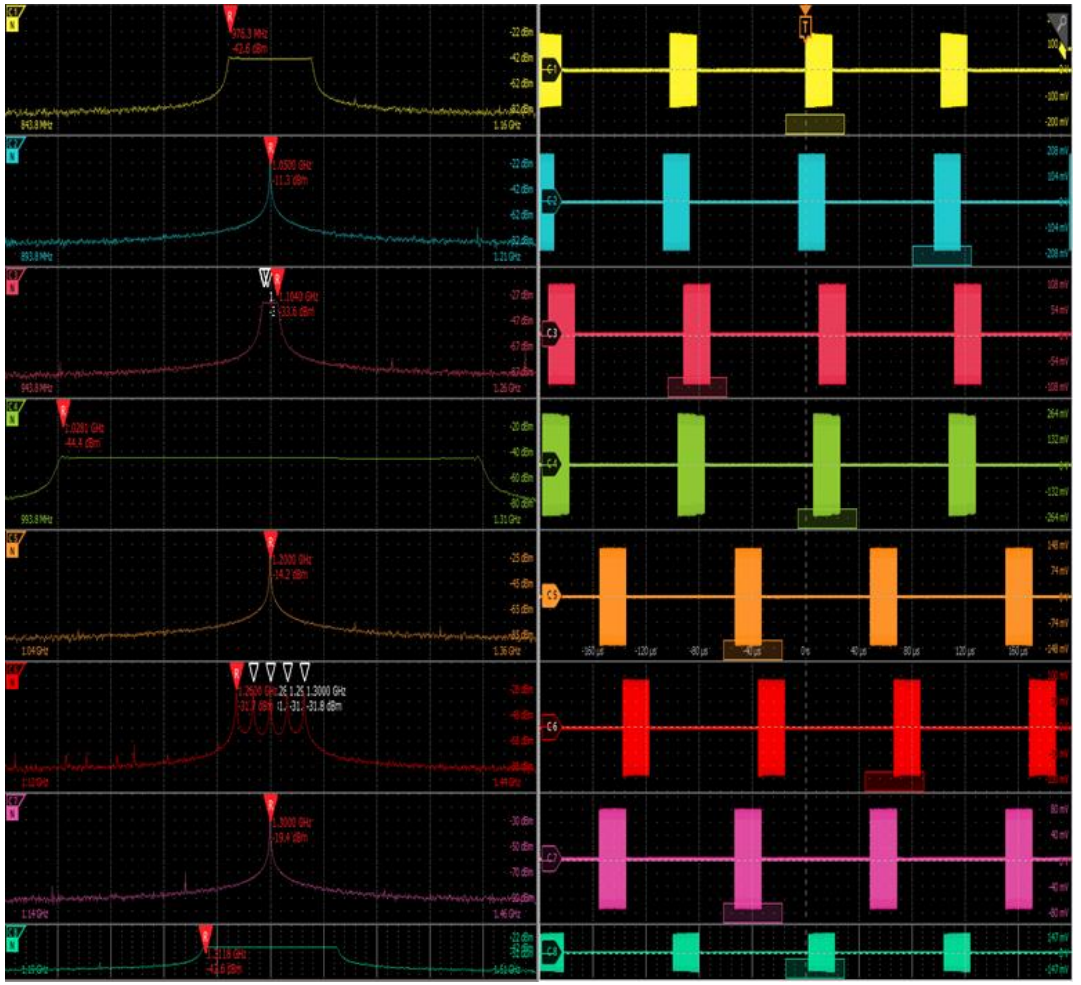
Tektronix®

Signal Analysis for Complex EW and Spectrum Manag.

July 3, 2024

Multi-Channel RF Analysis on MSO6B

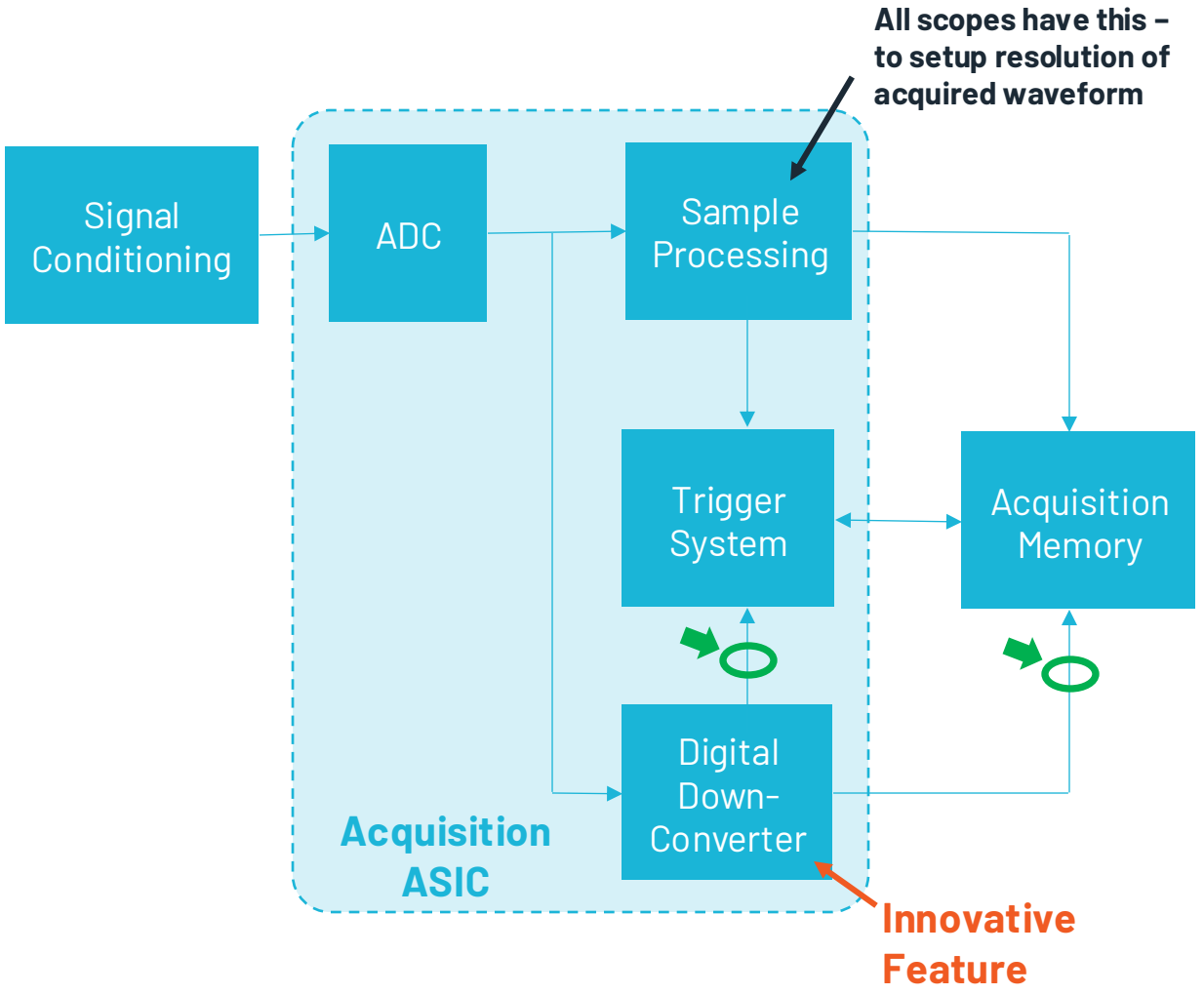
- Simultaneous time/phase correlated RF capture across multiple channels
- RF recording multiple sensors
- Beam steering
- MIMO applications
- EA: Threat/Response systems
- Same or different center frequencies across channels
- Frequency conversion / mixers
- Dynamic Harmonic/IMD generation
- Time correlated spurious RF



DDC Integration into Acquisition ASIC

INNOVATIVE TECHNOLOGY

- Signal processing path
- Hardware DDC
- IQ Baseband acquired for each channel – with Trigger capability
- Time correlated to analog capture
- Spectrum Processing vector independent of analog signal path
- Wide RF acquisition bandwidth
- On ALL channels!
  - Same or different center frequencies



NEW! Multi-Channel RF, IQ, Pulse Analysis

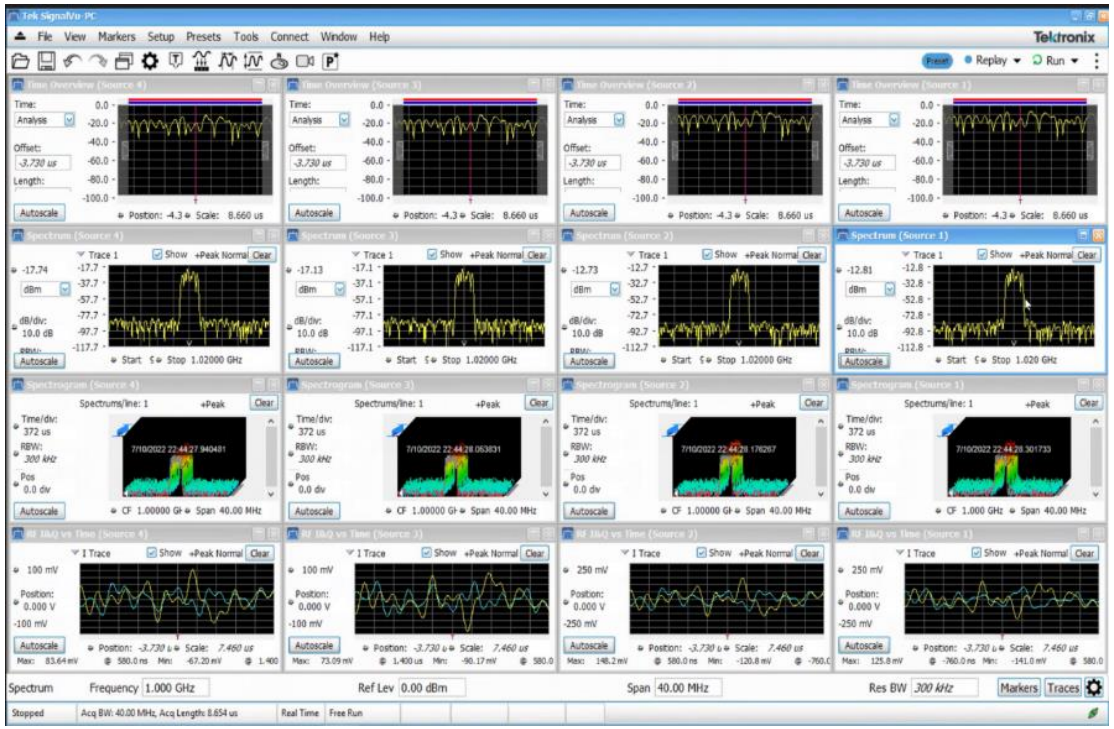
INNOVATIVE TECHNOLOGY

- Applications: Uplink/downlink systems
- Multi-channel or multi-frequency radar transmitter validation
- IQ-based downconverter validation
- Key Features:
  - Up to 8 simultaneous 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

6 Series B MSO

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

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

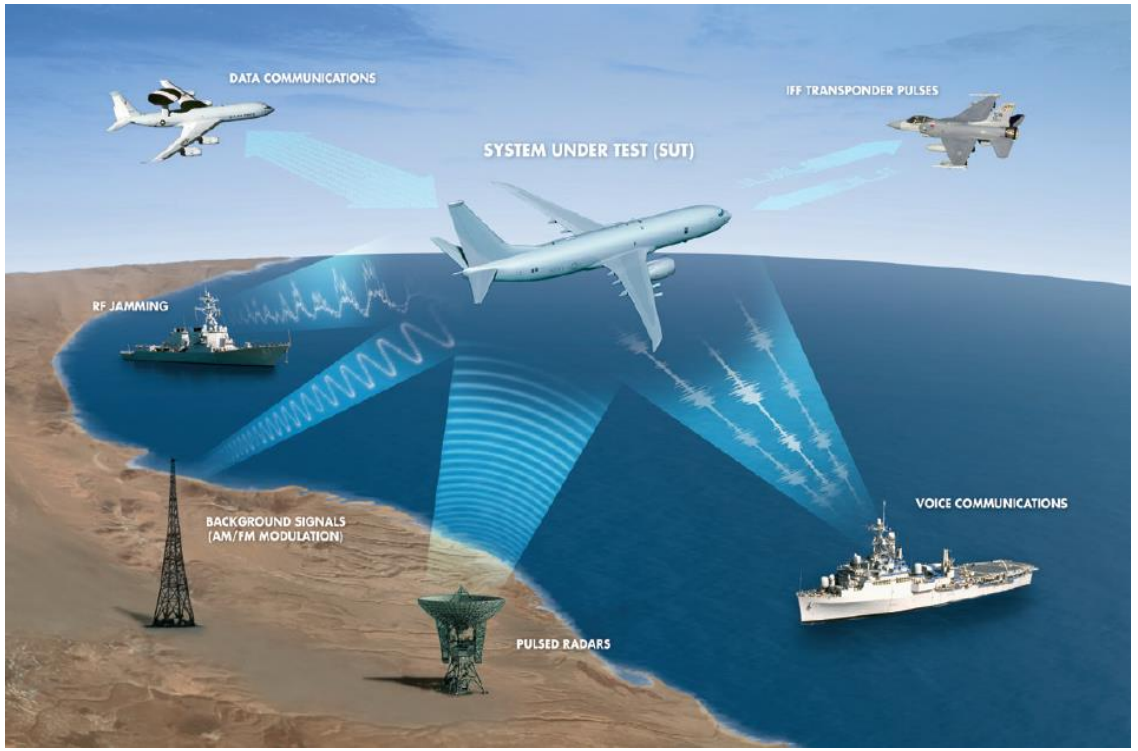


Demo 1: Multi Channel Analysis

Multi – Threat EW Scenario

RADAR CENTRIC SIGNAL GENERATION

- Very similar to RADAR needs, plus…
- Active Stimulus: Response signal generation
  - EA (electronic attack) activity: Environment, etc.
- Advanced RADAR Techniques
  - EP (electronic protection) operate in presence of EA activity



Summary: Instrumentation needs for EW are very similar to RADAR, more emphasis on flexible generation, signal recording, etc.

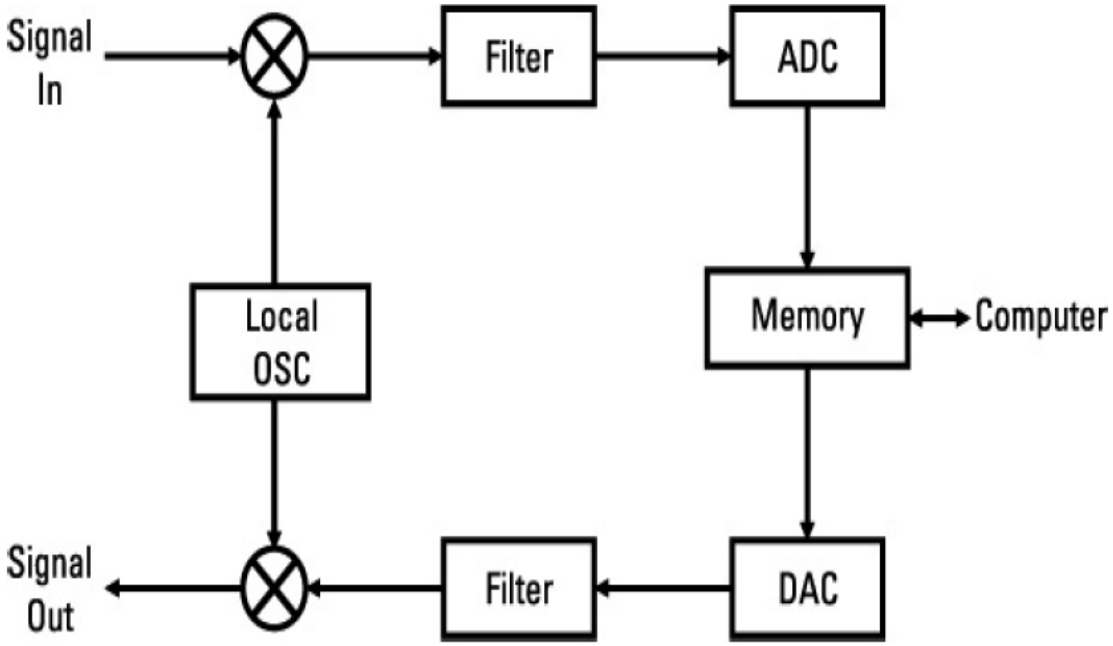
Demo 2: Multi Threat Analysis

DRFM radars

DIGITAL DUPLICATE

- The DRFM digitizes the received signal and stores a coherent copy in digital memory. As needed, the signal is replicated / modified and retransmitted. Could be Single Channel / multiple channel to handle multiple threats .
- One Example is **VGPO**

  Velocity Gate Pull Off



Courtesy: EW 103 by David L. Adamy

Deception Jamming

DECEPTIVE TECHNIQUES: RANGE GATE PULL-OFF" , "INBOUND RGPO"

- **Range gate pull-off** **:** self-protection technique that requires knowledge of the time of arrival of pulses at the target being tracked by the radar
- Jammer emits a false return pulse that is delayed from the reflected radar pulse by a gradually increasing amount
- Since the radar determines the range to the target by the time of arrival of reflected pulses, this technique makes the radar "think" that the target is farther away than it actually is.
- The effect is to deny the radar accurate range information. This technique requires 0-6dB j/s ratio.

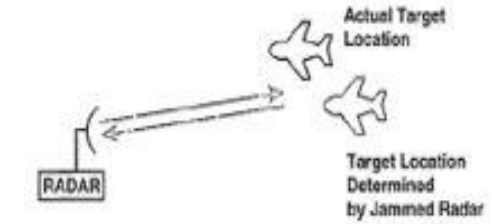


Figure 9.4 Deceptive jamming interferes with the radar's processing to create false information about the target's location or speed.

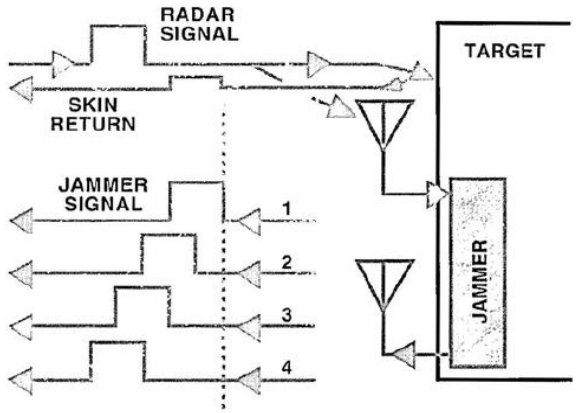


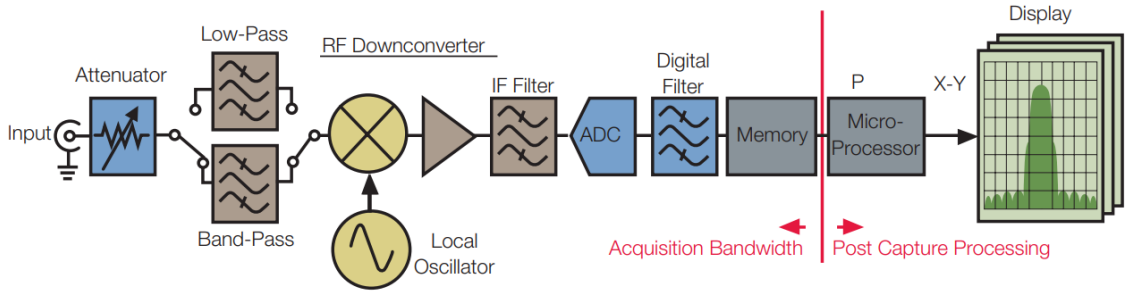
Figure 9.17 The range gate pull-off jammer transmits a higher-power return signal and delays it by an increasing amount.

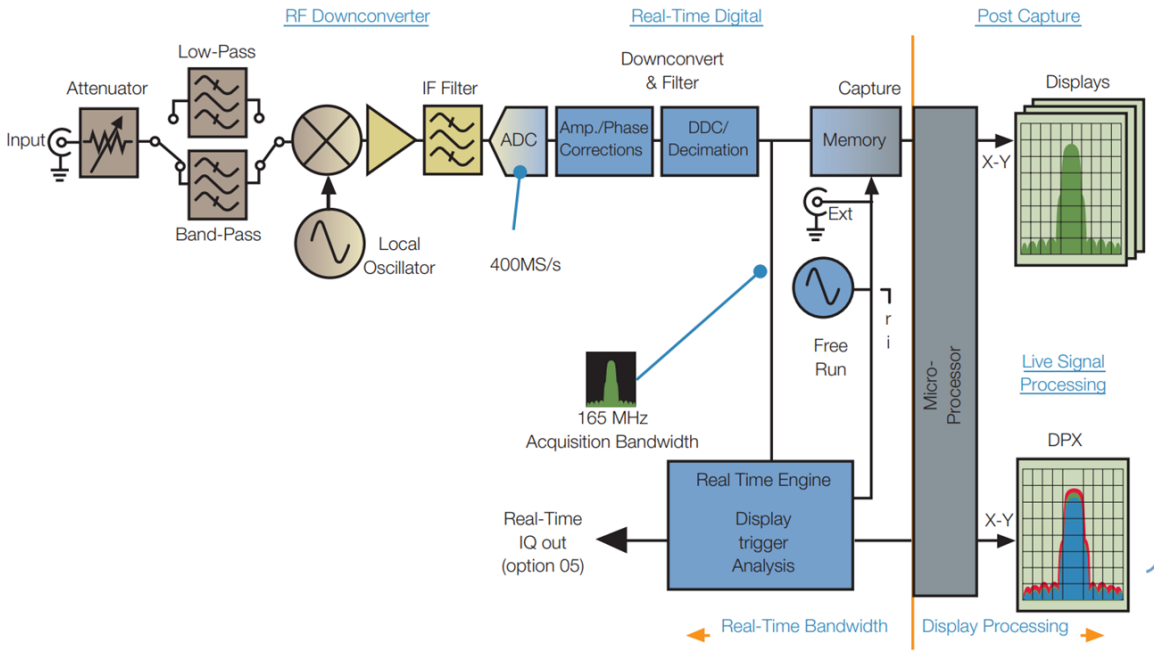
Courtesy: EW 103 by David L. Adamy

Demo 2, part2:
RGPO

Real Time Technology Architecture

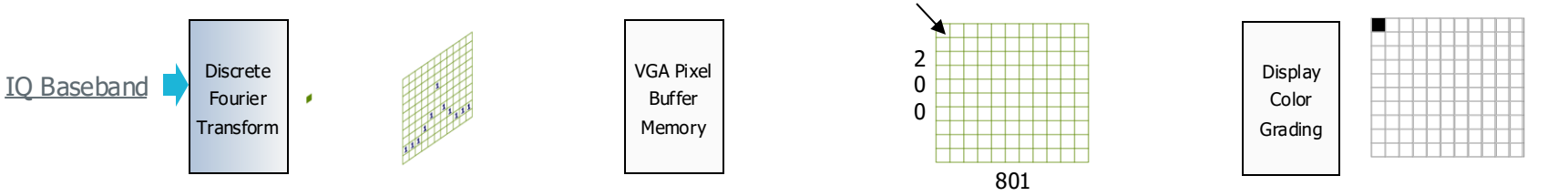
VSA VS REAL TIME

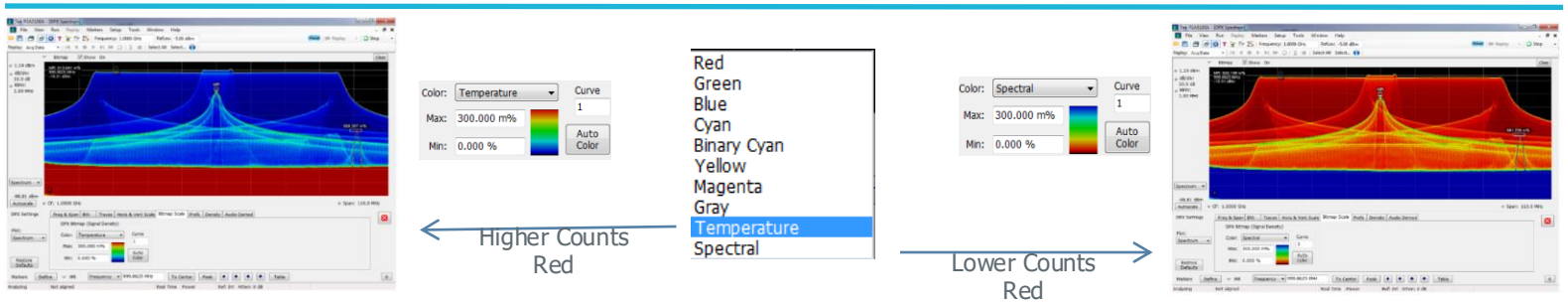




The DPx HW Transform Engine Technology

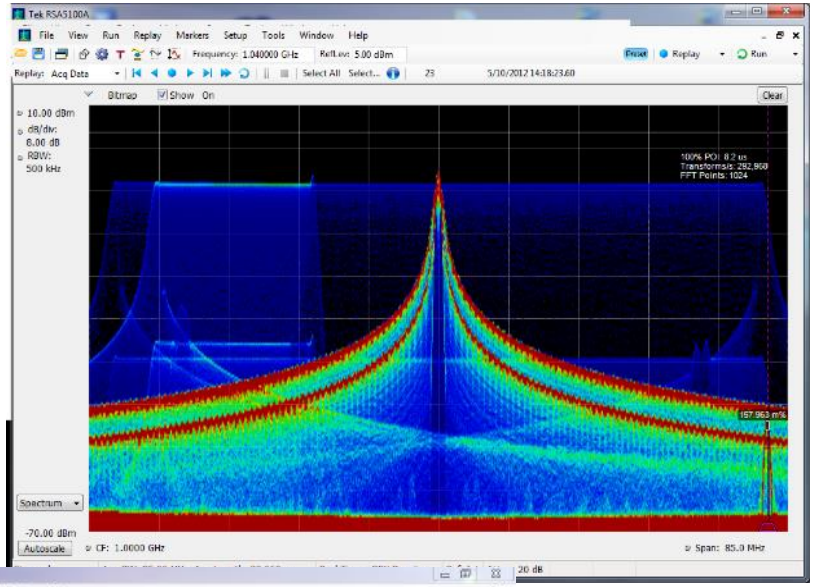
REAL-TIME DISPLAY PROCESSING:

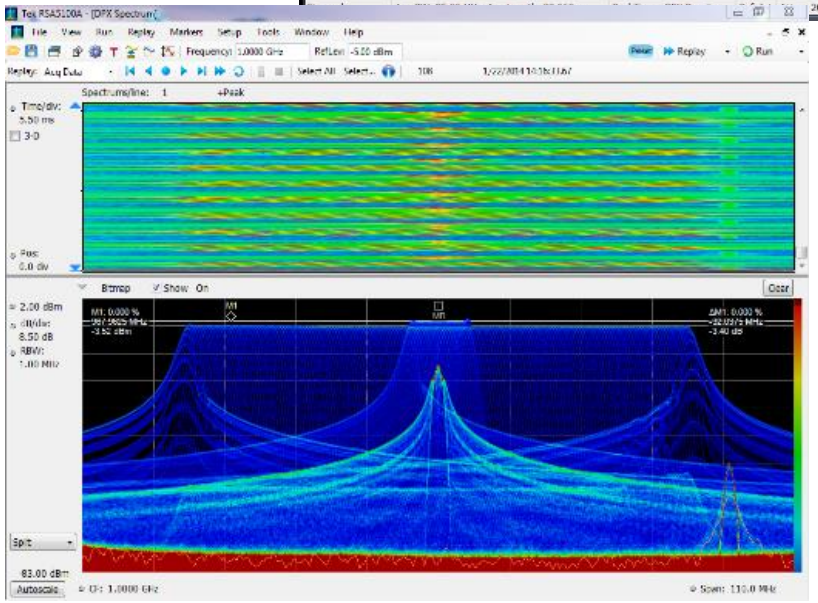


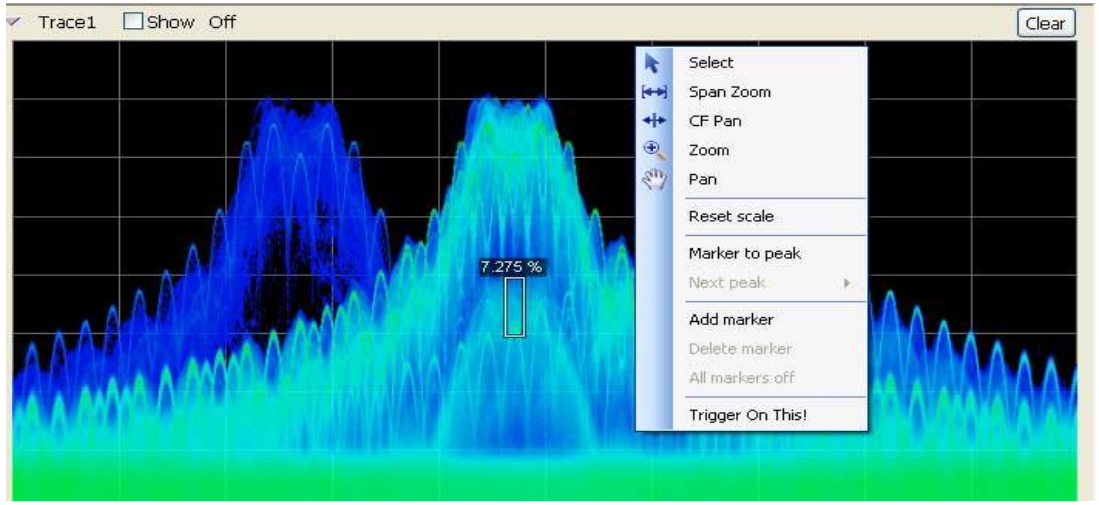


DPX Spectrum , DPXogram

- Highest spectrum rate: 3.125M/s
- Shortest event duration for 100% Probability of Intercept: 232ns
- Swept DPX
- Most flexible Span & RBW settings

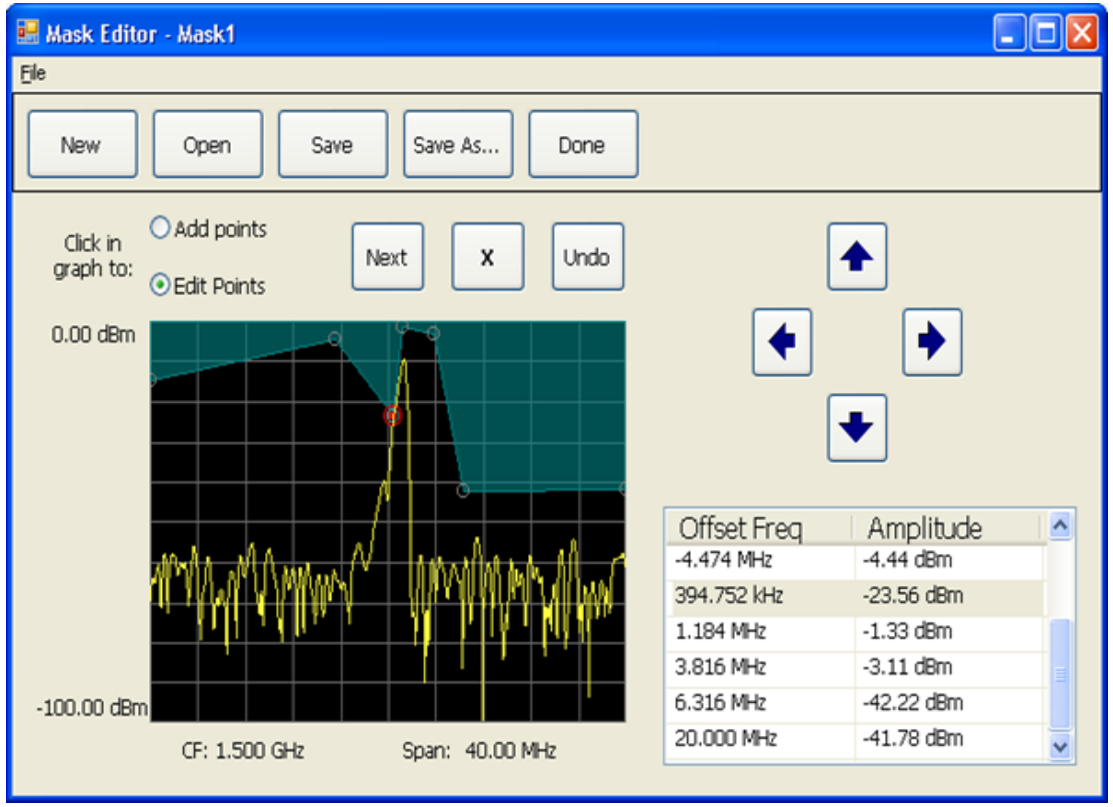






Powerful Triggering

- **Frequency Spikes Detection**: *Triggers when any frequency exceeds a specified threshold, crucial for RF interference, spectrum monitoring, and compliance testing.*
- **Absence of Specific Frequencies**: *Activates when frequencies are entirely below a certain level, essential for environments needing complete frequency absence, like secure communication channels.*
- **Signal Drop-out Detection**: *Triggers when a signal within a designated range unexpectedly drops out, useful in electronic equipment testing.*
- **Signal Appearance Monitoring**: *Activates when a signal enters a specified range from outside, important for scenarios like astronomical observations or unauthorized frequency detection.*
- **Spectrum Monitoring and Management**: *Activates on the second transition when a signal exits a monitored range, critical for understanding signal sources and confirming interference mitigation.*



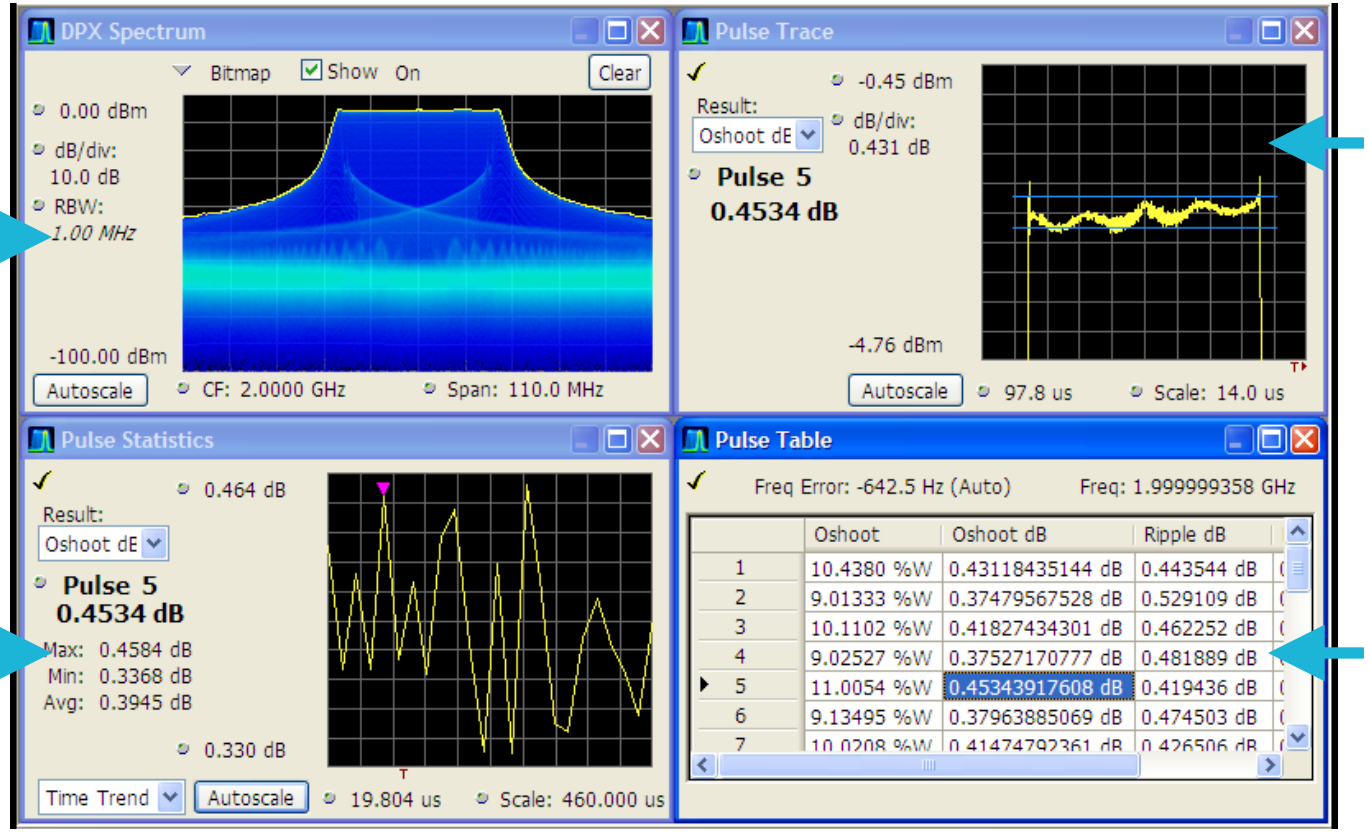
Demo 3:
Radar Sweeper

Radar Signature (Pulse measurements)

SIMULTANEOUS WITH SPECTRUM AND SIGNAL ANALYSIS

DPX detects anomalies in pulse streams

Trend plots and statistics available for each pulse measurement



31 pulse measurements available including average on power, peak power, pulse width, rise/fall time, repetition interval, duty factor and many more

Pulse Table shows all 31 measurements for up to 200,000 pulses (fast-frame)

Pulse Measurements

ADVANCED PULSE-PULSE AND CUMULATIVE ANALYSIS

- Pulse-ogram
- Amplitude vs. time
- Spectrum vs. time
- Works with Fast Frame only
- Cumulative Statistics
- Table
- Histogram
- …millions of pulses…

Demo 4:
Pulse analysis
Pulsogram
fire control radar

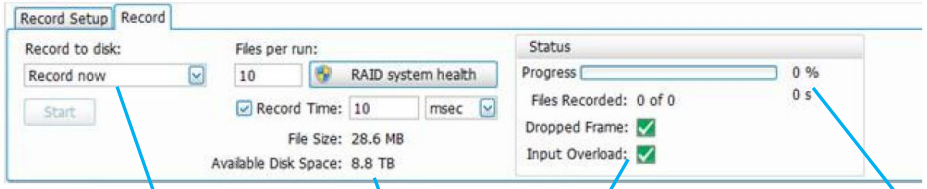
Wide Band Signals Recorder+Analyzer

- Wideband RF Signal Analyzer and Streaming Recorder
- Broad Frequency Range 16 kHz - 14/26.5 GHz
- Up to 800 MHz acquisition bandwidth (320 MHz standard) for advanced radar, communications and spectrum management
- Leading pulse measurement capabilities
  - Trigger on and measure signals of 232 ns duration in frequency domain in real time
  - Trigger re-arm time of 10 µs

Tektronix RSA7100B

RECORDING TIME SPECS

Acquisition Bandwidth (MHz)	Max. Recording Time	
	Opt C7100-B	Opt C7100-C
>320 to 800 MHz	20 min	2 hr.
>160 to 320 MHz	40 min	4 hr.
>50 to 160 MHz	80 min	8 hr.
>40 to 50 MHz	160 min	16 hr.
>20 to 40 MHz	320 min	32 hr.
>10 to 20 MHz	10 hr	64 hr.
10 MHz	20 hr	128 hr.



Recordings can start from a trigger, or manually

File size indication and available disk space

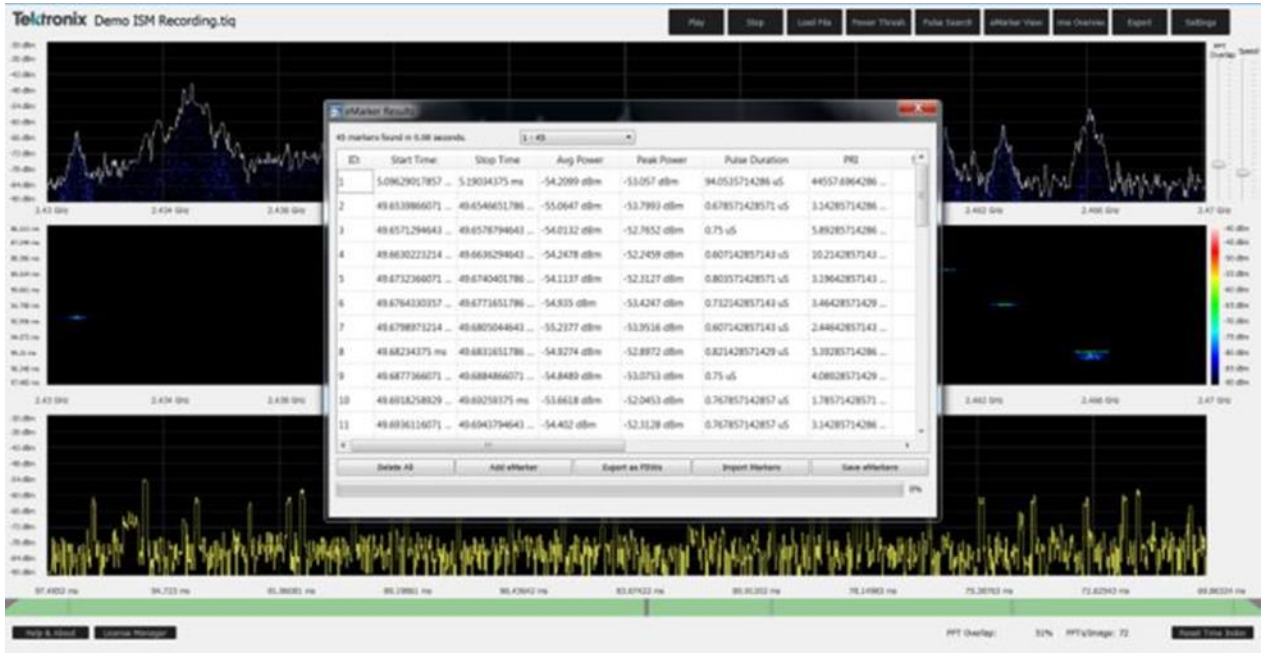
Recording quality indicators report overload conditions and dropped frames

Progress bar indicates time and % of file remaining

DataVu-PC: PULSE license

2,000,000 PULSES

- Start/stop time, average power, peak power, pulse duration, PRI and start/stop frequencies for each pulse. Pulse parameters can be exported as PDWs or .emrk for use with other tools.



RSA7100B Real Time Analysis

- Benefits of RTSA Technology in Capturing, Visualizing, and Triggering on Threats and ECM Responses
- Quickly discover/characterize:
- True RF Signature of SOI in Spectrum and Frequency/Amplitude/Phase vs Time Domains
- Physical characteristics of SOI even if hidden within or under other signals
- Validate threats and countermeasure response during operational testing (Data Streaming)
- Threat Stimulus signals and operational Mode
- Countermeasure Technique Responses
- Know that your captured data streams are of the quality you need to perform after action/capture analysis.

Simultaneous Multi-Domain Operation

IMPORTANT RSA DIFFERENTIATING FEATURE

- Traditional tools are mode driven:
- Spectrum Analyzer mode
  or
- Real-time / streaming mode
  or
- Vector Signal Analysis mode/app
  or
- Modulation Analysis mode/app
  or
- Pulse Analysis mode/app
- Triggering **limited** in some modes

- **RSA** allows **simultaneous**:
- Spectrum Analyzer
- Real-time Spectrum / Zero Span
- Vector Signal Analysis
- Modulation Analysis
- Pulse Analysis
- Streaming
- Triggering

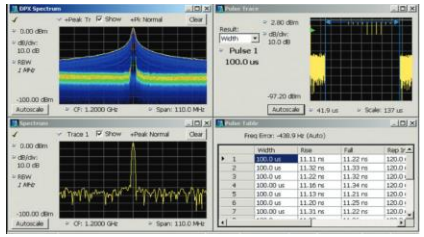
Demo 4: Wide Band Recording DataVu PC

The Full RF Dedicated Portfolio

Threat Simulation /EW

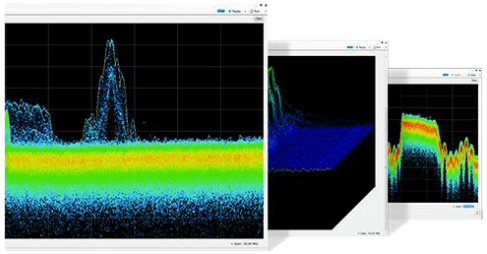
With ultra-wide instantaneous bandwidths, generate Radar and Scenario with AWG and analyzer with Real-Time oscilloscopes

RADAR Analysis Across Domains



Up to 70 GHz real-time bandwidth, using cross-platform VSA Software Signalvu-PC and Pulse Analysis Option.

Spectrum Monitoring, SIGINT & Recording



With DPX® technology, you can see RF characteristics invisible to a conventional spectrum analyzer. Wide Real-Time Bandwidth available for Monitoring and Recording for hours.

Remote, Distributed Signal Capture and Analysis

Ruggedized, small form factor up to 18GHz w/ data analysis capabilities

A Summary for Today

- Please consider:
  AWGs as a valuable tool for multi threat , wideband , fine phase control, Fast switching between waveforms .

  RSAs as valuable tool to understand dynamic behavior of Radar signal using Specific Triggers and Real time capabilities .

  MSO68B oscilloscope as valuable tool for debugging complex RF / radar systems using Time and Freq domain correlation on 8 independent and simultaneous channels with DDC

See you soon!