

InfiniiVision 3000G X-Series Oscilloscopes

通用电路调试的“瑞士军刀”



Keysight InfiniiVision Family

FROM 50MHz TO 6GHz

New!



1000 X-Series

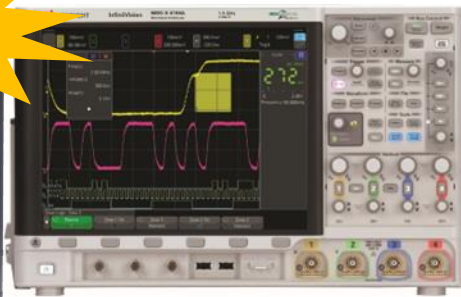


2000 X-Series



3000T X-Series

3000G
serials



4000 X-Series



6000 X-Series

Class's fastest waveform update rate (trigger rate)

All features are upgradable including the bandwidth

8 in 1 instrument integration

Up to 200 MHz

Up to 1 GHz

Up to 1.5 GHz

Up to 6 GHz

Capacitive Touch Operation

Zone Touch Trigger

Color grade & Histogram

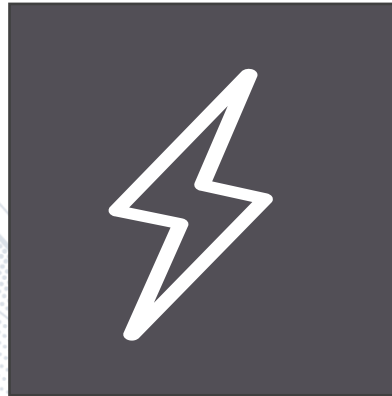
Jitter & Eye Pattern Analysis

InfiniiVision 3000G X-Series Oscilloscope

Equipped

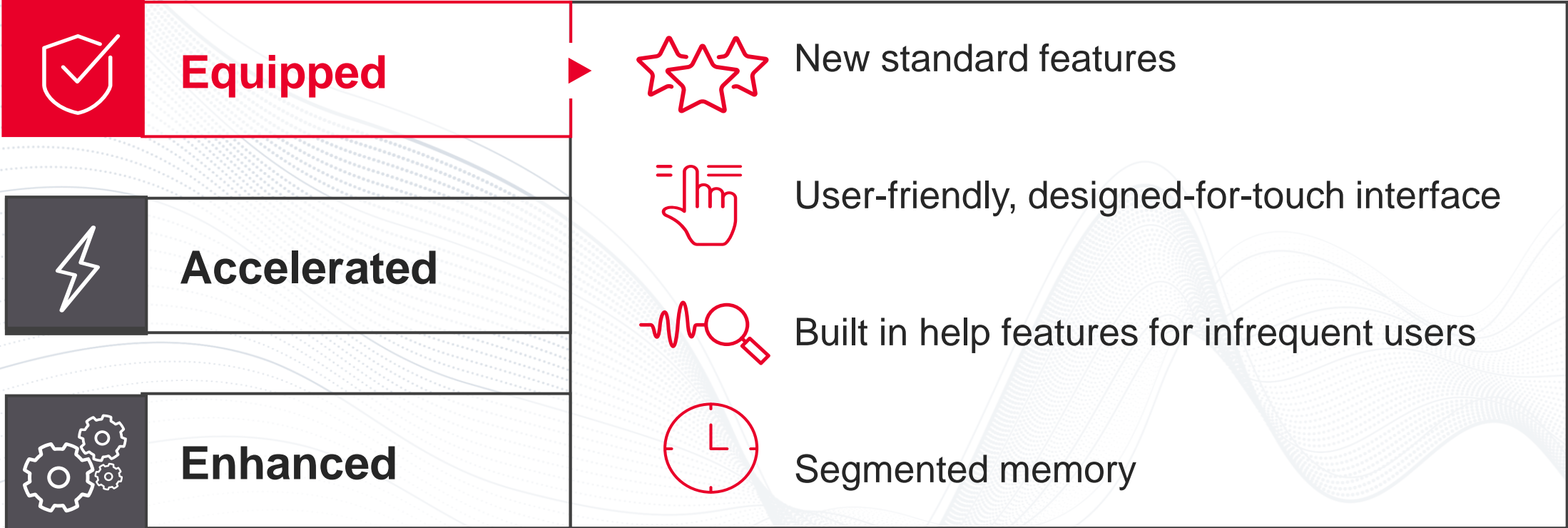


Accelerated



Enhanced





New Standard Features

INFINIIVISION 3000G X-SERIES OSCILLOSCOPE

- The 3000G includes the **best features standard**— enabling **ease of ordering** and eliminating customer need to anticipate optional upgrade requirements at time of purchase.



3000G Standard Features

- ✓ **Waveform & measurement histograms**
- ✓ **Built-in waveform generator**
- ✓ **I2C, SPI, UART, I2S, and USB PD trigger & decode**
- ✓ **Mask limit testing**
- ✓ **Measurement limit testing**
- ✓ **Frequency response analysis (Bode plots)**
- ✓ **Enhanced HDTV video analysis**
- ✓ **LAN/VGA connectivity module**

Designed-for-Touch Interface

INFINIVISION 3000G X-SERIES OSCILLOSCOPE

- 8.5-inch captive touch screen
- Large, easy-to-touch targets
- Touch screen enables quick and natural device operation: *facilitating deep-dive analysis* into signal anomalies



Built-In Help Features

INFINIIVISION 3000G X-SERIES OSCILLOSCOPE

- **Built-in help feature** designed to help infrequent users
- Built-in training signals
- Press and hold any front panel key or soft panel button for explanations on how to use **each scope feature**



Segmented Memory

INFINIIVISION 3000G X-SERIES OSCILLOSCOPE

- Segmented smart memory allows users to **selectively capture and store important signal activity** without capturing unimportant idle time
- Provides a time stamp of each segment, **enabling analysis of event frequency**
- Enables customers to effectively analyze **infrequent anomalies, data bursts, and multiple serial bus packets**





Equipped



Industry-Leading Waveform Update Rate



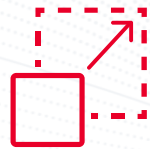
Accelerated



MegaZoom IV Smart Memory Technology



Enhanced

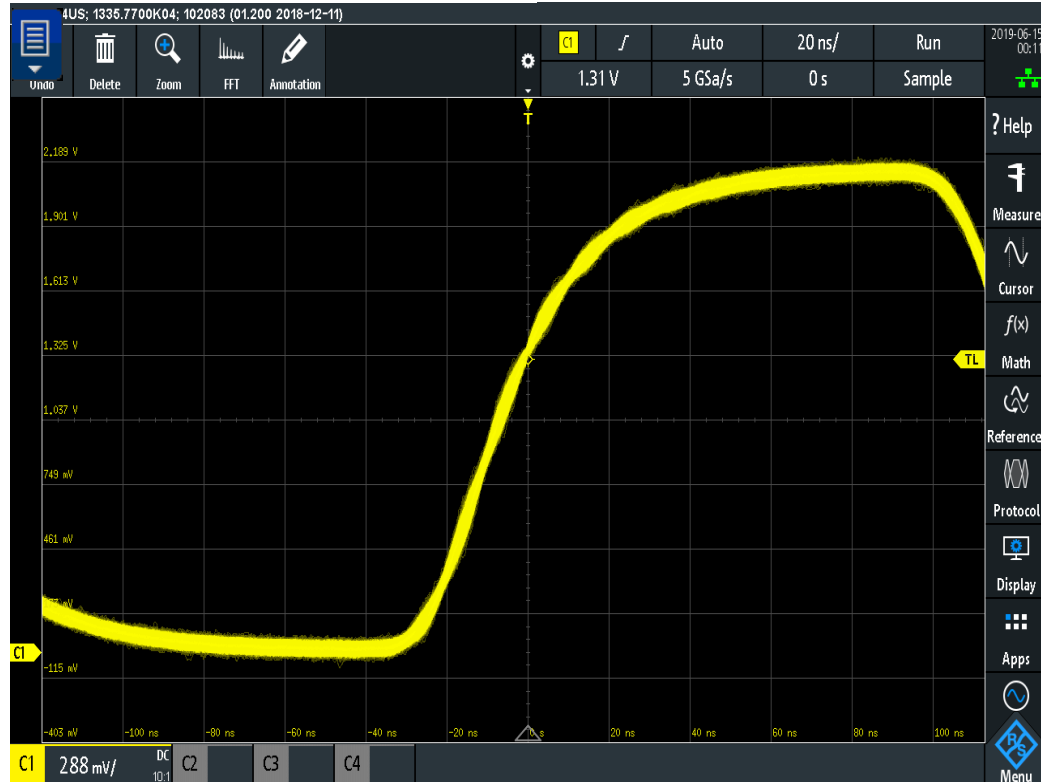


Zone Trigger

Capturing an infrequent glitch

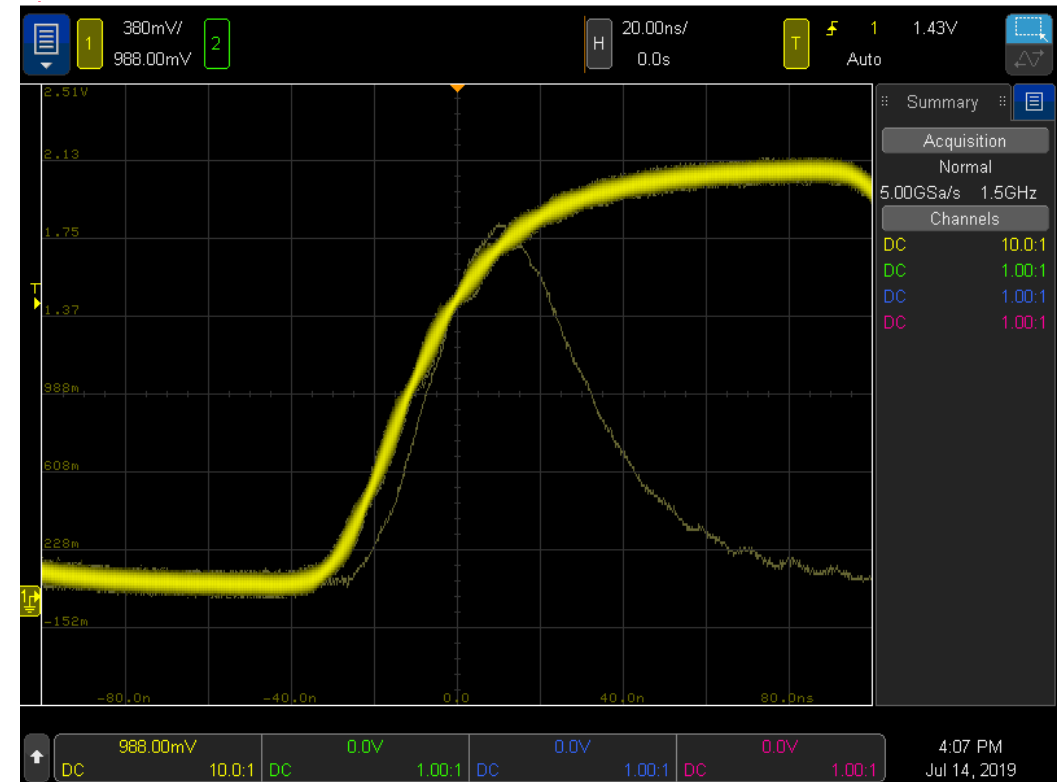
CAPTURING INFREQUENT EVENTS IS BASED ON STATISTICAL PROBABILITIES

45,000 waveforms per second



☹ Invisible glitch

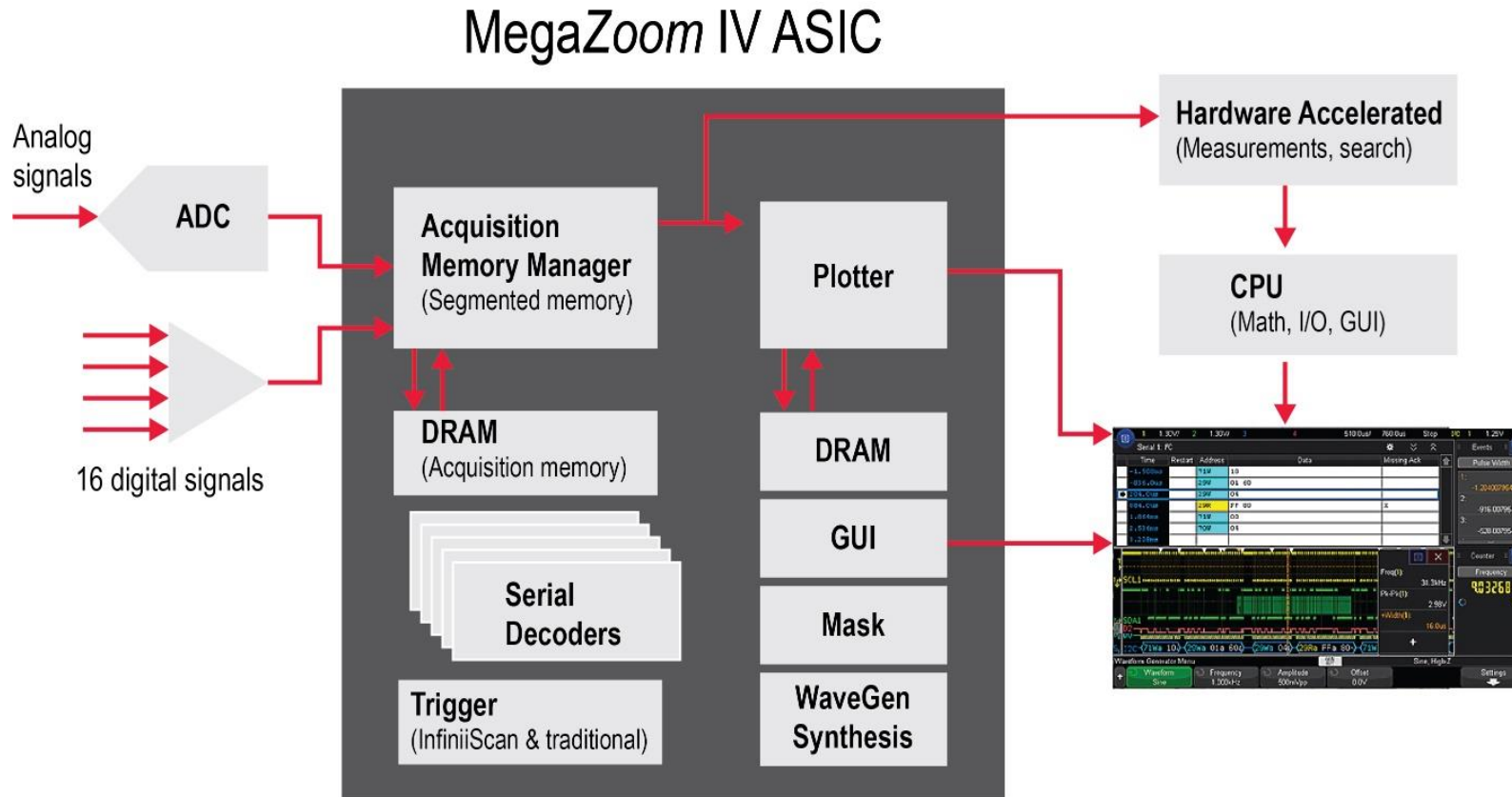
1,000,000 waveforms per second



😊 Glitch revealed

MegaZoom IV Smart Memory Technology

INFINIIVISION 3000G X-SERIES OSCILLOSCOPE



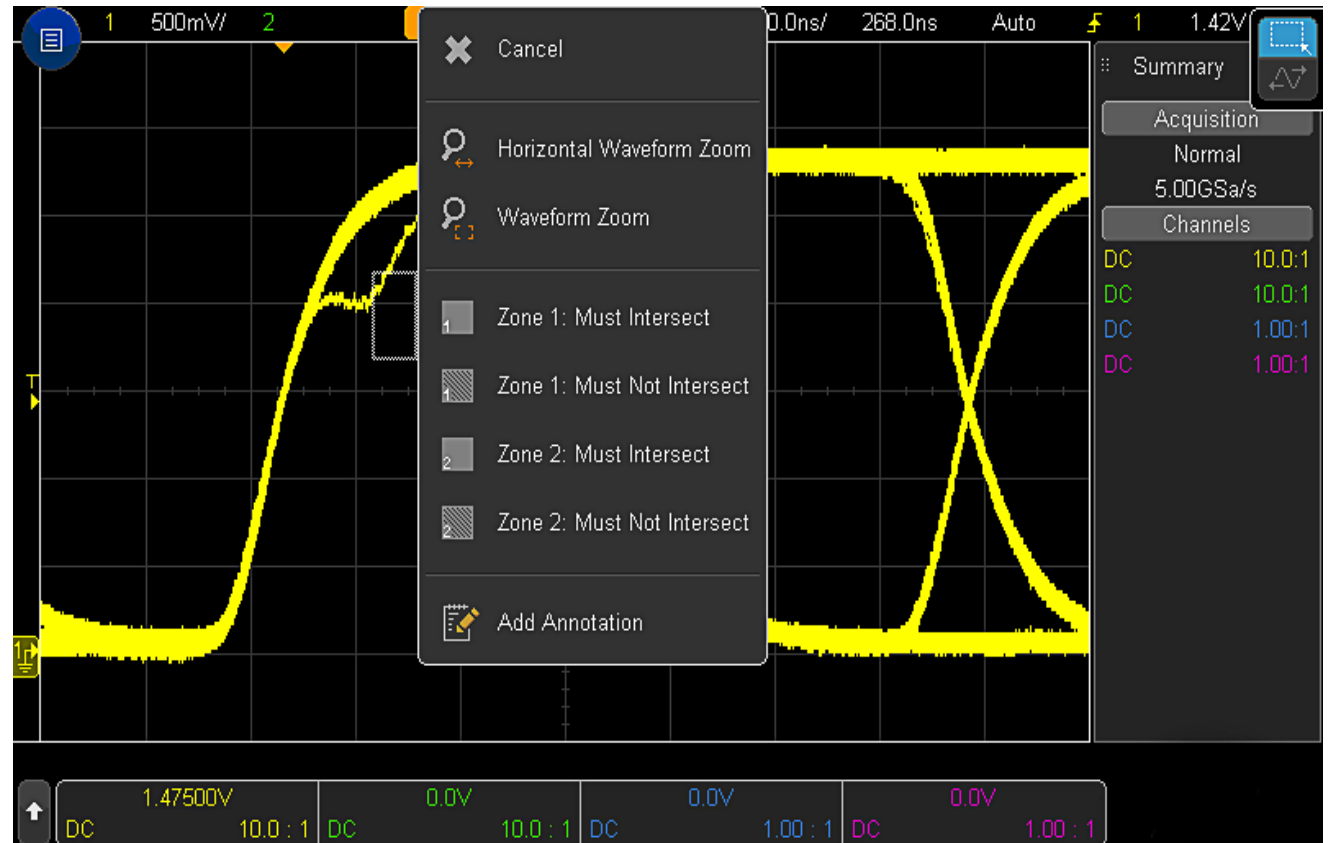
Core operations are handled by Keysight's MegaZoom IV smart memory ASIC— so 3000G requires minimum support from a CPU

Operations done in hardware = faster instrument performance

Zone Trigger

INFINIVISION 3000G X-SERIES OSCILLOSCOPE

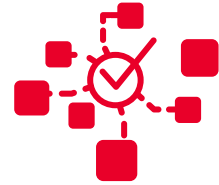
- Zone trigger feature **eliminates complexity** of setting up advanced triggers
- **Simplifies** a 13+ step process on a traditional scope with advanced triggers to **a mere 2-4 easy steps.**



Draw a box that intersects a portion of a waveform you want to isolate



Equipped



7-in-1 Instrument Integration



Accelerated



Optional Features/Software



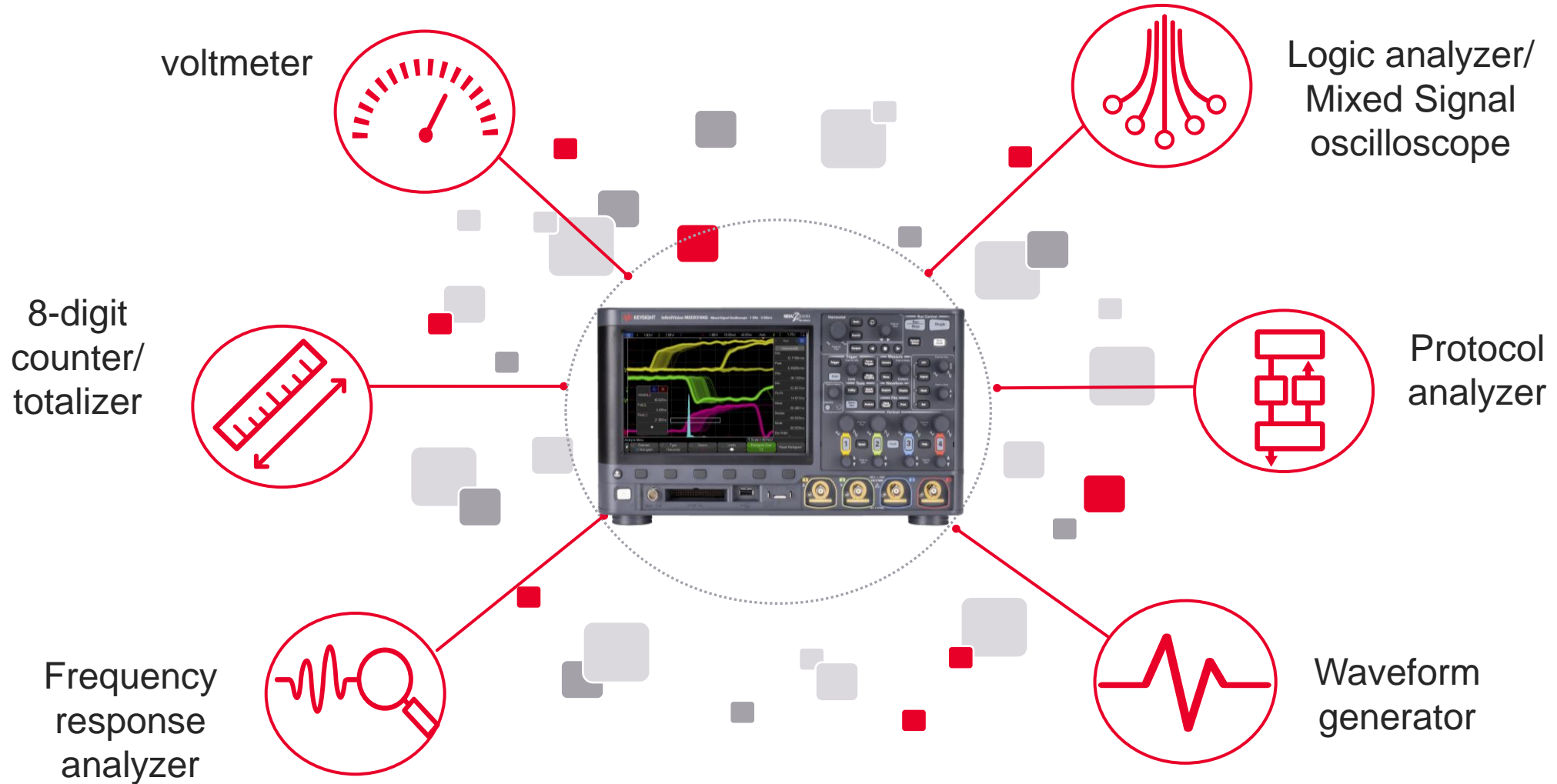
Enhanced



Probes

7-in-1 Instrument Integration

INFINIVISION 3000G X-SERIES OSCILLOSCOPE



FFT Analysis

INFINIIVISION 3000G X-SERIES OSCILLOSCOPE

- Dedicated frequency/spectrum analysis allows you to **time-correlate analog, digital, and frequency-domain waveforms in one instrument**
- Ability to peak search, max and min hold, and average FFTs



Triggered on a SPI command, the RF signal is at 400 MHz as indicated in the frequency peak search result lister.

Optional Software Applications

INDUSTRY-FIRST APPLICATION FOCUSED PACKAGES



AEROSPACE / DEFENSE

Enable protocol trigger and decode for MIL-STD 1553 and ARINC 429 series buses



AUTOMOTIVE

Enables decode for most common auto serial buses for power train and body control and monitoring



ULTIMATE BUNDLE

Enable all available software options



POWER

Enable automated power supply characterization measurements



USB

Extended capability for USB 2.0 triggering and analysis

InfiniiVision Applications Software

INDUSTRY-FIRST APPLICATION FOCUSED PACKAGES

Automotive



Dx000AUTA

CAN (.dbc symbolic)
CAN-FD (.dbc sym)
LIN (.ldf symbolic)
SENT
CXPI
FlexRay
User-definable Manchester
User-definable NRZ
Mask Limit Test
FRA (Bode)

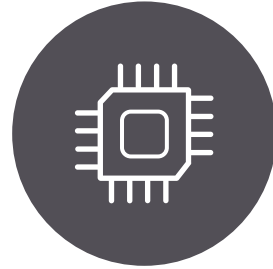
Aerospace & Defense



Dx000AERA

MIL-STD 1553
ARINC 429
Video Analysis
Mask Limit Test
FRA (Bode)

Embedded



Dx000GENA

I²C
SPI
UART/RS232/485
Audio/I²S
USB-PD
Video Analysis
Mask Limit Test
FRA (Bode)

Power



Dx000PWRA

Power Analysis
USB-PD
Mask Limit Test
FRA (Bode)

USB



Dx000USBA

USB 2.0 Full/Low
USB 2.0 Hi-speed
USB-PD
USB 2.0 Signal Quality
Jitter Analysis (6000X only)
Mask Limit Testing
FRA (Bode)

NFC



Dx000NFCA

NFC Trigger
NFC Automated Test
Resonant Frequency

Ultimate Bundle



Dx000BDLA

Dx000AUTA
Dx000AERA
Dx000GENA
Dx000PWRA
Dx000USBA
Dx000NFCA

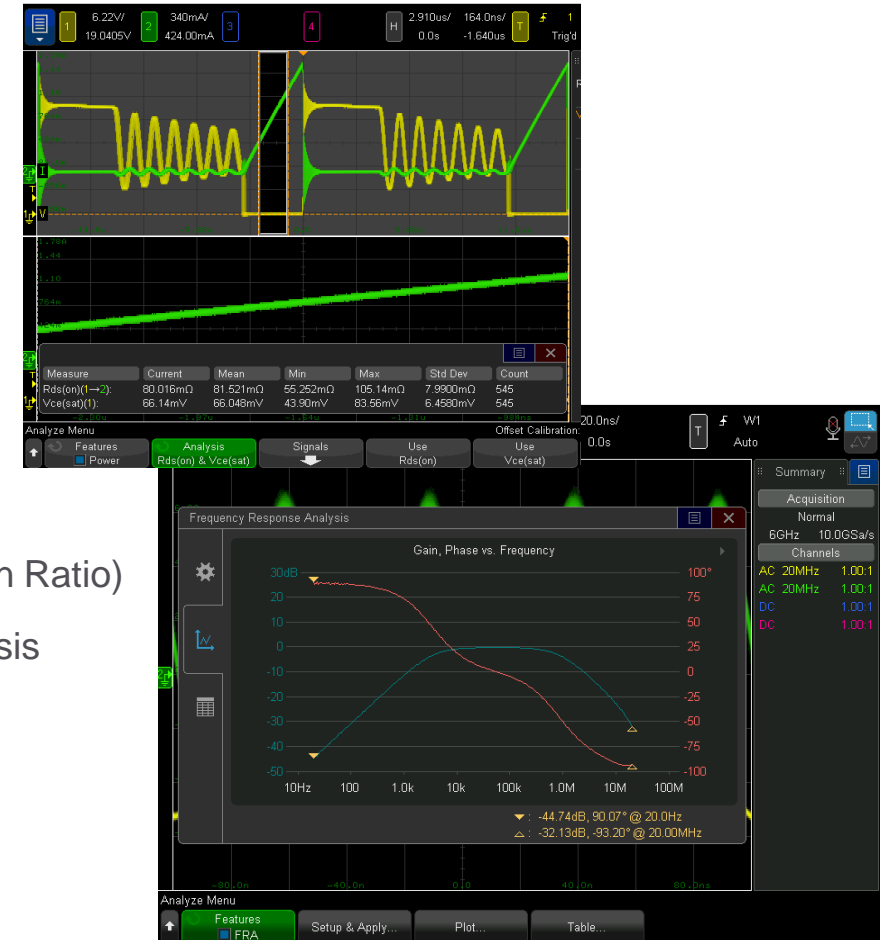
Power

Dx000PWRA



InfiniiVision Series:		3000A	3000T	4000A	6000A	M9240
Power Package Model Number:		D3000PWRA	D3000PWRA	D4000PWRA	D6000PWRA	M9240PWFB
Power Supply Characterization Measurements	Real power	✓	✓	✓	✓	✓
	Apparent power	✓	✓	✓	✓	✓
	Reactive power	✓	✓	✓	✓	✓
	Power factor	✓	✓	✓	✓	✓
	Crest factor (V&I)	✓	✓	✓	✓	✓
	Phase angle	✓	✓	✓	✓	✓
	Current harmonics	✓	✓	✓	✓	✓
	Inrush current	✓	✓	✓	✓	✓
	Switching loss	✓	✓	✓	✓	✓
	$R_{DS(ON)}$	✓	✓	✓	✓	✓
	$V_{CE(SAT)}$	✓	✓	✓	✓	✓
	Slew rate (V&I)	✓	✓	✓	✓	✓
	Modulation analysis	✓	✓	✓	✓	✓
	Auto probe deskew	✓	✓	✓	✓	✓
	Output ripple	✓	✓	✓	✓	✓
	Turn on/off time	✓	✓	✓	✓	✓
	Efficiency	✓	✓	✓	✓	✓
	Transient response	✓	✓	✓	✓	✓
PSRR		✓	✓	✓	✓	
Control loop response		✓	✓	✓	✓	
Frequency Response Analysis (Bode plots)		✓	✓	✓	✓	
USB PD (Power Delivery) Trigger & Decode		✓	✓	✓	✓	
Mask Test	✓	✓	✓	✓	✓	
Advanced Math	✓	Std	Std	Std	Std	

- Input AC Power Quality
- Current harmonics Analysis
- Switching Device Analysis
- $R_{DS(ON)}$ and $V_{CE(SAT)}$ Analysis
- Modulation Analysis
- Output Ripple Analysis
- Turn On/Off Time Analysis
- Transient Response Analysis
- PSRR(Power Supply Rejection Ratio)
- Control Loop Response Analysis



Aerospace & Defense

Dx000AERA



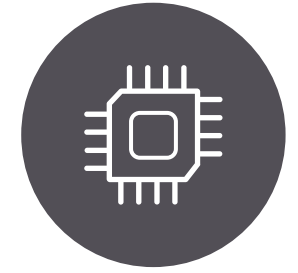
- MIL-STD 1553 trigger and decode
- MIL-STD 1553 eye-diagram mask testing
- ARINC 429 trigger and decode
- ARINC 429 eye-diagram mask testing
- Dual-bus time-interleaved protocol lister display
- Hardware-based decoding for responsiveness
- Decoding of all frames captured using segmented memory



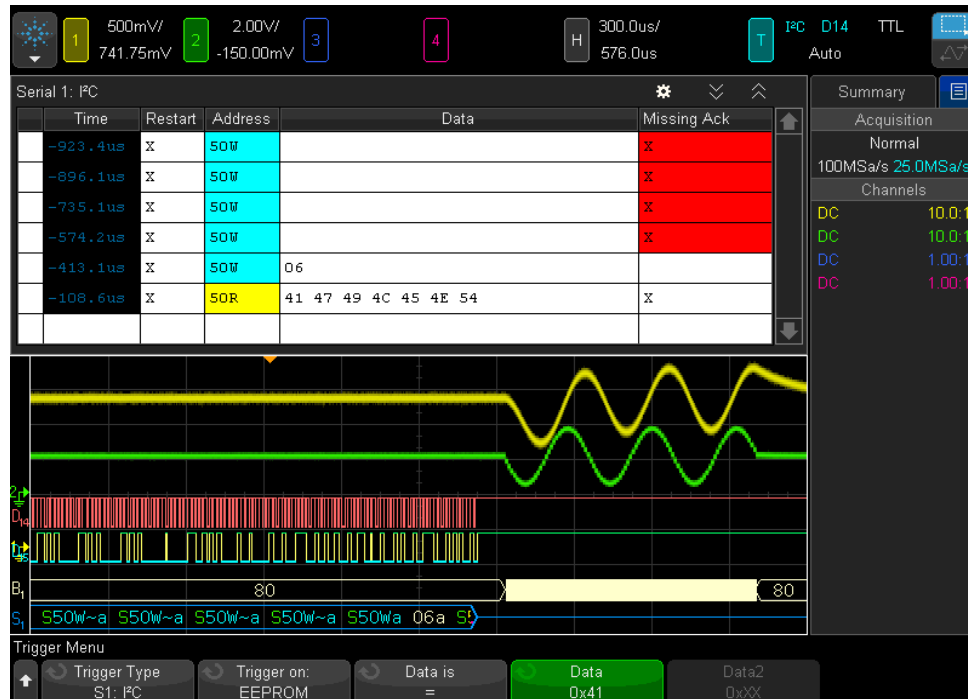
InfiniiVision X-Series:		3000A	3000T	4000A	6000A	P9240	M9240
Aero Package Model Number:		D3000AERA	D3000AERA	D4000AERA	D6000AERA	P9240AERB	M9240AERB
Serial Trigger & Decode	MIL-STD 1553	✓	✓	✓	✓	✓	✓
	ARINC 429	✓	✓	✓	✓	✓	✓
Advanced Analysis	Mask Test	✓	✓	✓	✓	✓	✓
	Frequency Response Analysis (Bode plots)		✓	✓	✓	✓	✓
	Enhanced HDTV Video Triggering & Analysis	✓	✓	✓	✓	✓	✓
	Advanced Math	✓	Std	Std	Std	Std	Std

Embedded

Dx000GENA



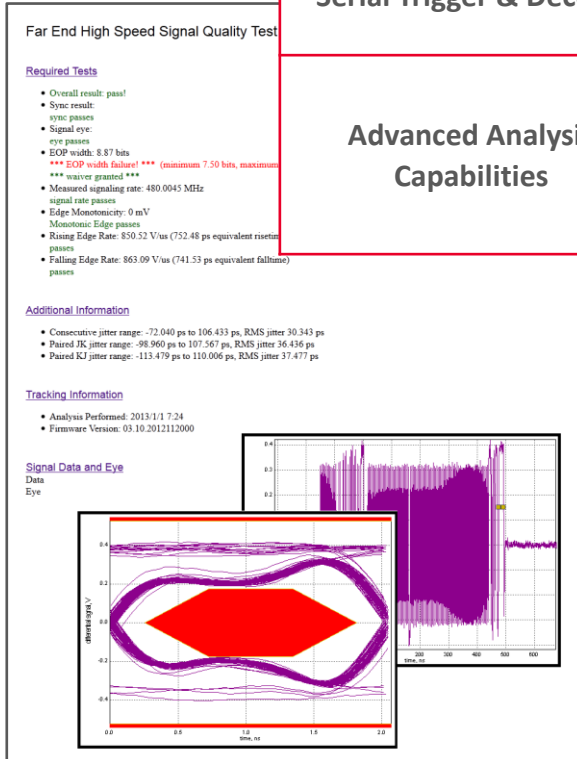
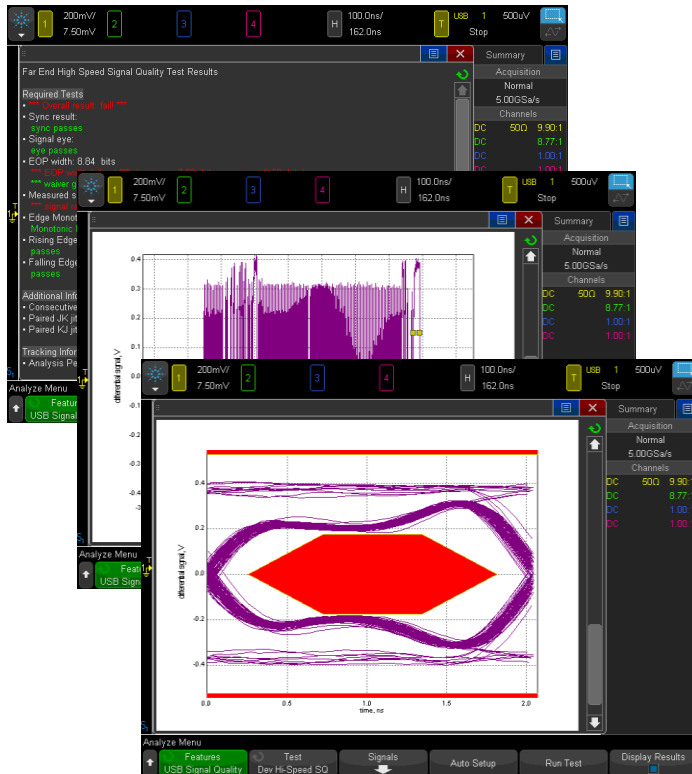
- Hardware-based decoding for responsiveness
- Dual-bus time-interleaved protocol lister display
- Decoding of all frames captured using segmented memory
- Real-time frame/error counter for some protocols



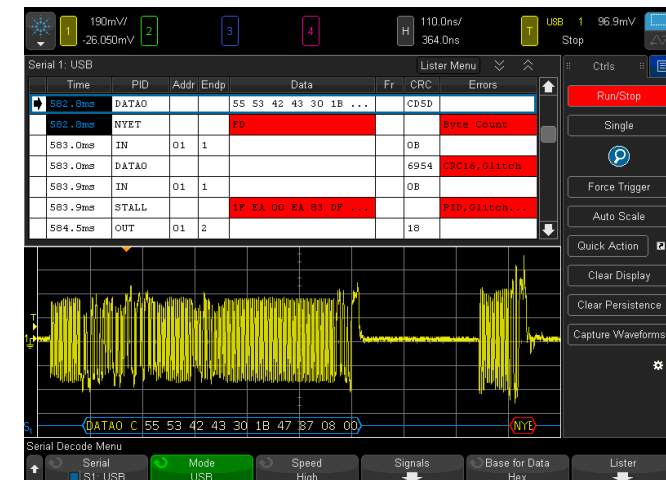
InfiniiVision Series:		2000A	3000A	3000T	4000A	6000A	P9240	M9240
General-purpose Package Model Number:		D2000GENA	D3000GENA	D3000GENA	D4000GENA	D6000GENA	P9240GENB	M9240GENB
Serial Trigger & Decode	I ² C	✓	✓	✓	✓	✓	✓	✓
	SPI	✓	✓	✓	✓	✓		
	UART (RS-232/485)	✓	✓	✓	✓	✓	✓	✓
	I ² S (Audio)		✓	✓	✓	✓		
	USB-PD			✓	✓	✓	✓	✓
Advanced Analysis	Mask Test	✓	✓	✓	✓	✓	✓	✓
	Frequency Response Analysis (Bode Plots)			✓	✓	✓	✓	✓
	Enhanced HDTV Video Test		✓	✓	✓	✓	✓	✓
	Advanced Math	Std	✓	Std	Std	Std	Std	Std

USB

Dx000USBA



InfiniiVision Series:		4000A	6000A
USB Package Model Number:		D4000USBA	D6000USBA
Serial Trigger & Decode	USB 2.0 Low- & Full-speed	✓	✓
	USB 2.0 Hi-speed ¹	✓	✓
Advanced Analysis Capabilities	USB PD (Power Delivery)	✓	✓
	USB 2.0 Signal Quality Test ²	✓	✓
	Jitter Analysis		✓
	Mask Test	✓	✓
	Frequency Response Analysis	✓	✓

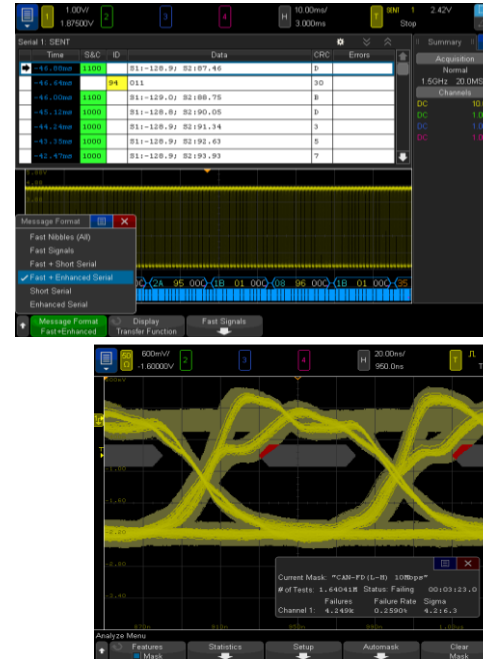


Automotive

Dx000AUTA



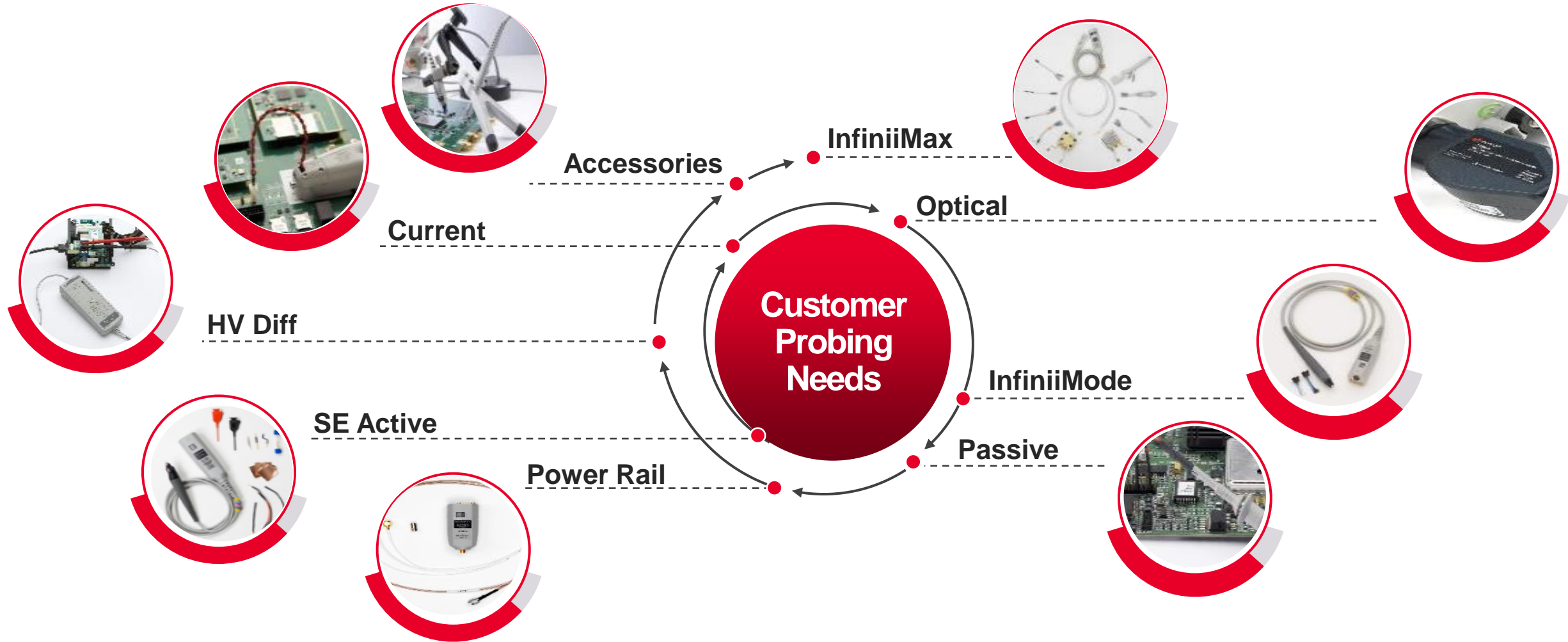
- CAN and CAN FD symbolic trigger and decode
- LIN symbolic trigger and decode
- CAN eye-diagram mask testing
- CAN FD eye-diagram mask testing
- FlexRay eye-diagram mask testing
- SENT mask pulse-shape physical layer testing
- Dual-bus time-interleaved protocol lister display
- Hardware-based decoding for responsiveness
- Decoding of all frames captured using segmented memory
- Real-time frame/error counter with bus load measurement
- Zone trigger to isolate occurrences of CAN bus arbitration



InfiniiVision Series:		2000A	3000A	3000T	4000A	6000A	P9240	M9240
Automotive Package Model Number:		D2000AUTA	D3000AUTA	D3000AUTA	D4000AUTA	D6000AUTA	P9240AUTB	M9240AUTB
Serial Trigger & Decode	CAN ¹	✓	✓	✓	✓	✓	✓	✓
	CAN FD ¹			✓	✓	✓	✓	✓
	LIN ²	✓	✓	✓	✓	✓	✓	✓
	FlexRay		✓	✓	✓	✓		
	SENT			✓	✓	✓	✓	✓
	PSI5 (User-definable Manchester)			✓	✓	✓	✓	✓
	User-definable NRZ			✓	✓	✓	✓	✓
Advanced Analysis	CXPI			✓	✓	✓	✓	✓
	Mask Test ³	✓	✓	✓	✓	✓	✓	✓
	Frequency Response Analysis			✓	✓	✓	✓	✓
	Advanced Math	Std	✓	Std	Std	Std	Std	Std

Keysight Probing Portfolio

ENGINEERED FOR SUPERIOR SIGNAL ACCESS & ACCURACY



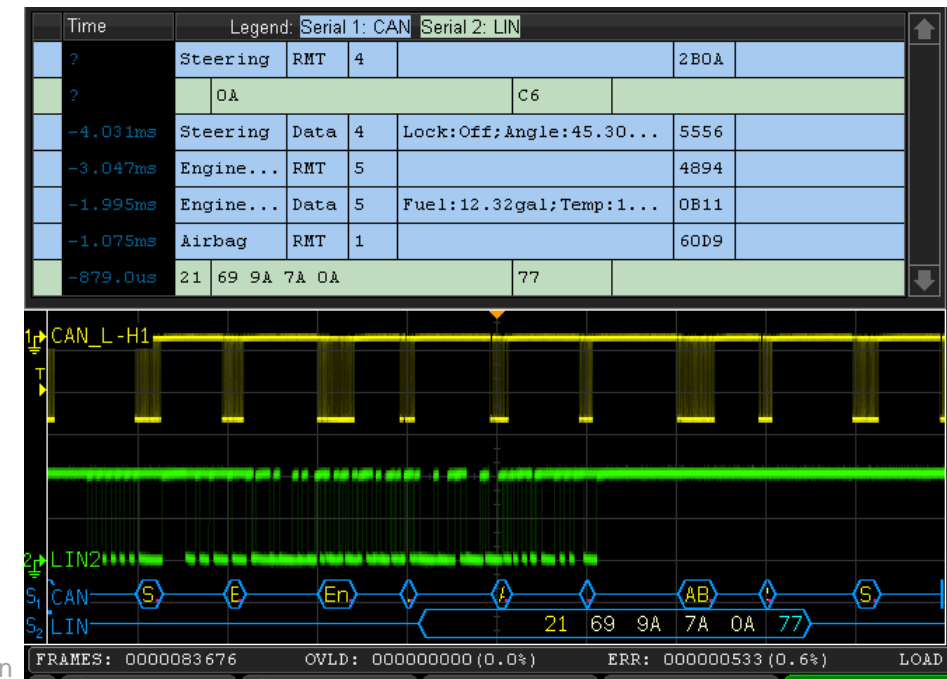
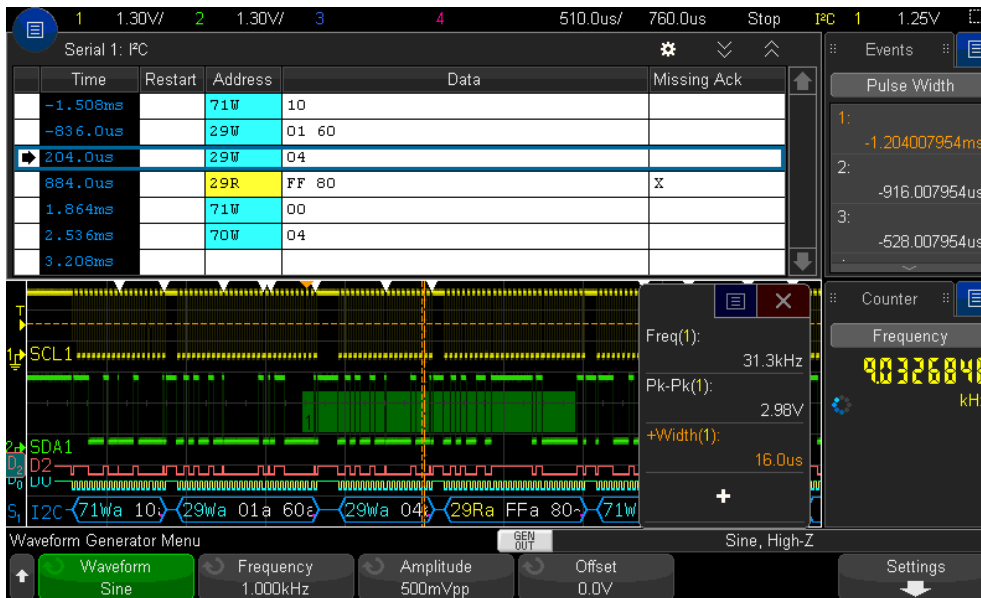
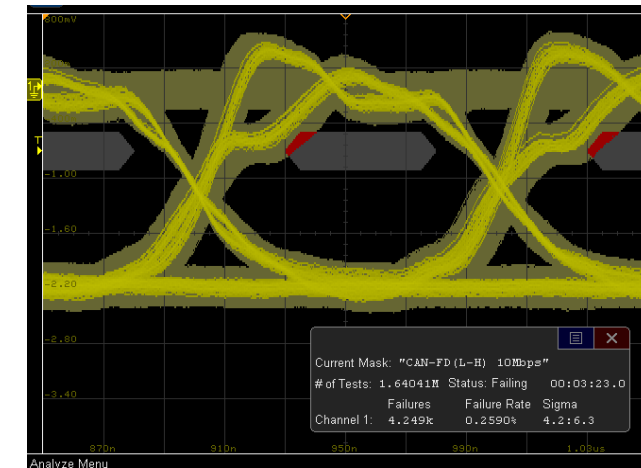
调试技巧组合讲解和实例



Unique Measurement Capabilities

SERIAL ANALYSIS AND DECODE

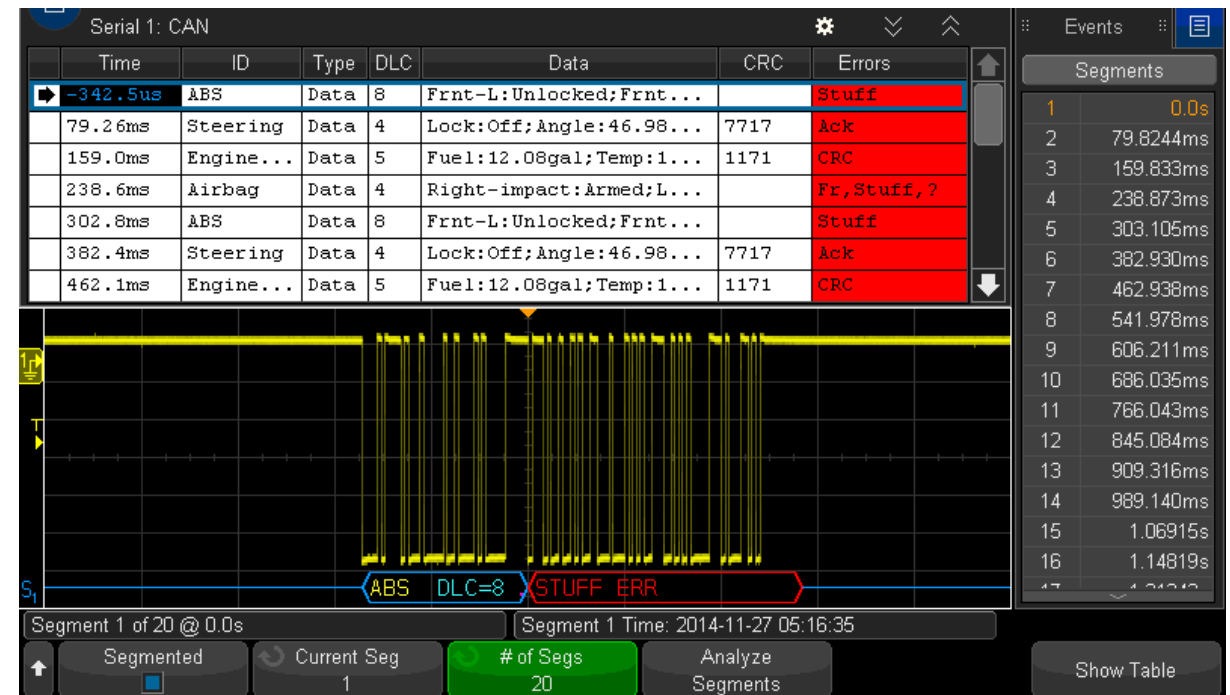
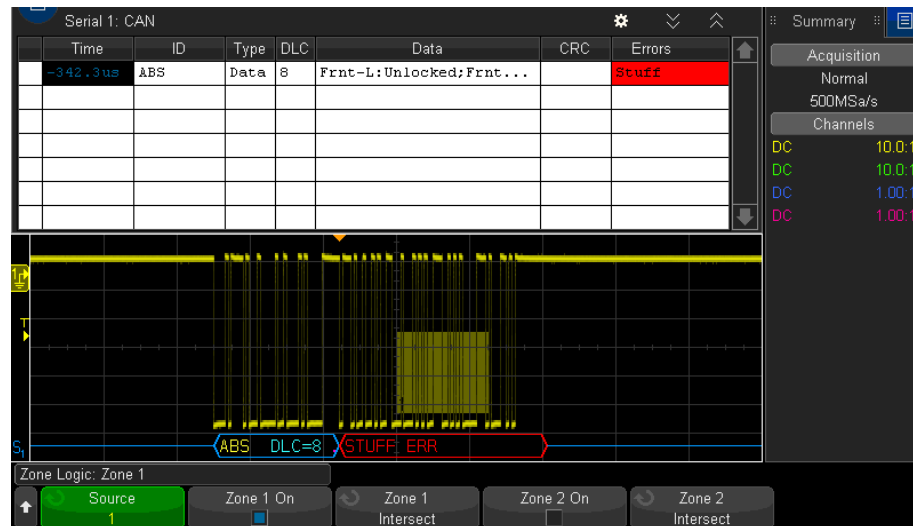
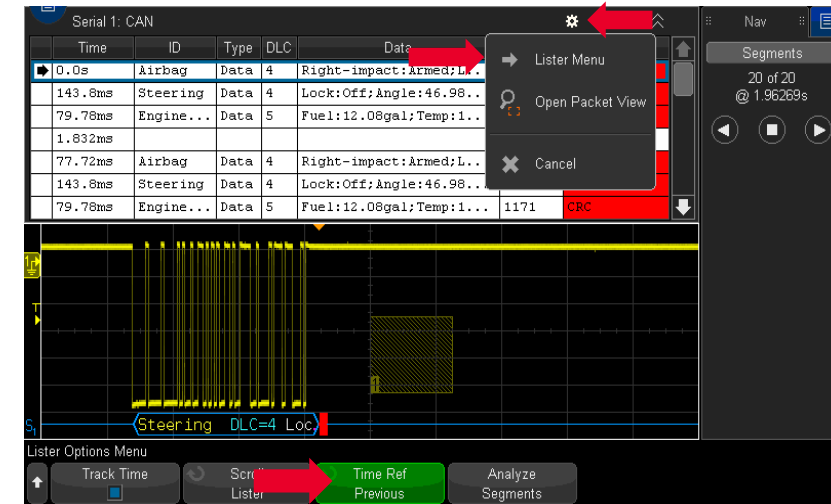
- Hardware-based decoding
- Dual serial bus analysis with time-interleaved “Lister”
- FlexRay and CAN eye-diagram mask testing
- Real-time frame counter with bus utilization (Bus Load)
- Segmented memory acquisition with decoding



Unique Measurement Capabilities

BEST IN THE CLASS

- Fast waveform update
- Trigger on a specific error
- Combine Zone Trigger with traditional serial bus trigger
- Stress Test
- Lister view with flexible time reference

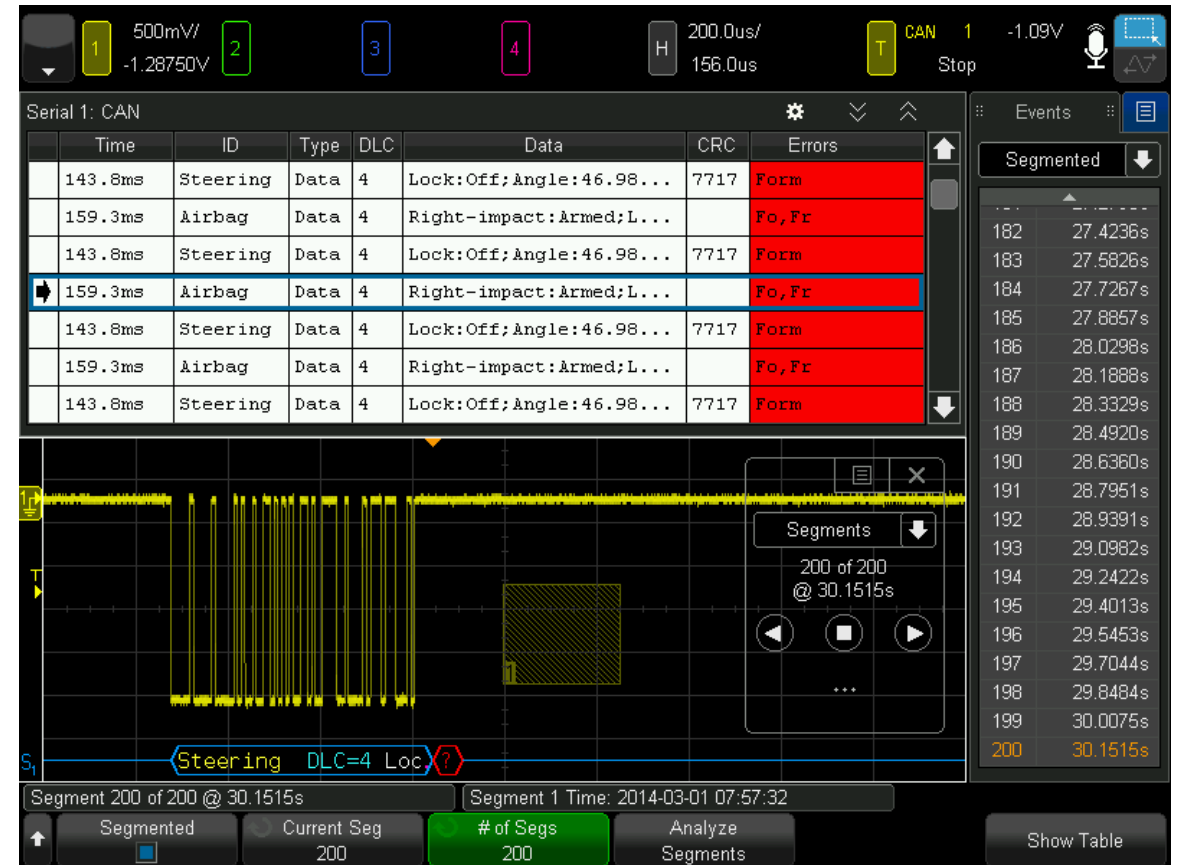


Advanced Debug Features

SERIAL BUS



Zone Trigger



Zone Trigger + Segmented Memory

A real example (CAN)

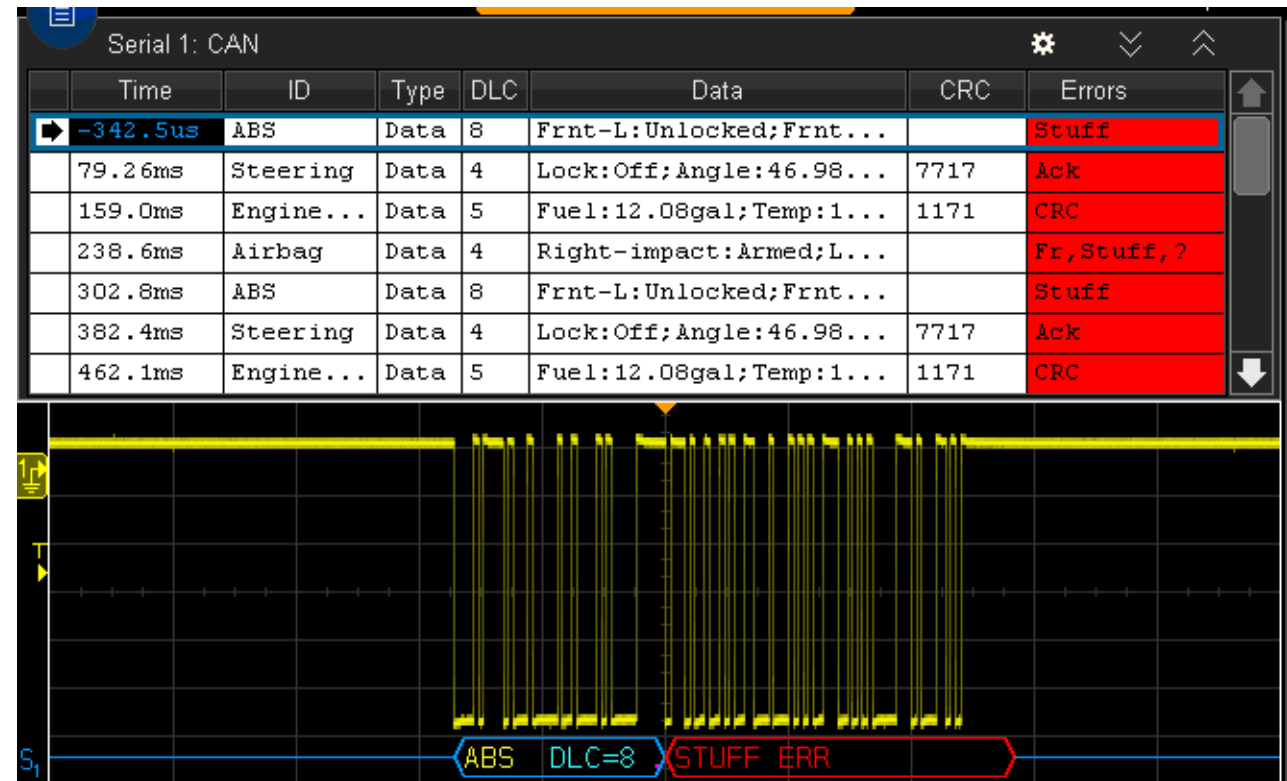
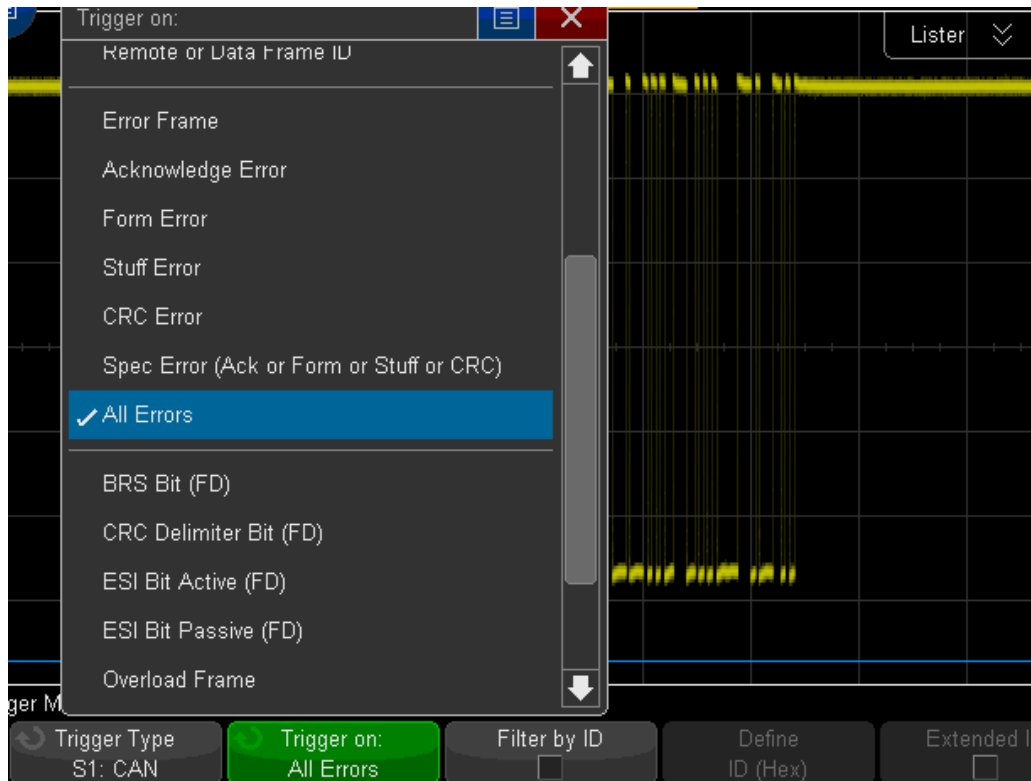
TRIGGER ON ERRORS, ZONE TRIGGER, AND SEGMENTED MEMORY

Trigger on “All Errors”

We can trigger on all the CAN error packets.

See different types of errors.

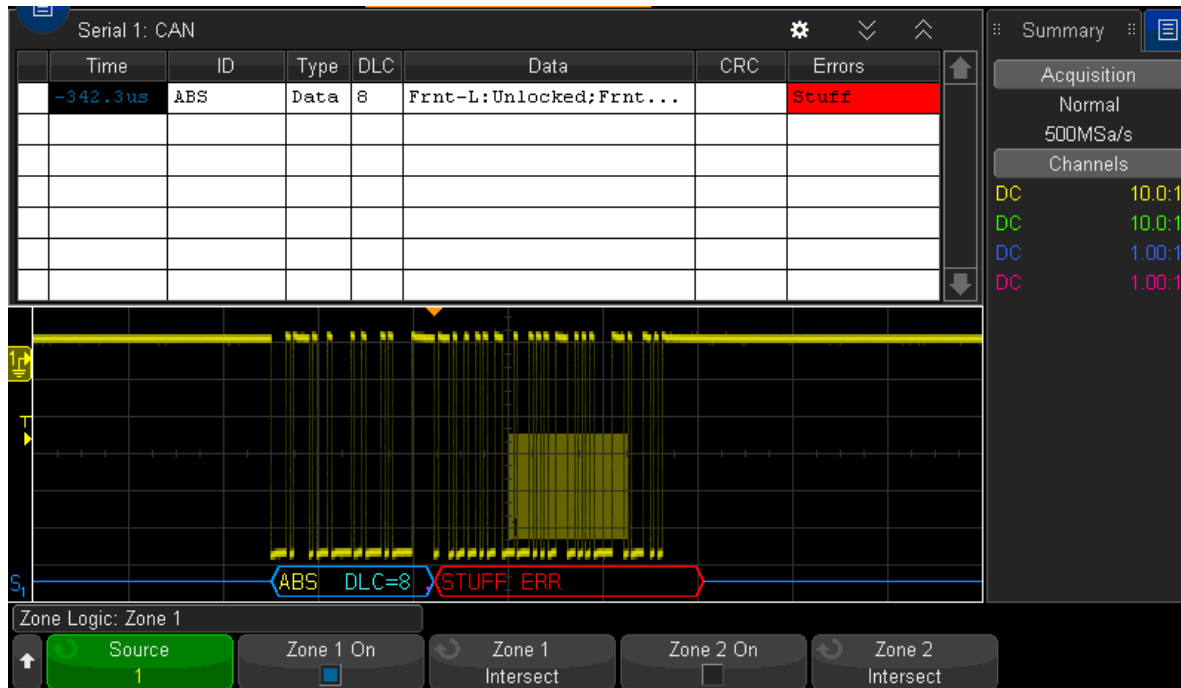
How to isolate different errors?



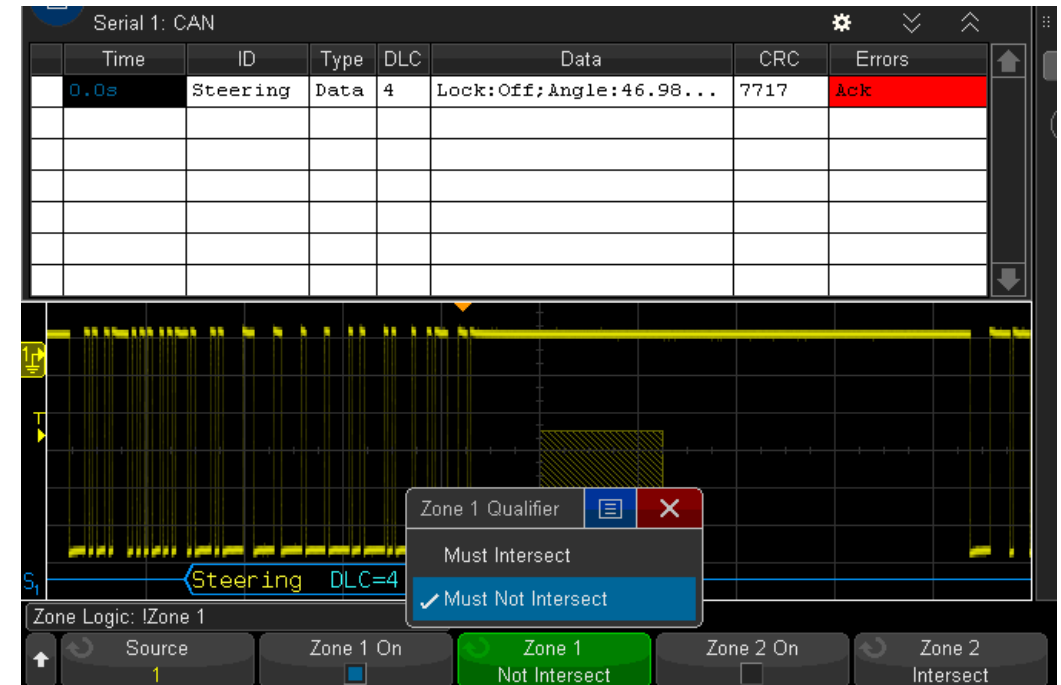
Isolate Error with Zone Trigger

USING ZONE TRIGGER

Isolate ABS errors by zone trigger.
Simply drawing a box on longer packet length of the ABS error.



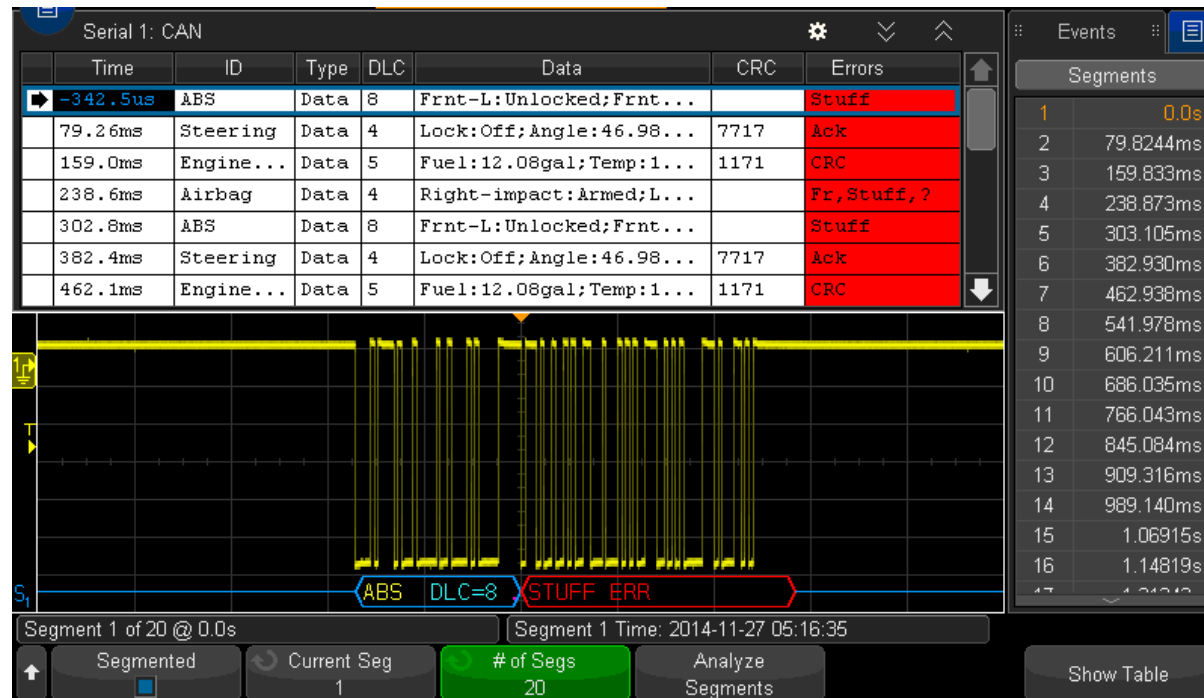
Alternatively, using “MUST NOT INTERSECT” to isolate steering error packets. (ignore ABS errors)



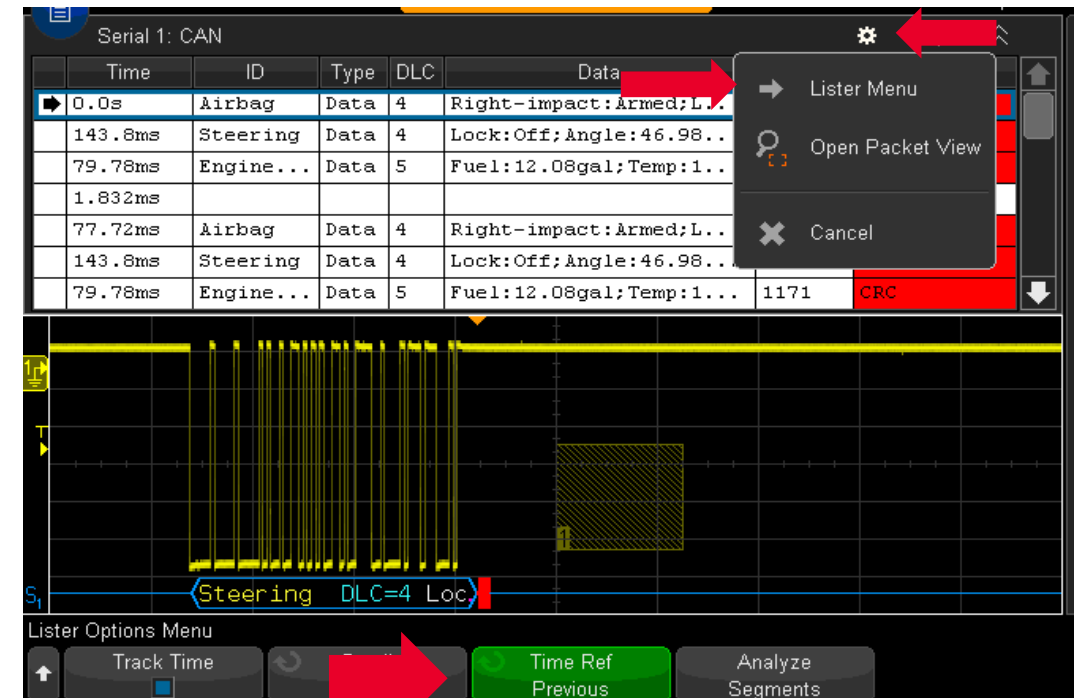
Segmented time tagging with relative time tagging

MORE INSIGHT

Using segmented memory to acquire 20 segments. We can see possible time correlation between the steering errors and airbag errors.



View segment times in reference to the first segment or in reference to the previous segment. Steering error always happens 143ms after the airbag error.



电源相关测试讲解和实例



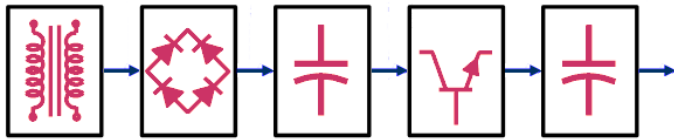
Power basics

电源的‘职责’：

从输出端产生稳定的低噪声的可控的电压、电流或功率输出

电源的种类：

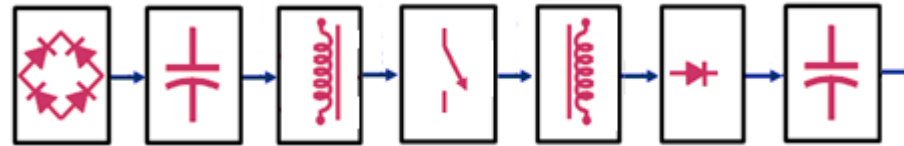
线性电源(LDO) 和 开关电源 (SMPS)



线性电源 (LDO)

工作在晶体管的线性区

- + 低噪声
- + 不需要太多滤波器件
- 只能做 ‘降压’
- 效率低

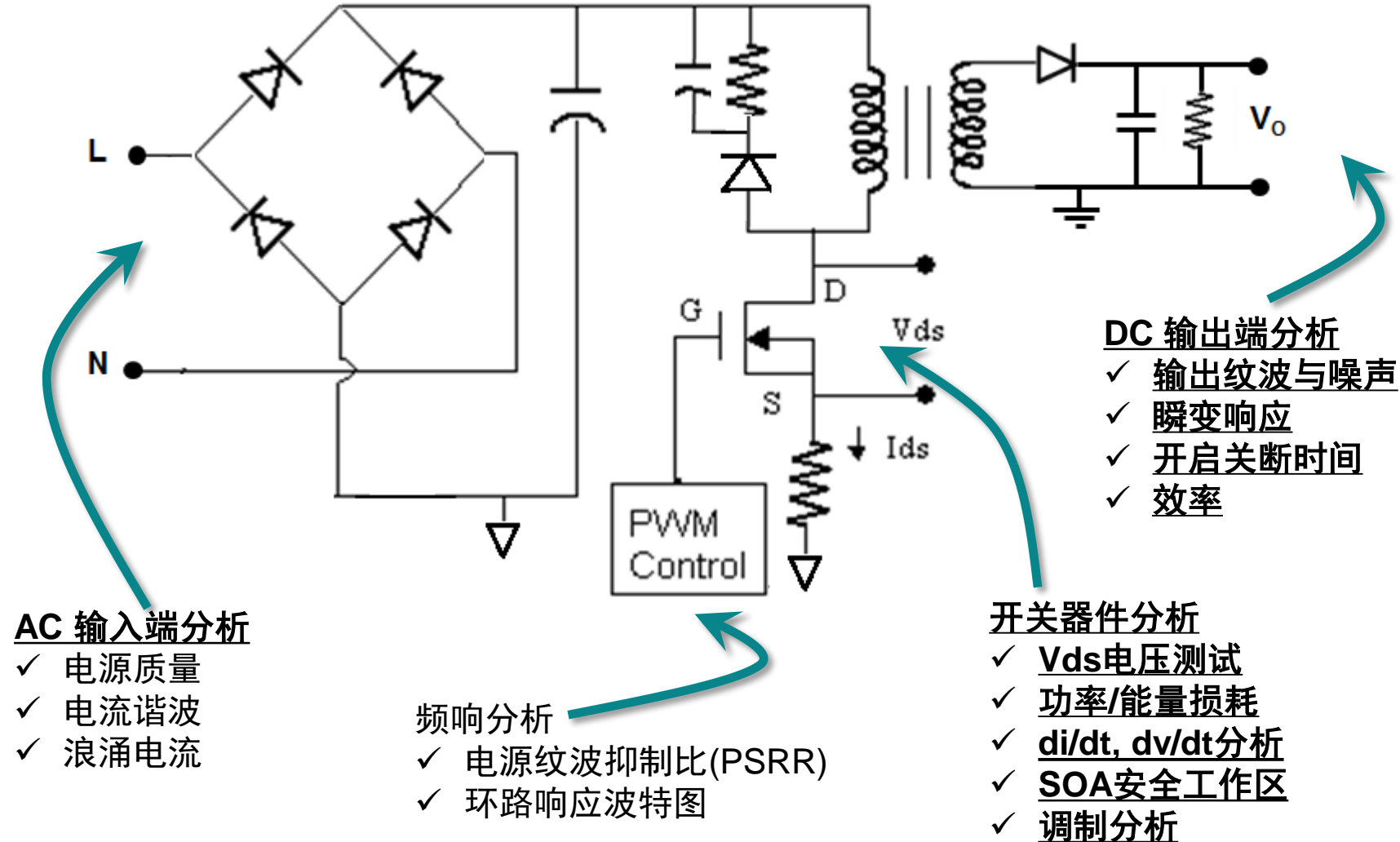


开关电源 (SMPS)

晶体管工作在开/关/开/关的状态，开关频率通常在 20Hz - 1MHz

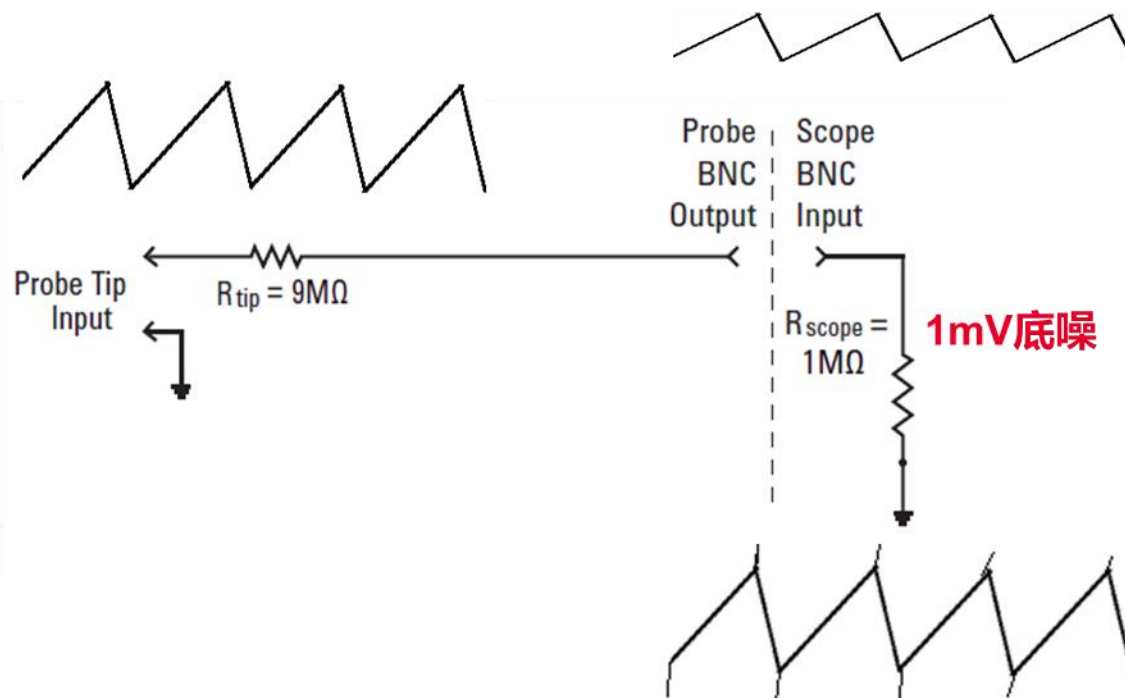
- + 效率高
- + 功率密度高
- + 可做降压也可升压
- 调制产生更多纹波和噪声

开关电源测试与测量

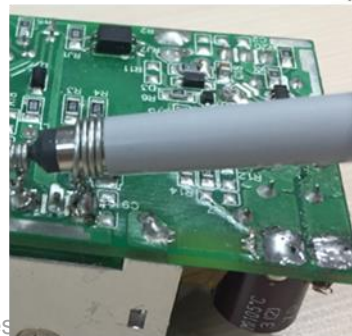
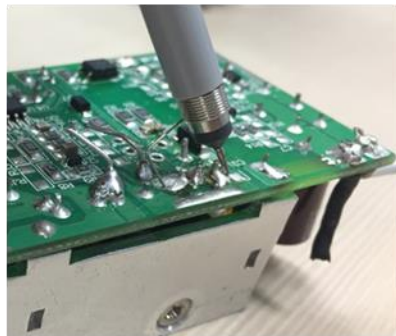


开关电源输出电压纹波的精确测试

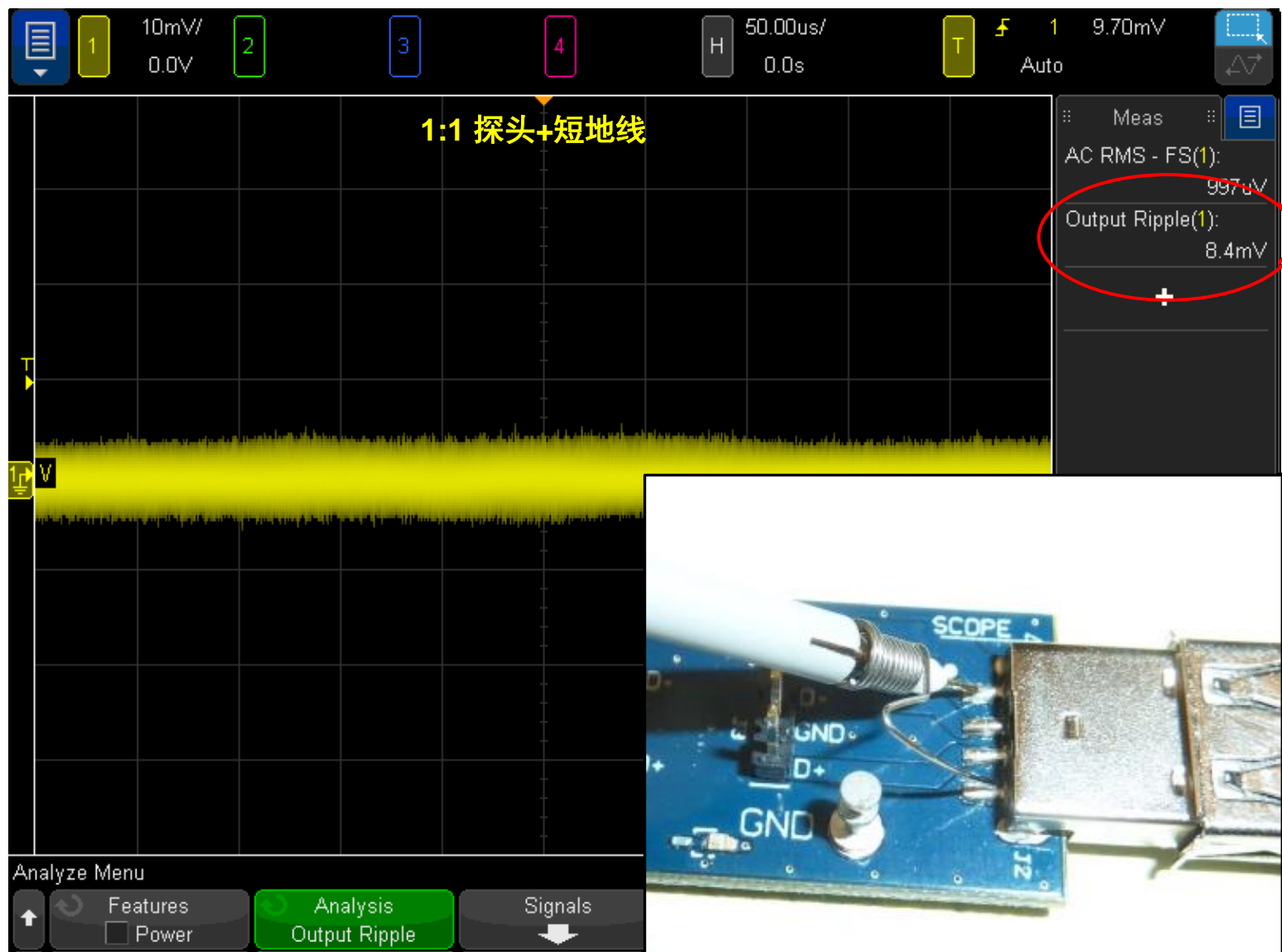
1, 探头衰减倍数



2, 地线长度



衰减比和底线长度实例



电源完整性供电电压噪声测量

N7020A高带宽低噪声探头:

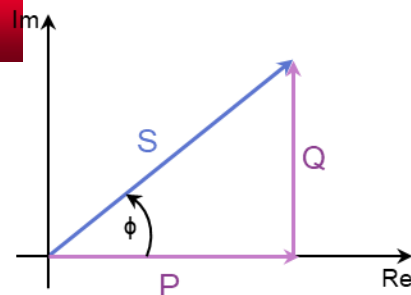
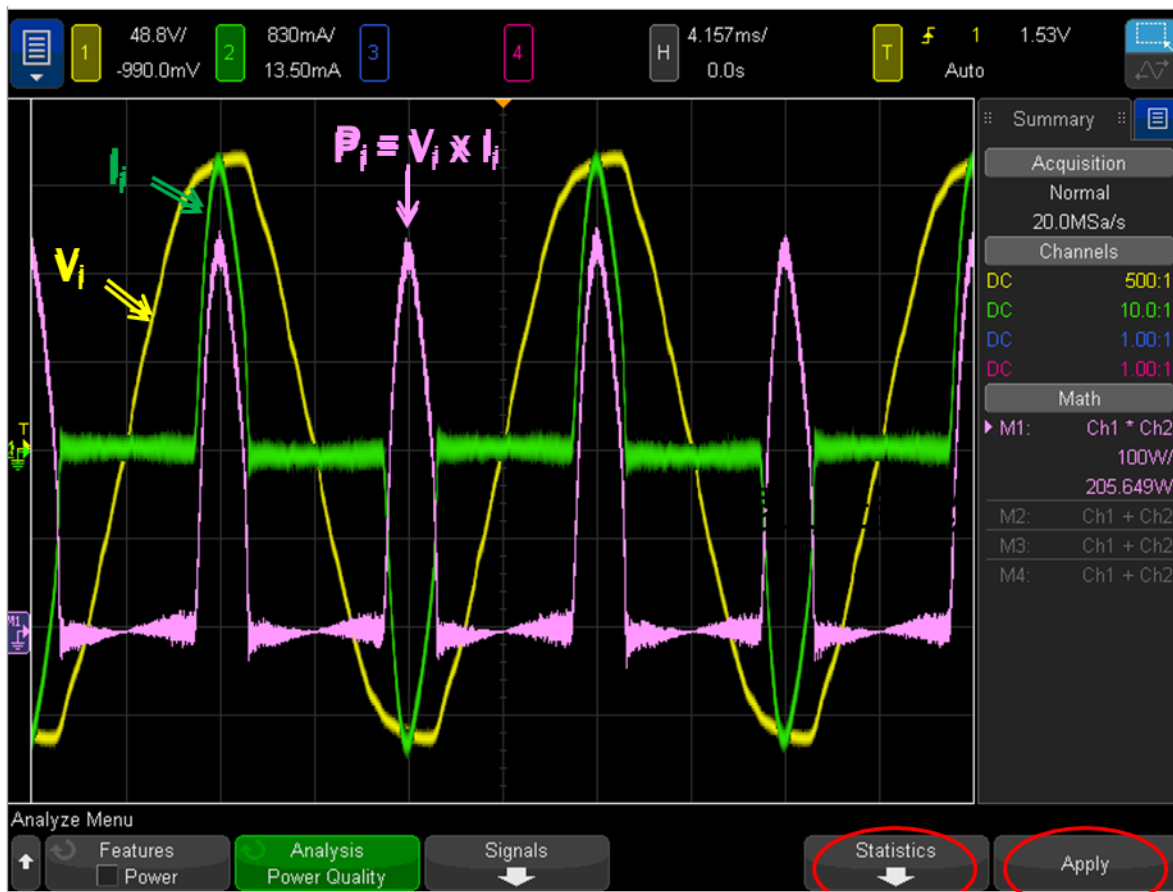
- ❖ 高达2GHz带宽
- ❖ 低噪声，衰减比仅为1:1
- ❖ 1mv/div高达+/- 24V的偏置范围
- ❖ 高输入阻抗：50 K Ω @ DC



	N7020A	BNC线缆	1:1无源探头	10:1无源探头
带宽	2GHz		20MHz	100-1000MHz
底噪(PK PK)	~500uV	~500uV	~1.1mV	11mV
AC耦合	24V偏置能力 不需要AC耦合	不能AC耦合 偏置能力弱	可以AC耦合 偏置能力弱	可以AC耦合 偏置能力弱
负载效应	50Kohm	50ohm	1Mohm	10Mohm



开关损耗测试



PF(功率因素) = P/S

P (有功功率)= P_i over N cycles

S (视在功率) = $V_{RMS} \times I_{RMS}$ over N Cycles

Q (无功功率) = $S \times \sin(\phi)$

CF_V (波峰因子)= V_{PK} / V_{RMS}

CF_I (波峰因子)= I_{PK} / I_{RMS}

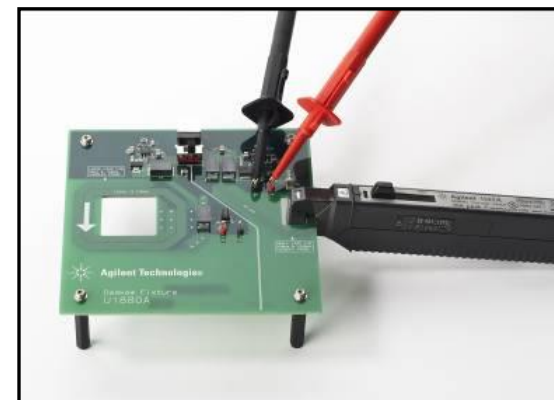
ϕ (相位角)= $\text{ACOS}(P/S)$

• 电压探头: 测量 $240V_{RMS}$ 电压需要高压差分探头, 推荐N279X A, 带宽 25MHz, $\pm 700V$.

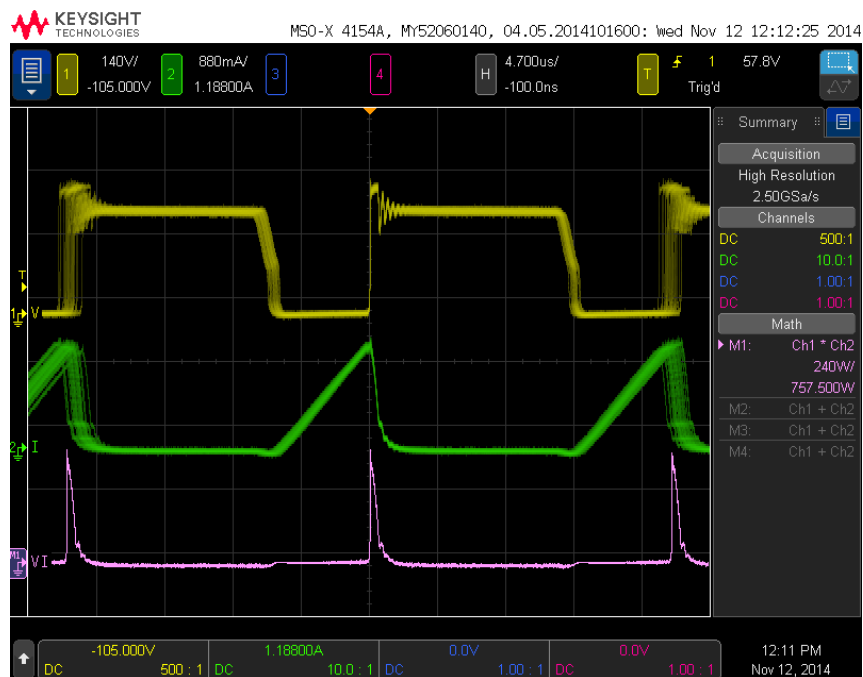
• 电流探头: 推荐N7026A N2893A 150MHz, 30Apk.

开关损耗测试技巧

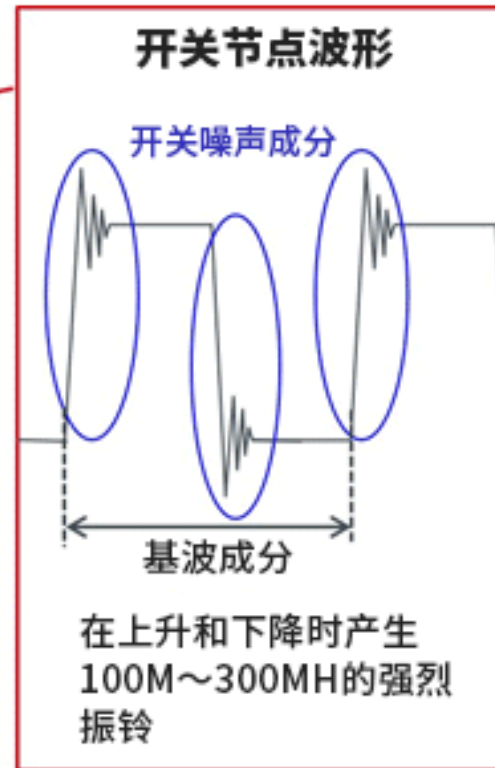
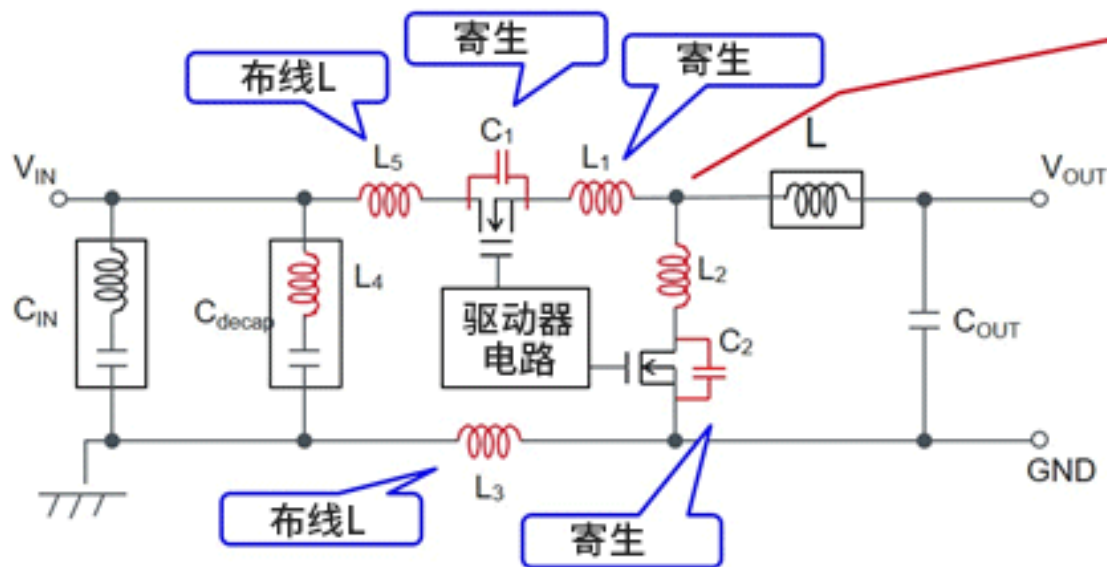
电压电流通道时延校准



校准后!



开关电源的噪声问题



- 1、每1mm的布线电感为1nH左右
- 2、开关用的MOSFET上升、下降时间为几ns

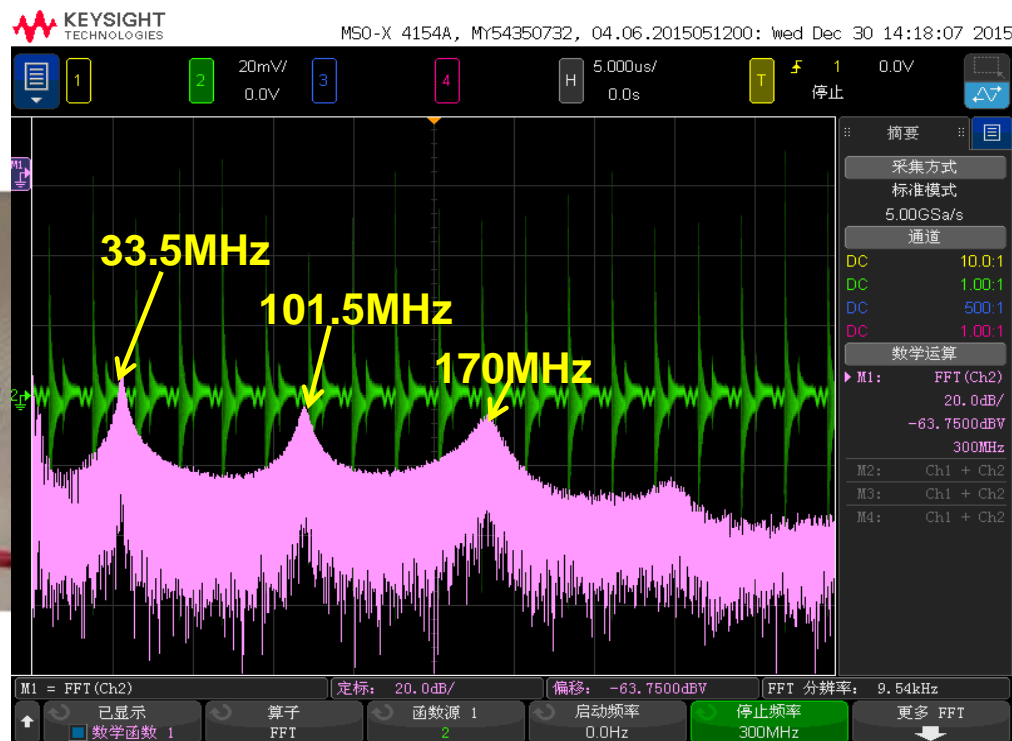
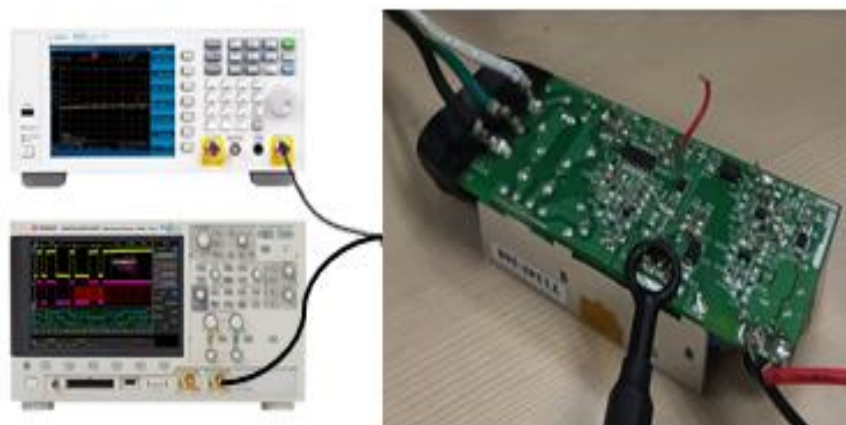
$$I = C \times \frac{dV}{dt}$$

$$V = L \times \frac{dI}{dt}$$

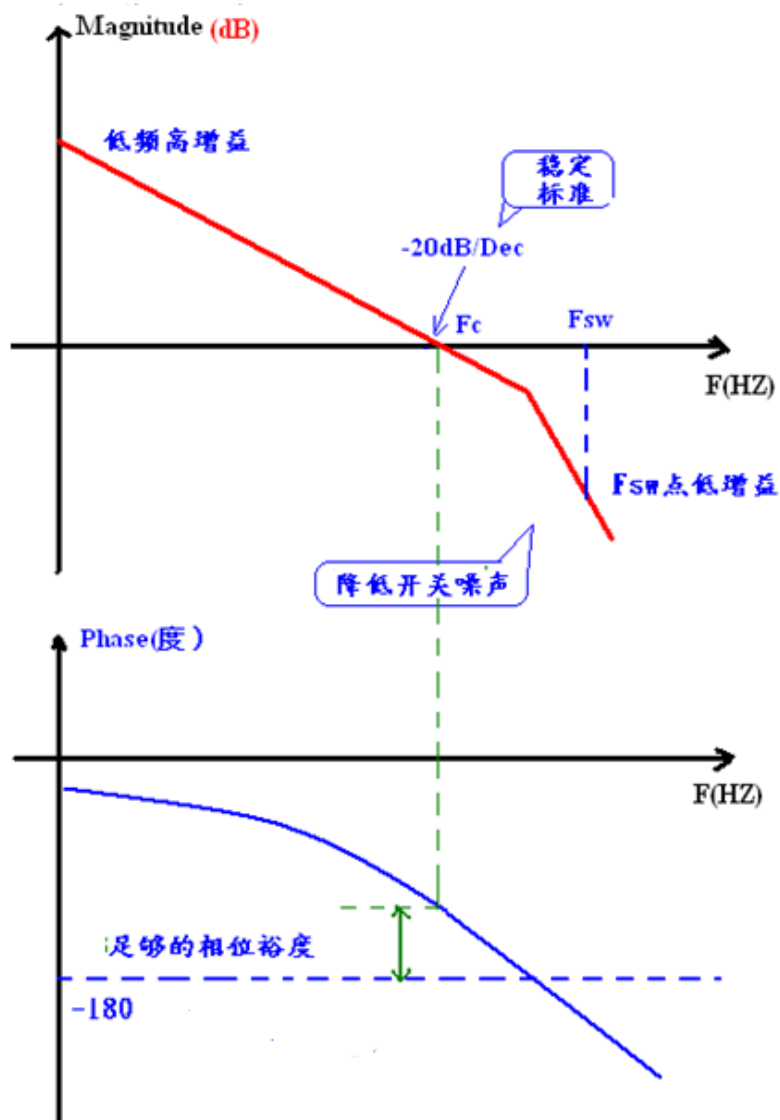
对策：电容 电感 布线 各类滤波器 等等

EMI故障排查的经济手段

基于示波器FFT功能或频谱仪进行EMI初步调试，确定噪声源，以经济且高效的手段解决EMI问题



环路稳定性测试



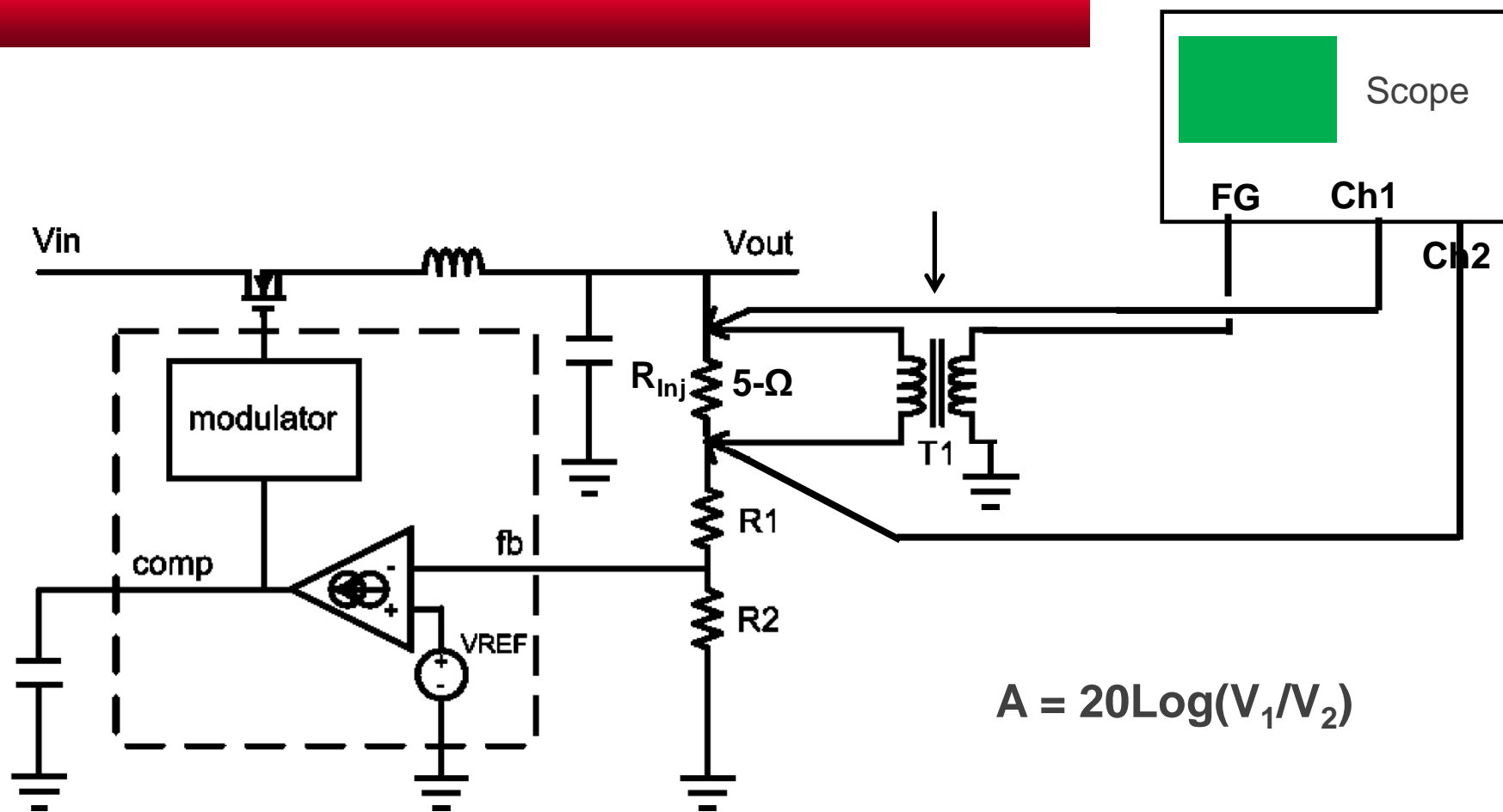
稳定系统的条件:

- F_c 小于 $0.5 \cdot F_{sw}$ (推荐值为 $5\% \sim 20\% F_{sw}$)
- 相位裕度大于 45° (在 F_c 之前的所有频率点)

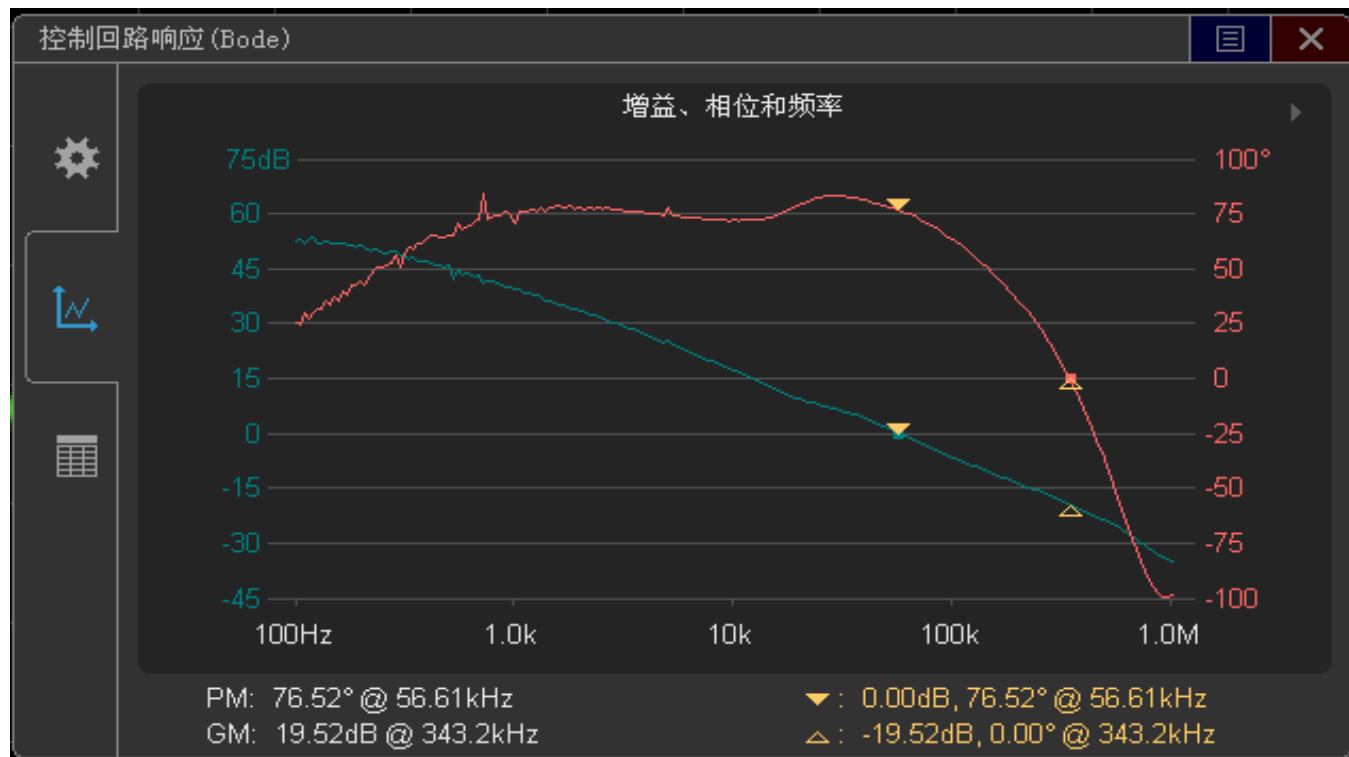
较好的系统:

- 比较高的 F_c , 提高放大器的响应速度
- 合适的相位裕度 ($45^\circ - 80^\circ$)
- 在 F_{sw} 时有足够的增益衰减, 降低开关噪声

基于示波器的环路测试方案



测试结果分析



- ◆ 增益裕度（相位为 0° 时）： 小于 -10dB
- ◆ 增益衰减（增益@开关频率）： 小于 -20dB
- ◆ 穿越斜率（0dB附近）： 单极点穿越（-20dB每十倍频）
- ◆ 相位裕度（增益为0dB时）： 大于 45° 建议 45° -- 80°
- ◆ 穿越频率（增益为0dB时）： 建议为开关频率的5%--20%

是德科技中高端示波器产品家族

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查找适合您的产品系列

无论是一般性调试还是深入分析，Infiniium 系列示波器都能提供您所需的性能。



Infiniium EXR 系列示波器

500 MHz 至 6 GHz
8 个通道，七合一仪器功能，硬件加速绘图，可全面升级。



Infiniium MXR 系列实时示波器

500 MHz 至 6 GHz
具有 8 个通道的实时频谱分析仪。八合一仪器功能，硬件加速绘图，MXR 系列可全面升级。



Infiniium S 系列示波器

500 MHz 至 8 GHz
配有 15 英寸 XGA 电容式触摸屏和 12 位 ADC，采样率高达 20 GSa/s，提供 DSO 和 MSO 型号。



Infiniium UXR 系列示波器

5 GHz 至 110 GHz
使用具有优异信号完整性的测试设备——Keysight UXR 系列示波器——帮助您成功开发下一代技术。



Infiniium V 系列示波器

8 GHz 至 33 GHz
4 个通道、160 位硬件串行触发和 16 个数字通道；通过更真实地显示被测信号，能够测量宽带射频信号的频谱内容或分析瞬态物理现象。



Infiniium Z 系列示波器

20 GHz 至 63 GHz
具有快速分析和硬件加速功能，测量上升时间不受示波器带宽限制。