Tektronix

더 빠르고 정확한 RF 신호 분석을 위한 SignalVu 소프트웨어 활용법

TEKTRONIX KOREA
AE TEAM

Agenda

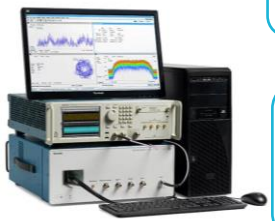
- SignalVu software Introduction
- Wireless signal analysis using SignalVu software
  - WLAN (IEEE 802.11 a/b/g/j/p/n/ac)
  - 5GNR
  - Multi-Channel RF Analysis
  - Advanced Pulse Analysis
- Demo
  - SpectrumView for pulse radar with multi-channel RF analysis
  - SignalVu for pulse radar with multi-channel RF analysis

RF Portfolio

High Frequency <70GHz

Sub 10GHz

DPO70KSX: 200GS/s, 2 Ch.
Freq Range 13GHz to 70GHz
SignalVu-PC



RSA7100B:
Freq Range 26.5GHz,
BW: 800MHz, PN= -134dBc/Hz
(CF=1GHz, offset=10kHz)
SFDR: 65-to-80dB, SignalVu-PC

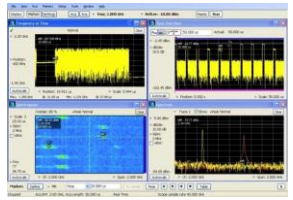
RSA5/600A: USB SA
Freq Range: 18GHz
Capture BW: 40MHz
SFDR: 70dB, SignalVu-PC

MSO6B Series: 50GS/s, 12b, 8Ch.
Freq = 10GHz, PN=-160dBc/Hz
(CF=1GHz, offset=10kHz)
BW= 2GHz, SpectrumView /SignalVu

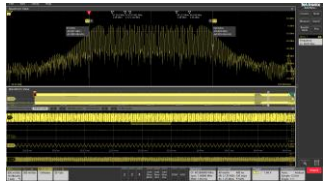
RSA306B: USB SA
Freq Range: 6.2GHz
Capture BW: 40MHz
SFDR: 65dB, SignalVu-PC

AWG70k: 50GS/s, 10bits, 1-2 Ch.
Freq Range: 20GHz, BW: 15GHz
Output range: -70 to +18dBm

AWG5k: 5GS/s, 16bit, 8-32 Ch.
Freq Range: 6GHz, BW: 2GHz
Output range: -80dBm to +10dBm



SignalVu: WLAN, BLE, LTE
OFDM, PN, Pulse Modulation,
3D Spectrogram, DPX



Spectrum View: DDC per ch.
Spectrum Analyzer, RF Trigger
Amplitude, Freq., Phase vs time,
Correlate freq and time domain

Spectrum Analyzer (SA) / Scope

Signal Generator

Software

SignalVu VSA Software

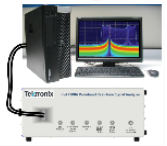
OSC only

Real-time spectrum analysis | 802.11xx WLAN analysis | 5GNR analysis | Multi-Channel analysis | Pulse Radar analysis

SignalVu(-PC) : Vector Signal Analysis software platform

USB Real-Time Signal Analyzers (RSA)

Powerful, affordable, compact IQ analysis, record & playback, for field, lab, and production use



Performance RTSAs

Wideband IQ recording and analysis, for full design validation and production use

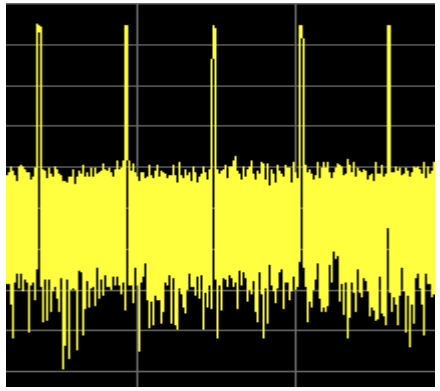
Advanced Signal Analysis Oscilloscopes

Ultra wideband multi-instrument (scope, spectrum analyzer, VSA) IQ analysis for lab use

SignalVu VSA Software

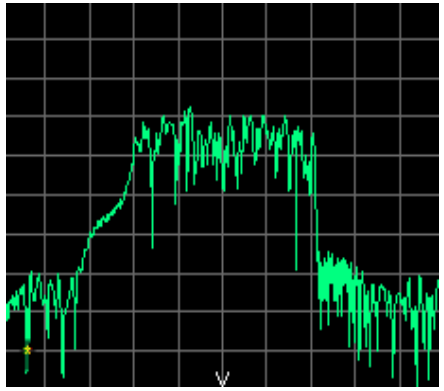
MULTI-DOMAIN TOOLSET FOR SPECTRUM ANALYSIS, VECTOR SIGNAL ANALYSIS, DEMODULATION, AND MORE…

Time



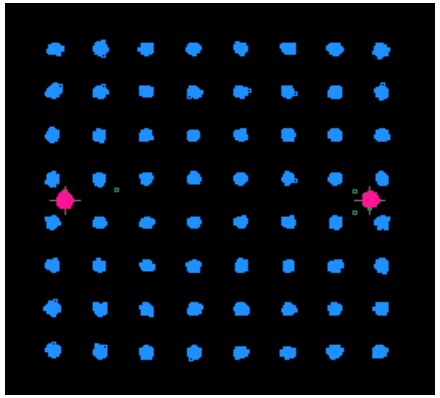
Magnitude, phase, frequency, pulse and EVM time domain analysis

Frequency



High resolution, FFT-based spectrum analysis

Modulation



Demodulation & signal quality (EVM) measurements

One user interface, many instruments

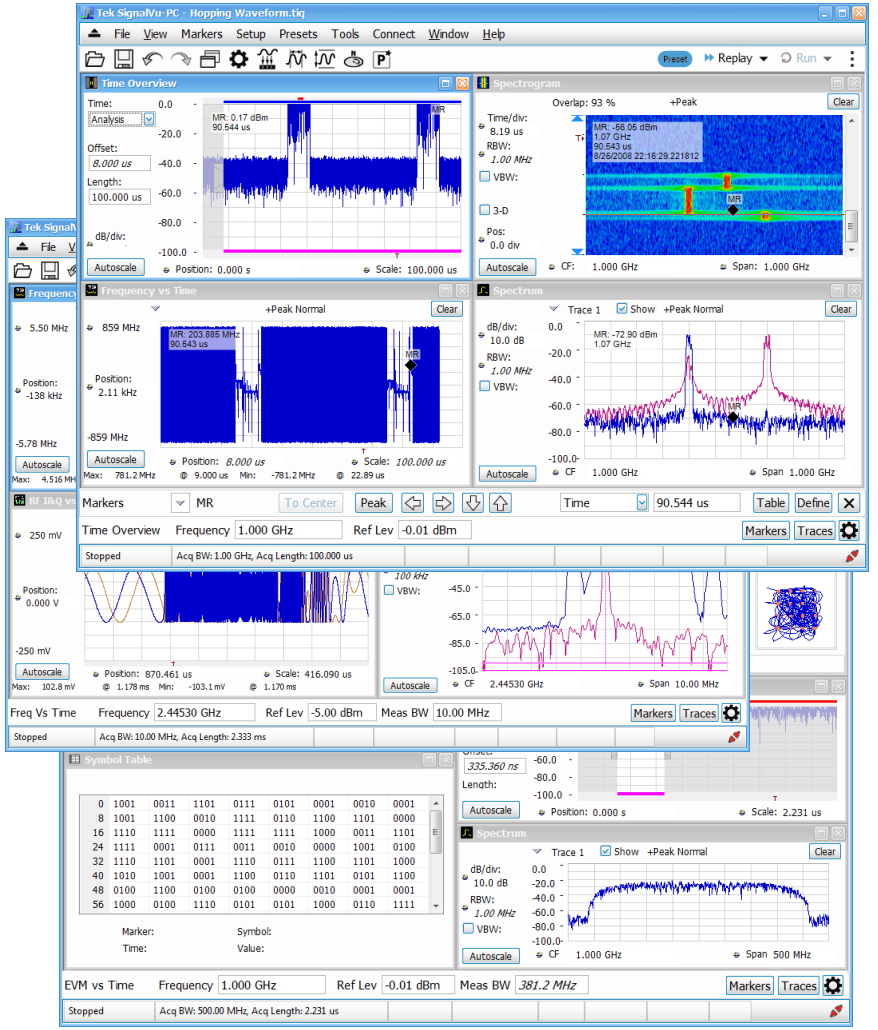
SIGNALVU(-PC) SOFTWARE CONFIGURATIONS

Instrument series	Instrument type	Connection & use	Software license	Max acq BW
RSA306B, RSA500 and RSA600	USB Real-Time Signal Analyzers (RSA)	USB 3.0 to a Windows PC with SignalVu-PC installed.	Free	40 MHz
RSA5100B	Performance Real-Time Signal Analyzer (RTSA)	SignalVu runs directly on the RTSA operating system	Free	165 MHz
RSA7100A	Performance Real-Time Signal Analyzer (RTSA)	2x PCIe USB 3.0 on front panel to a high speed RAID controller with SignalVu-PC installed	Free	800 MHz
5 or 6 series MSO	**Touch screen Mixed Signal Oscilloscope (MSO)**	**a) SignalVu-PC runs directly on the 5/6 Series operating system (Option 5/6-Win required) or** **b) USB2.0 to a separate Windows PC with SignalVu-PC installed**	**Requires** **1.) Connect (CON)** **2.) Opt. SV-RFVT, and optionally** **3.) Opt. 5/6-Win to run on scope Windows OS**	**0.312 - 2 GHz**
MSO/DPO70000SX/DX MSO/DPO70KC MSO/DPO5000 DPO7000	Performance Digital, Mixed Signal, and Mixed Domain Oscilloscopes	SignalVu runs directly on the performance oscilloscope operating system	Requires option SVE running on the oscilloscope	70 GHz

SignalVu-PC with 5/6 Series MSO

COMPREHENSIVE MULTI-DOMAIN RF ANALYSIS

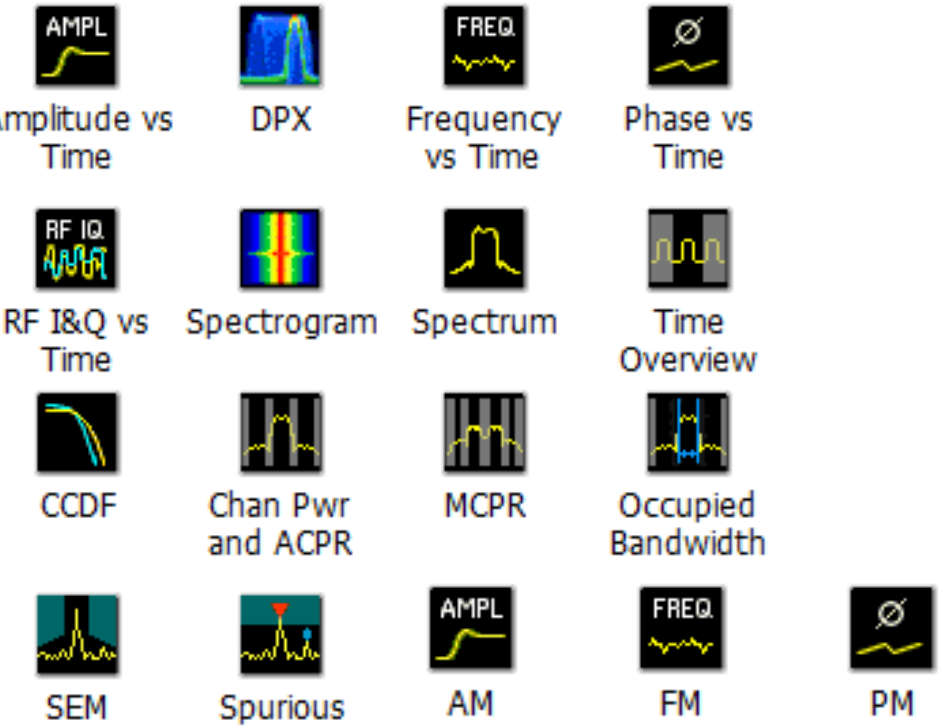
- **General Analysis** (Opt. CON, SV-RFVT, WIN)
  - Spectrum, Spectrogram
  - Amplitude, Frequency, Phase, IQ vs. Time
- **Analog Modulation**
  - AM, FM, PM analysis
- **RF Measurements**
  - ACLR, MCPR, CCDF, OBW, Phase Noise, Spurious, Mask Test
  - Settling time – freq. & phase (SVT)
- **General Purpose Modulation** (SVM)
  - 25 modulation types (nFSK, nPSK, 256QAM, etc.)
  - EVM, Mag/Phase Error vs. Time
  - Symbol Table, Constellation
  - Signal Quality, Demod IQ, Eye Diagram, Trellis Diagram
- **Pulsed RF Measurements** (SVP)
  - Pulse Trace, Pulse Trend, Pulse Table
  - 27 different pulse measurements: Power, Rise/Fall, PW, PRI, Freq & Phase Deviation, Accuracy, Impulse Response, Overshoot, Droop, etc.
- ***More…***



Advanced Analysis Options

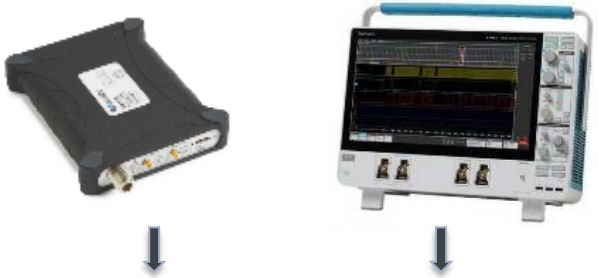
- Option SVP: Pulse Measurement Suite
- Option SVM: General Purpose Digital Demodulation
- Option SVO: OFDM Analysis
- Option SVA: Audio Analysis
- Option SVT: Frequency / Phase Settling Time
- Option SV23: WLAN 802.11a/b/g/j/p
- Option SV24: WLAN 802.11n
- Option SV25: WLAN 802.11ac
- Option SV26: APCO P25 Phase I & II Tx Measurements
- Option SV27/31: Bluetooth BLE Tx Analysis / BT5
- Option SV28: LTE RF Downlink Measurements
- Option CON: Live connectivity to MDO4000B oscilloscope
- Option MAP: GPS driven data collection on a map
- Option SV54: Signal Classification
- Option SV56: Playback of streaming data files
- Option SV60: Return Loss, VSWR, Distance to Fault

Measurements with base SW (SVE)



WLAN (IEEE 802.11 a/b/g/j/p/n/ac)

WLAN Transmitter Test(Opt. SV2C/SV2CH)



Key Features:

- WLAN spectrum and modulation transmitter measurements based on IEEE 802.11 a/b/g/j/p/n/ac standards
- The WLAN presets make the Error Vector Magnitude (EVM), Constellation, and Spectral Emission Mask (SEM) measurements pushbutton
- The WLAN RF transmitter measurements are defined by the IEEE 802.11 of the standard. Analysis of 1024-QAM 802.11ac signals is also possible

WLAN Transmitter Test(Opt. SV2C/SV2CH)

License structure:

SV23	SV23NL-SVPC	NL	WLAN 802.11a/b/g/j/p measurements
	SV23FL-SVPC	FL	
SV24	SV24NL-SVPC	NL	WLAN 802.11n measurements (requires SV23)
	SV24FL-SVPC	FL	
SV25	SV25NL-SVPC	NL	WLAN 802.11ac measurements (requires SV23 and SV24)
	SV25FL-SVPC	FL	

SV2CFL-SVPC	WLAN 802.11a/b/g/j/p/n/ac and Connect to 5/6 Series MSO or work with Spectrum Analyzer of acquisition bandwidth ≤40 MHz
SV2CNL-SVPC	
SV2CHFL-SVPC	WLAN 802.11a/b/g/j/p/n/ac and live link to MDO4000B to work with analyzer of any acquisition bandwidth
SV2CHNL-SVPC	

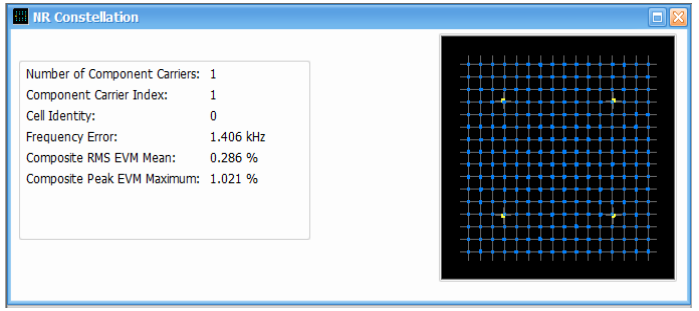
802.11 프로토콜	최초 배포[1]	주파수 (GHz)	대역폭 (MHz)
802.11-1997	1997년 1월	2.4	20
a	1999년 9월	5	20
		3.7[A]	
b	1999년 9월	2.4	20
g	2003년 1월	2.4	20
n	2009년 10월	2.4/5	20
			40
ac	2012년 12월	5	20
			40
			80
			160

5GNR

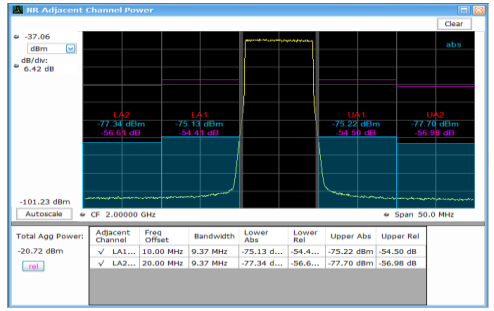
Signal Analysis for 5G New Radio(Opt. 5GNR)

5GNR MEASUREMENT PACKAGE AVAILABLE IN SIGNALVU-PC

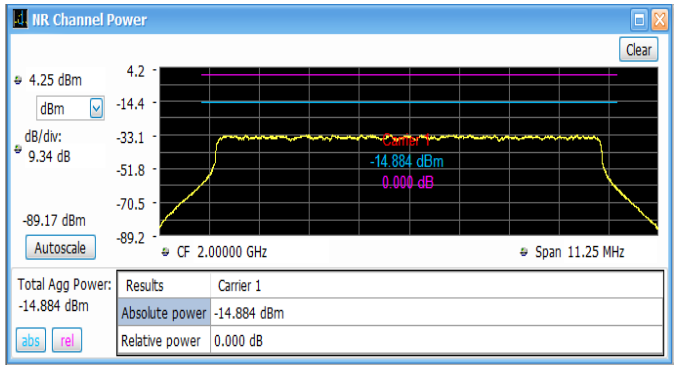
- Recommended for 6 Series B MSO (FR1) and DPO70000SX (FR2)
- Demodulation and PHY-layer signal analysis of 5G New Radio uplink/downlink based on 3GPP release 16
- Supports these key measurements
  - Error Vector Magnitude (EVM)
  - Adjacent Channel Power Ratio (ACPR)
  - Channel Power
  - Spurious Emissions Mask (SEM)



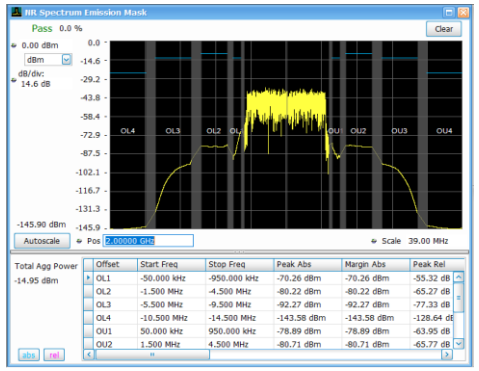
Error Vector Magnitude



Adjacent Channel Power Ratio (ACPR)



Channel Power



Spurious Emissions Mask

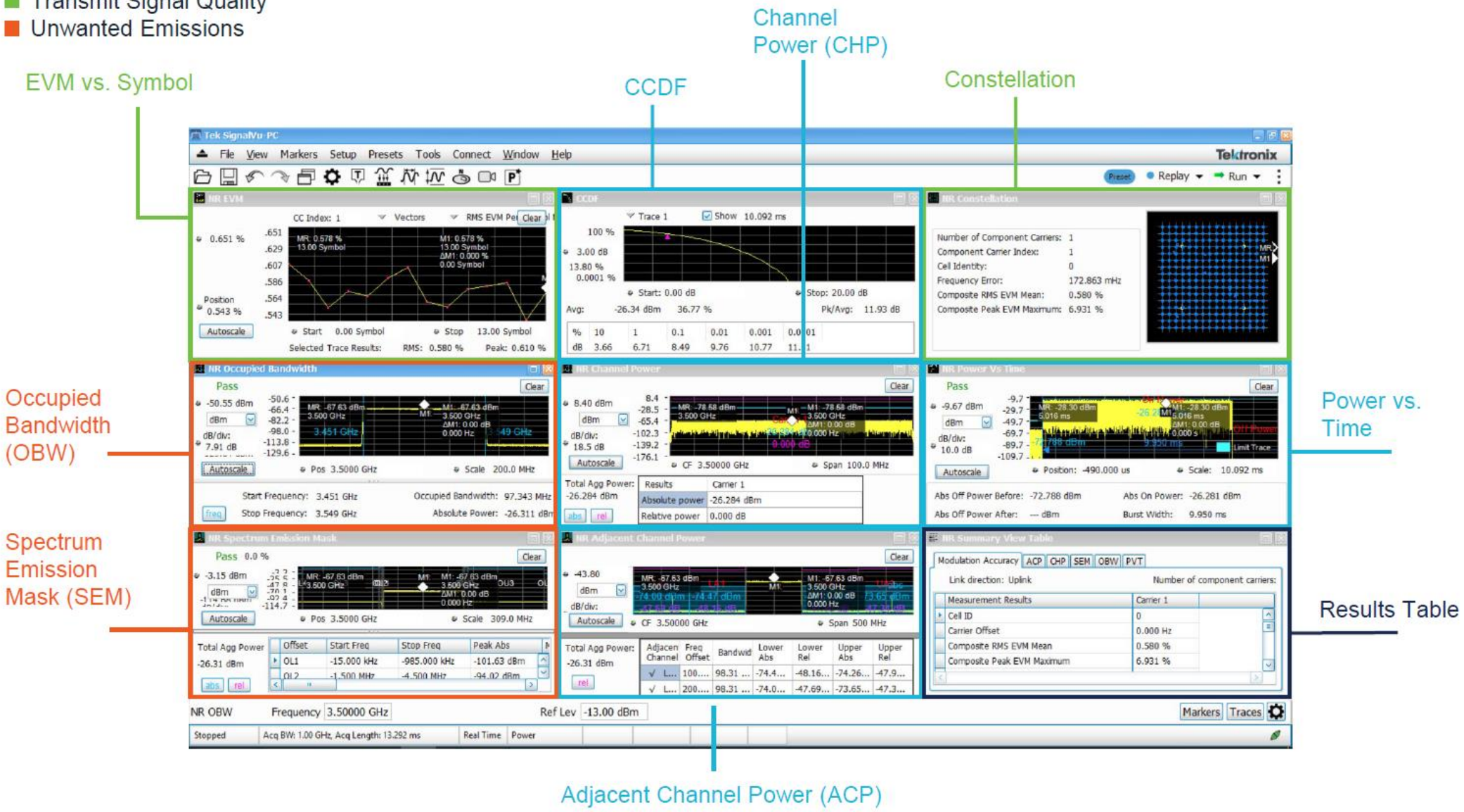
5GNR Key Features(Opt. 5GNR)

THE 5GNR MEASUREMENT ANALYSIS OPTION ENABLES YOU TO EVALUATE TO 3GPP STANDARDS

KEY FEATURES

- Analysis of Uplink and Downlink (FDD and TDD) frame structures
- 5GNR measurement displays
- Summary table with all scalar results for EVM, SEM, CHP, ACP measurements
- Coupled measurements across domains with multiple markers enables in-depth analysis and fast troubleshooting
- Save reports in CSV format with configuration parameters and measurement results
- Configurable parameters of PDSCH or PUSCH for each component carrier
- For downlink, supported test models for FDD and TDD per 3GPP specifications
- Up to 1024 QAM analysis
- Automatic Cell ID detection for Downlink waveforms

- Output Power Level and Dynamics
- Transmit Signal Quality
- Unwanted Emissions



Modern technologies require modern test systems

Modern Technologies

- Multi input multi output (MIMO)
- Phased array
- Beam forming
- Direction of arrival (DOA)
- Angle of arrival (AOA)
- Multi-Carrier
- Multi - port
- Radar testing
- Coordinated multipoint

Test System Needs

Hardware

- Wide analysis bandwidth
- Multi-Channel Phase-synchronous HW
- Acquire multiple frequency bands at once
- Multi-domain analysis

Software

- Analyze multiple channels simultaneously
- Make complex scenarios easy
- Flexible controls for all scenarios
    - Independent RF Controls
    - Independent Time Gating
    - Flexible Debugging Controls
- Analyse RF, IF and Mixed Signal Systems
- Advanced pulse analysis

SignalVu Multi-channel RF Analysis

SignalVu Multi-channel RF Analysis

Multi-Channel RF, IQ, Pulse Analysis

6 Series B MSO

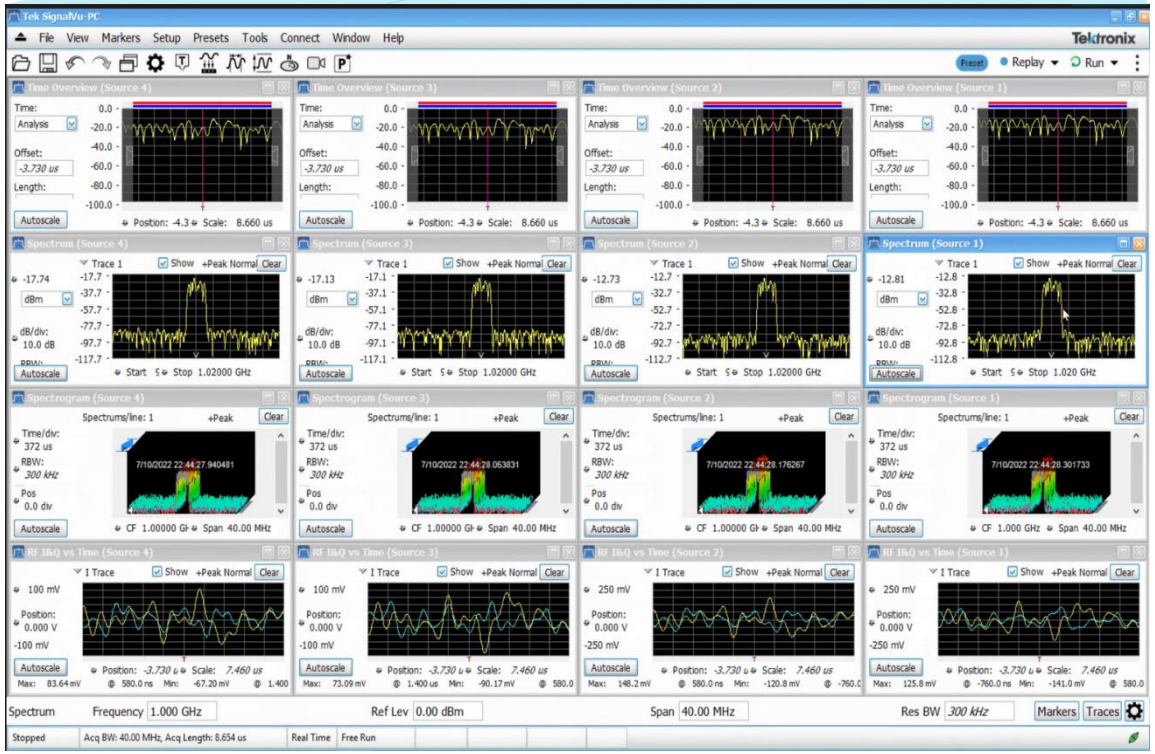
Frequency range: 10 GHz on up to 4 channels, 5 GHz on 8 channels
DDC Analysis BW: 1.25-2 GHz

Applications:

- Uplink/downlink systems
- Phased array transmitter calibration / validation
- Multi-channel or multi-frequency radar transmitter validation
- IQ-based downconverter validation

Key Features:

- Up to 8 simultaneous phase-coherent RF inputs, independent channel controls, and RF vs. Time triggers
- Supports RF, IQ or differential IQ signal sources
- Advanced pulse analysis with 31 automated pulse parameter measurements and statistics for multi-channel radar or EW systems



Supported in SignalVu-PC using the 5 and 6 Series B MSO

- Simplify the testing of complex RF scenarios with up to 8 simultaneous
- Independent channel controls
- RF vs. Time triggers

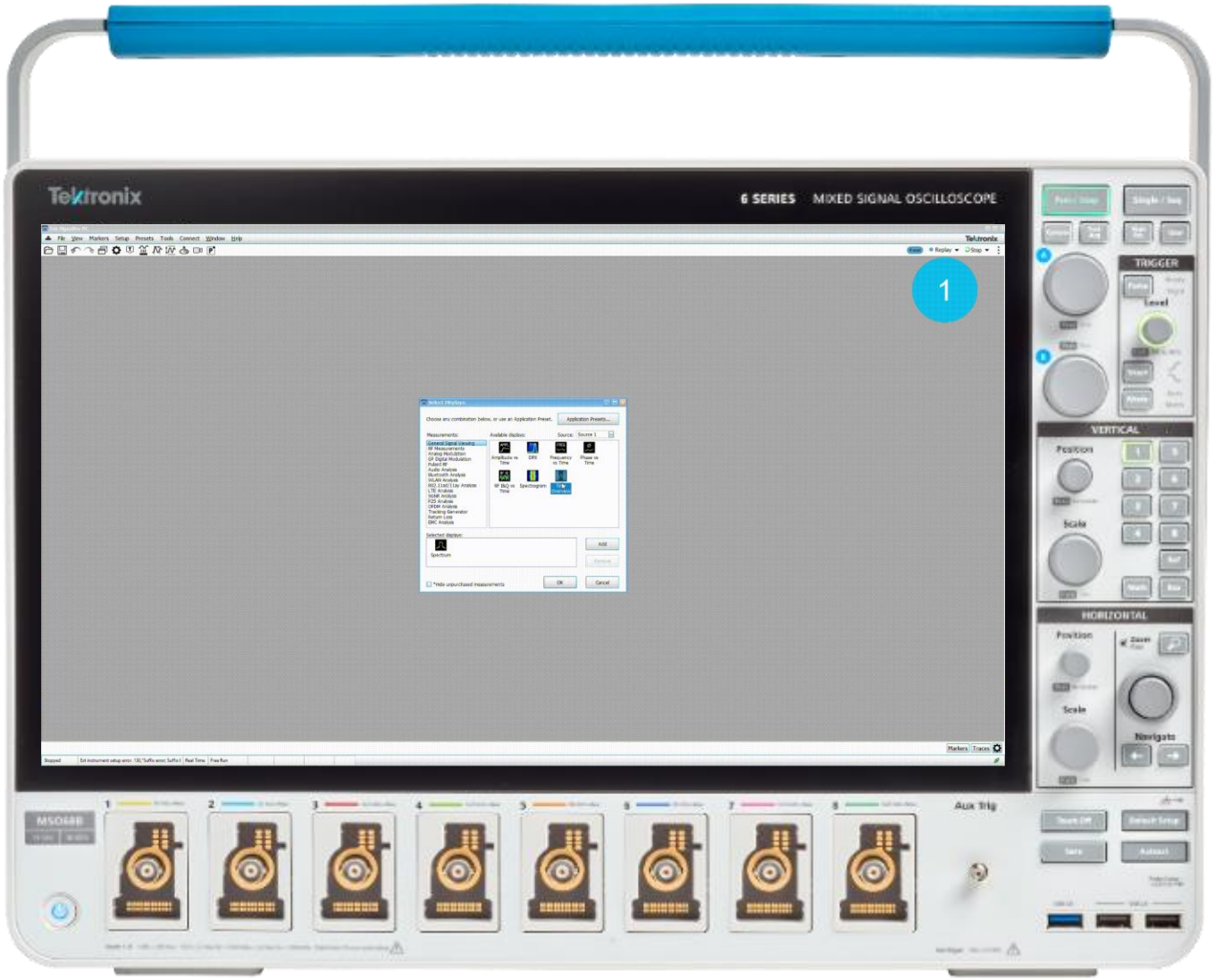
Configuring up to 8 RF Inputs has never been easier

1. Launch all needed measurement displays

2. Assign sources and channels

3. Configure RF settings to any scenario

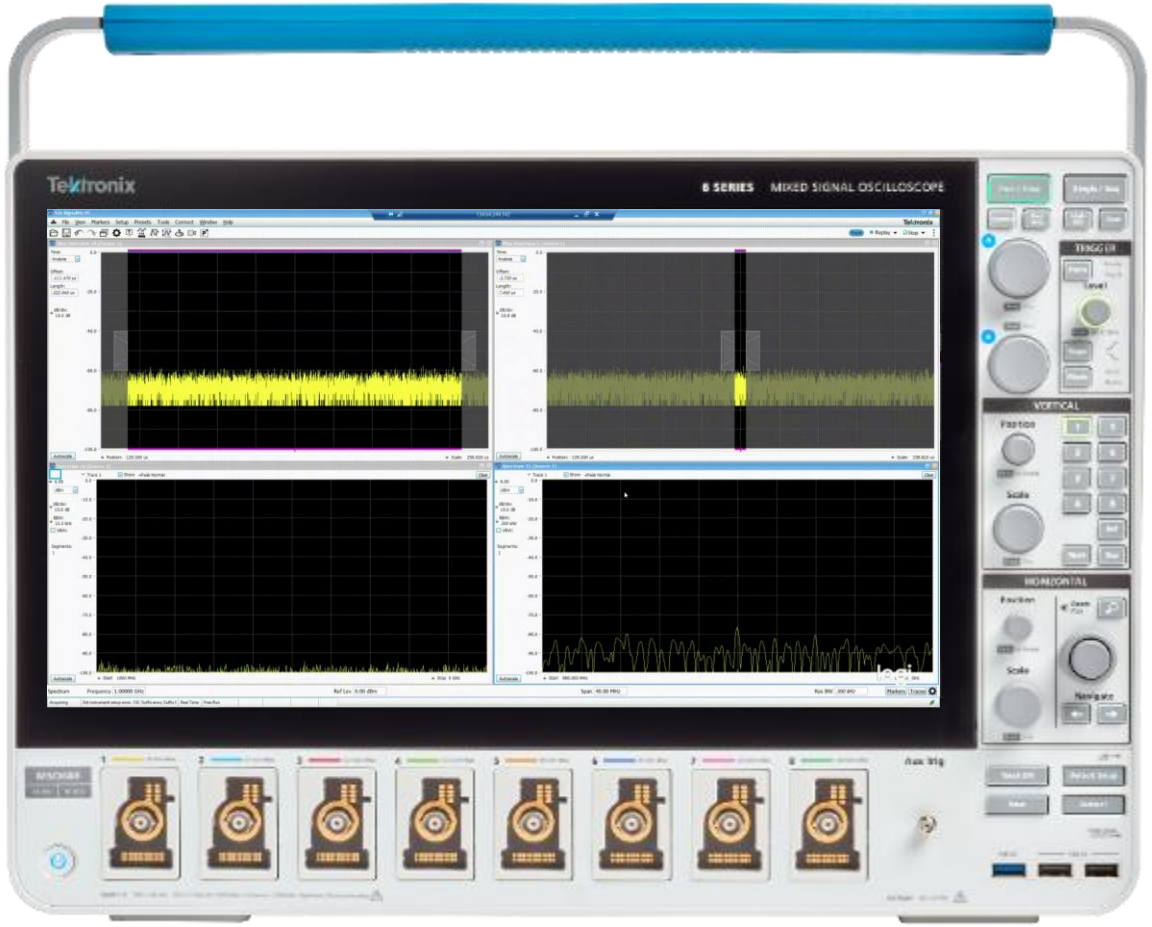
   Independent RF, acquisition, and analysis settings for each source



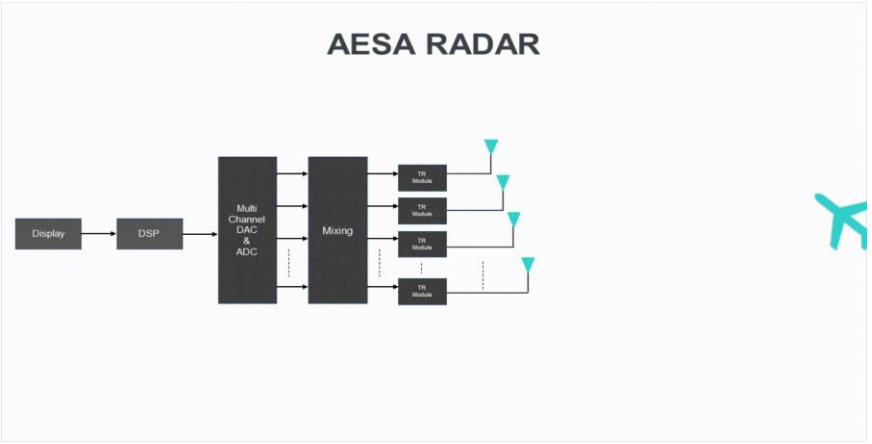
Independent RF channel setting controls

MAKES COMPLEX SCENARIOS EASY

- Center Frequency
- SPAN
- RBW
- Reference Level



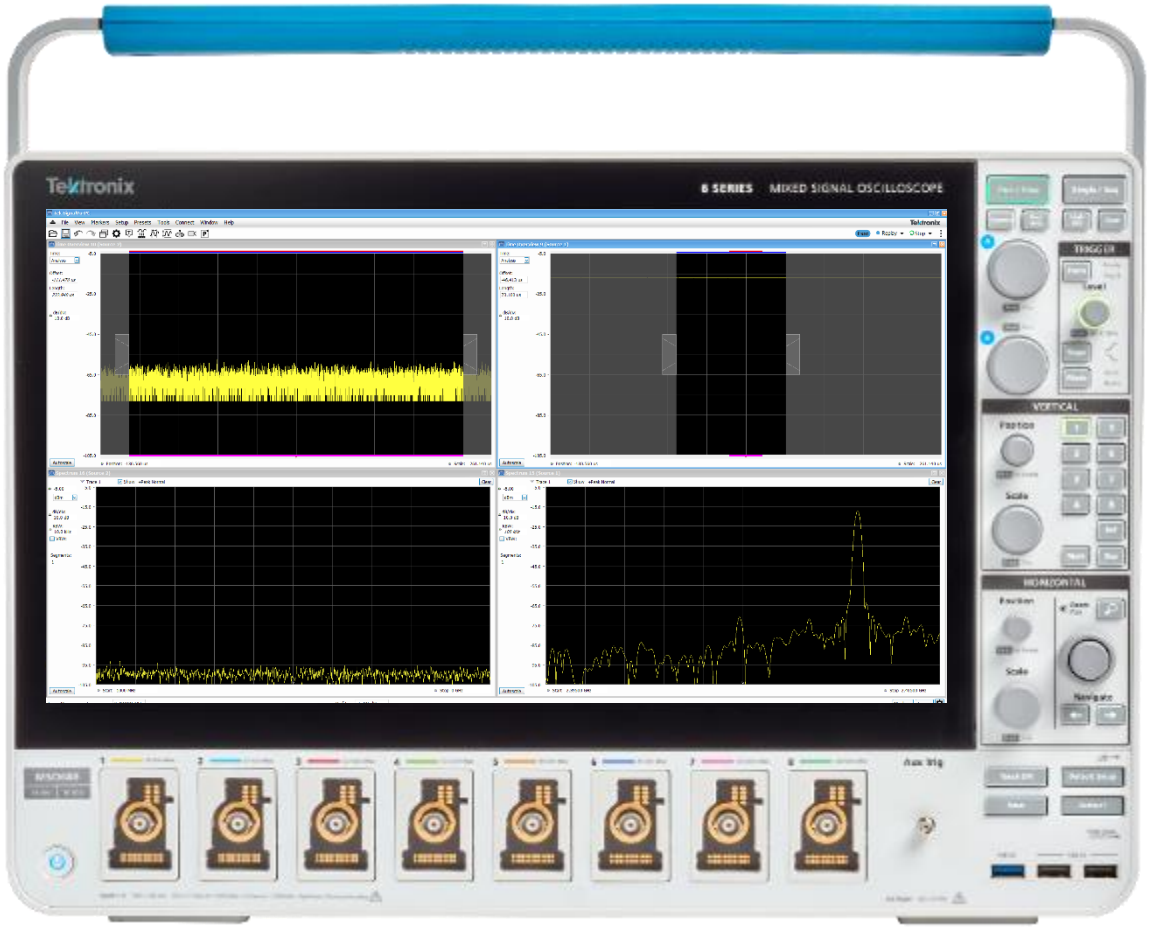
Use Case



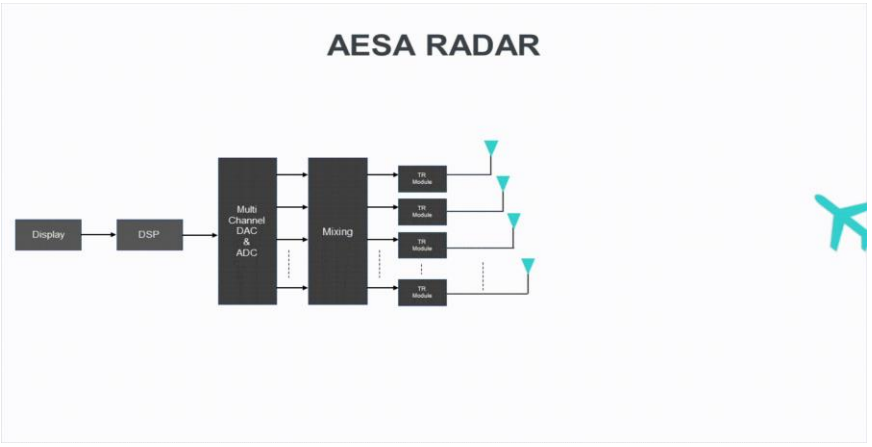
Independent time gating for each channel-source

FLEXIBILITY TO CONFIGURE FOR ANY SCENARIO

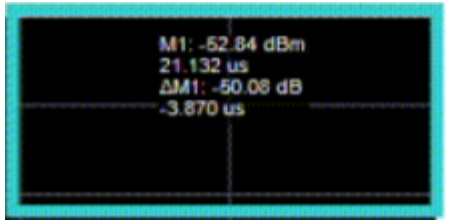
- Each source has its own “Time-Overview” display with adjustable windows to independently gate:
  - Acquisition time
  - Spectral time
  - Analysis time



Use Case

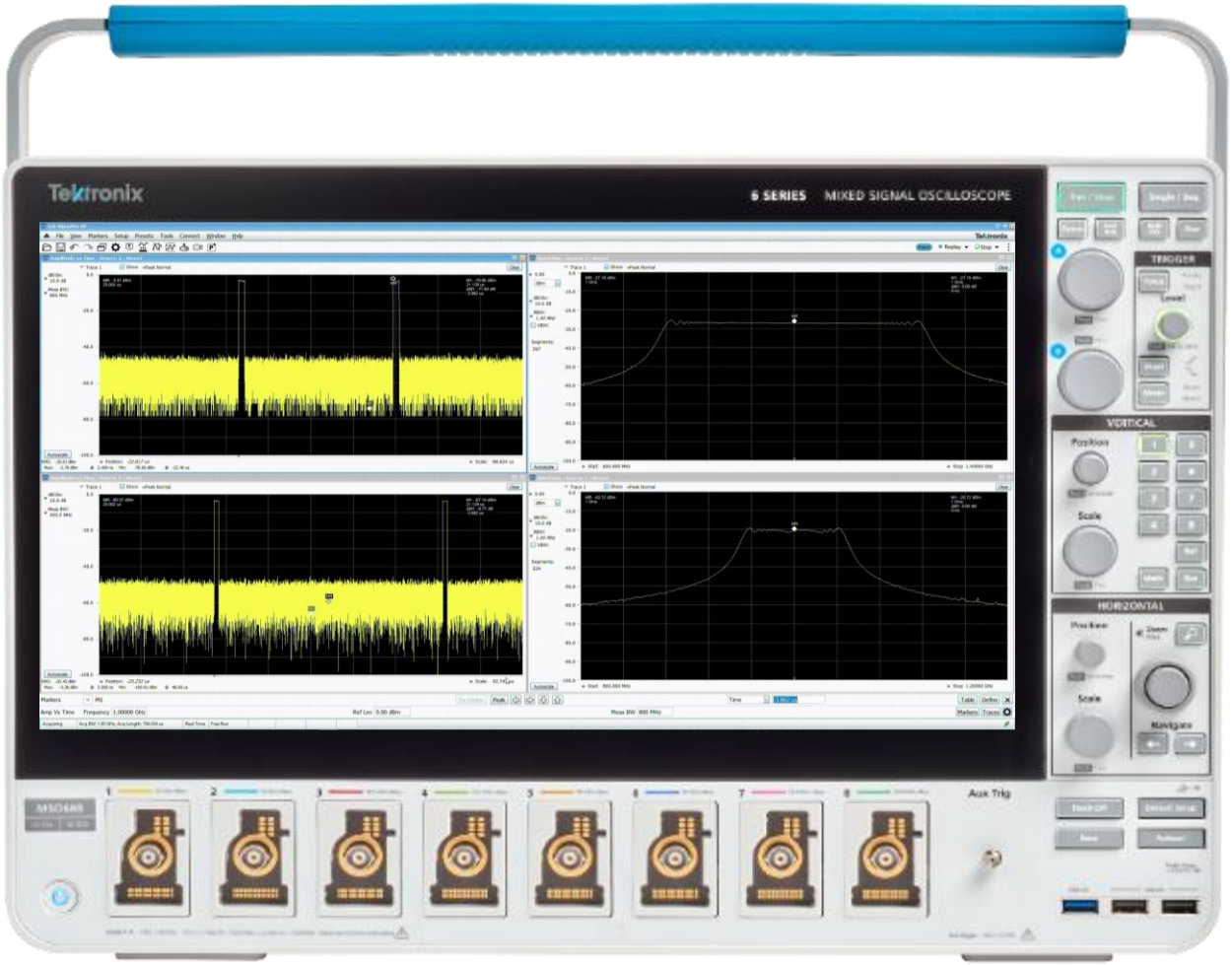


Coupled markers between signal sources

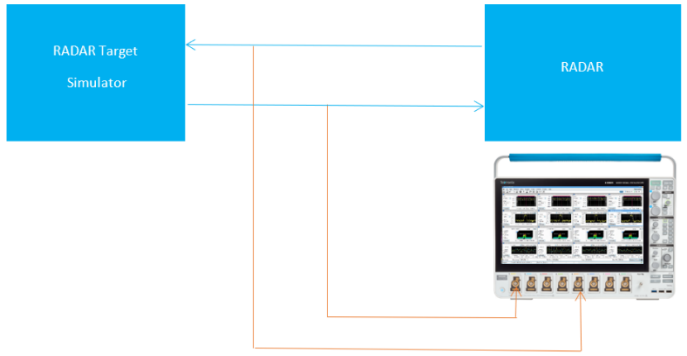


ANALYSIS & MEASUREMENTS MADE EASY

- Correlated marker navigation
  - Rapidly view time, frequency, phase, or power differences between channels
- 4 + 1 peak markers per display



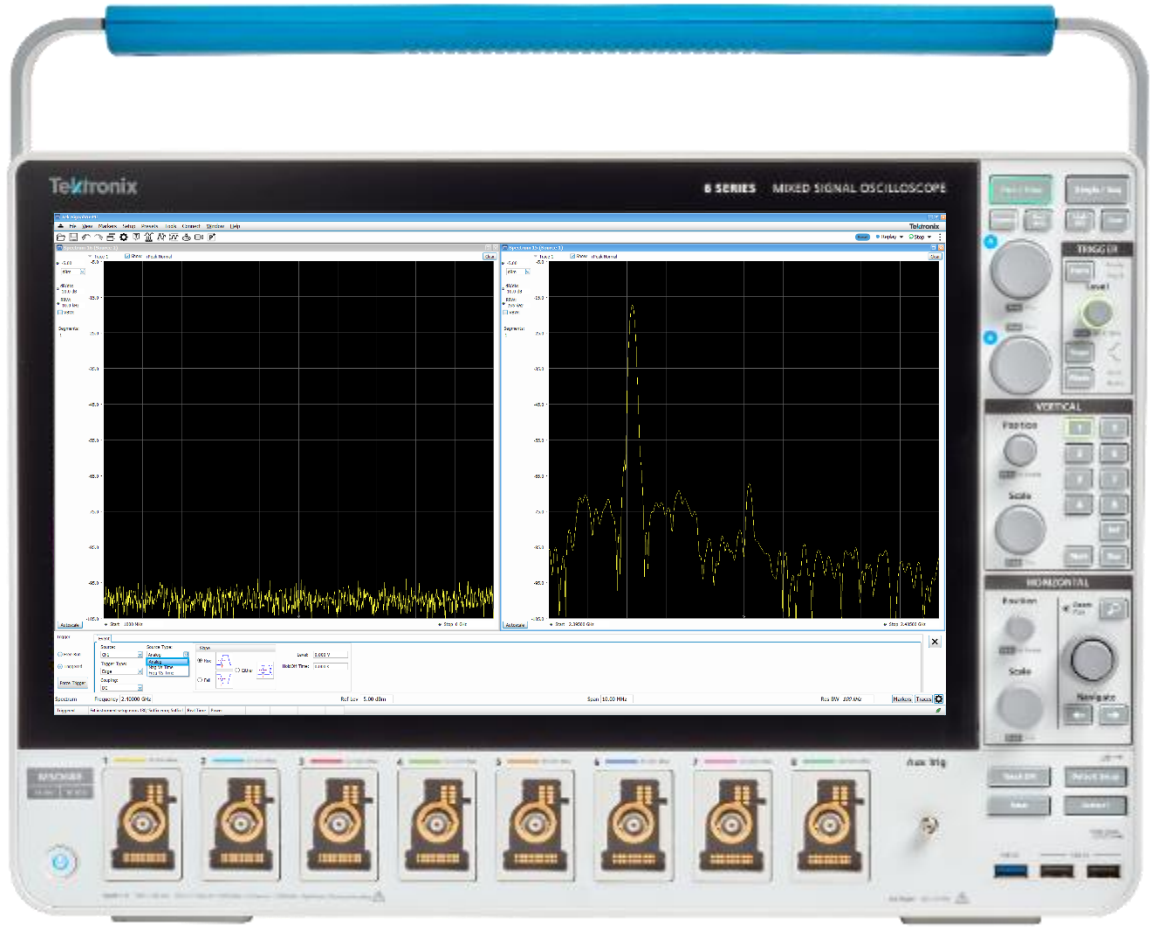
Use Case – Monitoring RADAR Test Systems



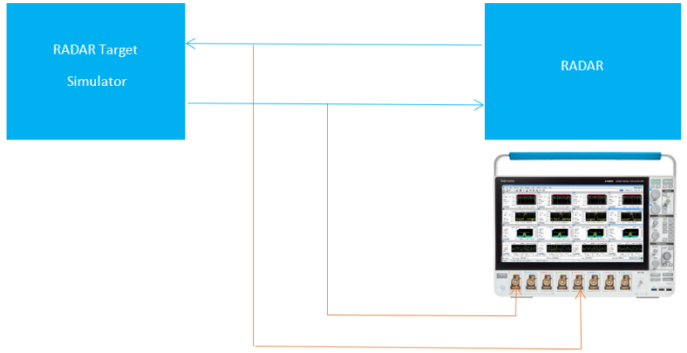
Configure triggers directly from SignalVu

TIGHTLY INTEGRATED WITH THE 6 SERIES MSO

- Seamless oscilloscope control
- Unlock full potential of your MSO's trigger settings
- Debug and analyze complex problems with amplitude and frequency vs. time triggers



Use Case – Monitoring Radar Test Systems

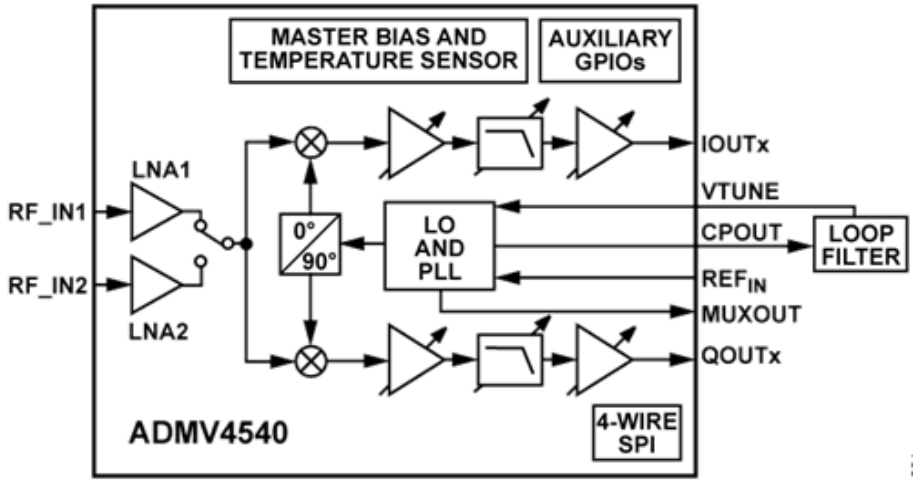


- Directly measure baseband signals by configuring each channel source as IQ or differential IQ

IQ-Based Downconverter RFIC Test

- Many RF systems rely on IQ-based modulators and demodulators to increase RF bandwidth with lower-speed ADCs/DACs
  - These devices can be baseband IQ, or complex real IQ, or differential IQ
- Testing of these ICs requires multi-channel measurement interfaces, like scopes, to perform RF measurements on the incoming signals and determine the quality of performance

Example DUT: ADMV4540



Key measurements:

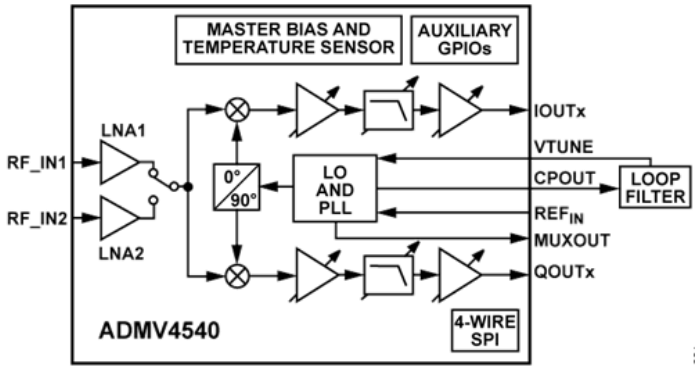
- Voltage
- Power (for measuring Rx Gain Δ)
- IQ impairments (image, LO)
- Modulation accuracy (EVM)

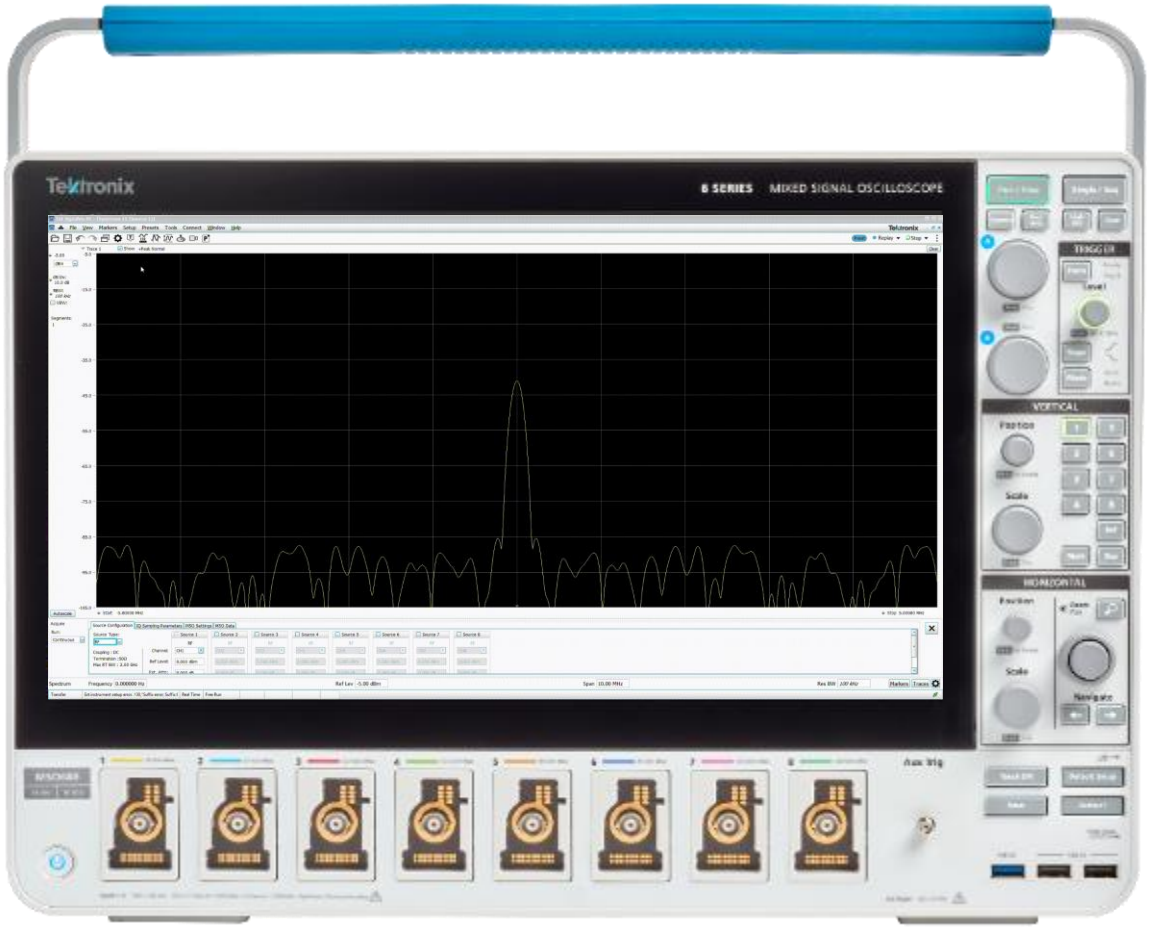
SignalVu supports RF, IQ & Differential IQ

USE THE 6 SERIES MSO FOR ALL YOUR TEST NEEDS (RF OR MIXED SIGNAL SYSTEMS)

- Analyze I and Q signals on two channels, or differential I and Q signals on four channels.
- Adjust skew and gain differences between channels (Correction of IQ errors)
- Key Measurements: IQ impairments, Gain Imbalances, Modulation Accuracy (EVM)

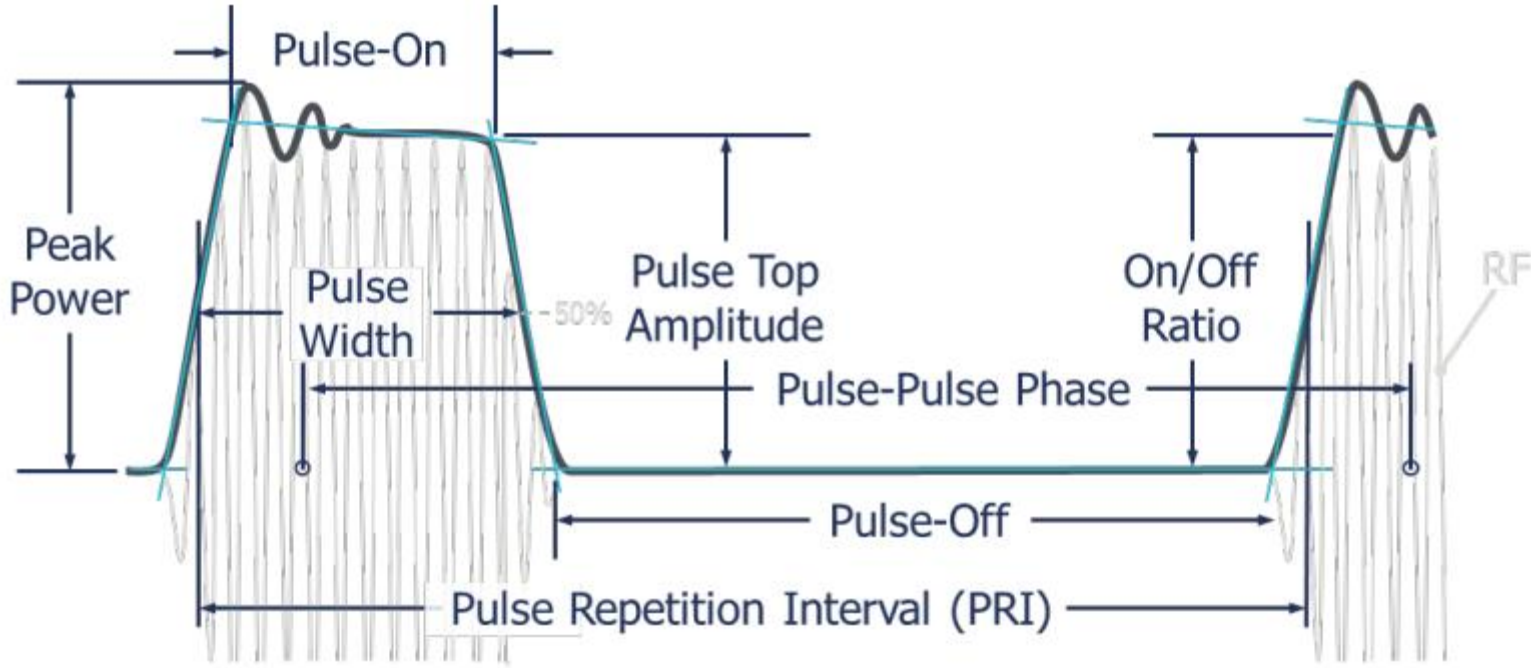
Use Case - ADMV4540





- Analyze 31 automated pulse parameter measurements and statistics for multi-channel radar or EW systems

Radar characteristics reveal capability and likely source – sailboat, battleship, passenger plane, bomber, missile, etc.



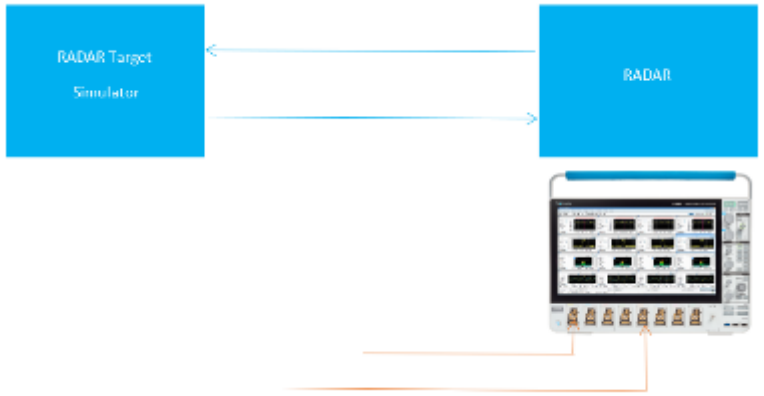
RF Engineer's tasks include measuring radar RF pulses with respect to frequency, modulation, rise/fall time and pulse repetition interval (PRI), duration and amplitude to judge if they fulfill their requirements

Advanced Pulse Analysis simultaneously on all channels

AUTOMATED ANALYSIS FOR COMPLEX PULSE SIGNALS

- Automatically characterize pulses with up to 31 different vector and scalar measurements
- Pulse table presents results of all measurements
- Statistical measurements like histograms display pulse measurements over many pulses
- Individual pulse traces available for all measurements
- Save results or export as .CSV for further analysis

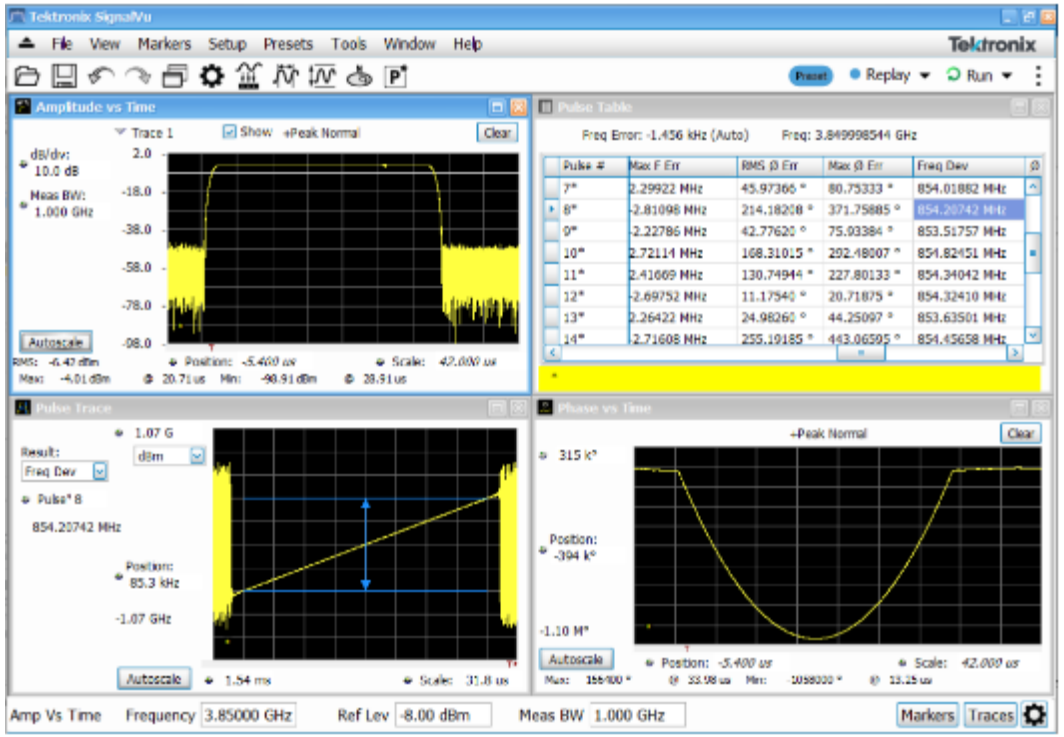
Use Case

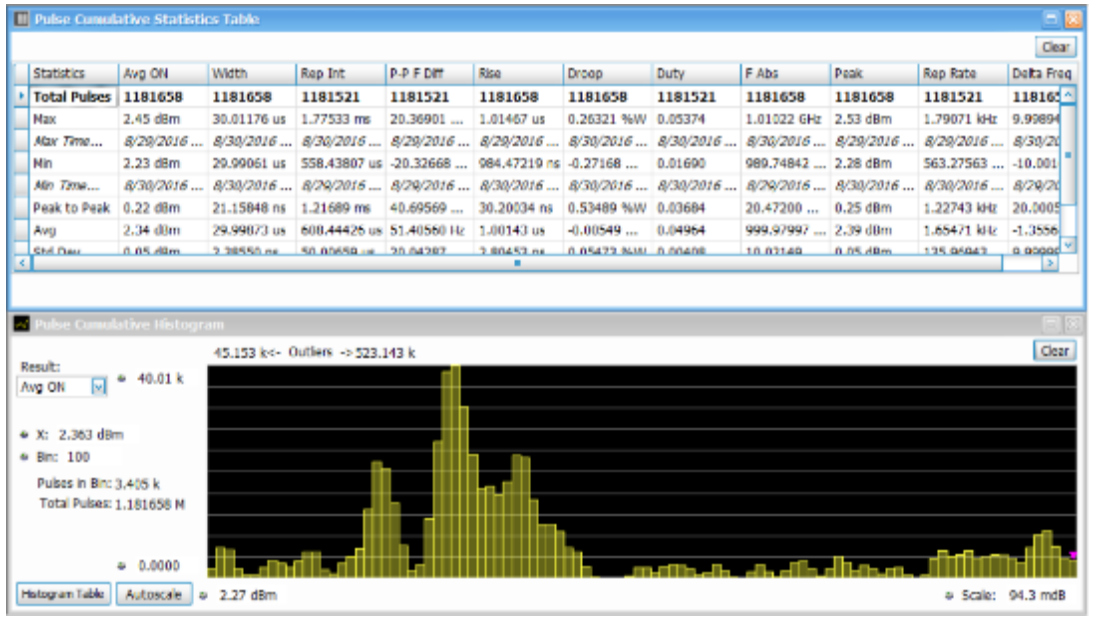


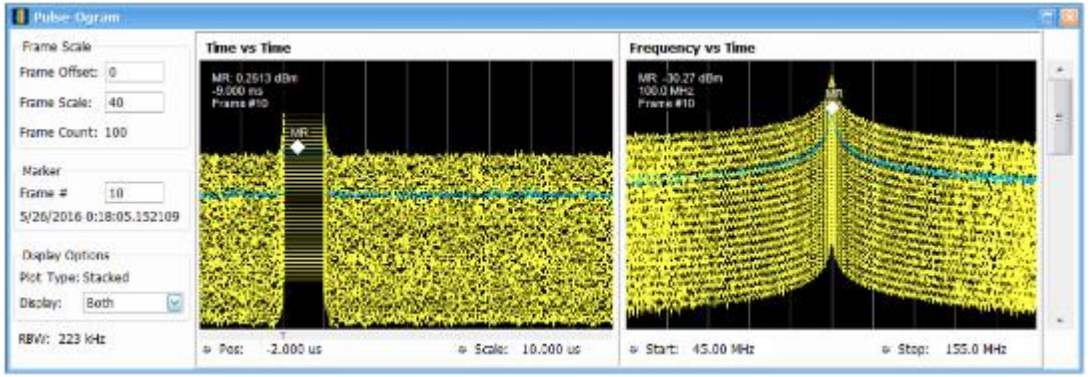
•Capture pulse trains of up to 10's of seconds long by leveraging the hardware DDCs on each MSO input.

Advanced Pulse Analysis (SignalVu Opt. SVP)

- ✓ Analyze 31 automated pulse parameter measurements and statistics over millions of pulses for deep insight into multi-emitter pulse train behavior (with upgrades to option SVP)
  - ✓ [NEW] Support for up to 8 phase-coherent channels







Pulse Statistics Table
Histogram and Pulse-Ogram™ to show outliers, target range, and speed

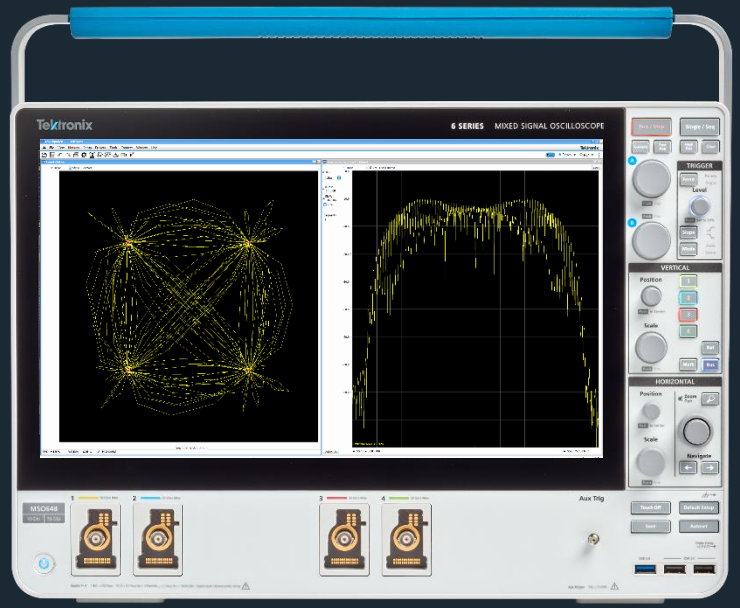
[NEW] Analyze 2+ RF pulse trains simultaneously

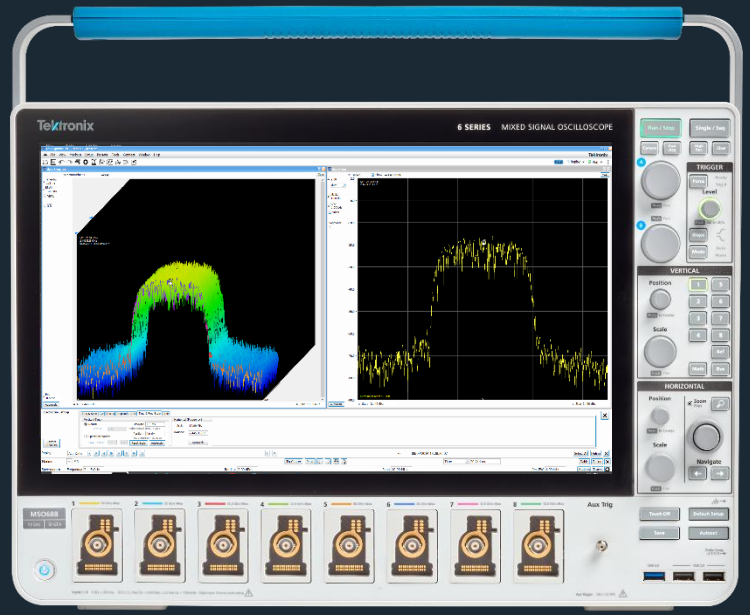
SignalVu multi-channel software differentiators

Unlike competing vector signal analysis (VSA) software offerings, Tektronix 5/6 Series B MSO with SignalVu-PC offers greater flexibility and usability for fast and accurate analysis.

- Independent RF controls like CF, Span, RBW across channels
- Independent time gating on each channel (Time Overview)
- Tight integration with oscilloscope triggering system
- Coupled and correlated markers across all 8 RF channels
- Full cross-domain analysis of time and frequency (simultaneously)
- Full simultaneous analysis of up to 8 phase-coherent channels

6 Series B Mixed Signal Oscilloscopes





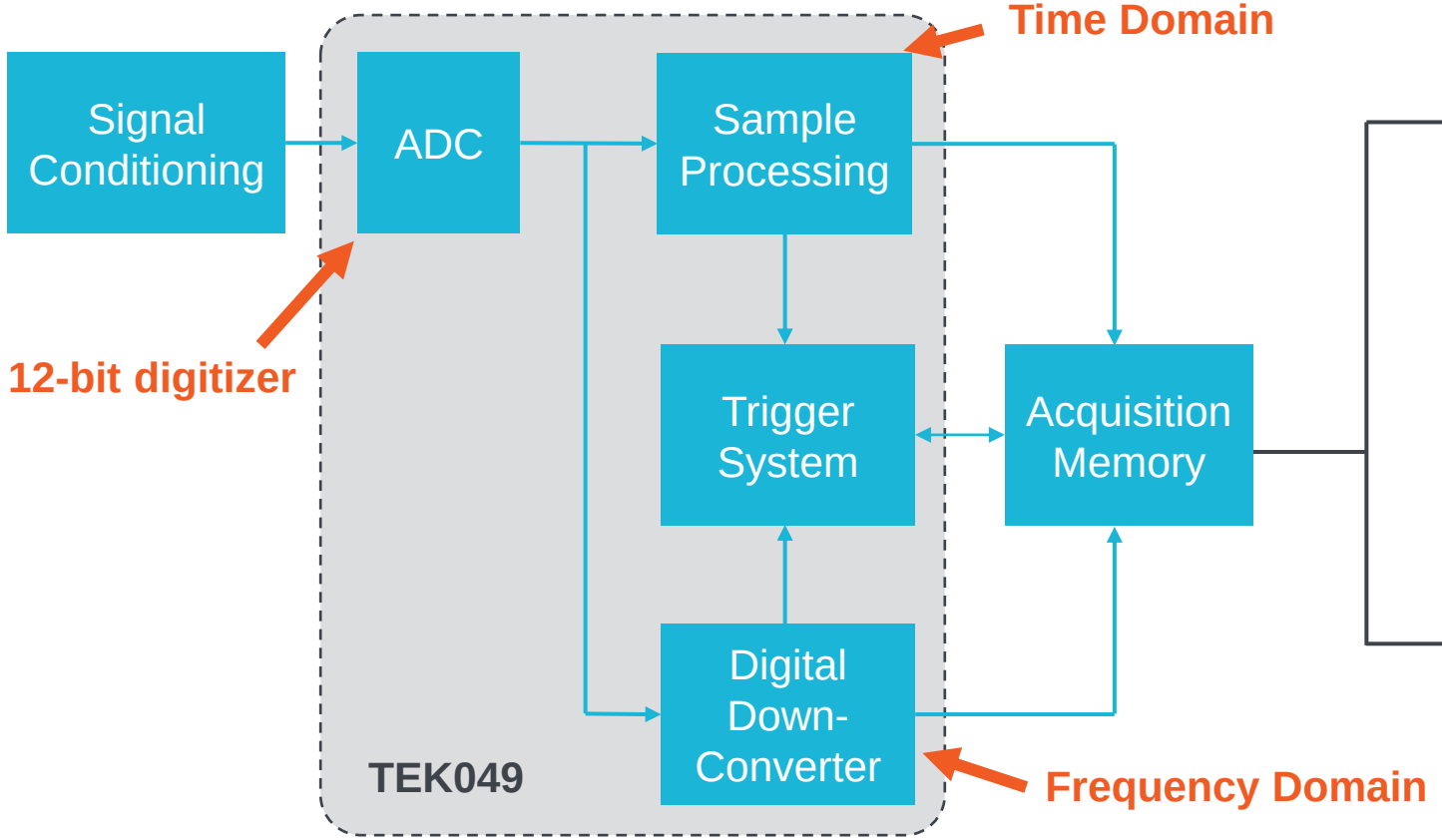
Up to 10 GHz bandwidth

Best signal fidelity with 12-bit ADCs and ultra-low noise

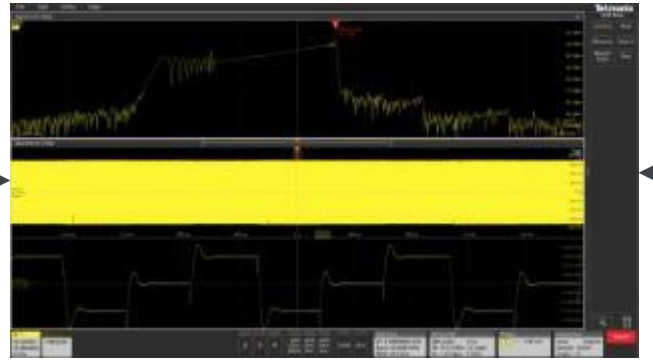
4, 6 or 8 FlexChannel™ inputs

Analyze and debug complex RF systems with these powerful, elegant instruments

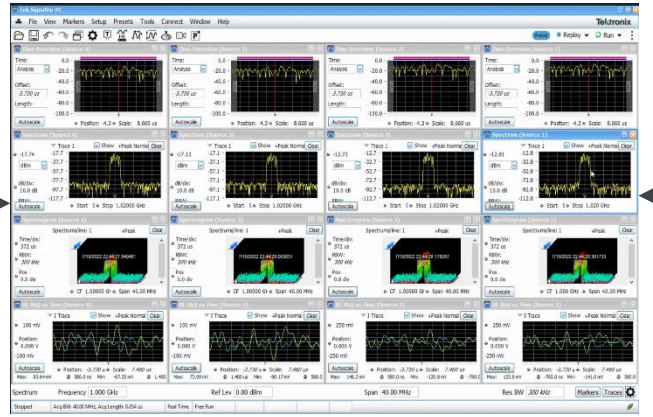
Technology behind the Tektronix MSO



Spectrum View Spectrum Analysis



SignalVu Signal Analysis (VSA)



NEW!

Patented architecture enables superior cross-domain analysis and triggering

SpectrumView

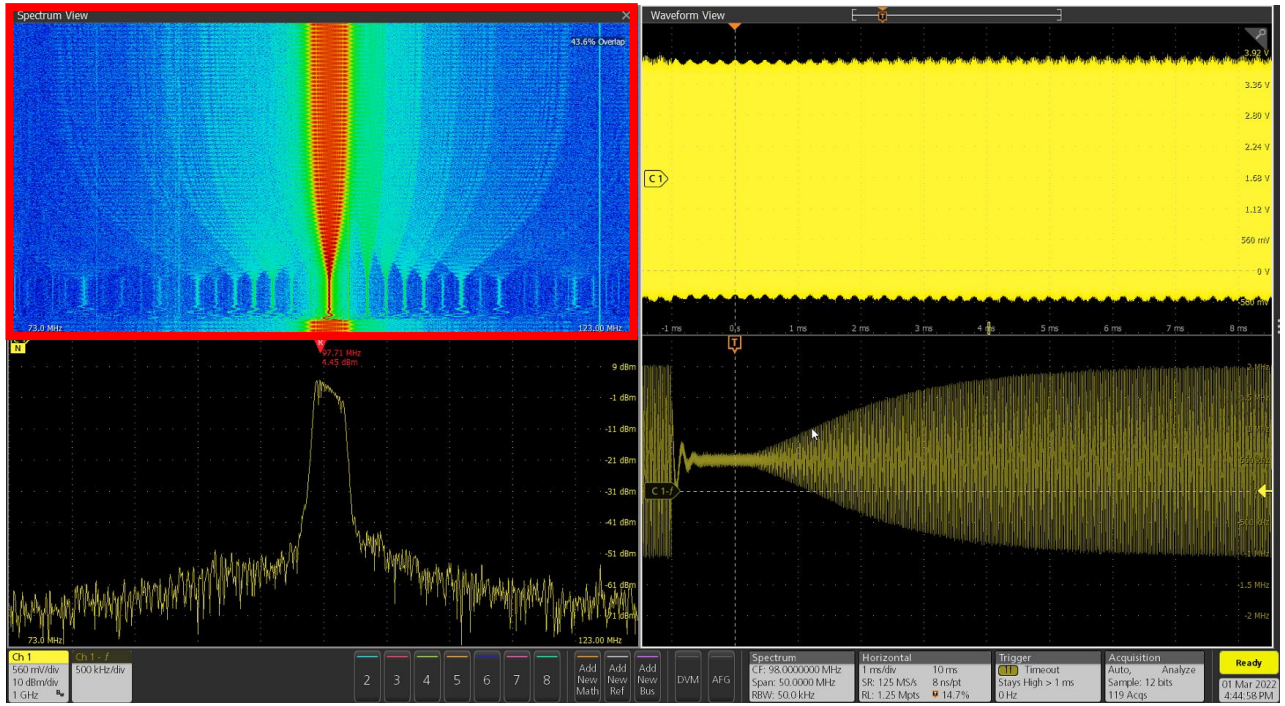
SPECTRUM VIEW ENHANCEMENTS FOR 4/5/6 SERIES MSO SCOPES

1. independent acquisition settings in each domain

- Center Frequency
- Span
- Resolution Bandwidth

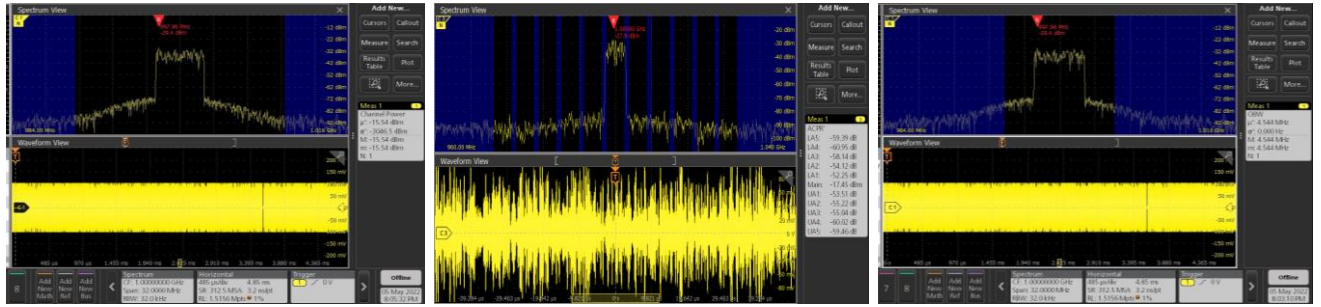
2. Spectrograms on each RF input

- View RF amplitude and frequency changes over time
  - To-be included with existing SV-RFVT or Ultimate Bundle options



3. RF Measurements:

- Channel Power (CHP)
- Adjacent Channel Power (ACP)
- Occupied Bandwidth (OBW)



Comparison of RF analysis tools

Spectrum View	*BOTH*	*SignalVu-PC*
• Multi-channel RF ◦ Same or different frequencies • Correlating RF to: ◦ Analog Signals ◦ Digital signals ◦ Bus signals ◦ Other RF signal • RF Triggering ◦ RF Magnitude vs Time ◦ Frequency vs Time • Measurements on RF vs Time	• Spectrum Analysis with familiar controls on each channel ◦ Center Frequency ◦ Span ◦ RBW • Spectrum Analysis vs Time • Basic Vector Signal Analysis ◦ RF Magnitude vs Time ◦ Frequency Deviation vs. Time ◦ Phase Deviation vs. Time	• Multi-channel RF Same or different frequencies • Comprehensive RF Analysis ◦ Spectrogram ◦ IQ vs Time ◦ Ch Power, OBW, ACPR, MCPR, etc. ◦ Freq/Phase Settling Time (SVT) • Detailed Vector Signal Analysis ◦ Modulation Analysis (SVM) ◦ Pulsed RF (Radar) Analysis ◦ Standards (WLAN, 5GNR, etc.)

Demo

SpectrumVu for Pulse Radar

SignalVu for Pulse Radar

Tektronix®

Tektronix®

TEK Service Solution
Service Team

June 12, 2023

Agenda

- TEK Care Service Plan
- TEK Manufacturer Calibration

TEK Care Service Plan

TEK Care Service Plan

WHAT IS TEK CARE SERVICE PLAN?

수리 및 교정 비용 절감을 위한 연간 계약 서비스 프로그램

TEK Care Service Plan

WHAT IS BENEFITS?

- 고장 등으로 인한 갑작스러운 수리비 문제 해결
- 수리비 대비 최대 90% 저렴한 서비스 비용
- 서비스 요청 시 우선순위 진행
- 최신 펌웨어 업데이트를 통해 장비의 성능을 항상 최상으로 유지
- 예측 가능한 비용으로 예산 편성 가능

TEK Care Service Plan

비용 절감 효과

MODEL	Repair Price	TEK Care Price	Cost Saving
MD034	5,940,000	838,000	86%
MD032	4,810,000	673,000	86%
MS044	6,400,000	1,350,000	79%
MS054B	11,000,000	1,390,000	87%
MS058B	11,000,000	2,320,000	79%
MS064B	17,000,000	2,030,000	88%
MS066B	20,700,000	2,560,000	88%
MS068B	27,400,000	3,390,000	88%
DP05054B	10,100,000	1,580,000	84%
DP05104B	12,400,000	1,930,000	84%
DP07054C	12,400,000	2,000,000	84%
DP07104C	15,500,000	2,500,000	84%
DP07254C	20,900,000	3,370,000	84%
DP071254C	37,700,000	10,900,000	71%
DP072004C	54,600,000	14,100,000	74%
DP072304SX	63,700,000	15,900,000	75%
DP073304SX	72,200,000	18,000,000	75%
DP072304DX	59,500,000	14,900,000	75%
DP073304DX	63,700,000	15,900,000	75%

MODEL	Repair Price	TEK Care Price	Cost Saving
P6015A	2,800,000	243,000	91%
P6243	2,820,000	393,000	86%
P6245	3,890,000	528,000	86%
P6248	5,600,000	772,000	86%
P7506	5,720,000	1,260,000	78%
P7508	5,720,000	1,240,000	78%
P7513A	5,950,000	964,000	84%
P7516	6,010,000	1,620,000	73%
P7625	12,800,000	1,580,000	88%
TCP202A	2,040,000	268,000	87%
TCP305A	1,920,000	261,000	86%
TCP312A	1,920,000	215,000	89%
TCP0030A	2,750,000	408,000	85%
TCPA300	2,350,000	268,000	89%
TIVP05	5,350,000	1,430,000	74%
TPA-BNC	1,180,000	255,000	78%
TPP1000	1,200,000	315,000	74%

TEK Care Service Plan

HOW TO START?

- 이미 TEK Care Service Plan(혹은 보증 기간 내)을 이용하고 계신 고객은 별도 조건 없이 즉시 가입 및 연장 가능
- TEK Care Service Plan 가입 요청 시 전문 엔지니어의 점검 후 가입 가능
- 프로브는 고장 발생 시 새 제품으로 교환

TEK Manufacturer Calibration

TEK Manufacturer Calibration

WHAT IS TEK MANUFACTURER CALIBRATION?

- 해당 모델의 **제조사가 보증하는 모든 기능**에 대한 교정 및 조정
- 교정 중 장비의 기능 점검, 고장 유무 확인 후 필요시 즉시 조치 가능

TEK Manufacturer Calibration

WHAT IS BENEFITS?

- 제조사 교정을 통해 오계측 방지 및 측정 데이터의 신뢰성 향상
- 조정(Adjustment) 및 펌웨어 업데이트를 통해 장비의 상태를 최상으로 유지

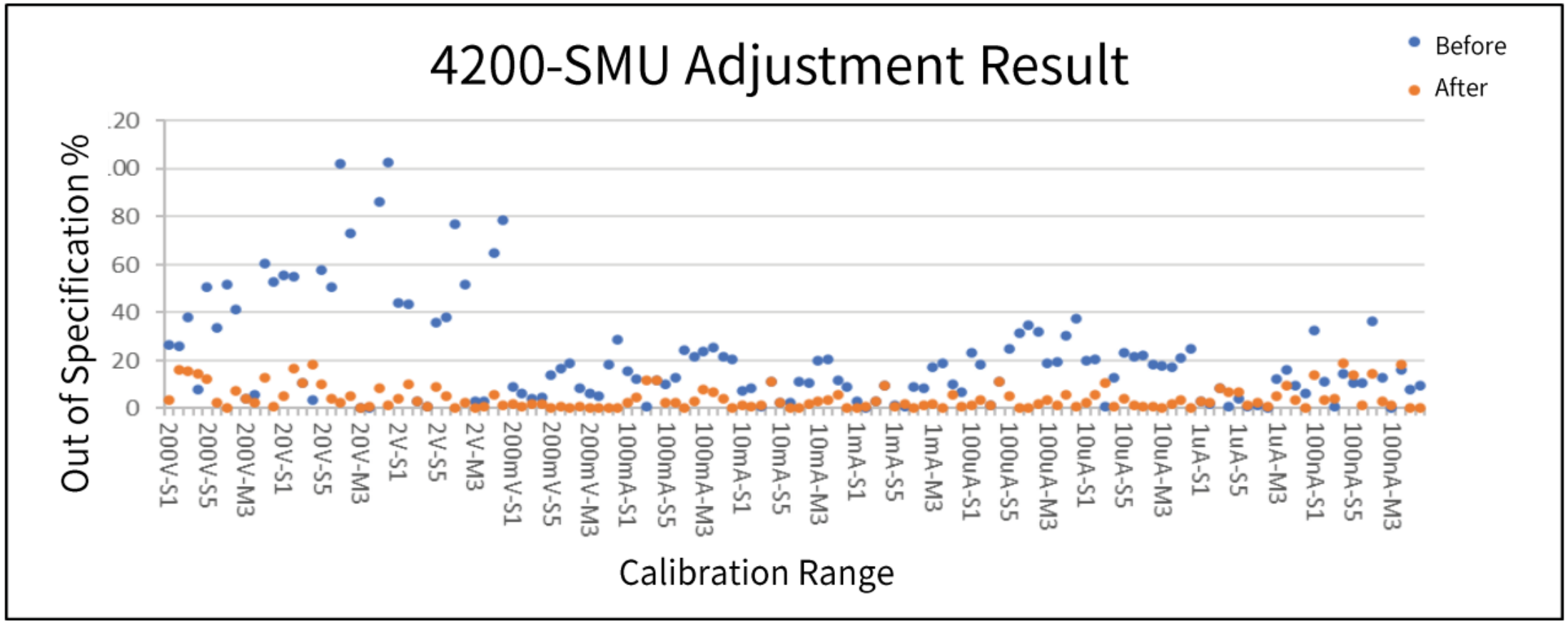
TEK Manufacturer Calibration

CALIBRATION : TEK VS KOLAS

교정 서비스 비교	텍트로닉스 교정	일반 교정
공식 교정 소프트웨어	공식 제조사 시스템	X
조정 (Adjustment)	공식 제조사 시스템	X
테스트 포인트	제조사 보증 전체 항목	일부 항목
기능 테스트	제조사 보증 전체 항목	일부 항목
캘리브레이션 데이터 리포트	제조사 보증 전체 항목	일부 항목
장비 이상 시 즉각 조치 가능	공식 서비스 센터	X
제조사 교정 데이터 관리	CalWeb Cloud 시스템	X

TEK Manufacturer Calibration

CALIBRATION SAMPLE



THANK YOU

Contact Information

류수열 부장

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010 – 5447 – 2453

TEK.COM