Oscilloscope Calibration

Oscilloscope Products Div.

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How does Agilent Calibrate Real-Time Scopes?

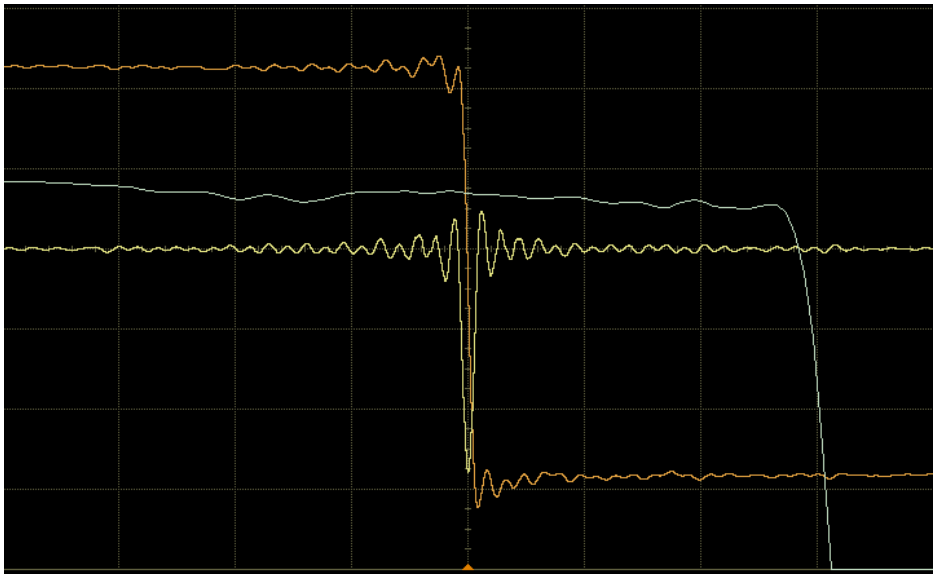
1. Magnitude & Phase Correction
2. Interleaving Spur Suppression
3. Calibration Extension

How does Agilent Calibrate Real-Time Scopes?

1. Magnitude & Phase Correction
   → overall average frequency response (±0.5 dB from 0 to BW)

We need a source with the following properties:
1. Desired frequency content
2. Known impulse response

This allows us to tune the oscilloscope's response until the source is reproduced without any magnitude or phase distortions.

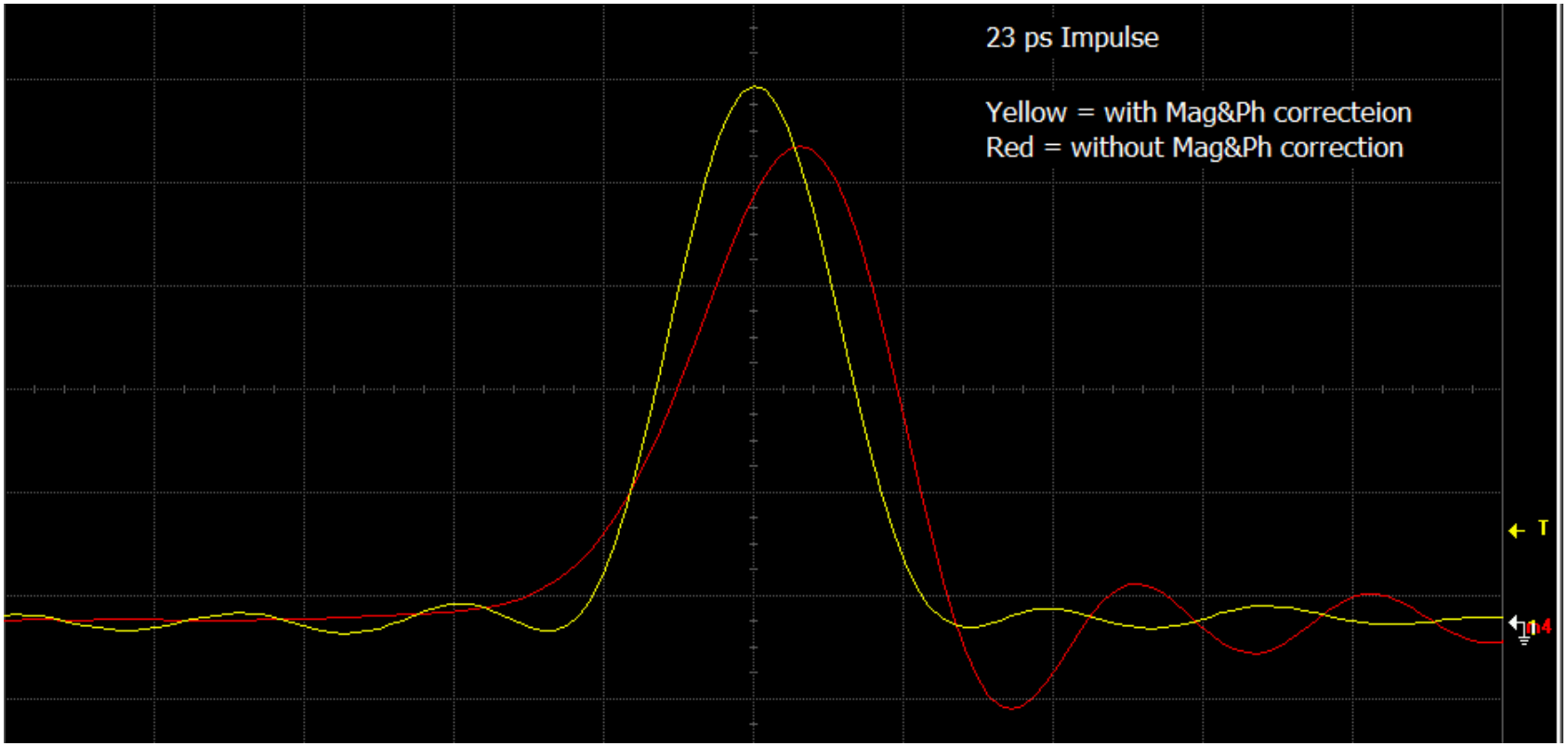


Flat or Gaussian Magnitude and Flat Phase From 0 Hz to Bandwidth

2. Interleaving Spur Suppression
3. Calibration Extension

How does Agilent Calibrate Real-Time Scopes?

1. Magnitude & Phase Correction
   → the effects of magnitude and phase distortion

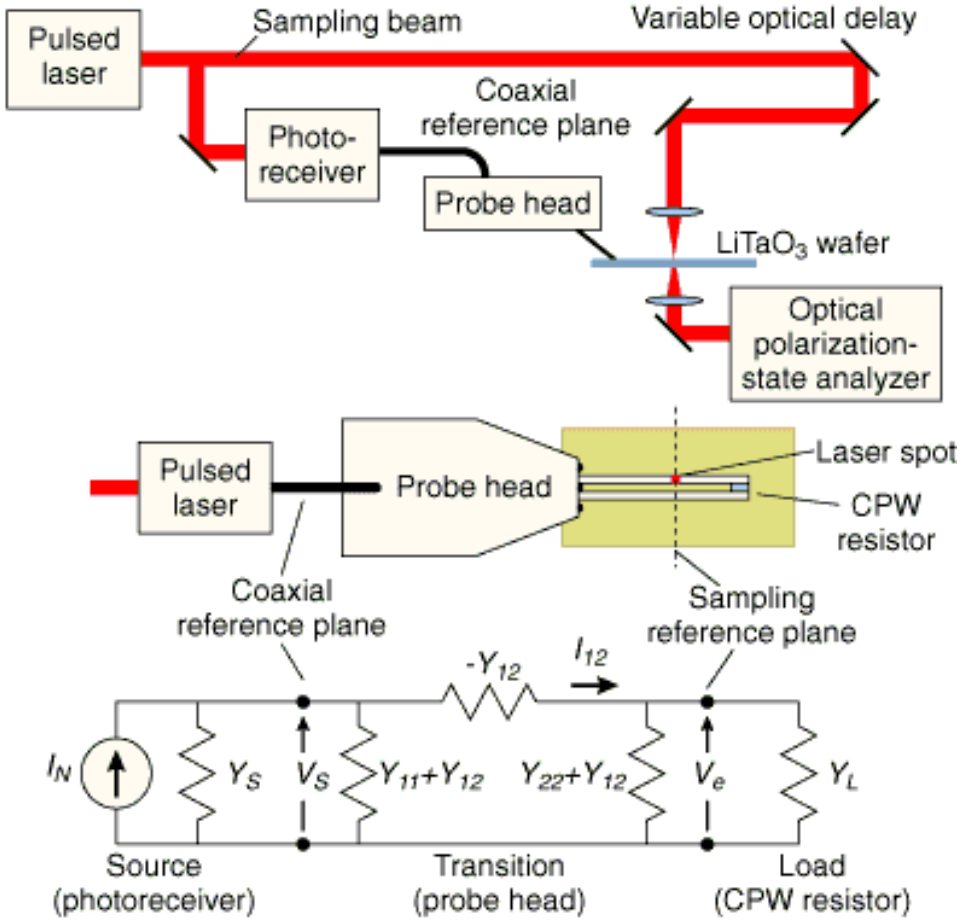


2. Interleaving Spur Suppression
3. Calibration Extension

How does Agilent Calibrate Real-Time Scopes?

1. Magnitude & Phase Correction

→ NIST provides known source, calibrated photodiode



NIST Photodiode
1.0 mm connector
Calibrated to 110 GHz
~4 ps FDHM

Provides ideal calibrated response when driven with fs optical impulse generator

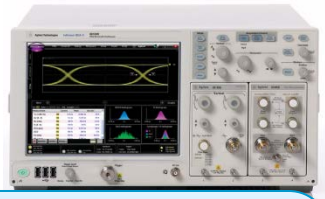
3. Calibration Extension

How does Agilent Calibrate Real-Time Scopes?

1. Magnitude & Phase Correction
   → The whole process at 30,000 feet

NIST EOS

NIST Calibrated Photodiode



Agilent 86100D Equivalent Time Sampling Oscilloscope

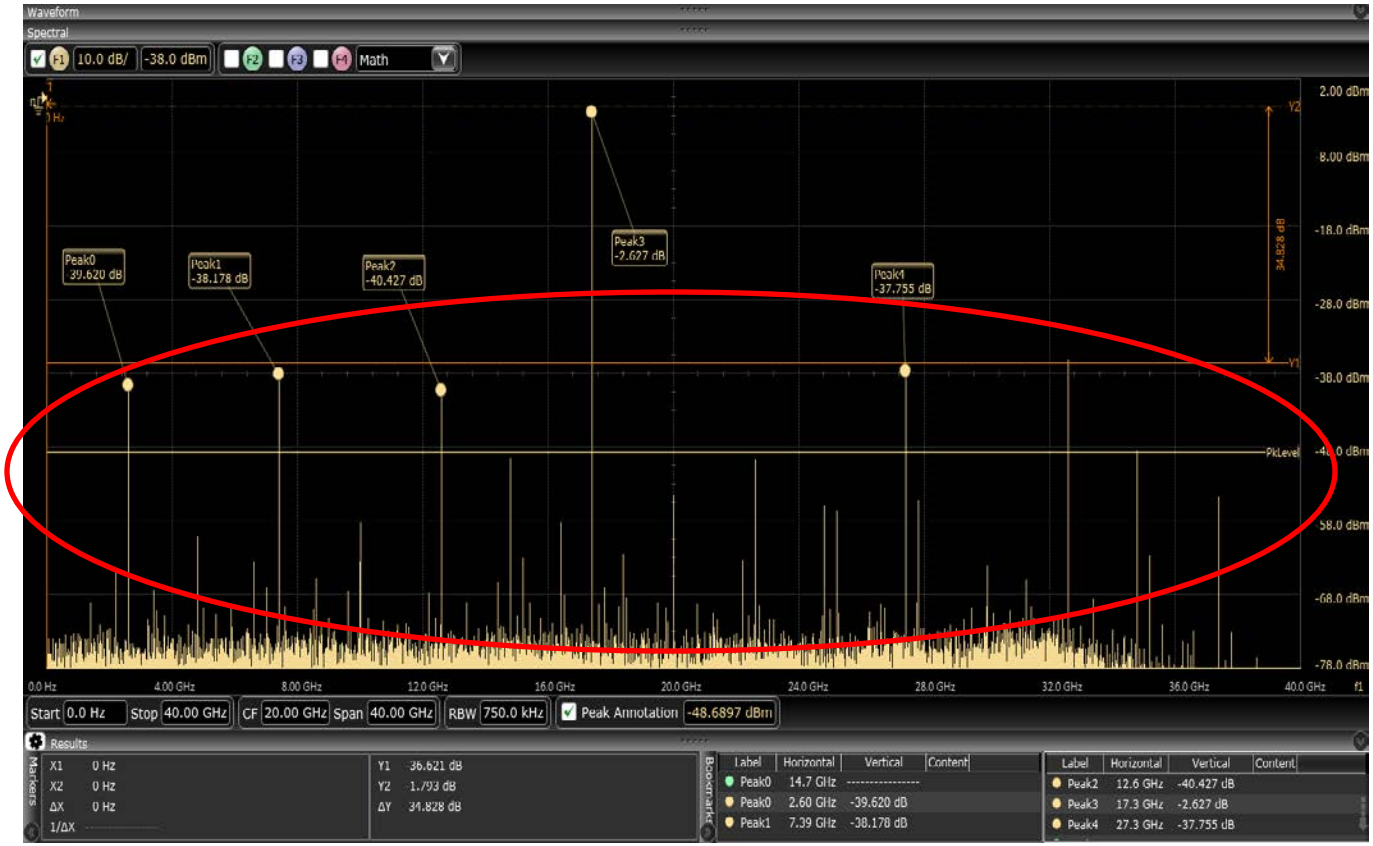
Agilent Infiniium Real-Time Oscilloscope

Agilent N2806A sub-7ps Calibration Pulse Generator

2. Interleaving Spur Suppression
3. Calibration Extension

How does Agilent Calibrate Real-Time Scopes?

1. Magnitude & Phase Correction
2. No Interleaving Spur Suppression

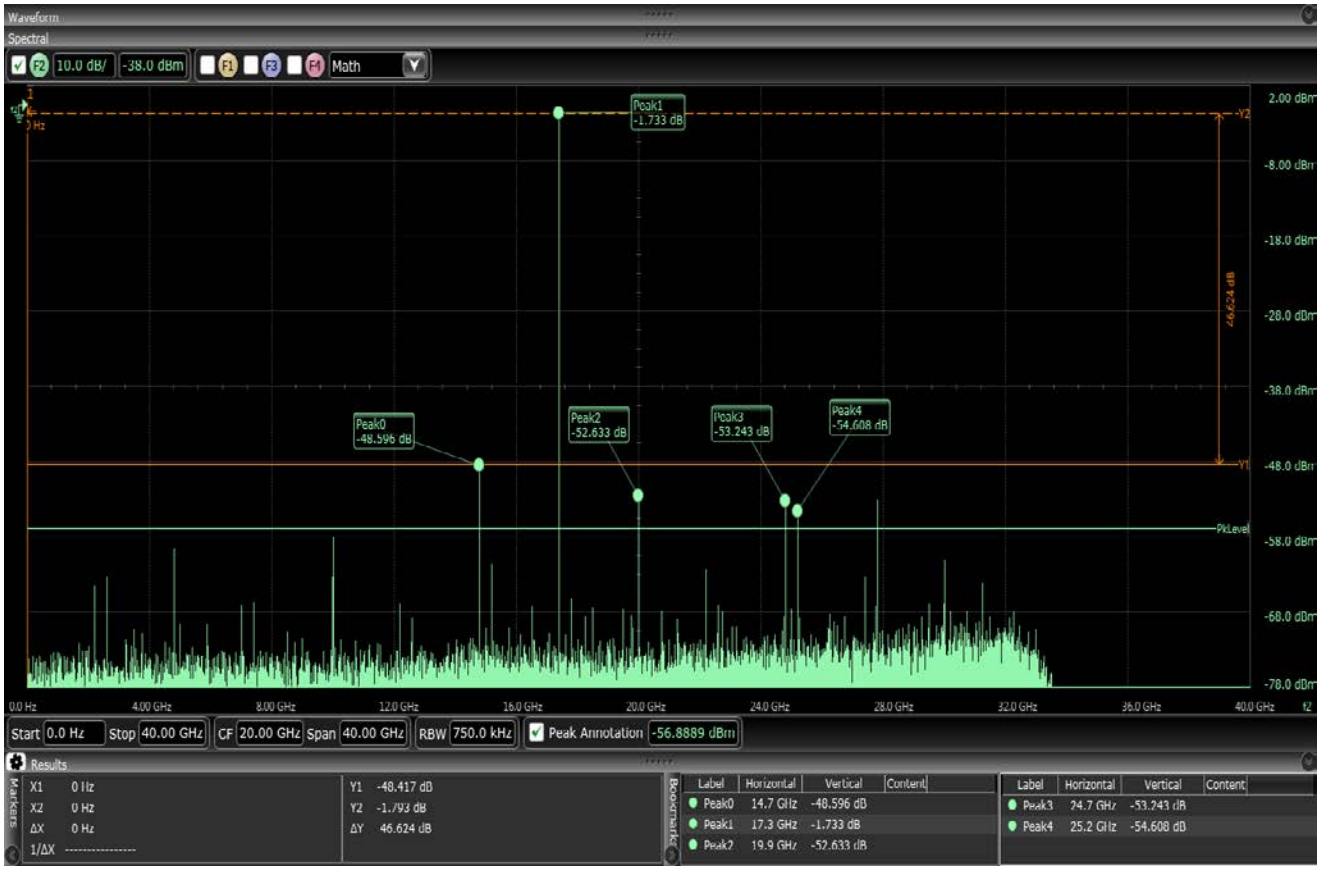


Spurs caused by ADC interleaving errors, SFDR = 35dBc

- Agilent uses a pipelined ADC which slices multiple 250 MS/s ADC slices into a bigger 20 GS/s ADC
- The interleaving of the ADCs can cause errors, which show up as spurs in the frequency domain and are a large part of SFDR degradation

How does Agilent Calibrate Real-Time Scopes?

1. Magnitude & Phase Correction
2. Interleaving Spur Suppression → Sine Wave Cal!



ADC spurs *significantly suppressed*, *SFDR = 47dBc*

- Problem: A step/impulse has very little signal energy at specific frequencies
- Solution: Use swept sine wave source to improve matching between A/Ds.

How does Agilent Calibrate Real-Time Scopes?

1. Magnitude & Phase Correction
2. Interleaving Spur Suppression
3. Calibration Extension → PrecisionCable

Quickly and easily remove losses due to cables, switches, or other circuit elements and…

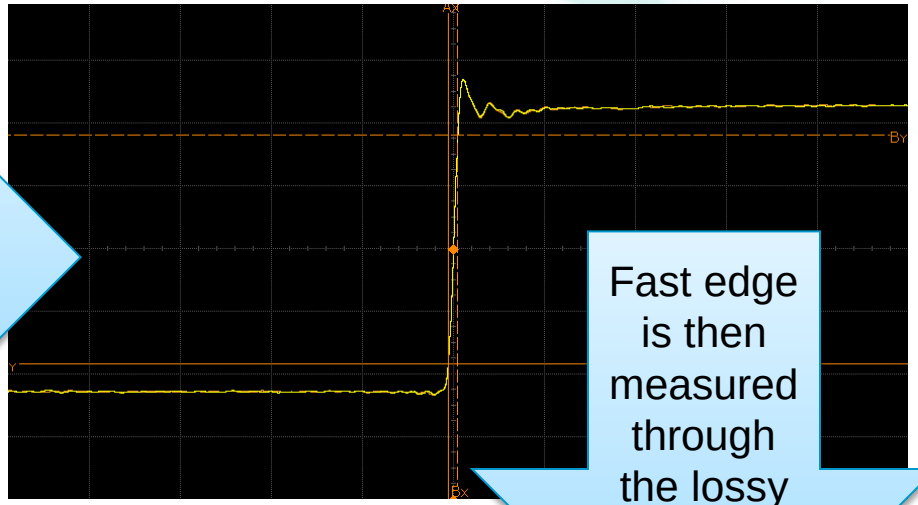
…extend the oscilloscope calibration to your entire measurement system!

How does Agilent Calibrate Real-Time Scopes?

3. Calibration Extension → PrecisionCable

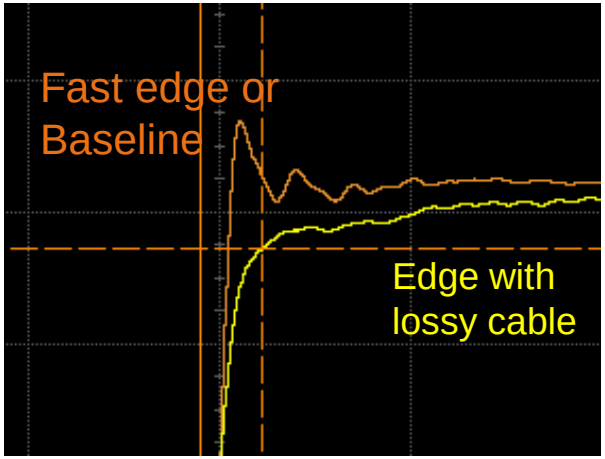
Agilent's 90000 Series scopes use a built in edge generator to provide a fast edge for removing insertion loss effects with PrecisionProbe.

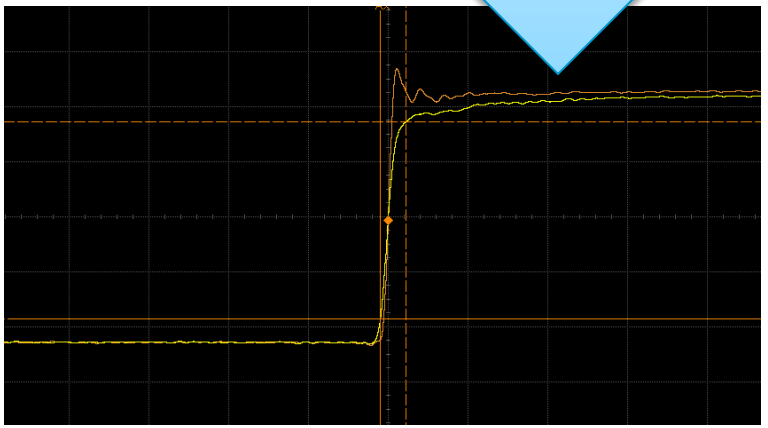
The scope makes a baseline measurement of the edge



Fast edge is then measured through the lossy cable

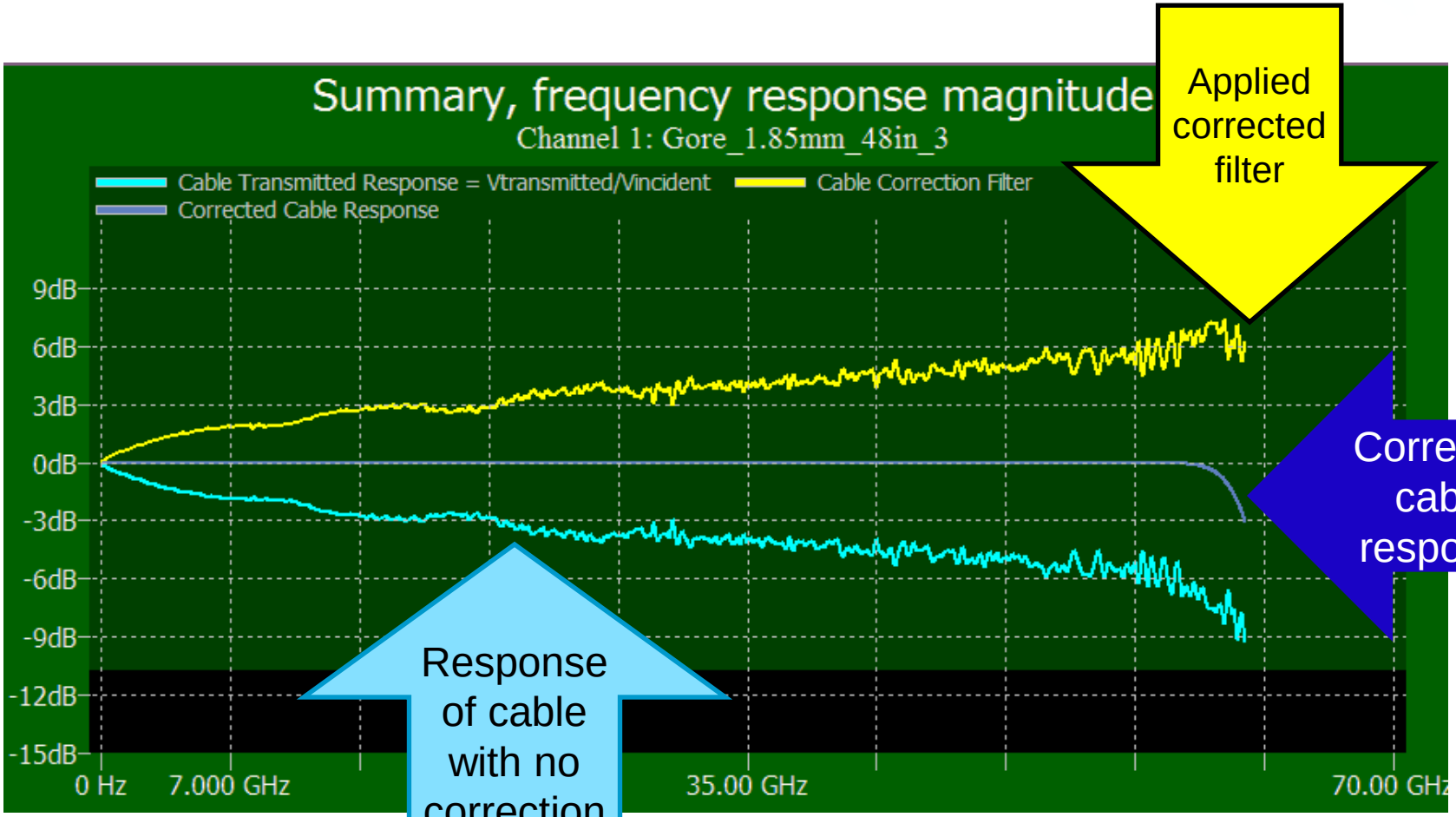
Comparing the baseline measurement with the cable's influence, the scope **automatically characterizes and removes cable loss**.





How does Agilent Calibrate Real-Time Scopes?

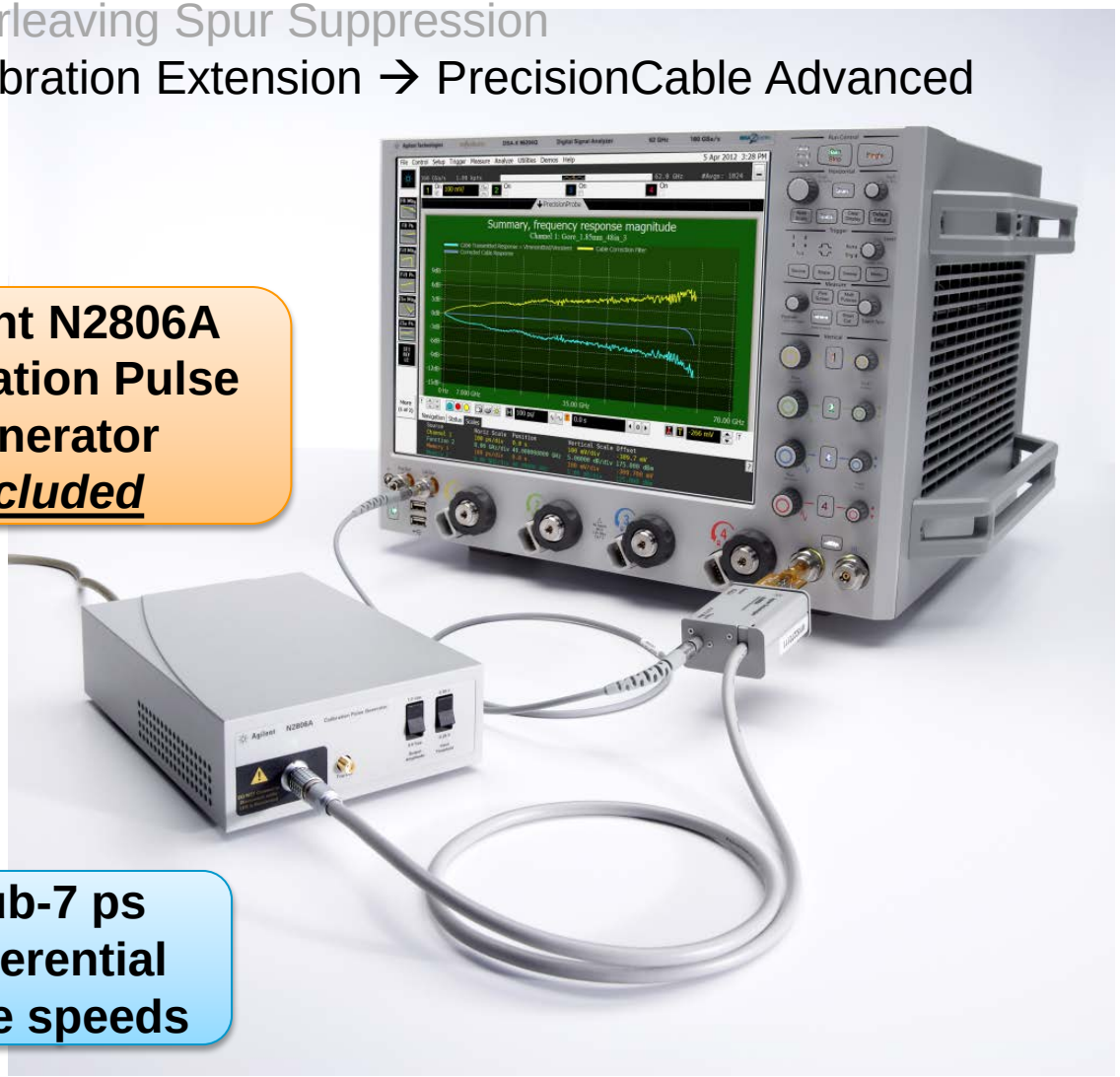
1. Magnitude & Phase Correction
2. Interleaving Spur Suppression
3. Calibration Extension → PrecisionCable



How does Agilent Calibrate Real-Time Scopes?

1. Magnitude & Phase Correction
2. Interleaving Spur Suppression
3. Calibration Extension → PrecisionCable Advanced

Agilent N2806A Calibration Pulse Generator *Included*



Sub-7 ps differential edge speeds

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Thank you!