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VSA Considerations for Traditional and Ultra-Broadband Applications

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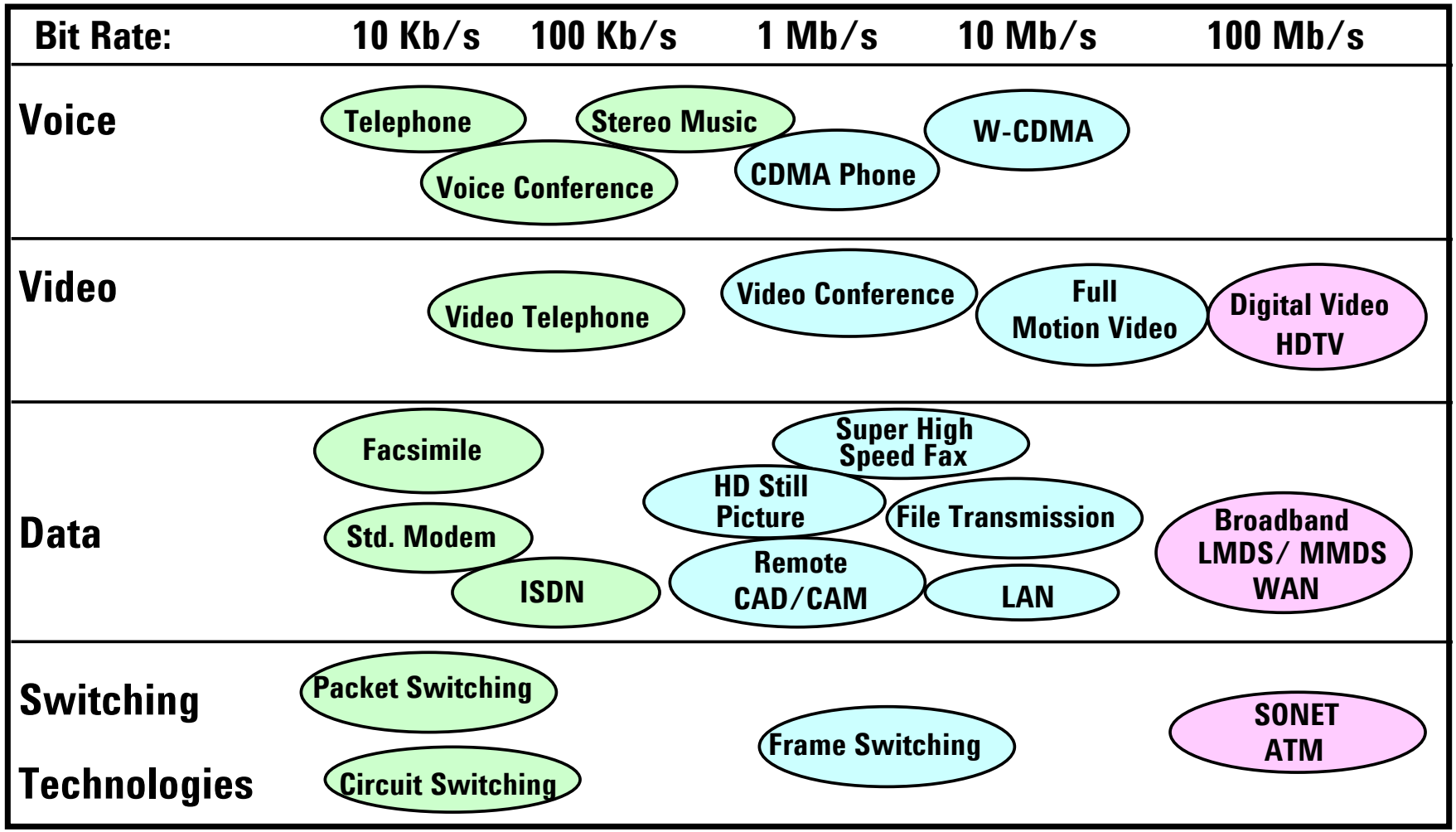
Current Communication Services and Bit Rate



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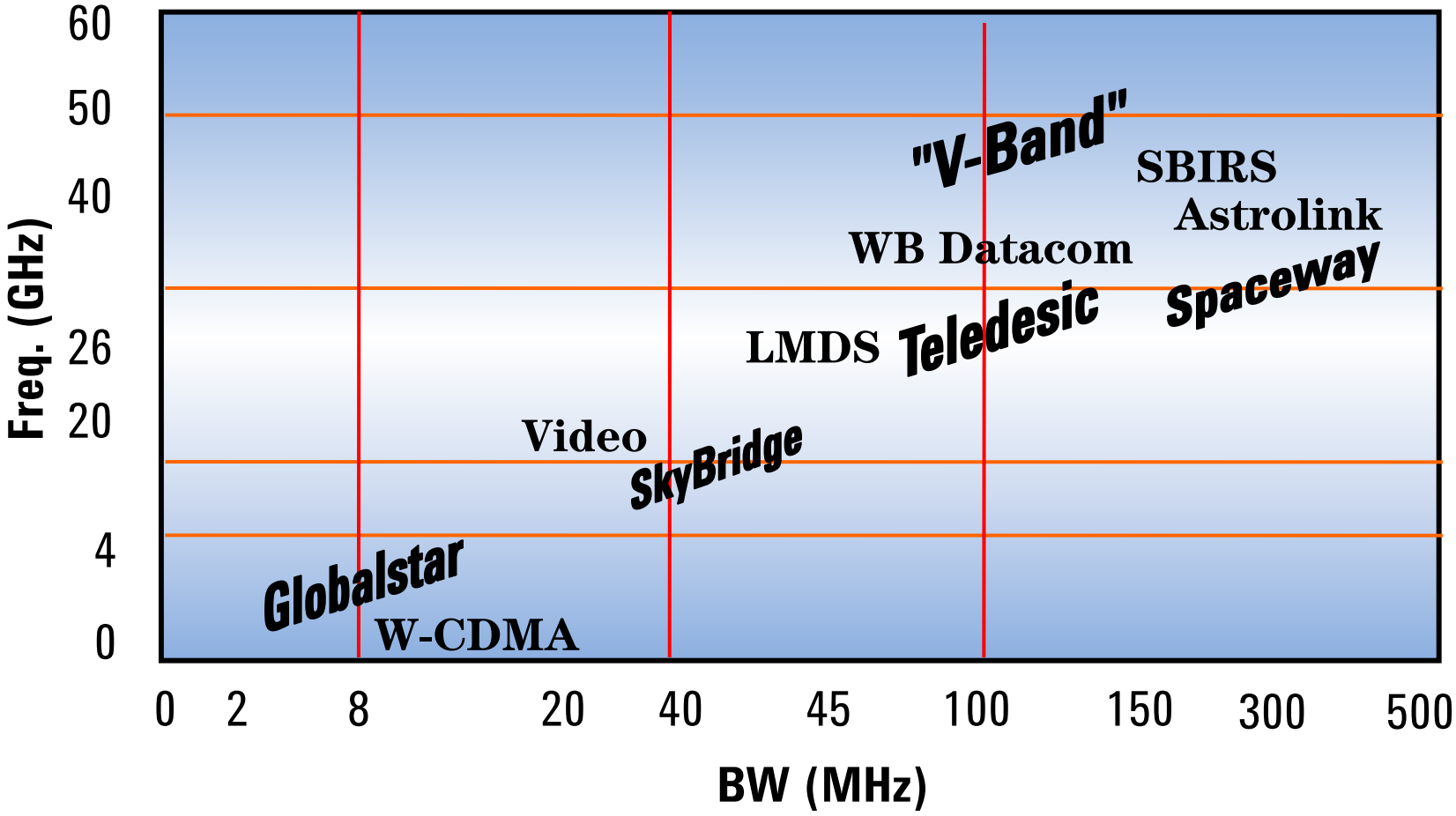
Future Communication Services and Signal Bandwidth



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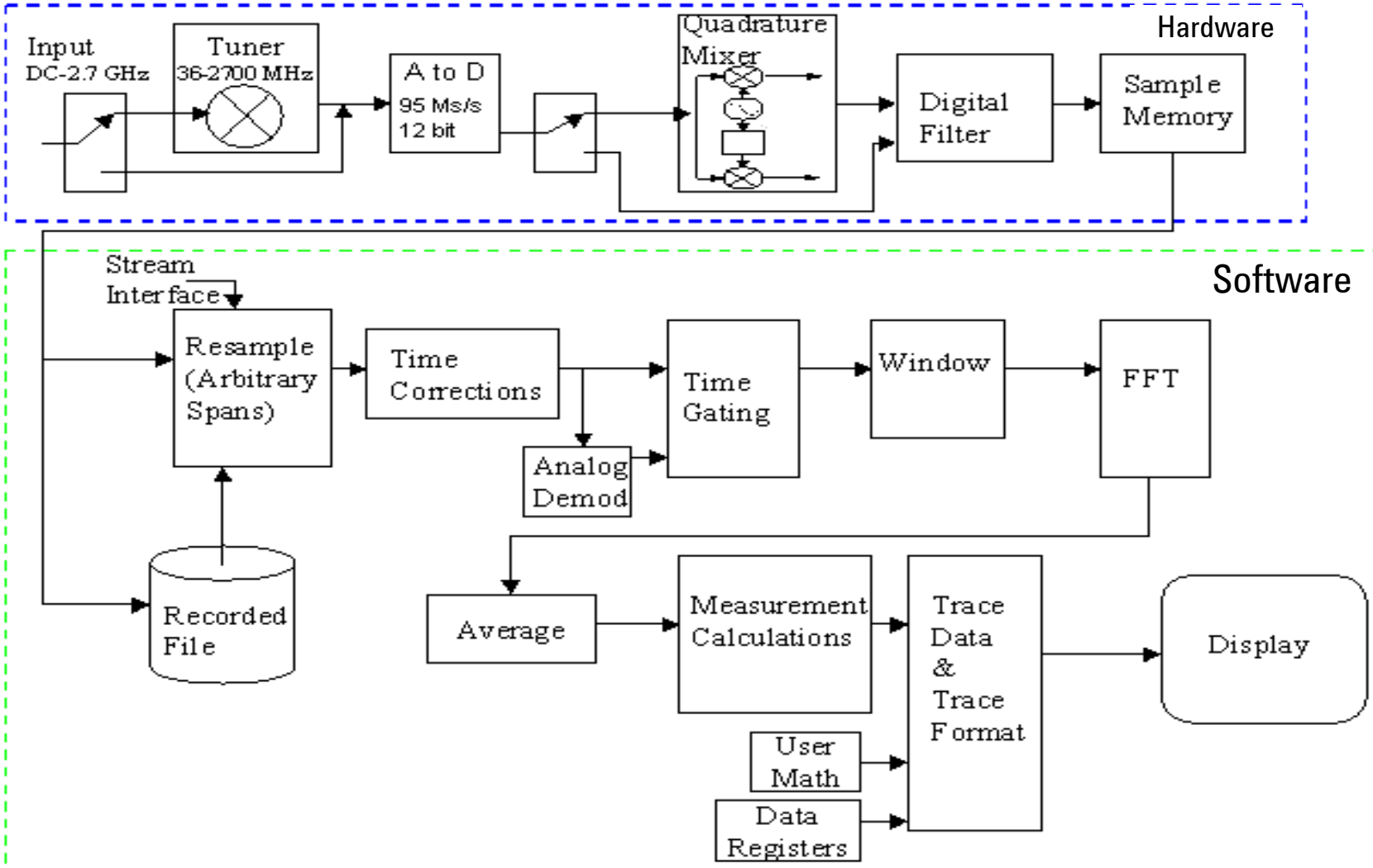
Traditional Instrument

Vector Signal Analyzer c. 1993

Agilent 89400 Series
Vector Signal Analyze

- 2700 MHz freq. range
- 7 MHz meas. BW
- Built-in signal capture memory
- Wide selection of flexible demodulators
- Built-in equalizer
- Many time-, freq-, mod-domain displays

VSA Architecture



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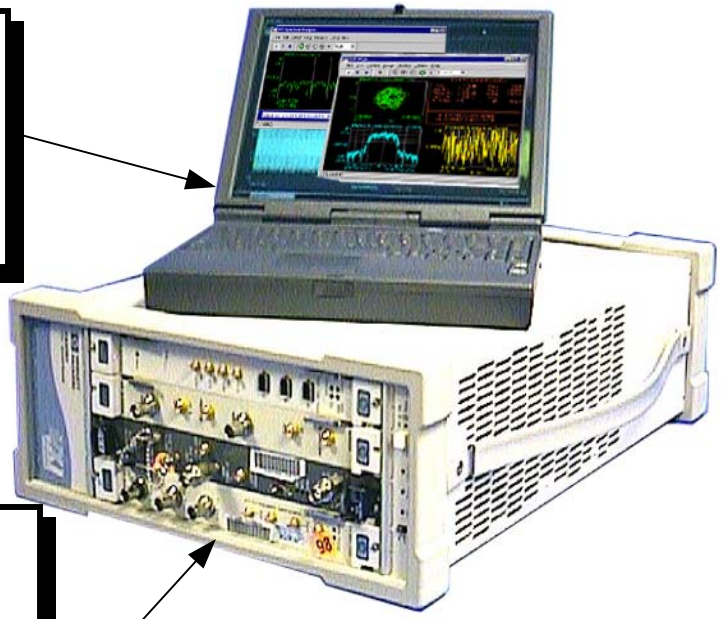
A Systems Optimized

Wide-Bandwidth Vector Signal Analyzer c.2000

COMPUTER
- Analysis DSP
- Display

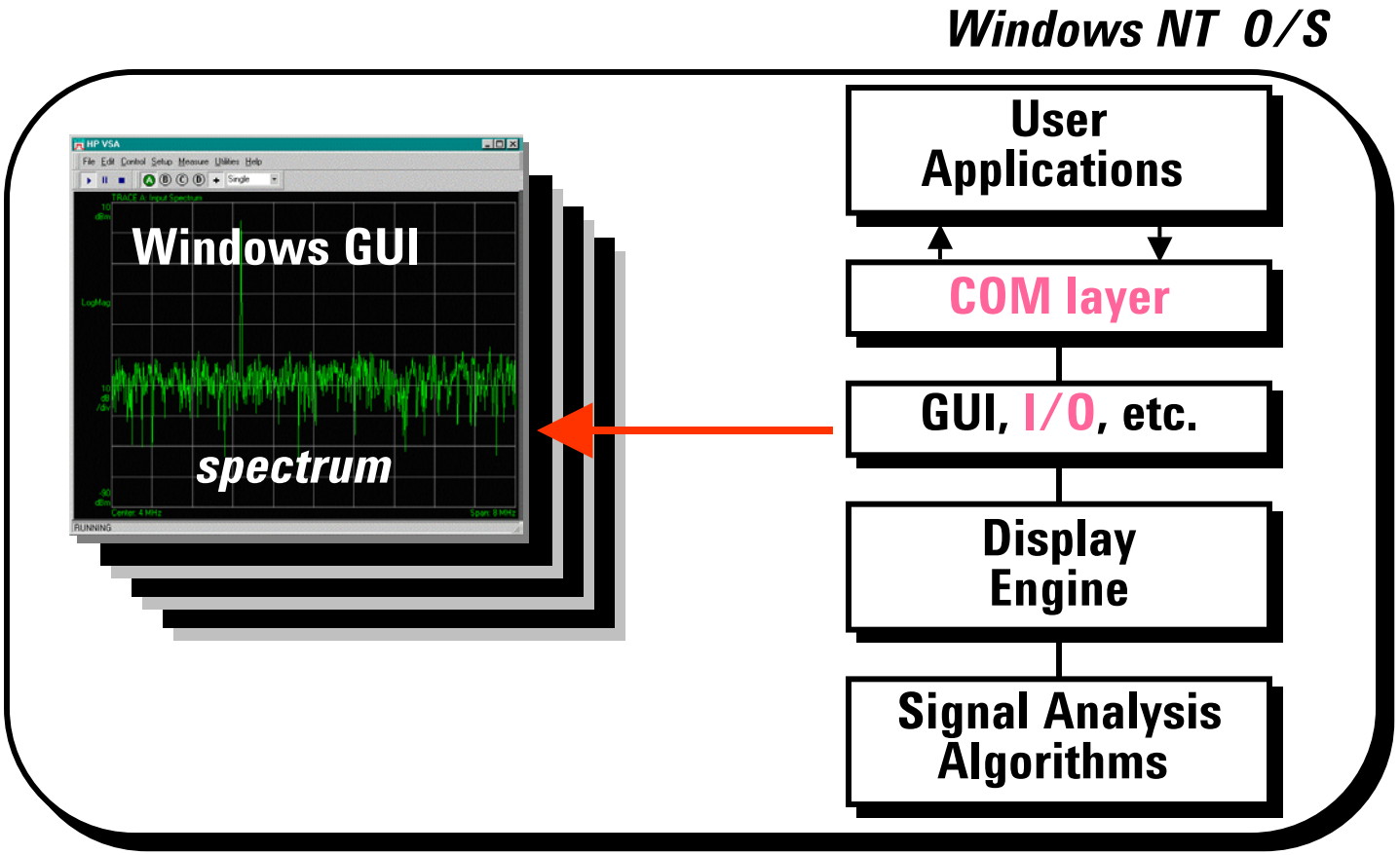


- 2700 MHz freq. range
- 36 MHz meas. BW

VXI Rack
- RF Tuner
- A/D Converter + Tune-Zoom DSP + Calibrator

Agilent 89600 Series Vector Signal Analyzer

Open System Architecture



Front End → digitized waveform

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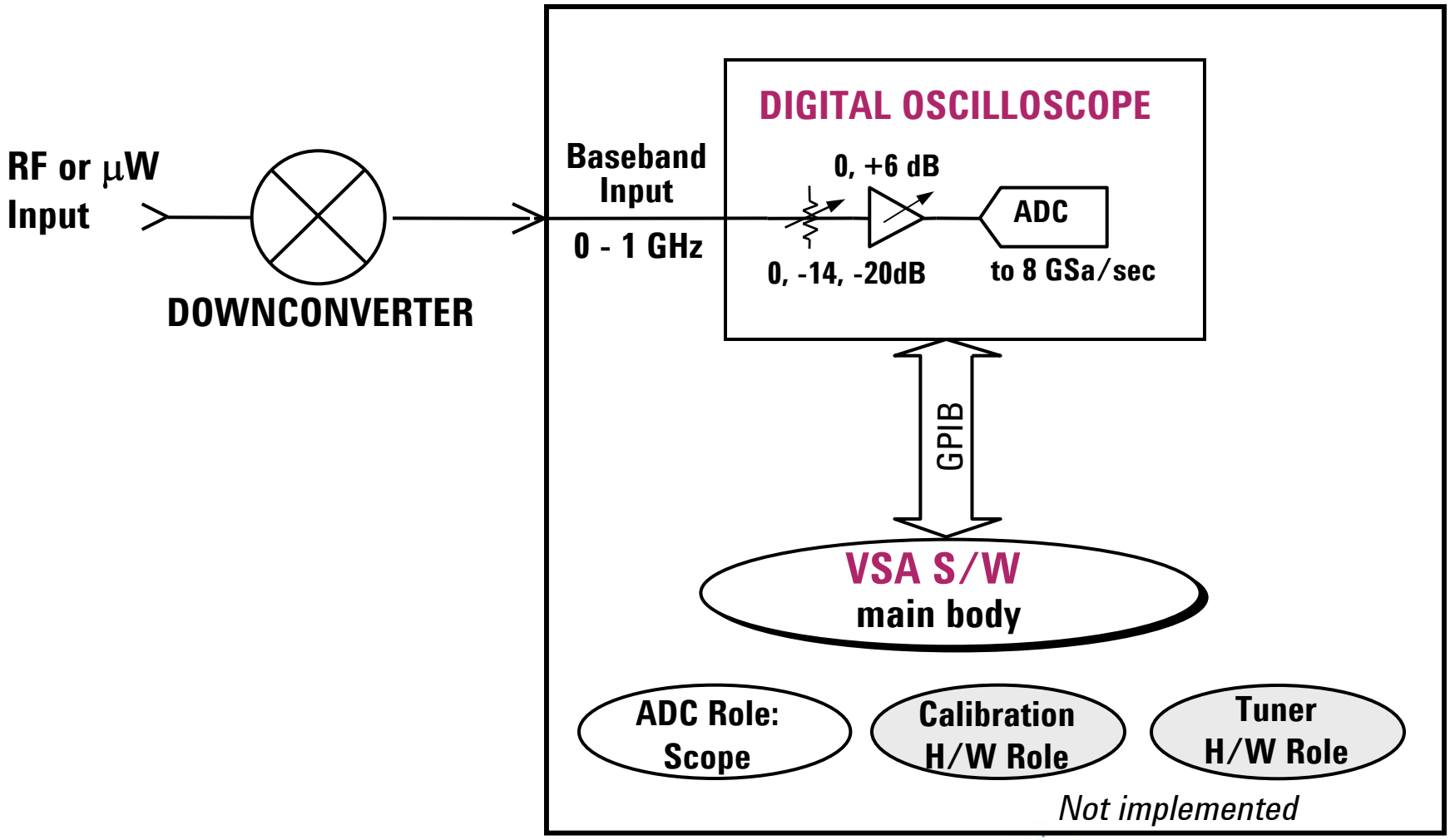
Ultra-Wideband Vector Signal Analyzer



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Troubleshooting Digital Communications Systems

- Digital modulation requires new test methods
- Difficult to gauge system performance with traditional parameters
  remember:
  the Data is digital, but the Modulation is analog
- Evaluate modulation accuracy in the same way the customer's demodulator sees the signal:
  in the time domain, at symbol decision time

Vector Signal Analyzer Capability

Modulation Formats

FSK, BPSK, 8PSK, MSK, GMSK

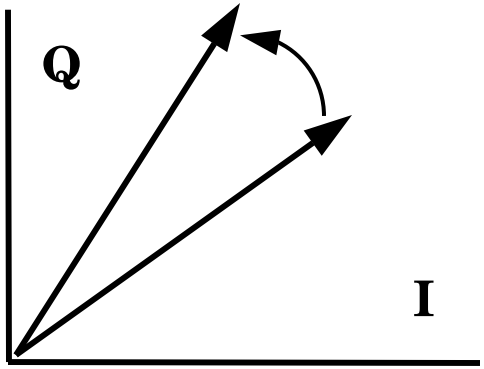
QPSK, OQPSK, DQPSK, π/4 DQPSK

16 QAM, 32 QAM, 64 QAM, 128 QAM, 256 QAM

COFDM, 8 VSB, 16 VSB

Display Types

Eye, constellation, vector, error vector magnitude (EVM) spectrogram, data table



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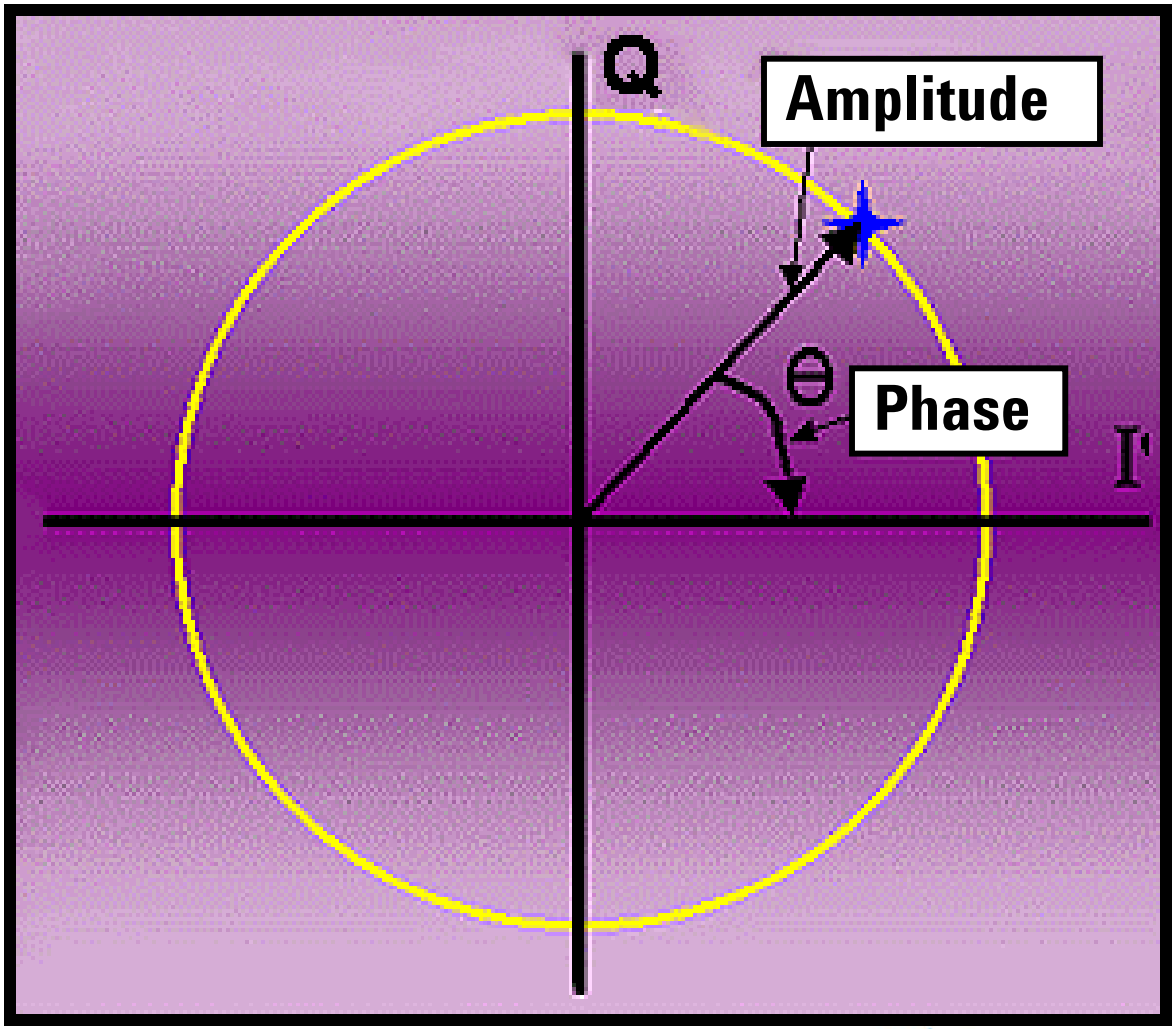
Typical I/Q Diagram



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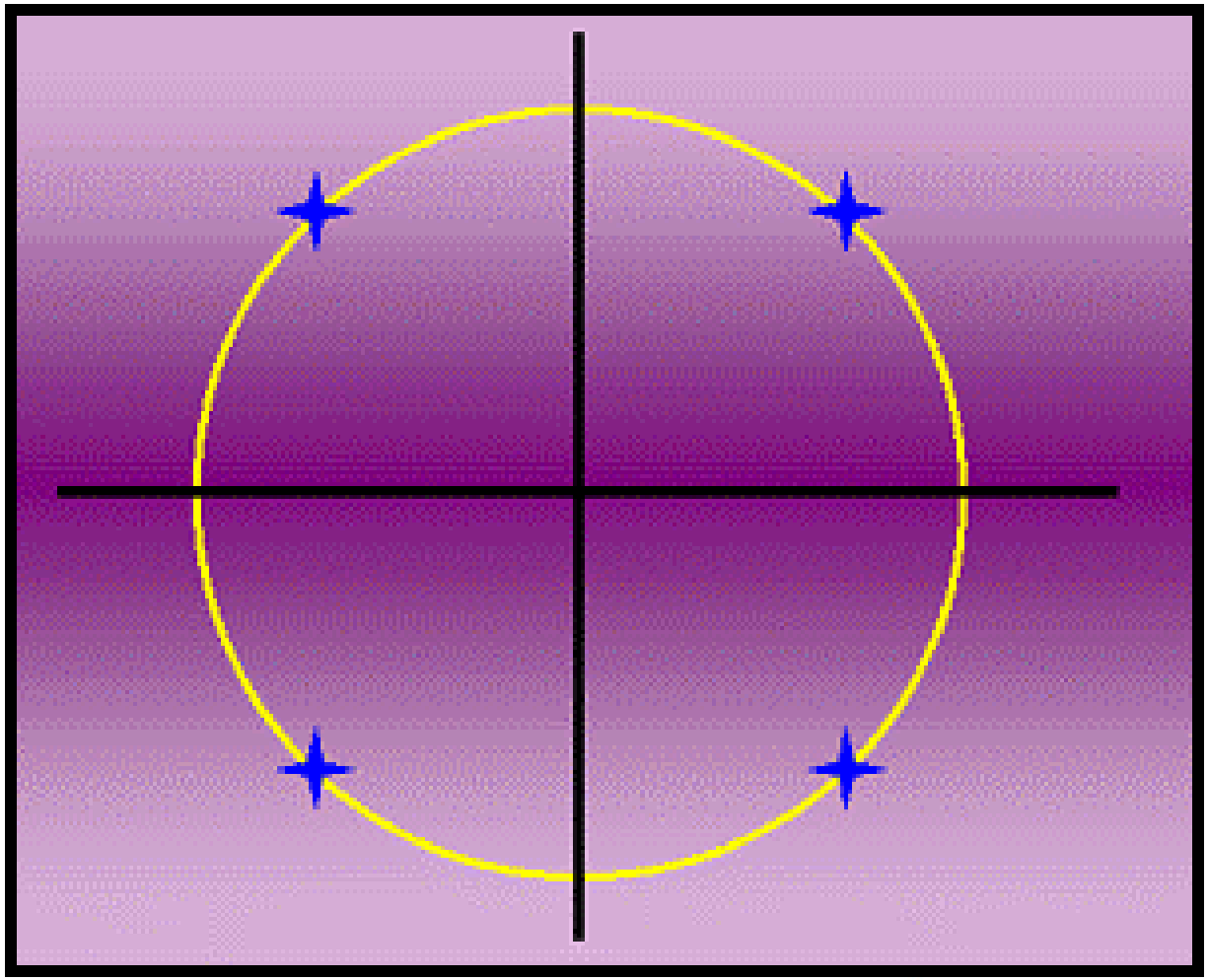
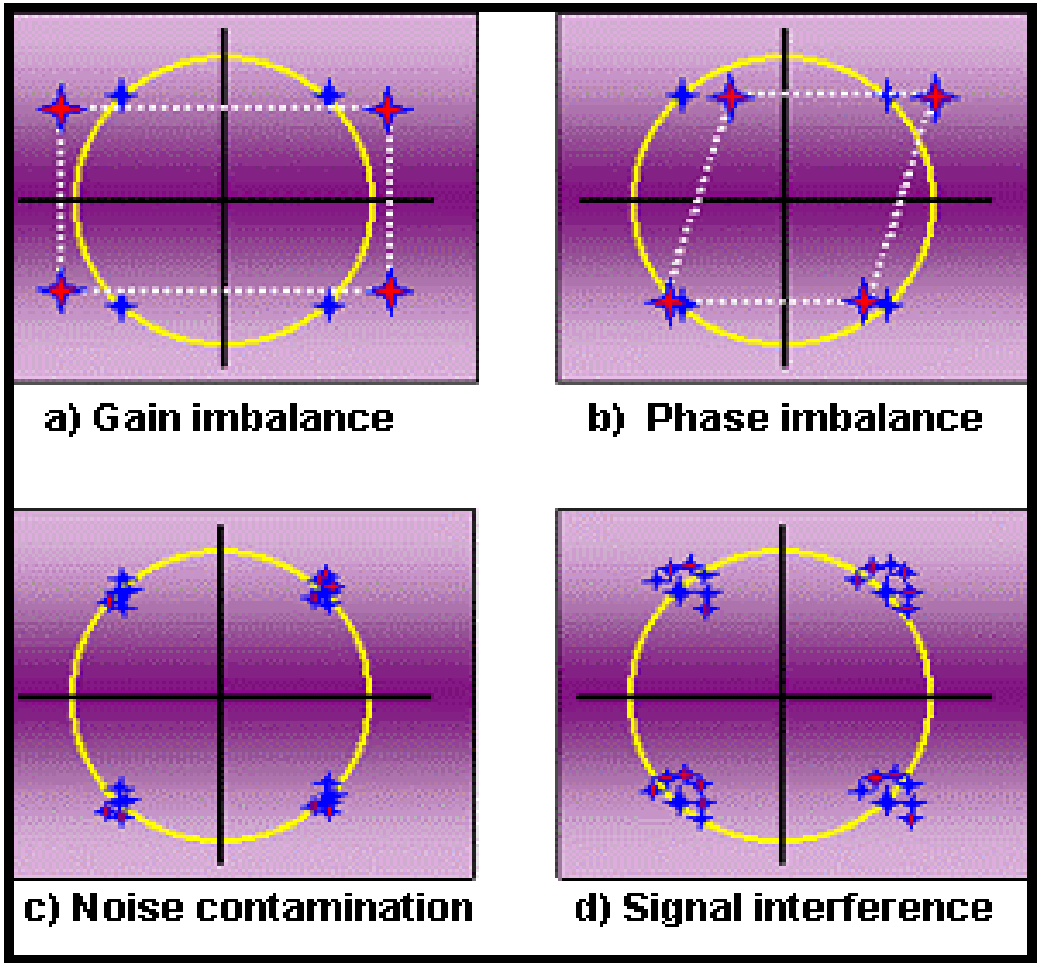
Four-Phase Modulation Scheme



Common Modulation Errors



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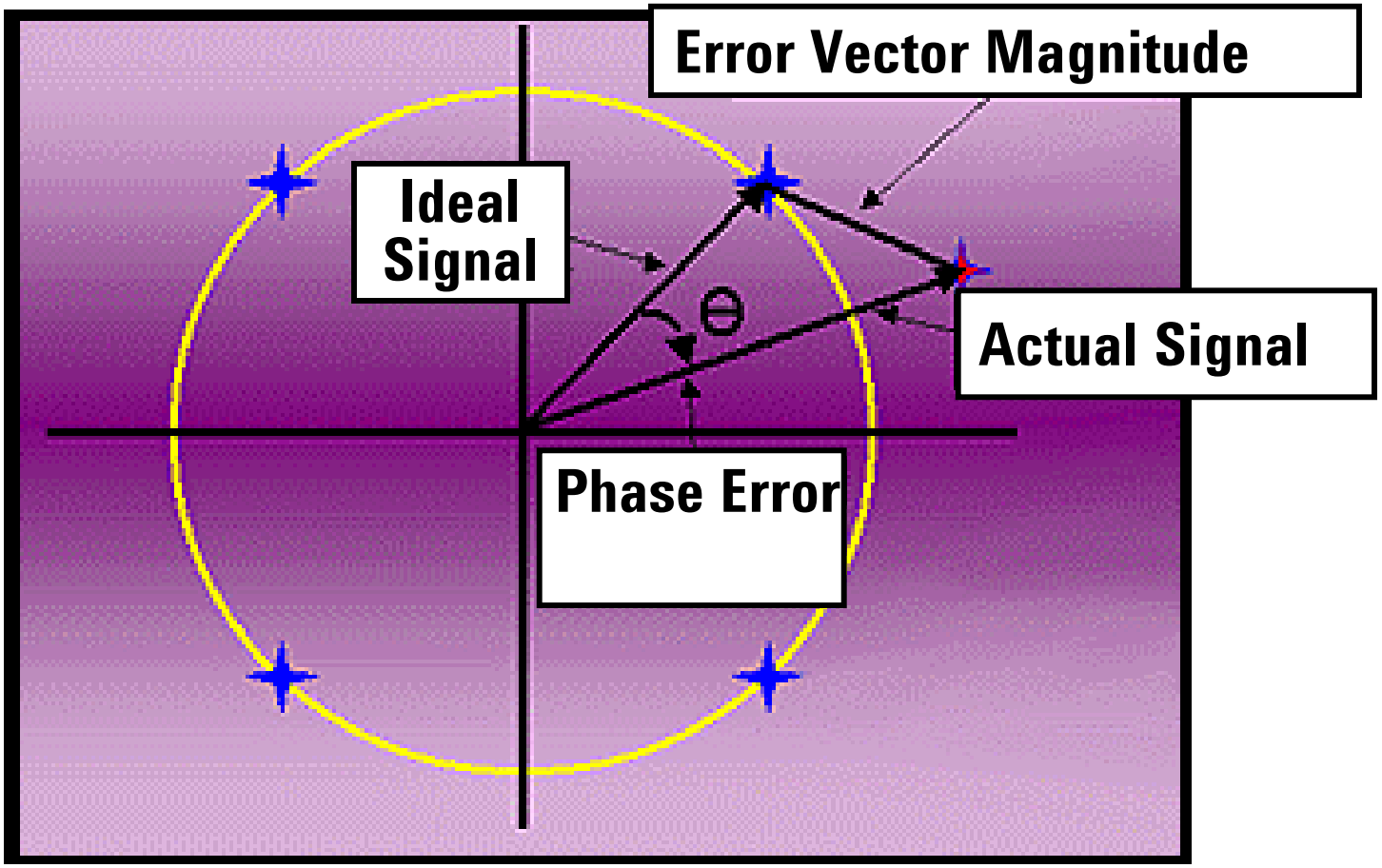
EVM Measurement



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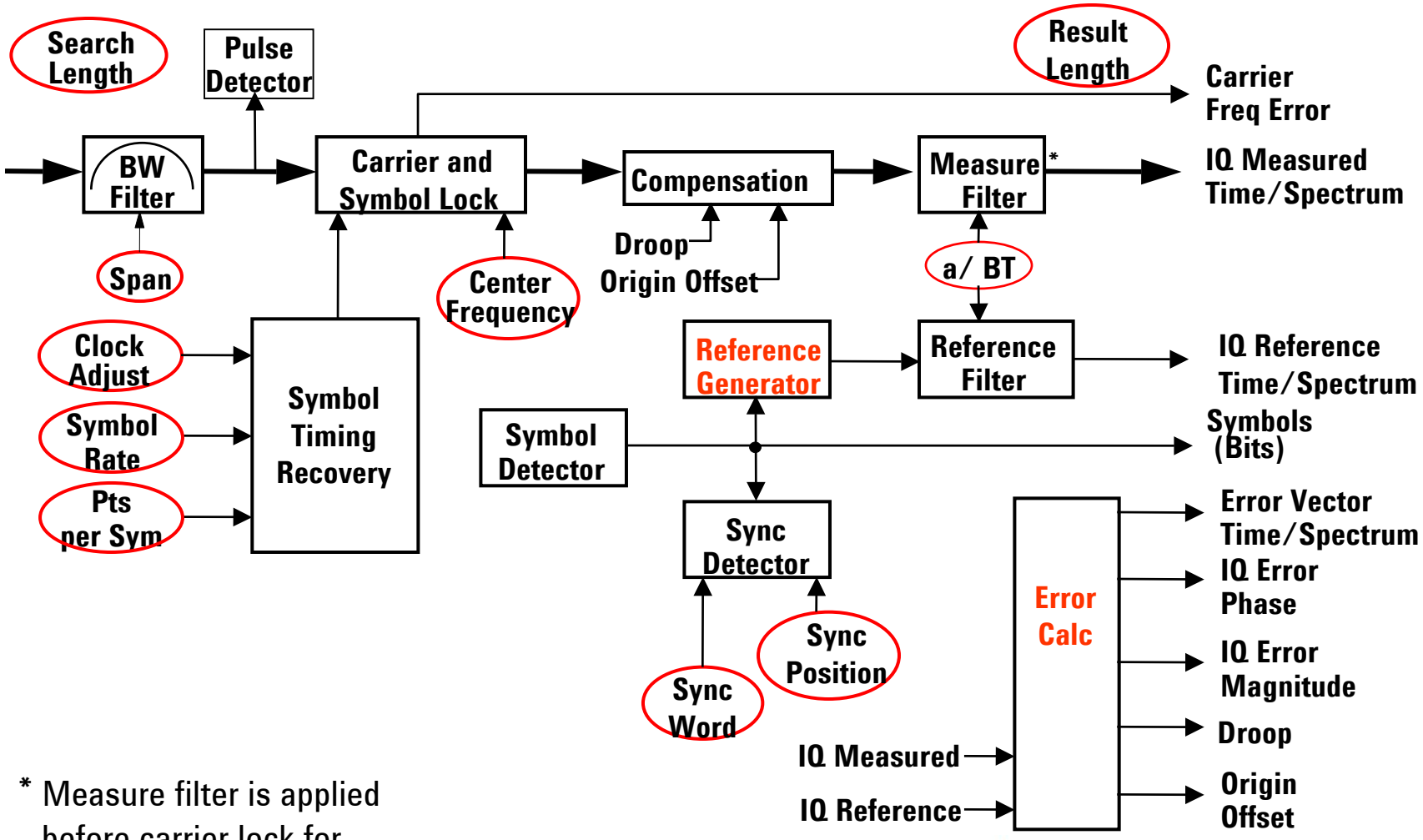
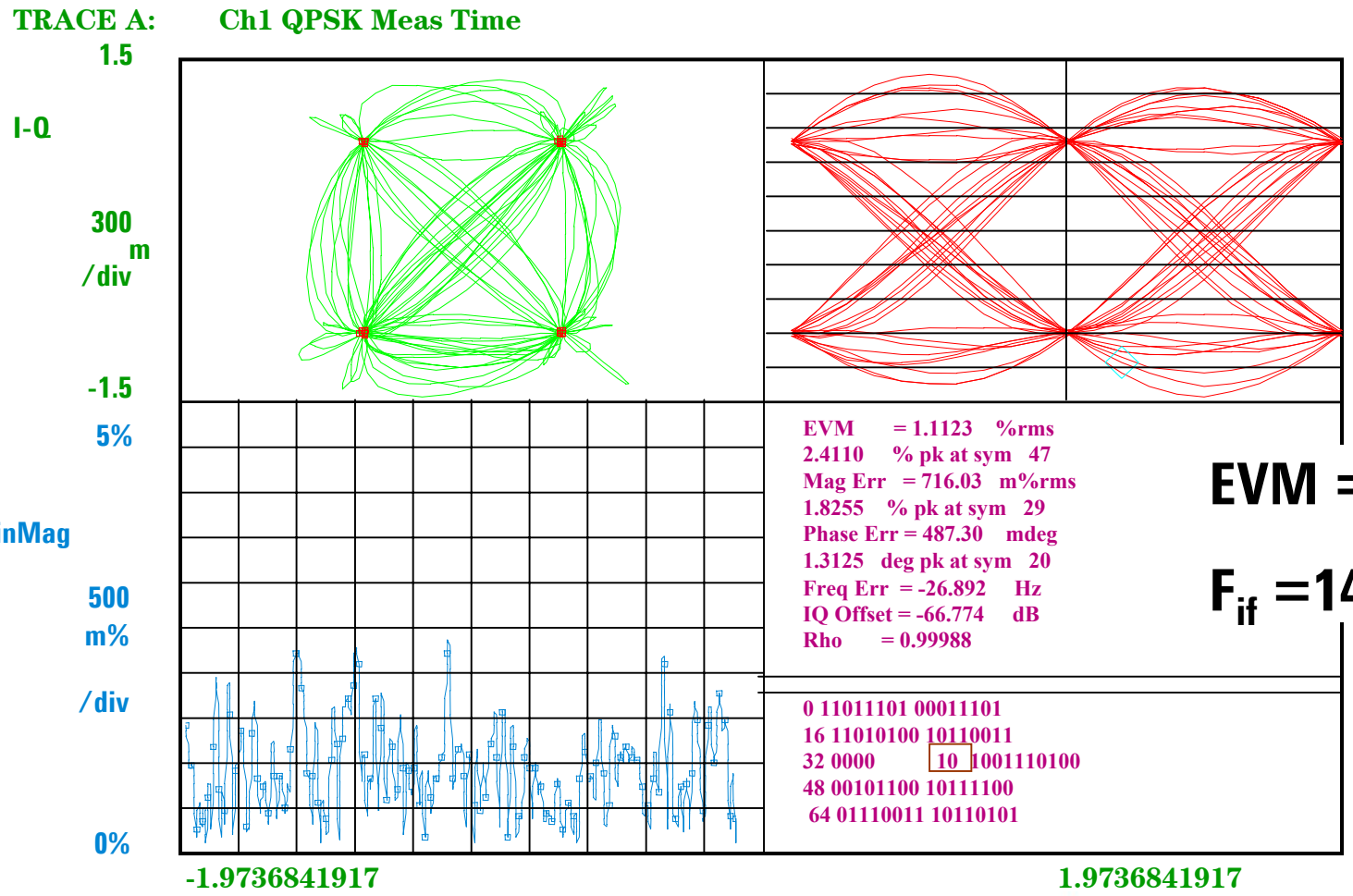
Digital Demodulation System



* Measure filter is applied before carrier lock for MSK demodulators

EVM Technique yields Numerous Results UWBW

Example 1 Lab Reference signal 200 Mbps QPSK



EVM = 1.1%

F_{if} =140 MHz

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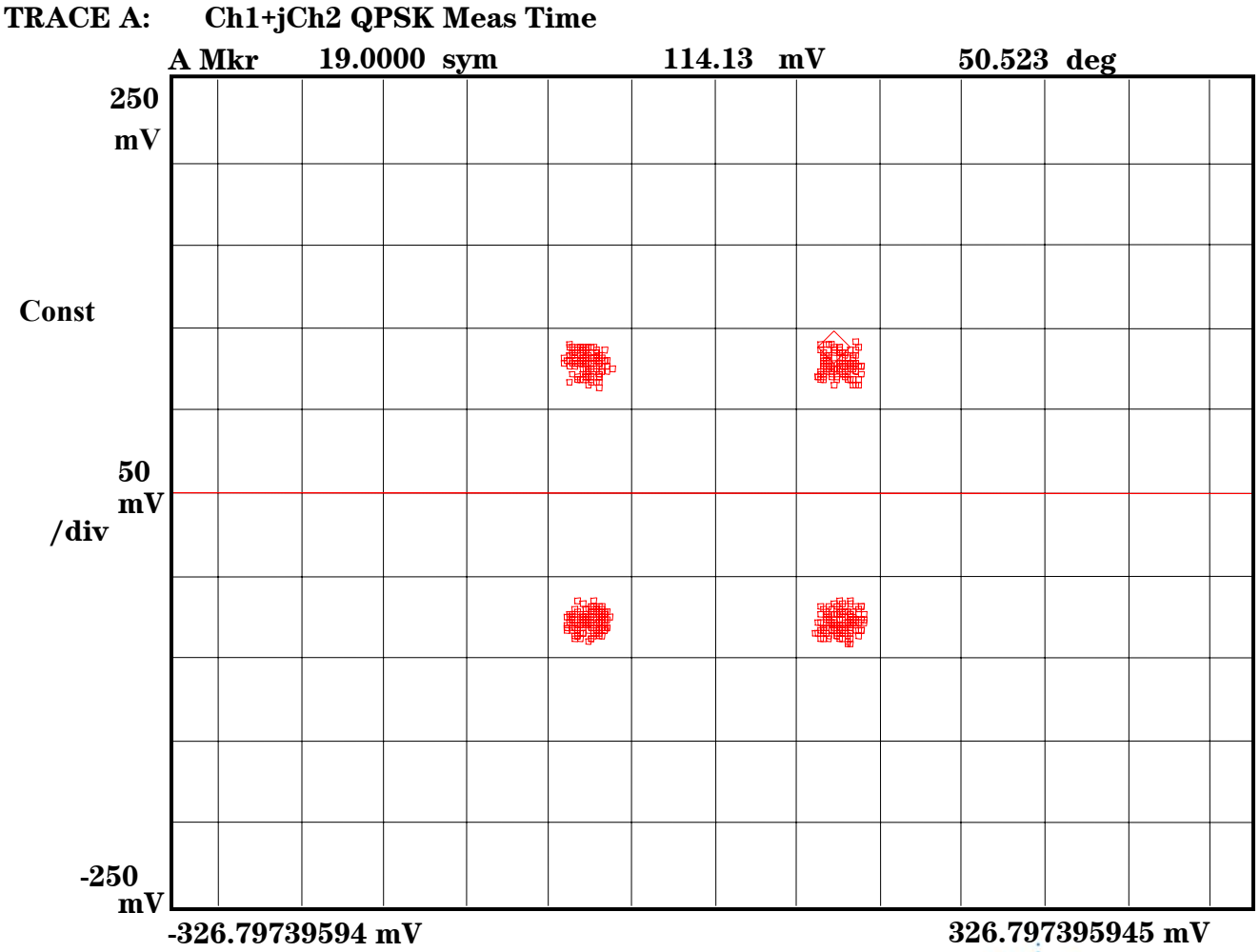
Some signals need further examination

QPSK with 8% EVM



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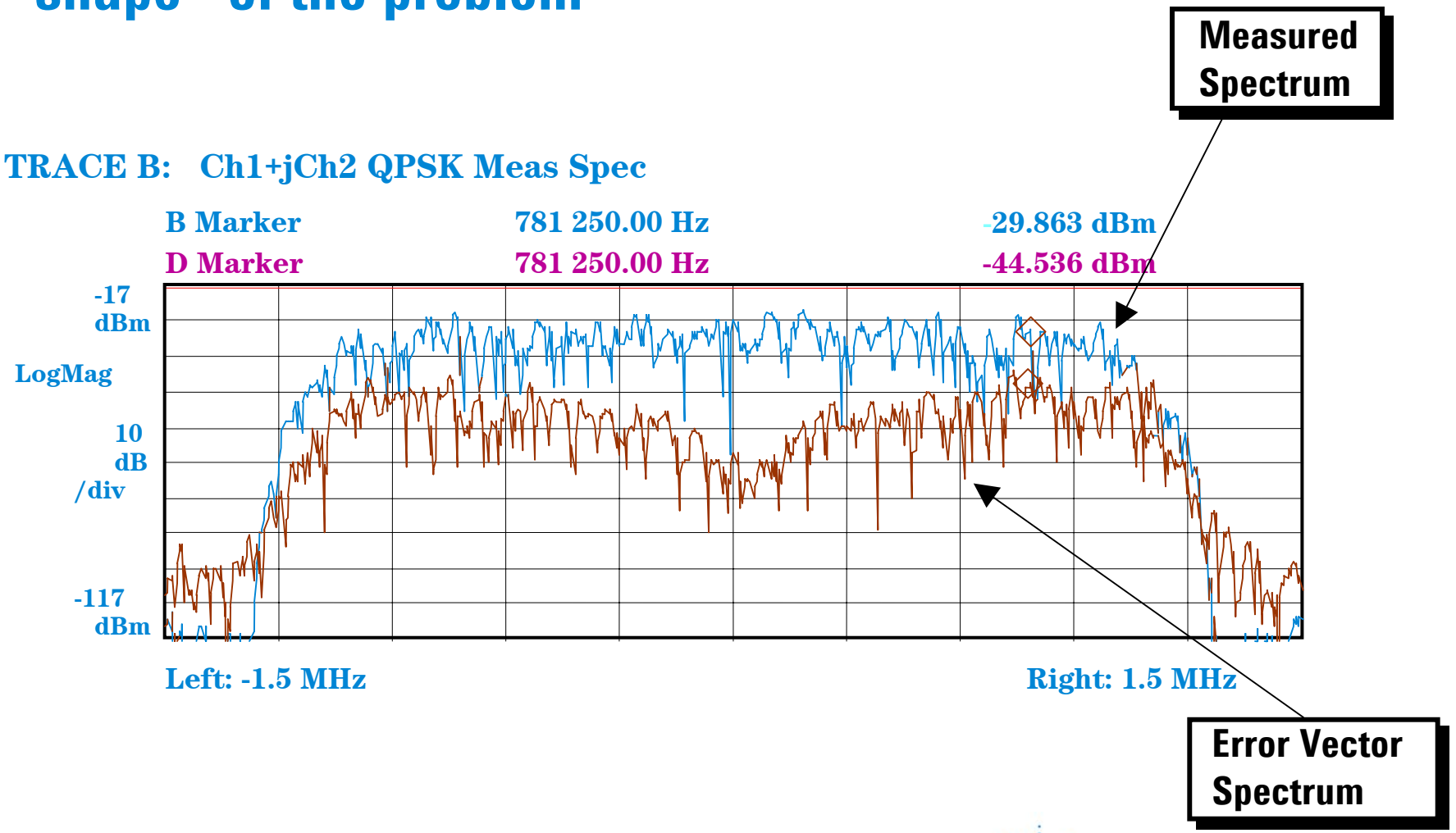
Error Vector Spectrum reveals

"shape" of the problem



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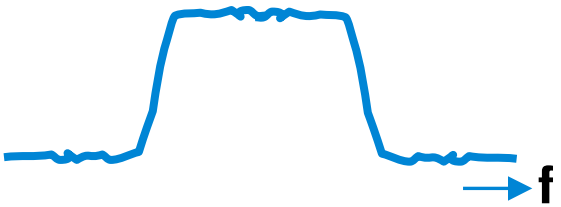
Troubleshooting with EVM Spectrum

Spectrum



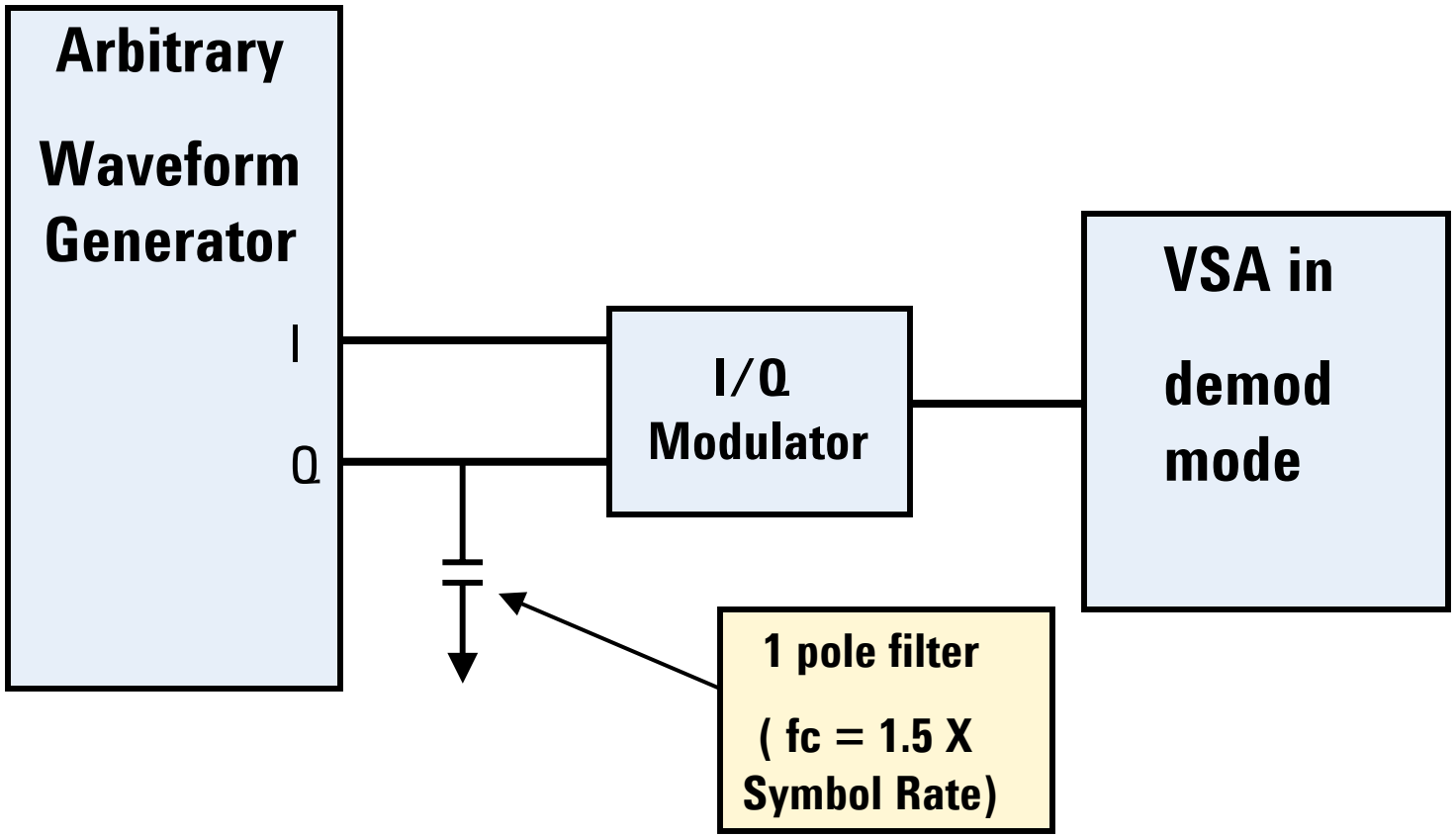
Ideal Signal

Impaired Signal
-is it only distortion?

EVM Spectrum

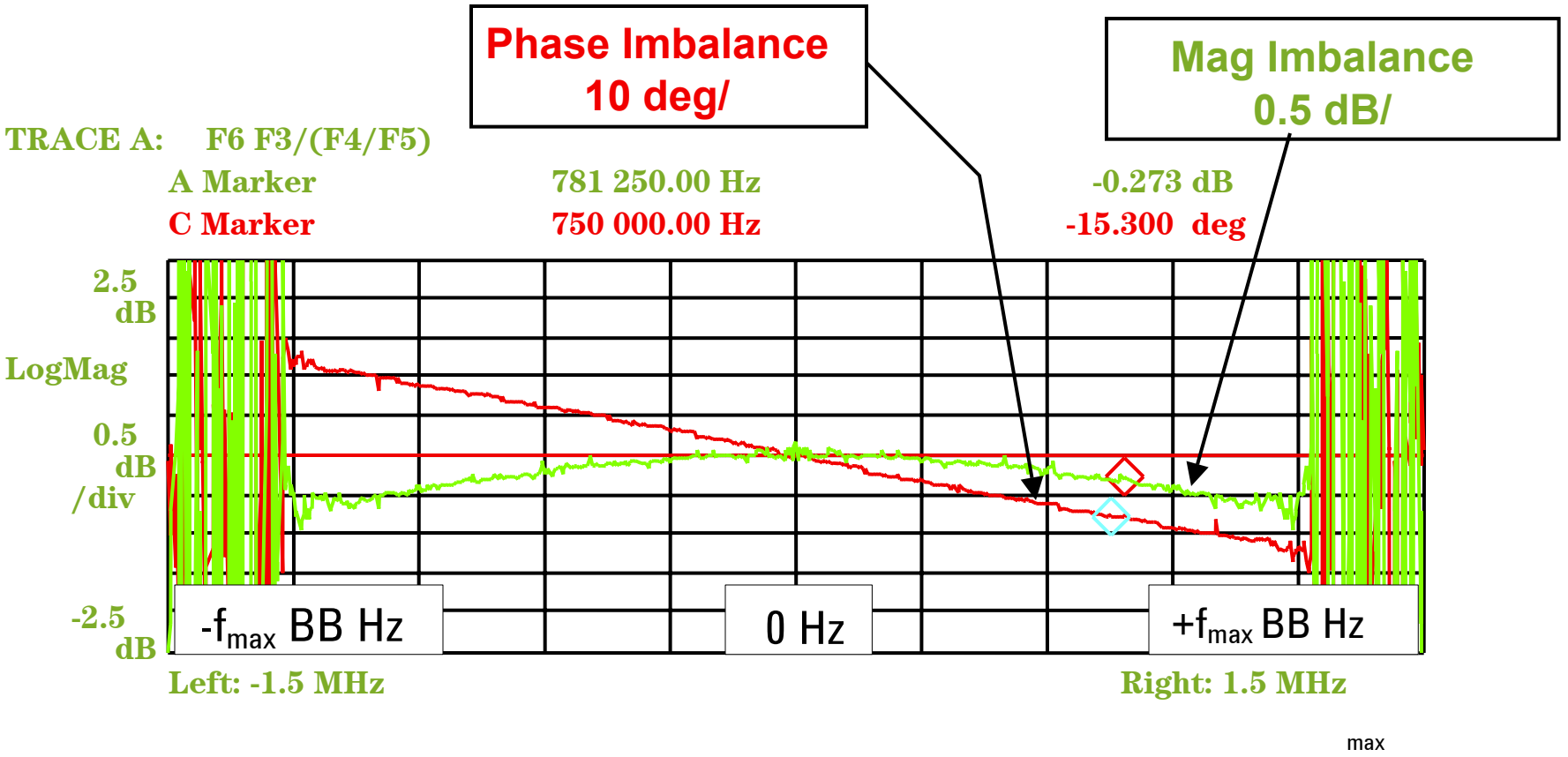
NO- EVM Spectrum Display reveals
it is distortion plus I/Q imbalance.

Simulated I/Q imbalance



I/Q Imbalance Analysis

shows precise nature of problem



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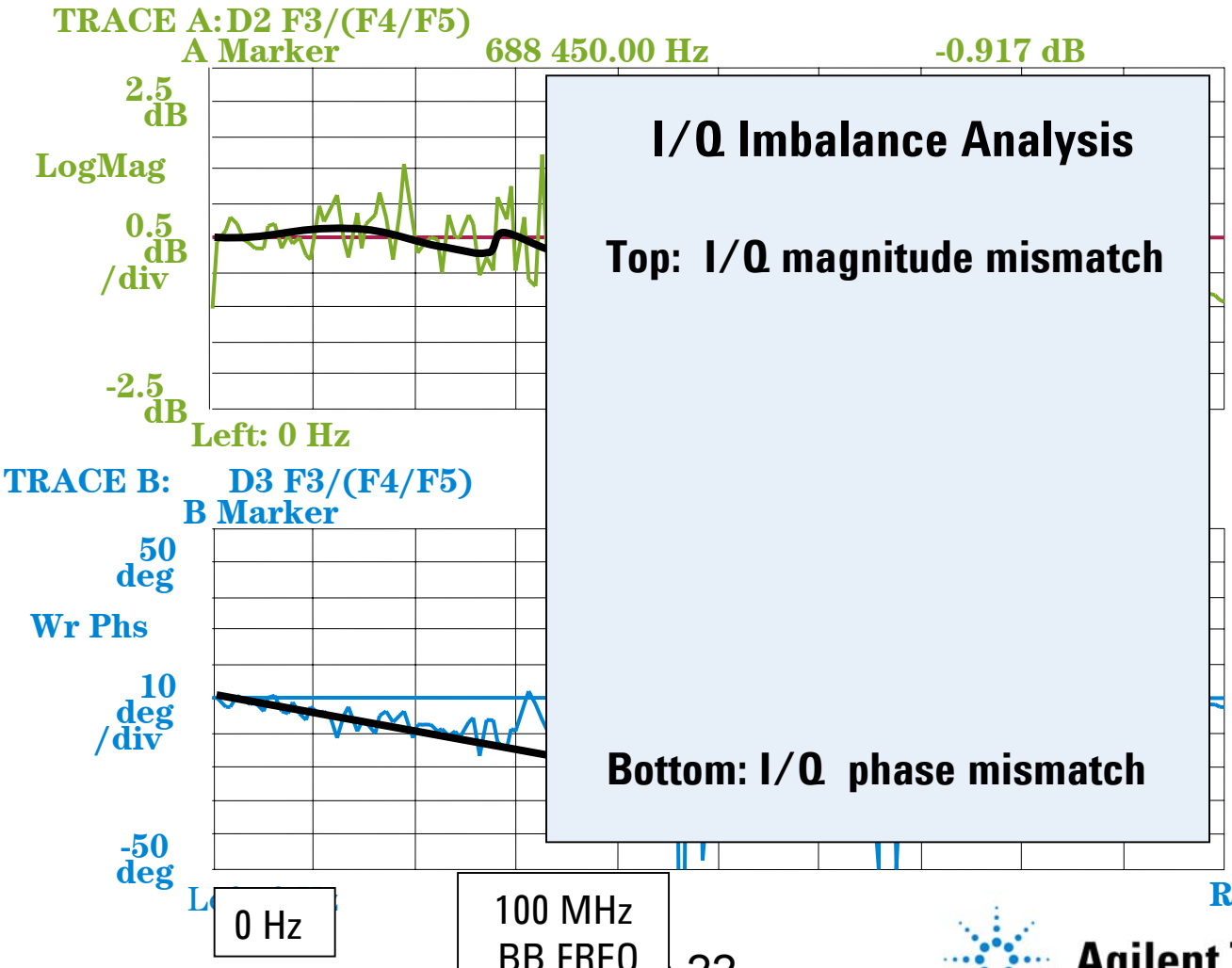
Example 2:

Satellite Downlink 200 MSymbol/sec



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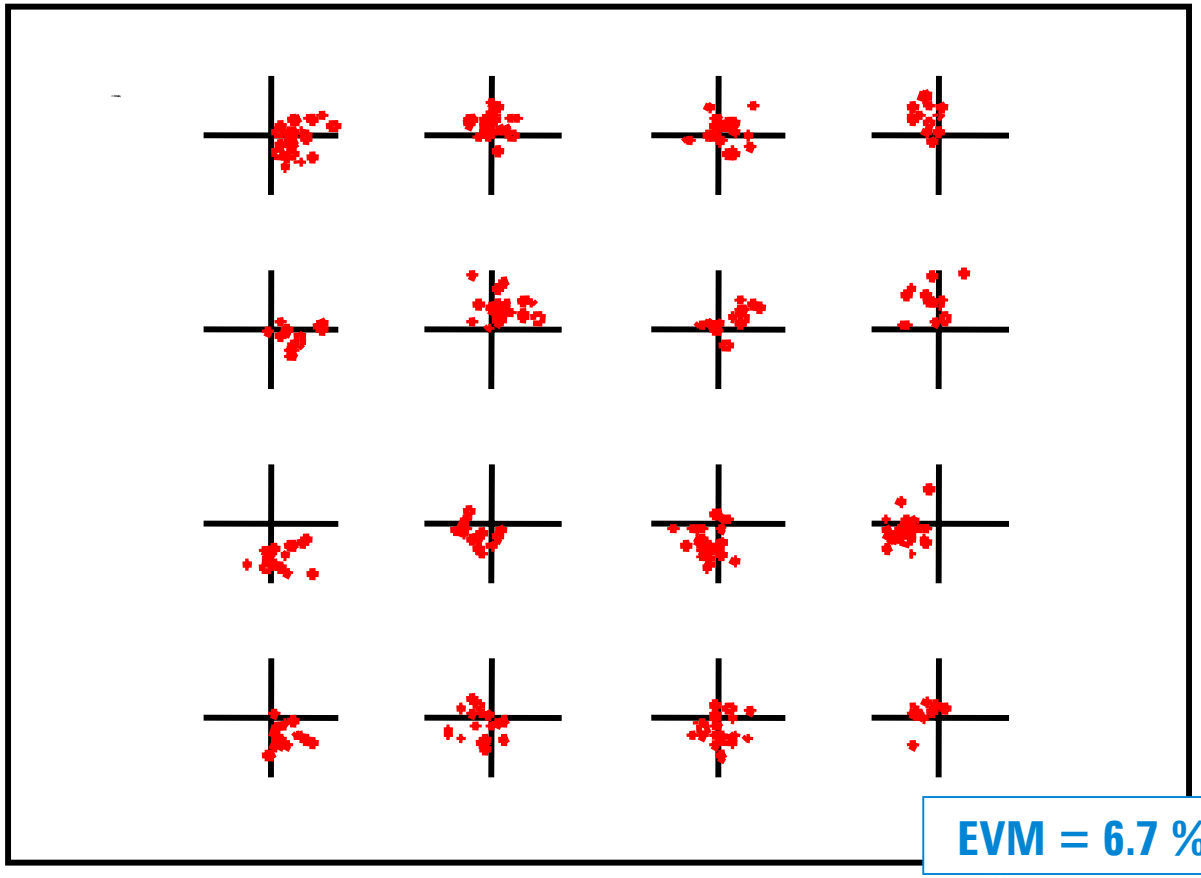
Example 3:

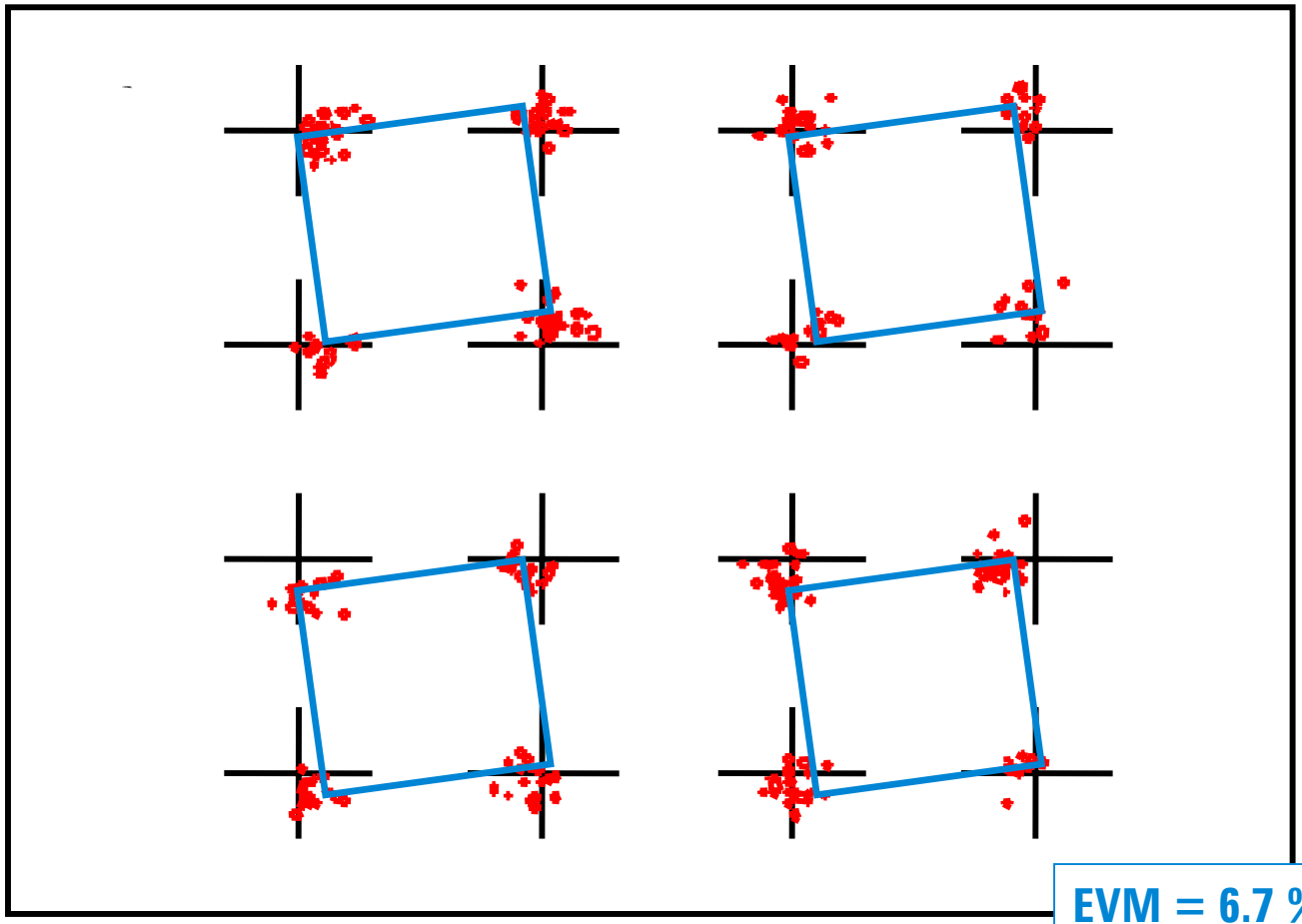
1.2 Gbps Fiber-to-Wireless 16 QAM Constellation



EVM = 6.7 %

Example 3:

1.2 Gbps, 16 QAM Constellation



EVM = 6.7 %

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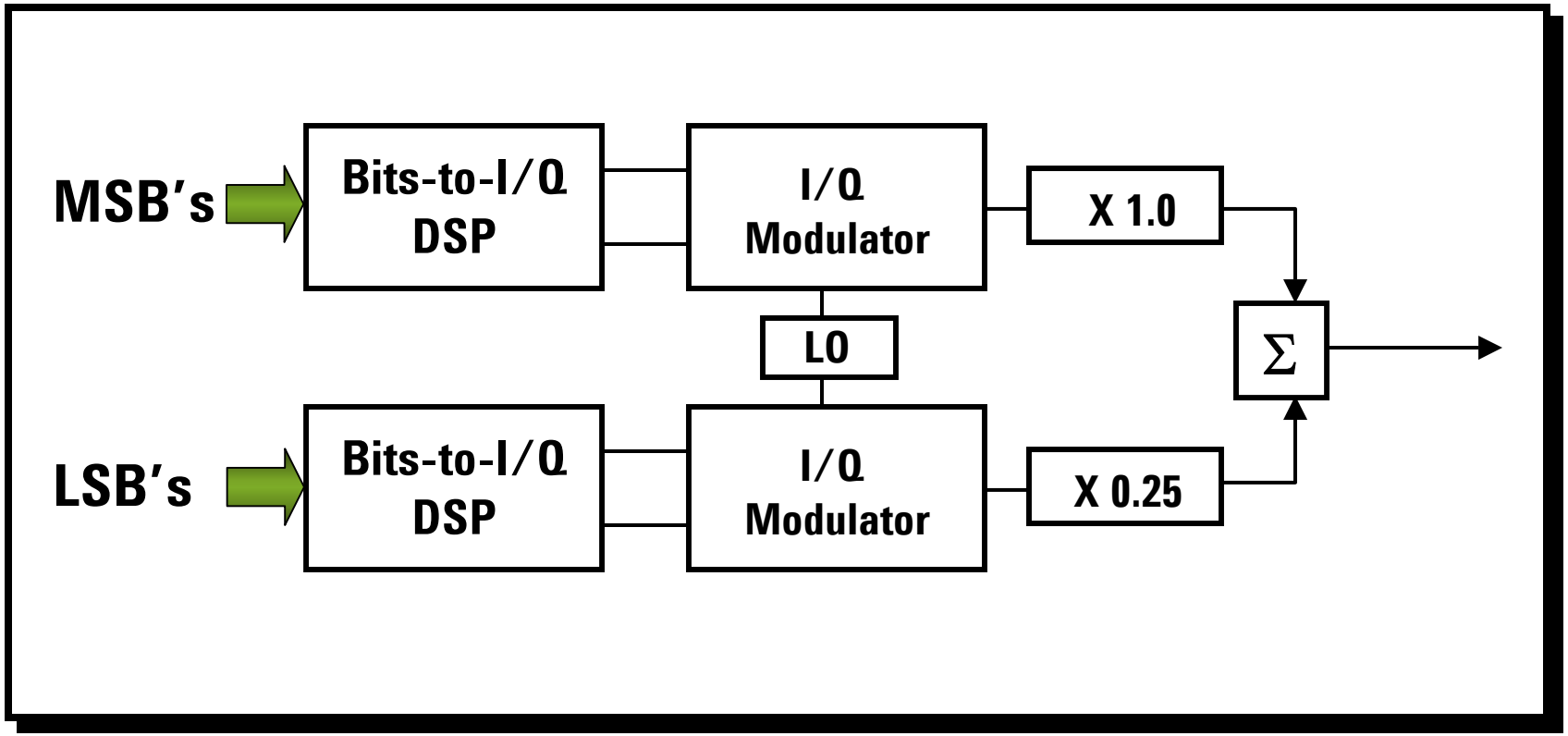
Dual Stage I/Q Modulator



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Conclusion

- Vector Signal Analyzers with partitioned block diagrams allow for higher sample rate digitizers to increase measurement bandwidth
- Now the same techniques as for narrow band signal can be applied to UWBW satellite transponders and terrestrial transmitters
- I/Q imbalance can reveal transmitter problems