Browser Access
Dimensions (Height)	3.44 inches (2U Rack)

The 5 Series MSO low profile provides best combination of channel density, performance, and cost per channel providing deeper insights in less space

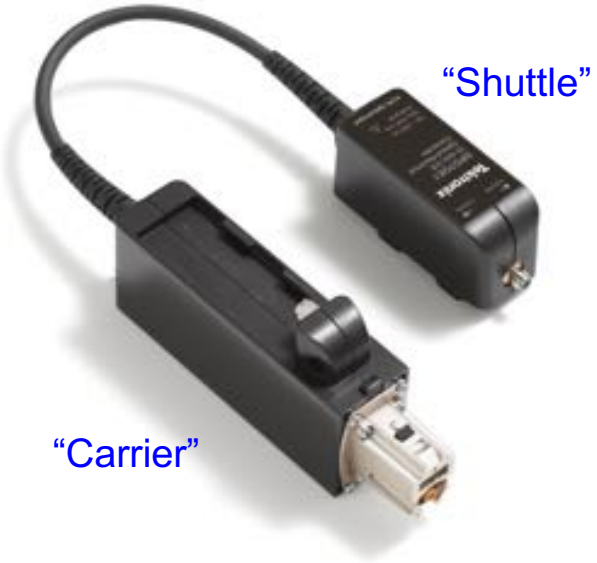
High / Ultra Performance O/E

Calibrated O/E

DPO7OE1 AND DPO7OE2

- Broad wavelength O/E 750nm – 1650nm
- 33GHz/59GHz electrical bandwidth
- Single mode, multi-mode,
- Compatible with TekConnect and ATI inputs
- Use with DPO/MSO70kC/D/DX and DPO70kSX models

TekConnect – 33 GHz O/E



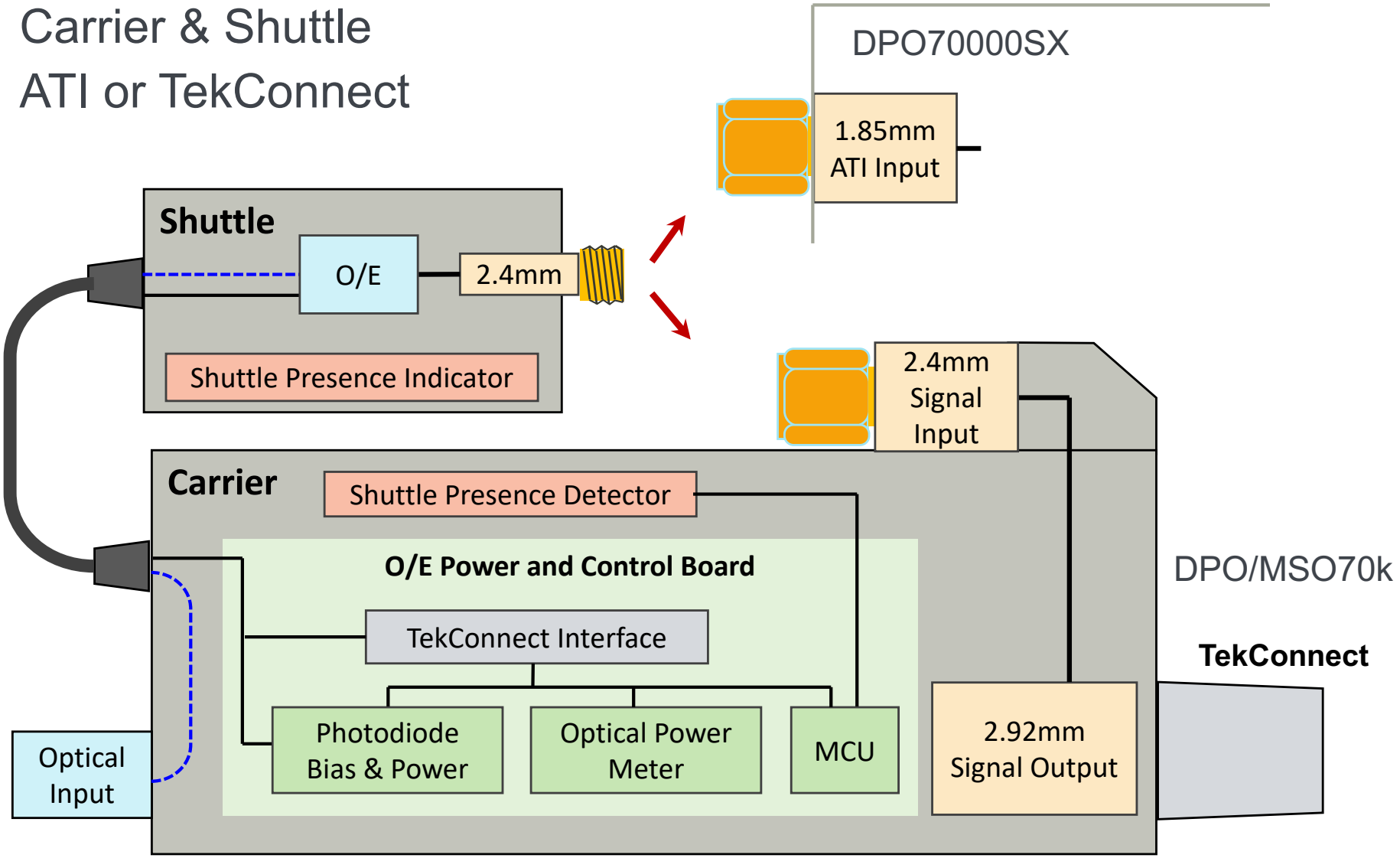
ATI – Mechanical support deck

O/E Key Specs

Feature / Function	DPO7OE1		DPO7OE2	
Connector Type	FC/PC & FC/APC		FC/PC & FC/APC	
Input Fiber Type and Diameter	FC/PC: 50 µm (SMF and MMF compatible) FC/APC: 9 µm (SMF compatible)		FC/PC: 9 µm (SMF compatible) FC/APC: 9 µm (SMF compatible)	
Wavelength Range	750 nm – 1650 nm (Opt FC/PC) 1260 nm – 1650 nm (Opt FC/APC)		1200 nm to 1650 nm (Opt FC/PC) 1200 nm to 1650 nm (Opt FC/APC)	
Calibrated Wavelengths	850 nm, 1310 nm, 1550 nm (Opt FC/PC) 1310 nm, 1550 nm (Opt FC/APC)		1310 nm, 1550 nm (Opt FC/PC) 1310 nm, 1550 nm (Opt FC/APC)	
Electrical Bandwidth	33GHz		59GHz	
Coupling	DC		DC	
Risetime (10-90%, typical)	10.2ps		8ps	
RMS Optical Noise (1310 nm)	Typical	Max	Typical	Max
Raw O/E Response - (TekConnect / ATI)	7.42uW / 9.31uW	8.83uW / 9.93uW	11uW / 16uW	13uW / 18uW
Flat to 33Ghz Response - (TekConnect / ATI)	10.6uW / 9.84uW	12.71uW / 12.31uW	11uW / 16uW	13uW / 18uW
Max Input Power - typical (linear / non-destruct)	4 mW / 8 mW		2mW / 4mW	
Operating Temperature	10^0C to 40^0C		10^0C to 40^0C	

DPO7OE1 Block Diagram

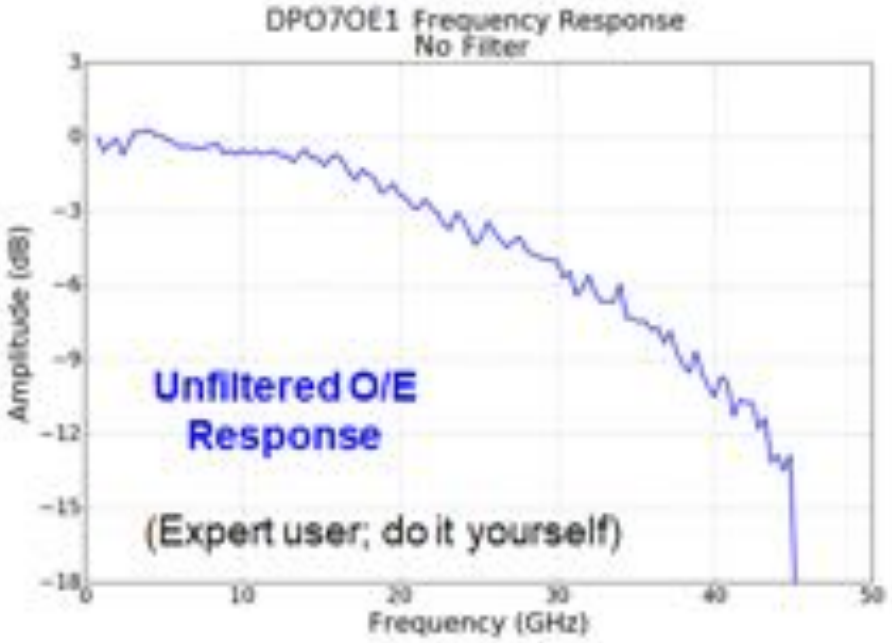
- Carrier & Shuttle
- ATI or TekConnect

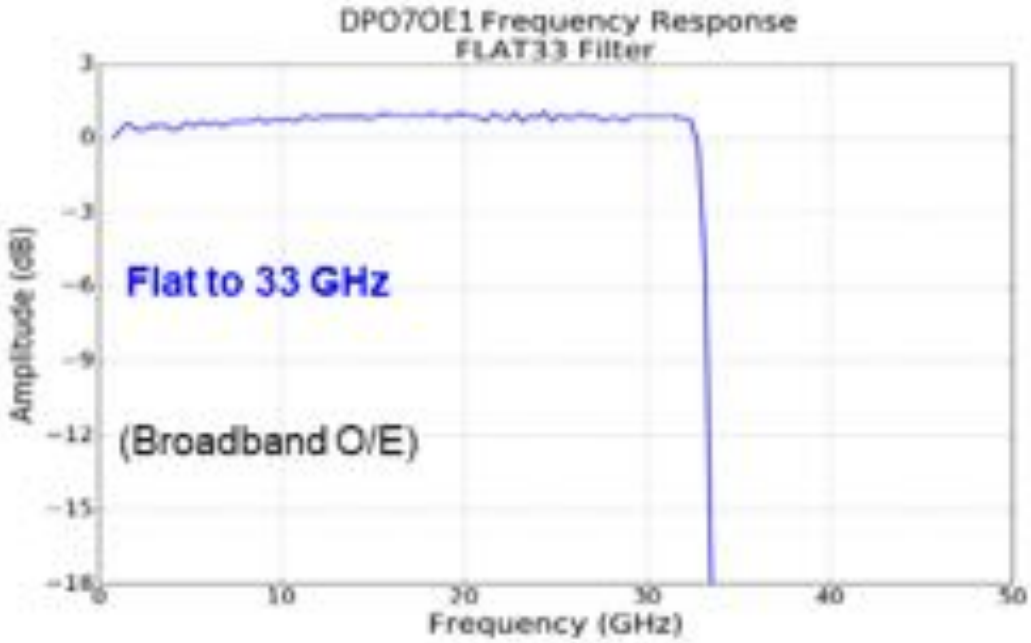


DPO7OE1 – Frequency Response Selection

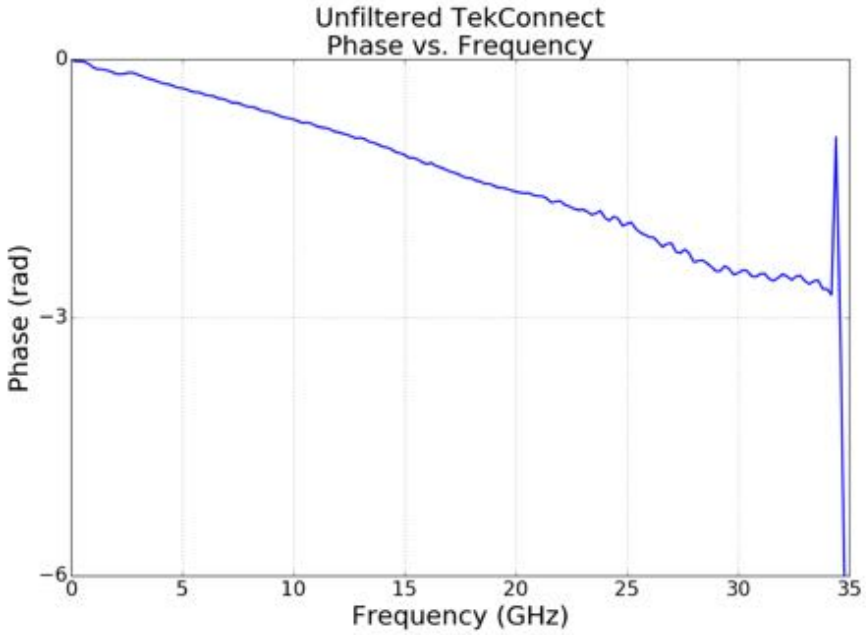
SELECTABLE FILTER

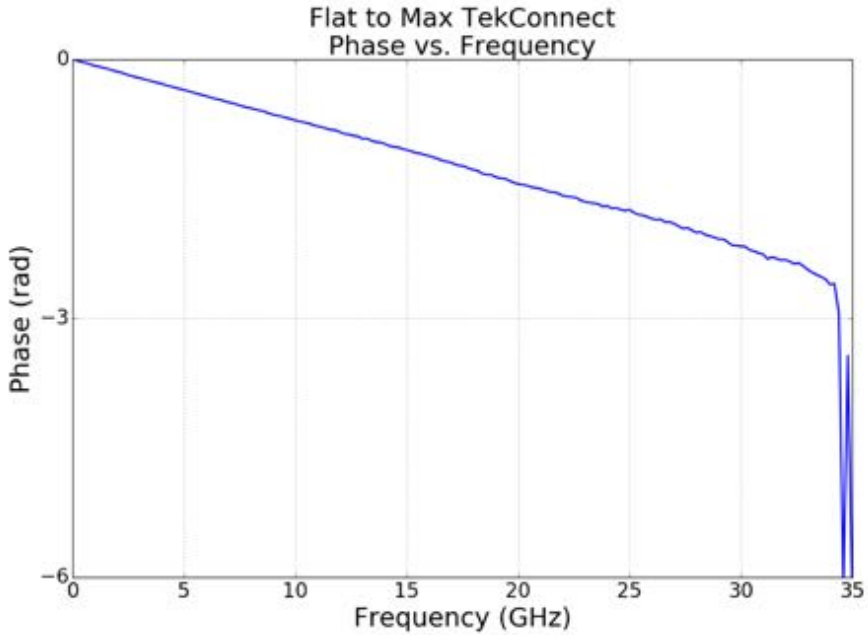
- Frequency Response
  - Unfiltered O/E response
  - Flat to 33GHz, sharp roll-off





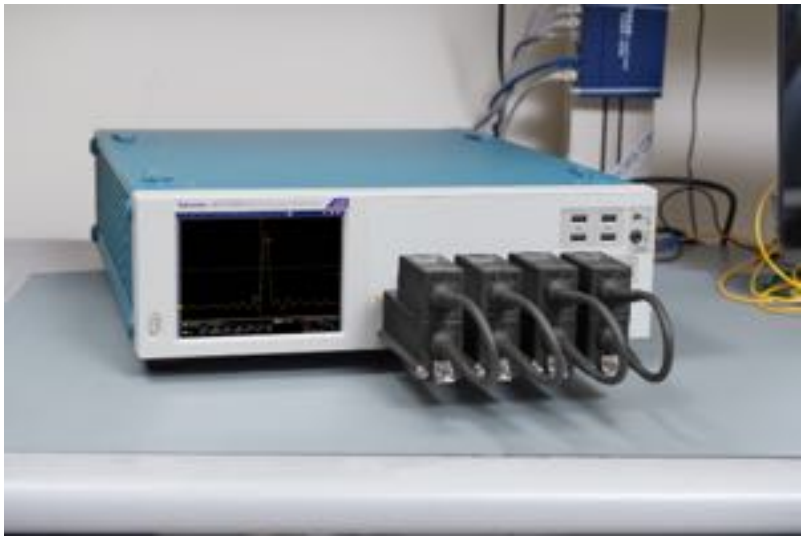
DPO7OE1 Phase Response

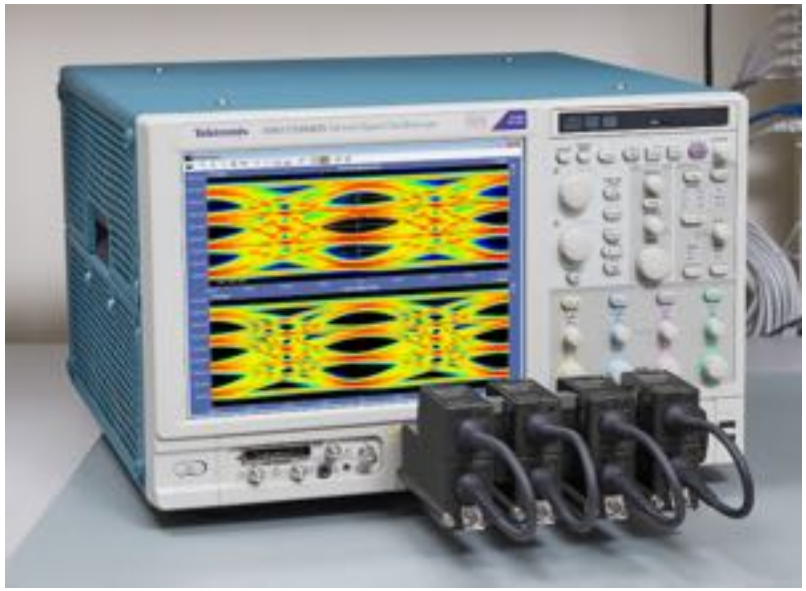




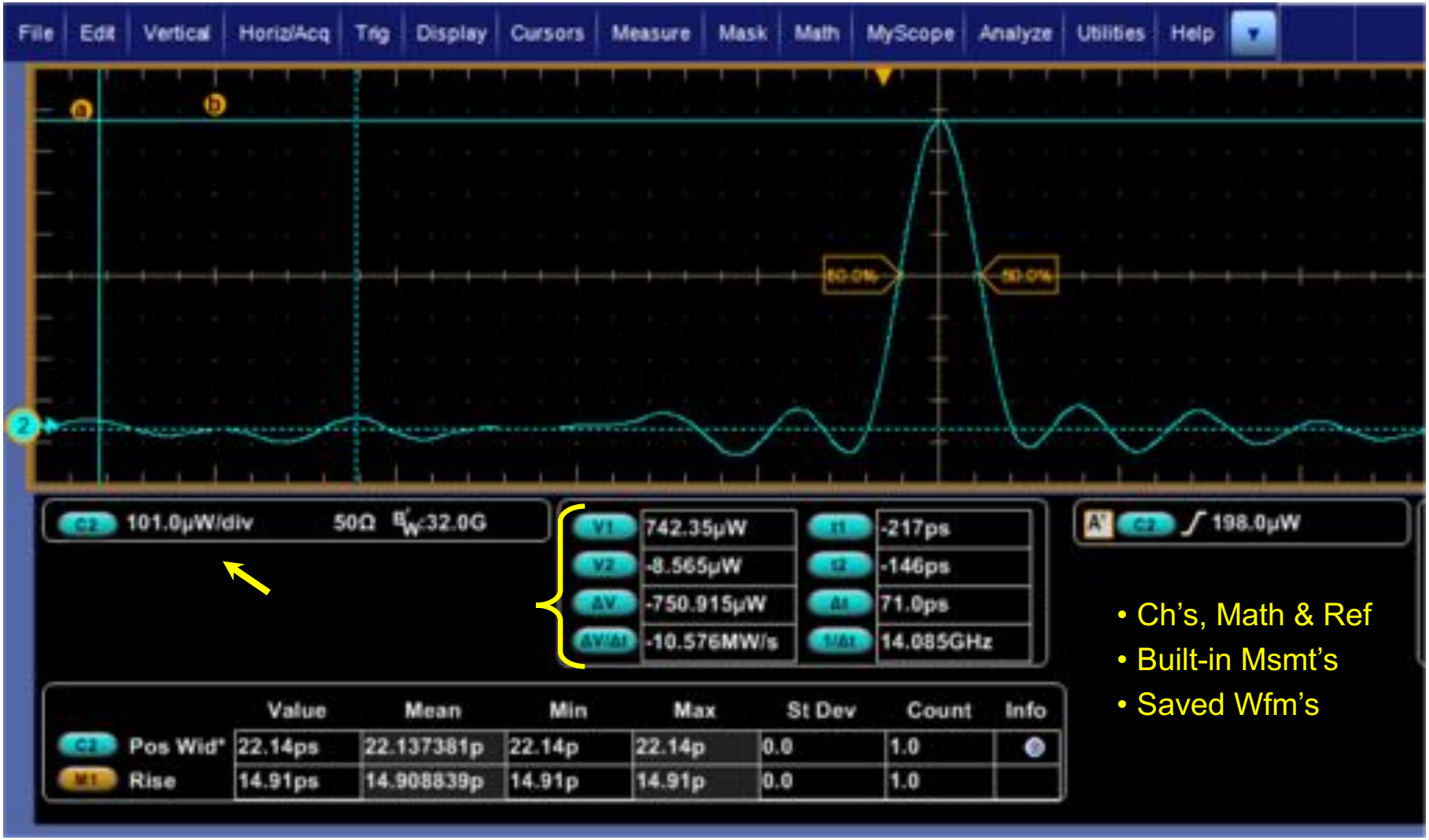
O/E Configurations

MSO/DPO70KC/D/DX AND DPO70KSX - ATI OR TEKCONNECT





DPO7OE1 – Optical Power Scaled in Watts



DPO7OE1 / DPO7OE2 – Control Panel

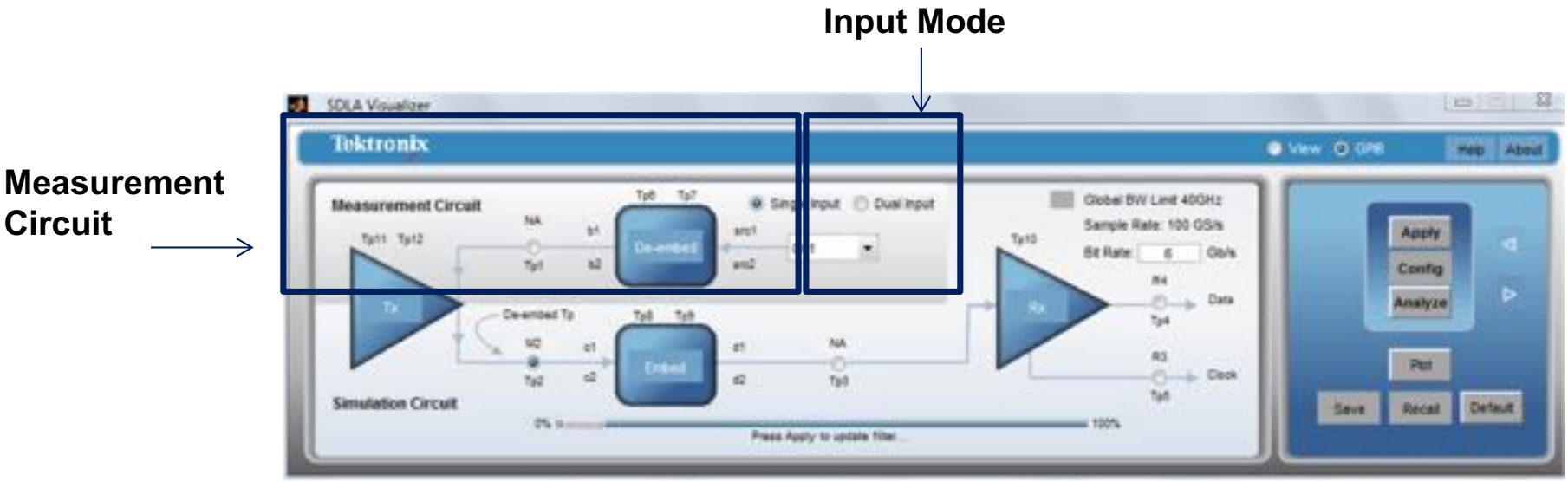
De-embedding Channel Effects

De-embedding Channel Effects

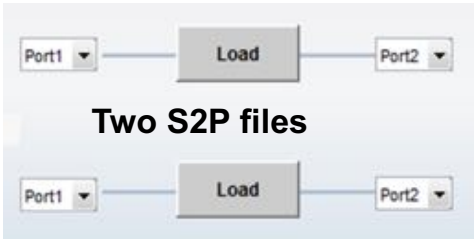
- **Methods for Insertion Loss Correction Only**
  - Precomp (AWG and Scope)
  - Tek SignalCorrect
- **Method for Insertion Loss and Reflection Correction**
  - SDLA Visualizer
    - Originally created to correct serial data channels
    - Can be used with a variety of applications
    - Robust multi-port S-parameter de-embed environment
    - Requires S-parameter data for best results (typically from VNA)
    - Preserves original acquired data
    - Provides corrected signal as a Math Waveform

SDLA Basic Channel Model

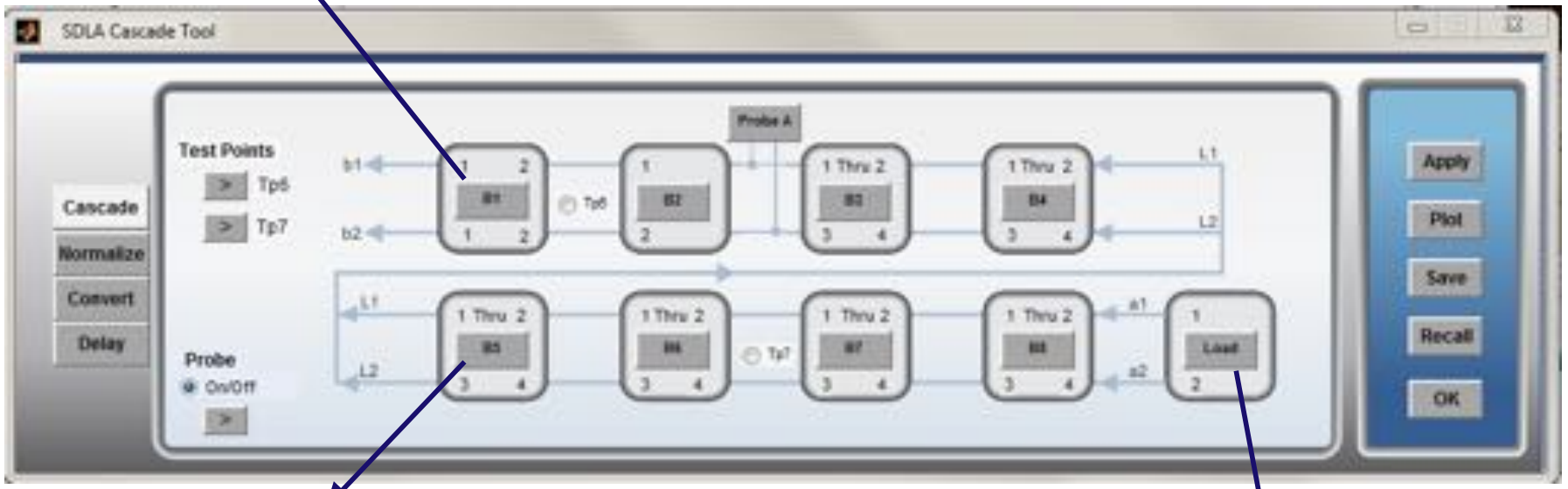
- **Elements applicable to PDV work**
  - Measurement Circuit De-embed (includes Scope S11)
  - Transmit Circuit (includes O/E S22)

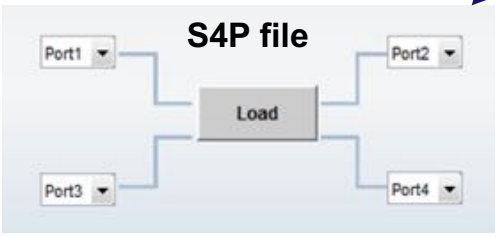


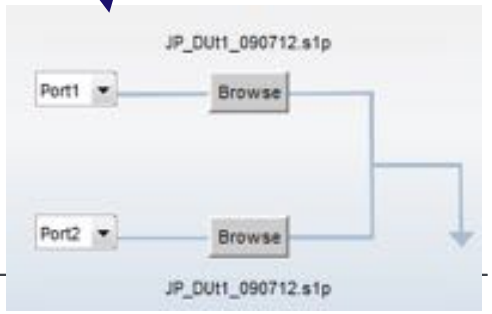
Configuration Options for De-Embed Block



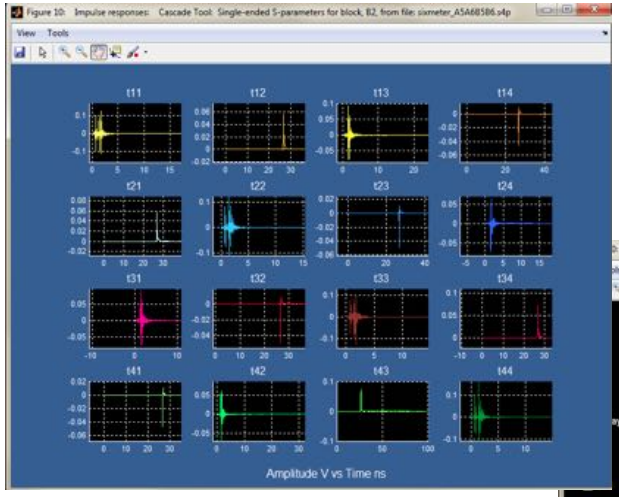
Or Two Transfer function files
Or Two FIR files



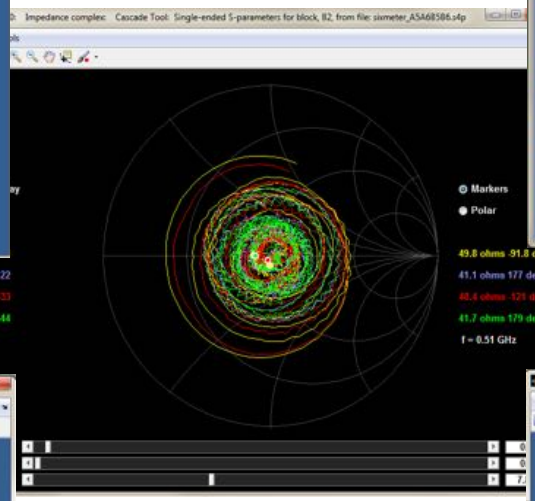




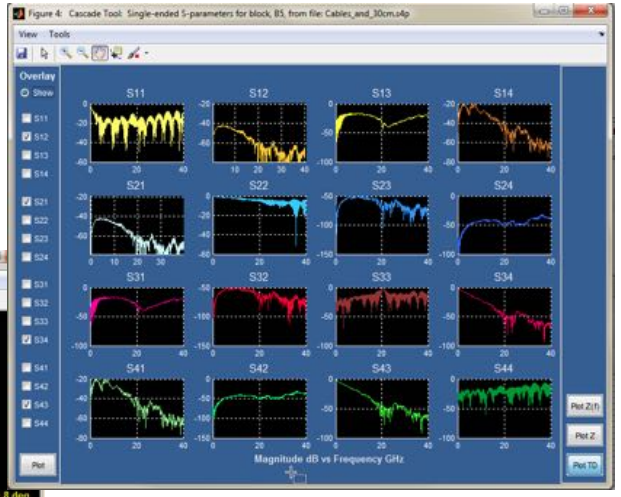
Plot Options for De-Embed and Embed Block Elements



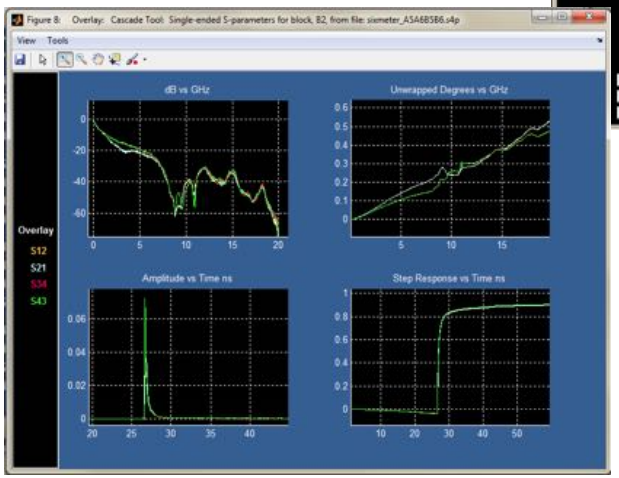
Impulse Response
Time Domain



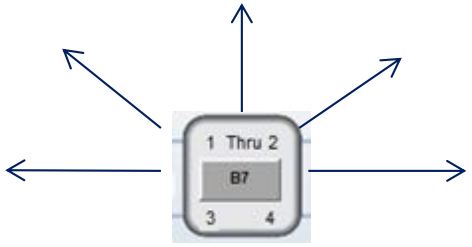
Smith Chart

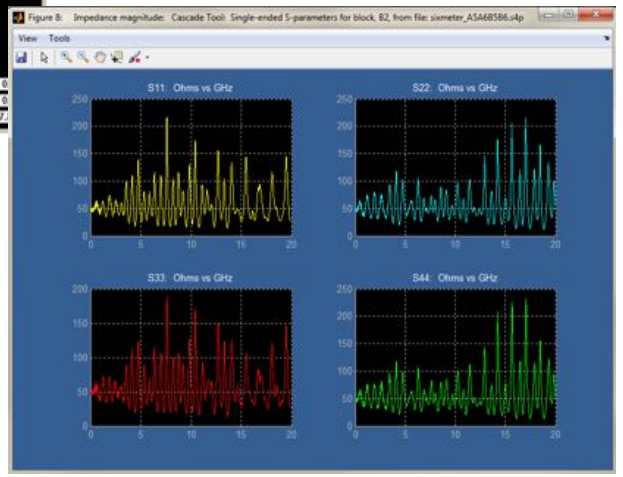


16 S-Parameters
Frequency Domain



Magnitude, Amplitude, Step Response



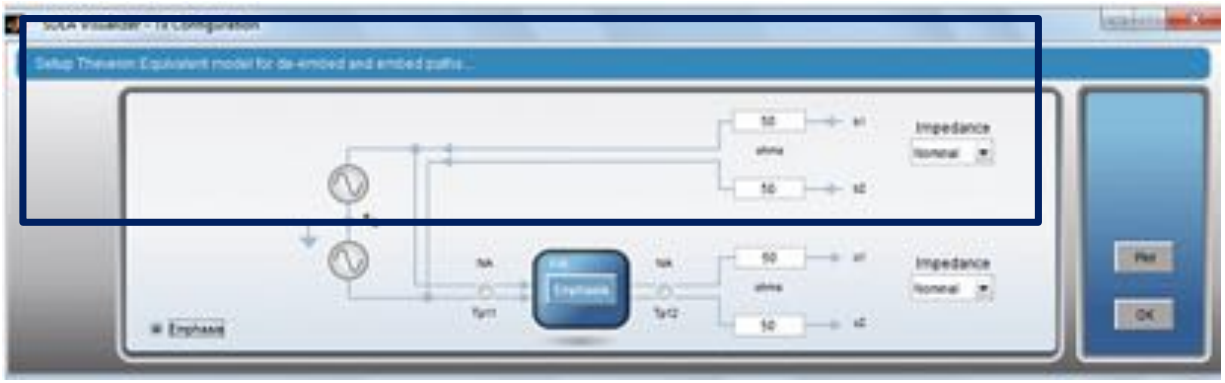


Impedance vs. Frequency

Configuration for Transmitter Block

- O/E S22 is entered into the Transmitter Block

Measurement Circuit



Final Steps

- **Once the Transmitter and Measurement blocks have been defined, the remaining step is to build the correction filter and apply it to the waveform data**
  - Apply button builds the FIR filter
  - Analyze button applies the filter to the waveform data to correct signal
  - Corrected signal is displayed in specified Math channel

Uses of SDLA Visualizer

- High Speed Serial testing – compensating for cable and fixture losses, as well as reflections, resulting in larger eye opening and lower measured jitter. Visualizing and measuring signals that may be impossible to access directly with a probe.
- Coherent Optical test – removing reflections between O/E and Scope Input
- SATCOM test – removing losses, phase shift, and reflections that degrade EVM measurements. Includes de-embedding waveguides

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