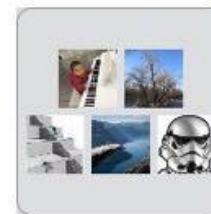


From Design to Test Keysight RFIC Total Solution

Updated Mar 24, 2017



Jiwei Du
Product Lines and Solutions Manager
Optical and Digital
Internet Infrastructure

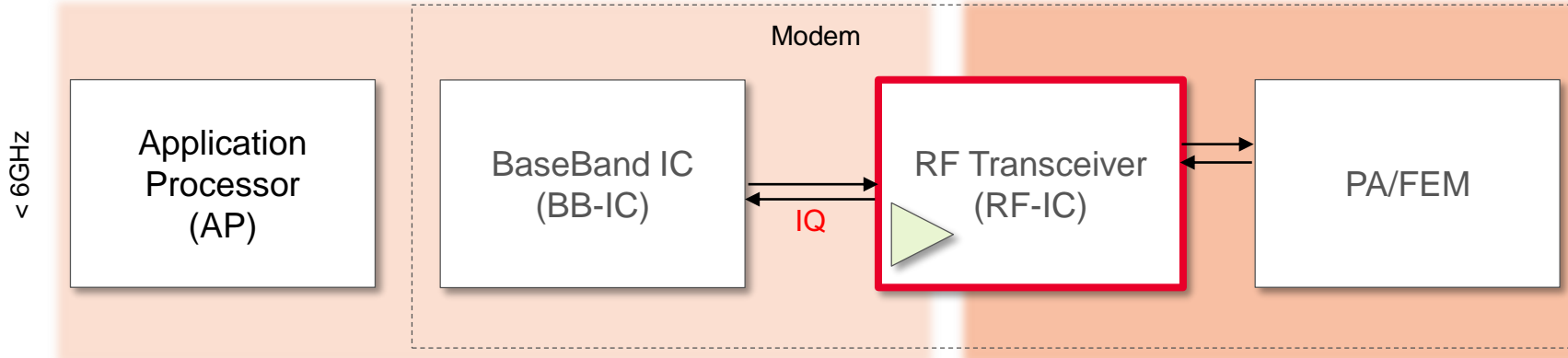


读书群:高速上数字电
路设计和测试

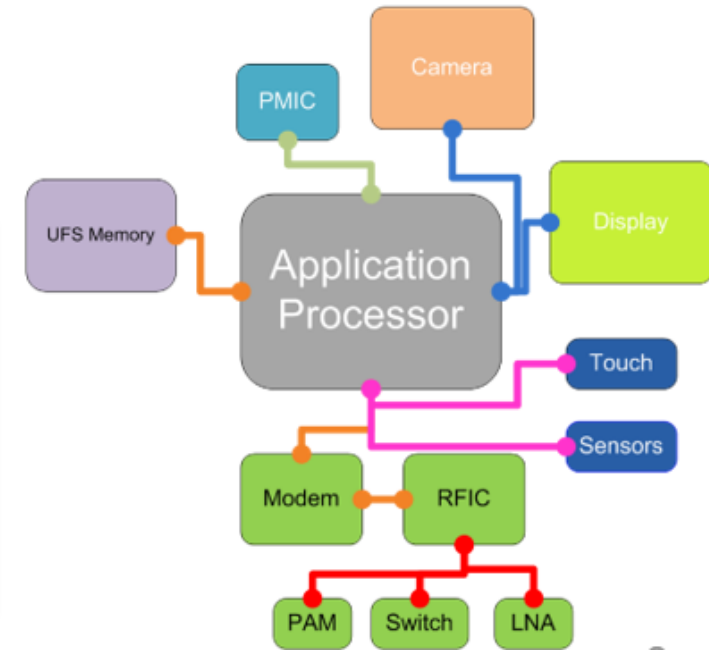
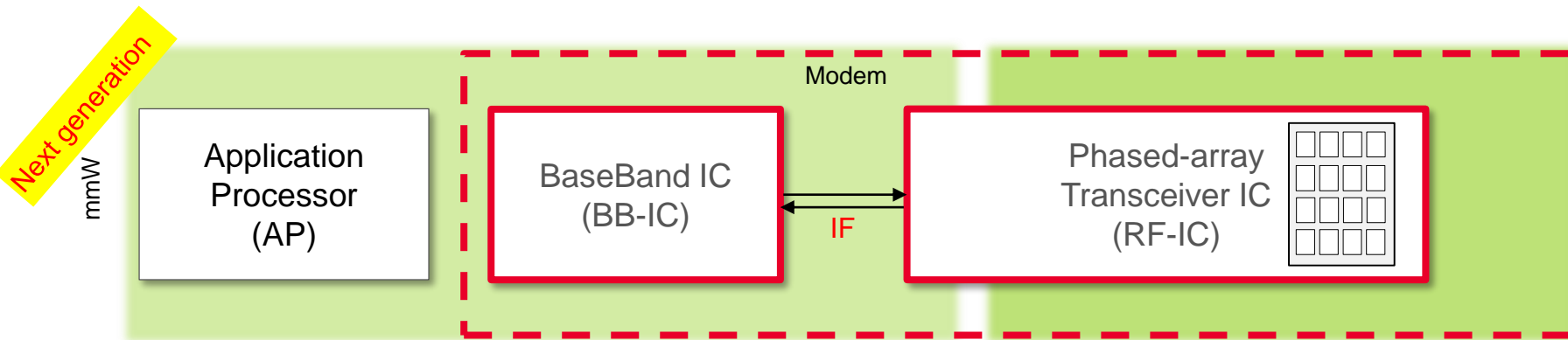


Valid until 3/29 and will update upon joining group

RFIC Structure



Transceiver Characterization



- RF: 超外差式接收机 (二步法)
- RF: 射频前端和天线独立
- RF: 天线电缆连接



- mmWave: homodyne receiver (直接变换)
- mmWave: Phased-array Transceiver IC and antenna array
- mmWave: Antenna on-chip (no RF connector port)

Agenda

通信芯片中的主要测试项

1. AP与外设的数字接口
2. 存储
3. 基带处理器 和Modem的各项测试
4. 功放和前端 模块的测试
5. 无线Connectivity的测试
6. 功耗测试

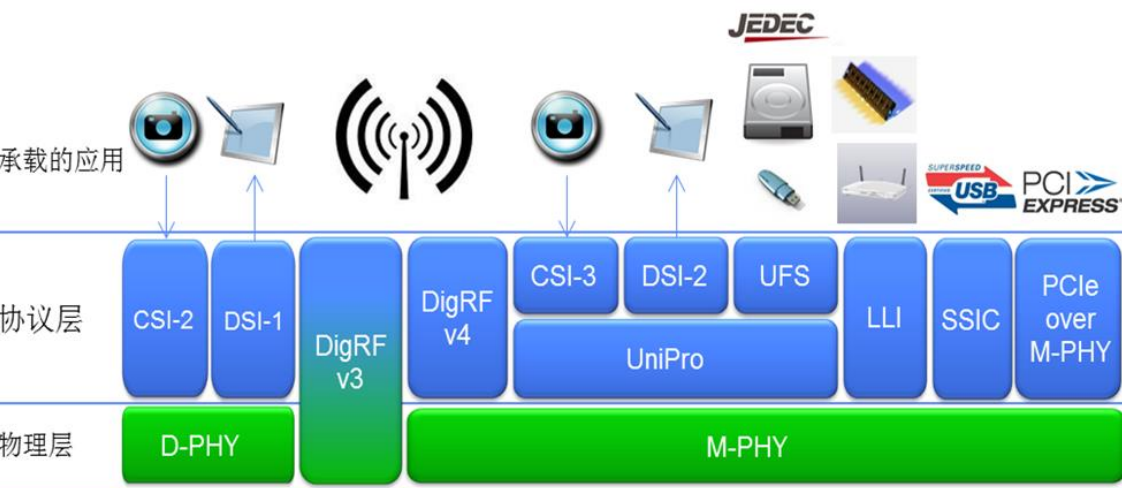
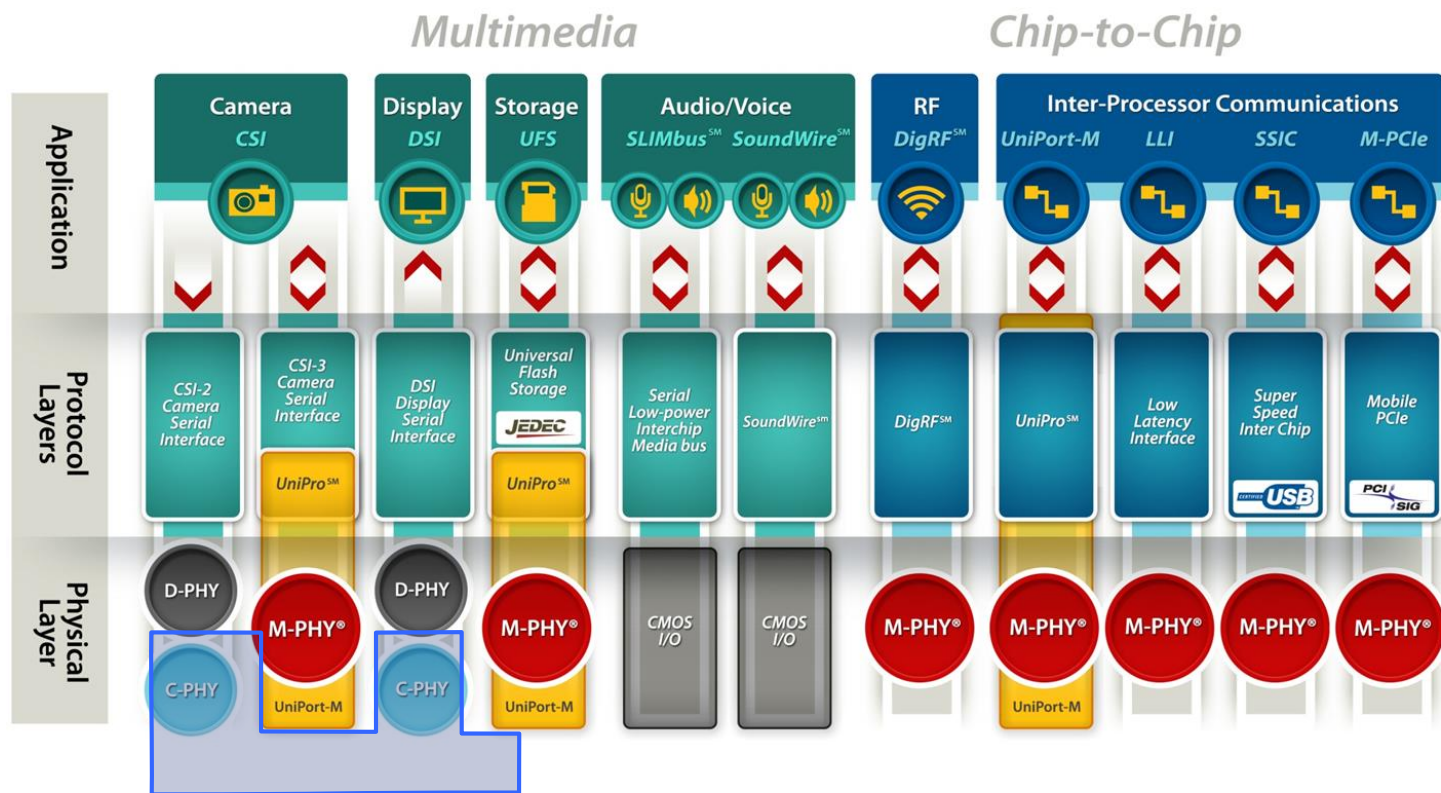
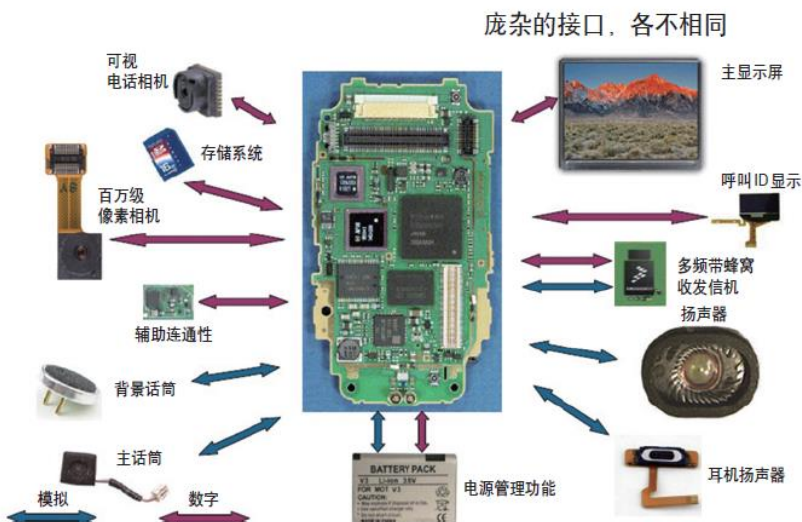


读书群:高速上数字电
路设计和测试





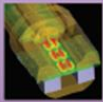






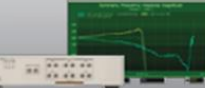





AP (Application Processor)的各项互联




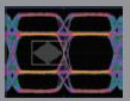





智能手机包含丰富的传感器、终端和外设



| | PHY test | Protocol decoder |
|---------|----------|-------------------------------|
| D/C-PHY | Yes | Yes(CSI2, DSI, DSI2) |
| M-PHY | Yes | Yes(UniPro, LLI, DigRF, CSI3) |
| I3C | | Yes |
| SPMI | | Will be |
| RFFE | | Yes |

Keysight MIPI Solution : From Design To Test

| | | | | |
|---|--|---|---|--|
| <p>Design and Simulation</p> <p>ADS software</p>  <p>SystemVue electronic system-level design software</p>  <p>EMPro 3D simulation software</p>  | <p>Impedance/Return Loss Validation</p> <p>E5071C ENA Option TDR</p>  <p>DCA 86100D Wide band sampling oscilloscope with N1055 TDR/TDT or 54754A TDR/TDT</p>  <p>N1055A TDR/TDT</p>  <p>54754A TDR/TDT</p>  | <p>Transmitter Characterization</p> <p>Infiniium DSAV3304A</p>  <p>U7238C D-PHY, U7249C M-PHY, N5467B C-PHY</p> <p>InfiniiMax Probes</p>  <p>Switch matrix N5465A InfiniiSim N2809A PrecisionProbe</p>  | <p>Receiver Characterization</p> <p>M8020A J-BERT</p>  <p>M8190 AWG</p>  <p>N5990A Automated characterization</p>  | <p>Protocol Stimulus and Analysis</p> <p>U4421A D-PHY CSI-2/DSI Analyzer and Exerciser U4431A M-PHY Analyzer (UFS, UniPro, CSI-3, SSIC, M-PCIe)</p>  <p>Scope Protocol Decoder N8802A CSI-2/DSI N8807A DigRF v4 N8808A UniPro N8818A UFS N8809A LLI N8819A SSIC N8820A CSI-3 N8824A RFFE</p>  |
| <p>Industry's standard for design automation in DC and RF semiconductor device modeling.</p> | <p>Precision impedance measurements and S-Parameter capability</p> | <p>Industry's highest analog bandwidth, lowest noise floor/sensitivity, jitter measurement floor with unique cable/probe correction</p> | <p>Highest precision jitter lab source with automated compliance software for accurate, efficient, and consistent measurement</p> | <p>Fast upload and display, accurate capture, intuitive GUI and customizable hardware. Correlate physical and protocol layer.</p> |

| | | | |
|-------------------|---|---|---|
| Physical Standard | M-PHY | D-PHY | C-PHY |
| Transmitter Test | <p>Infiniium V-Series real time oscilloscope</p>  <p>U7249C Compliance test software</p>  <p>U7238C Compliance test software</p>  <p>N5467B UDA based compliance test software</p>  | | |
| Receiver Test | <p>J-BERT M8020A/M8070/85A</p>  | <p>AWG M819XA and BERT M8020A</p>   | <p>N5990A and M8070A compliance test software</p>   |

Agenda

通信芯片中的主要测试项

1. AP与外设的互联
2. 存储
3. BP/Modem的各项测试
4. PA/FEM的测试
5. Wireless Connectivity的测试
6. 功耗测试



读书群:高速上数字电
路设计和测试



Valid until 3/29 and will update upon joining group

存储

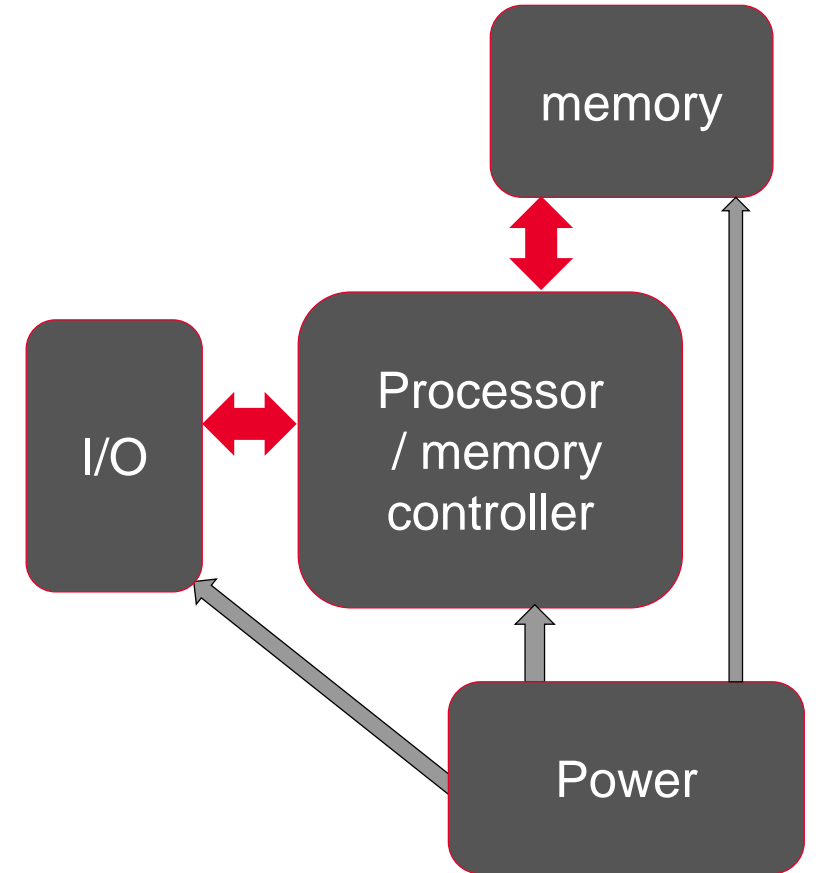
调试和验证的挑战

Tasks

- Make the system work
- Check compliance
- Maximize system performance

Challenges

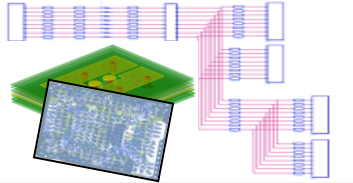
- Shorter deadlines
- Faster data rates
- Shrinking margins (power, voltage swing, eye size,)




Keysight has DDR4/LPDDR4 Memory Solutions Covered

HARDWARE + SOFTWARE + PEOPLE = DDR INSIGHTS


Design
Keysight Eesof ADS
Simulation Measurement
Correlation



Signal Integrity




Infiniium V-Series Scope
Software Compliance
Applications for all
generations of DDR and
LPDDR memory

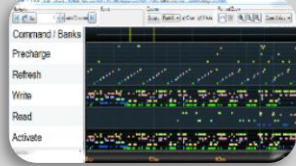


M8020 High-Performance
JBERT

Protocol/Bus Level SI



U4164A Logic
Module



B4661A
Memory
Analysis SW

Keysight 行走在无人区的技术：

- 超过2400MT/s 的协议分析
- 支持ONFi 时序和协议分析
- 专用的电源完整性探头方案
- 实时示波器中的串扰分析定位
- DDR4/DDR5 的接收端测试
- 打通仿真和测试环节的壁垒

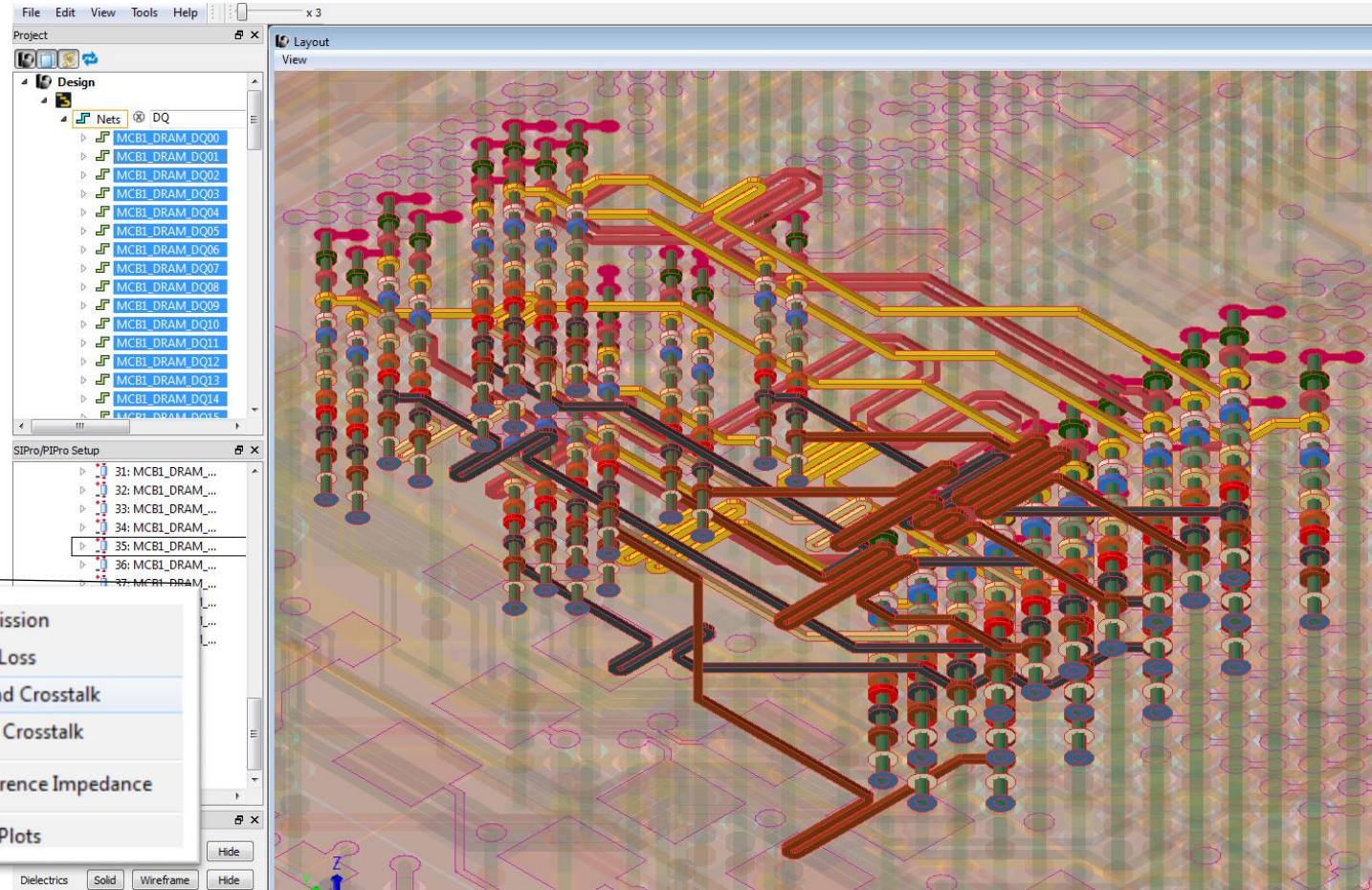
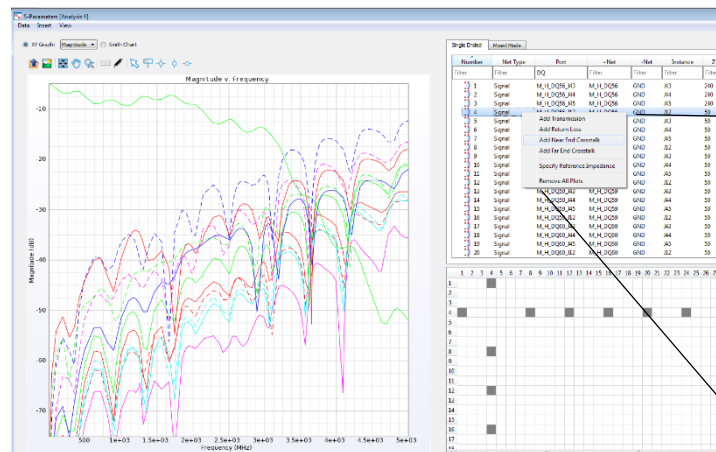
**Custom & Standard Probing
& Interposer Solutions**



Predicting Crosstalk: EM Characterization of PCB

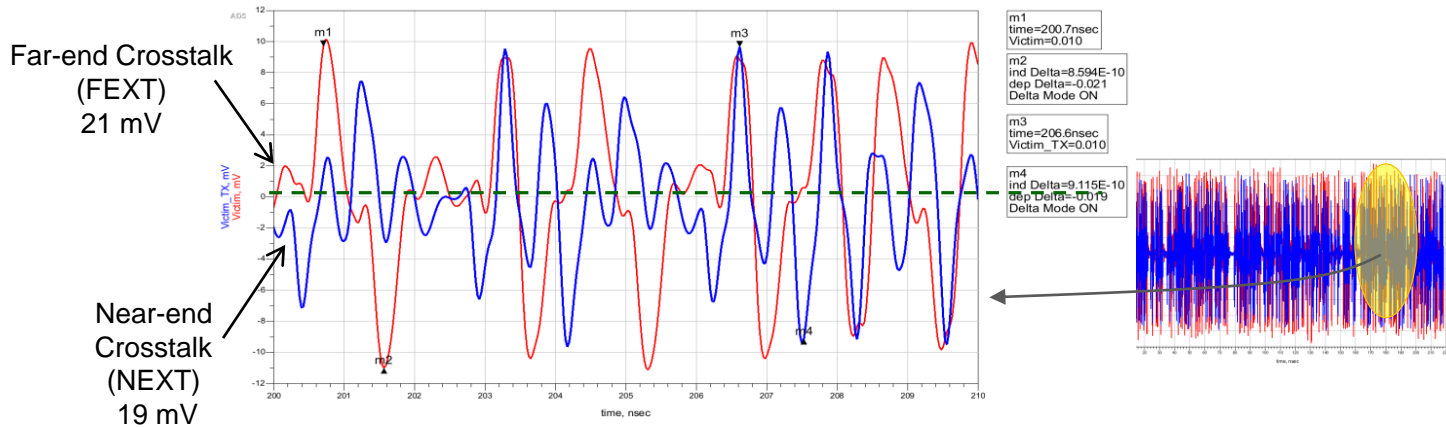
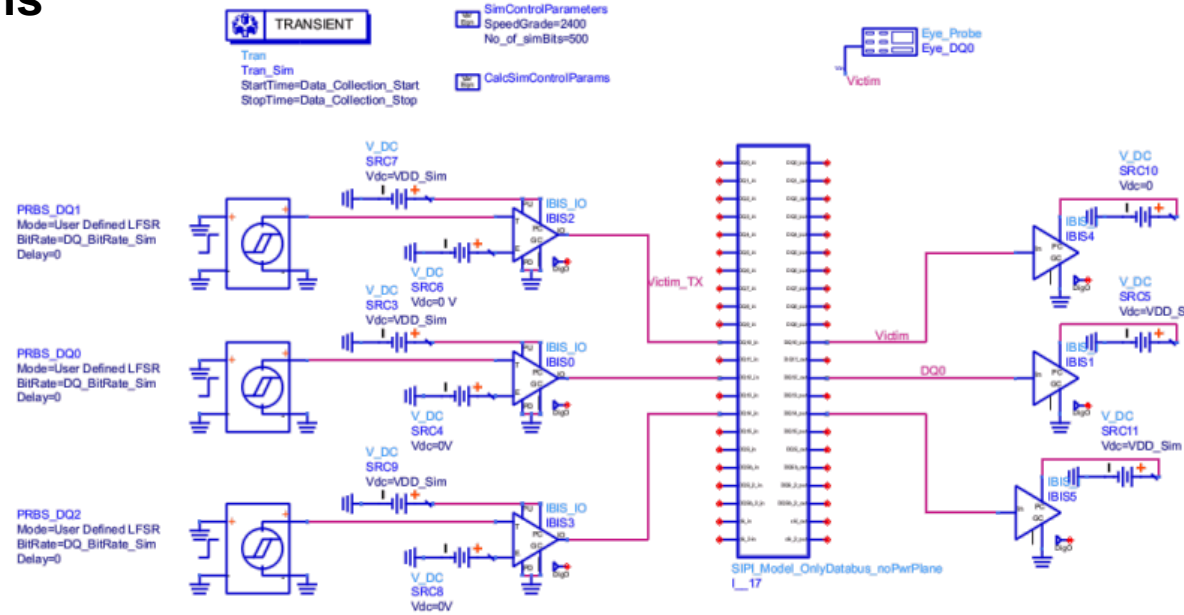
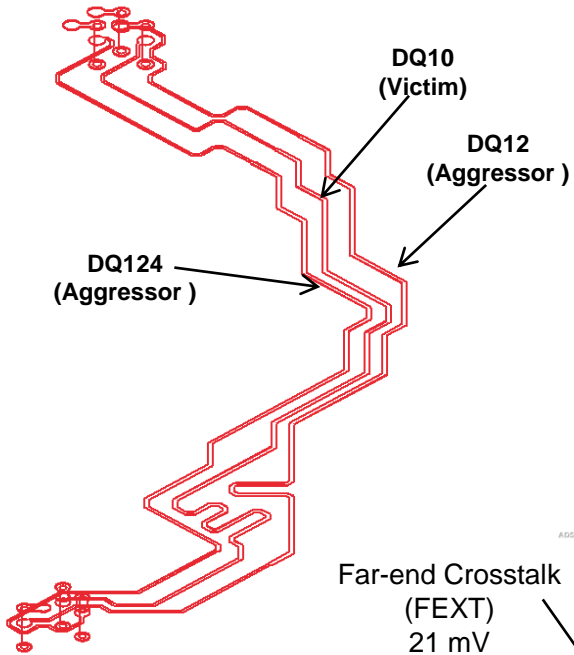
ADS 2016 SIPro & PIPro released at DesignCon 2016

- High-capacity
- High-frequency accuracy
- PDN and Signals



Predicting Crosstalk

Analyzing ISI contributions



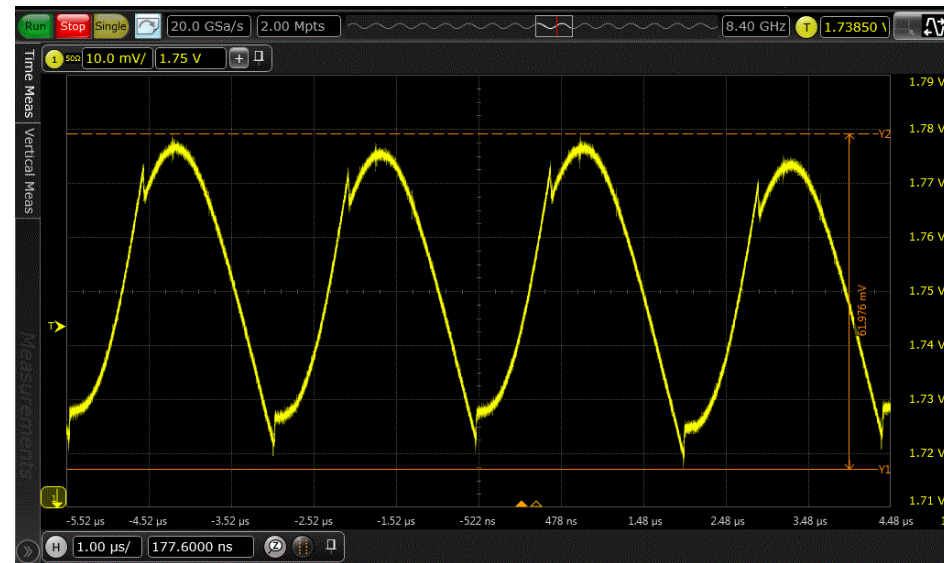
On Static Low Victim vs Time (3 Aggressors)

Power Rail Measurement (PDN)

The Need for Power Integrity Measurements

- Increased functionality, higher density and higher frequency operation drives need for lower supply voltages
- Power rail tolerances are much tighter (from +/- 5% down to +/- 1%)
- Ripple, noise and transients riding on these lower DC supplies can adversely affect clocks and digital data

Believe it or not, this is what a typical 1.8V DC supply looks like if you zoom-in on the top of it.



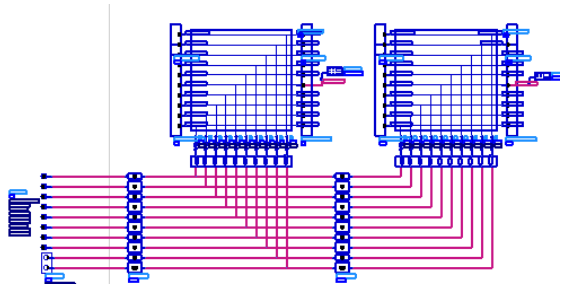
Power Rail Probe 配合10-bit ADC示波器完成电源纹波测量分析

| Characteristics and Specifications: N7020A Power Rail Probe | |
|---|---|
| Probe Bandwidth (-3dB) | 2GHz |
| Attenuation Ratio | 1:1 |
| Offset Range | ± 24V |
| * Input Impedance @ DC | 50kΩ +/-2% |
| Active Signal Range | ± 850mV about offset voltage |
| Flatness (for source impedances <0.1Ω) | ±1% to 1MHz (hardware only) ± 2% to 1GHz (DSP) |
| Probe Noise | 10% increase to the noise of the connected oscilloscope |
| Probe Type | Single-ended |
| Included accessories | N7021A—Coaxial Probe Head (qty 3) (\$175 us) |
| | N7022A –Main Cable (\$240) |
| Maximum non-destructive input voltage | +/-30V (DC + peak AC) |
| Output impedance | 50Ω |
| Cable length | N7021A Main Cable: 48” N7022A Coaxial Probe Head: 8” |
| Ambient operating temperature | Probe Pod: 0 – 40°C, N7021A main cable, N7022A coaxial probe head: 0 – 85° C |



Predicting Crosstalk

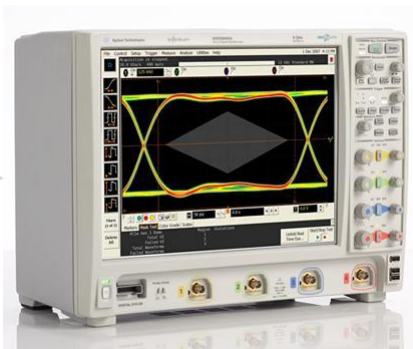
Compliance Test For Final Design Sign-off



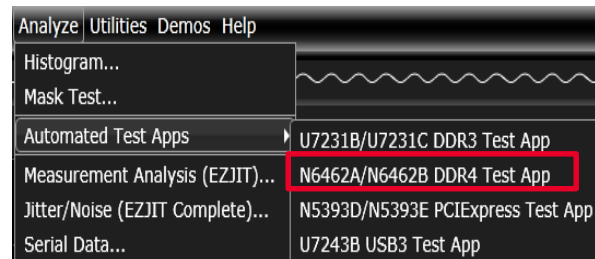
Simulated Waveforms saved as .h5 files for Infiniium Offline



Real test bench



Infiniium oscilloscope



- Before committing the board to prototype, a final test can be performed simulating the transient waveforms for DQ, CA, CTL lines.
- The waveforms are then used within the Infiniium Offline software, where the DDR4 Compliance Application is launched to performs compliance tests.
- This is the same compliance test that is used with the final board under test on the bench, so there is no argument as to whether the simulation compliance test has missed anything critical.

Overview: DDR4 / LPDDR4 Insight with a Logic Analyzer

Protocol Analysis

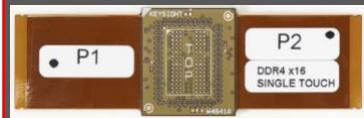
Connect

Acquire

View & Analyze



DIMM
SODIMM
Interposers



BGA Interposers



Mid-Bus & specialty
Probing



Capture highest data rates!
Address and command for DDR4 or
LPDDR4 up to 5000 Mb/s
Data up to 4200 Mb/s

Capture smallest eyes
100mV x 100ps at probe point.

Sequential Triggers up to
2.5GHz or 4200Mb/s

12.5GHz Timing Zoom
256k deep

Up to 400M deep traces

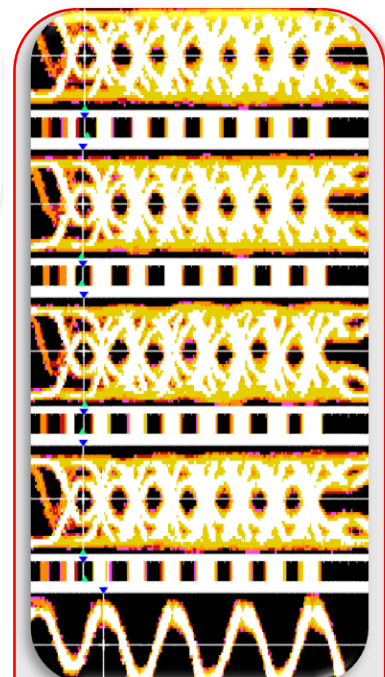
U4164A Logic Analyzer
Module



Memory Analysis SW
Listing with Decoders
Traffic Overview
Protocol Compliance across
Speed changes
Performance Analysis

Waveforms

B4661A Memory
Analysis SW

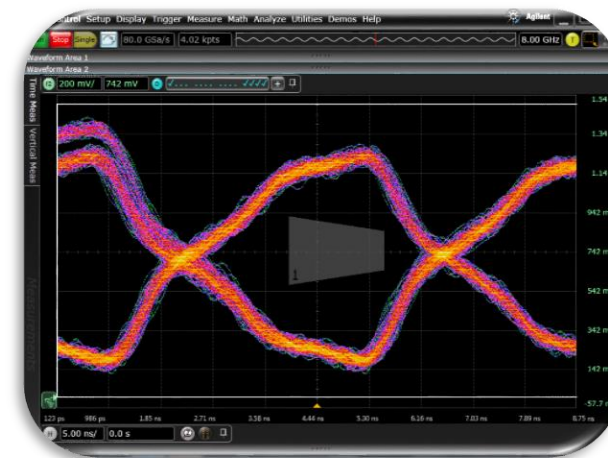
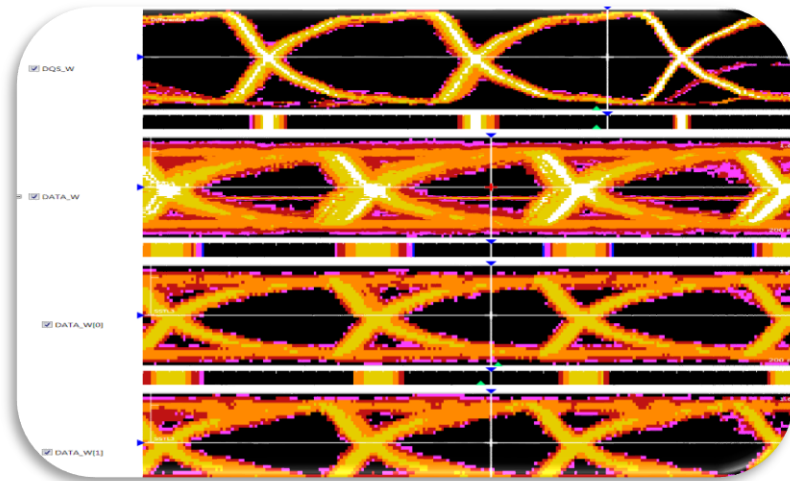


Bus Level Signal
Integrity Insight

Complementary Solutions - Logic Analyzer and MSO

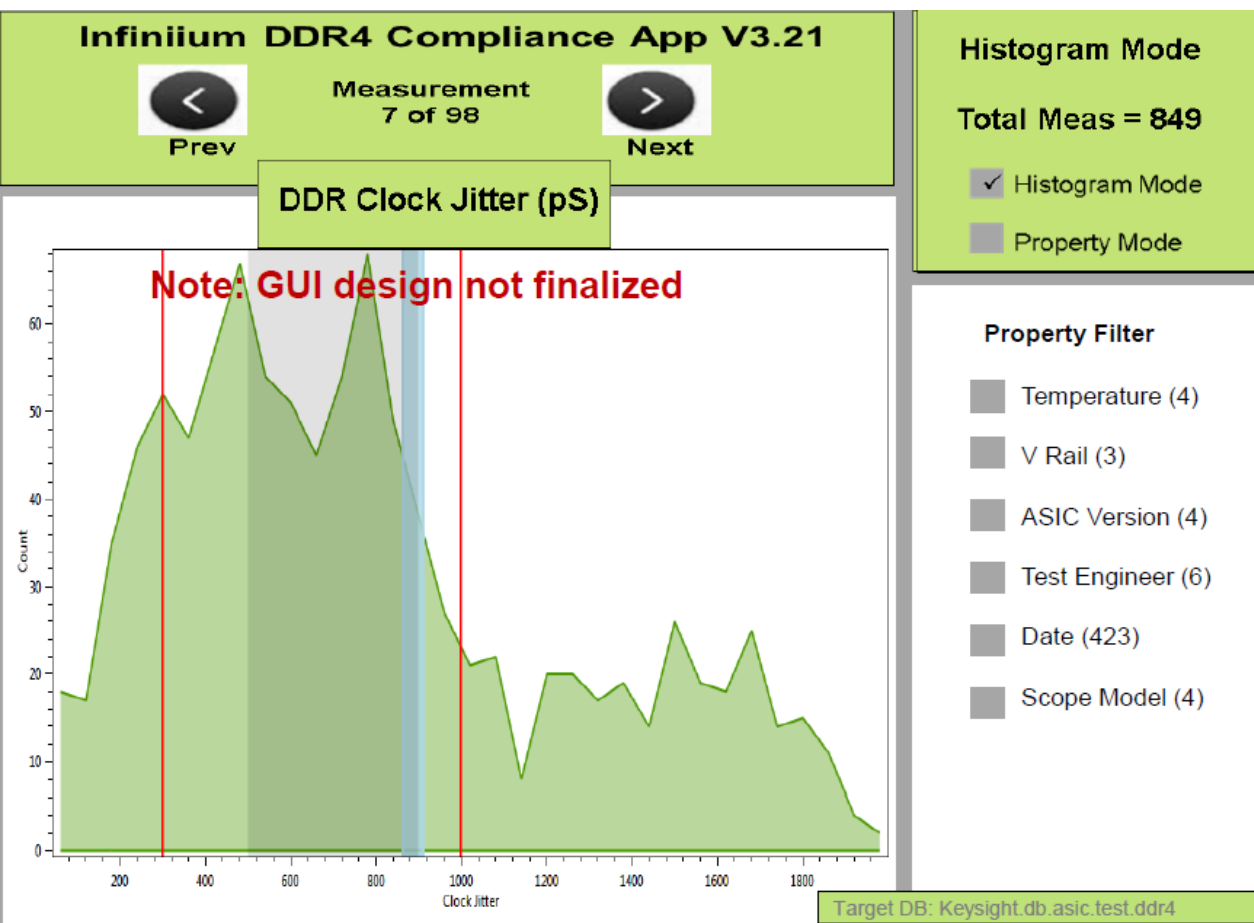
Use complementary solutions to debug faster

| Features | Logic Analyzer | MSO (Mixed Signal Oscilloscope) |
|-----------------------|---|---|
| Functional validation | Complete View all ADD/CMD/DQ/DQS <ul style="list-style-type: none">• Functional Compliance Tests• Address/command/control and data validation | Partial view <ul style="list-style-type: none">• 16 command and address (depending on number of digital channels connected). |
| Eye diagram display | <ul style="list-style-type: none">• Qualitative bus level signal integrity insight• Simultaneous eye diagram displays to view all signals relative to each other.• No measurement on eye | <ul style="list-style-type: none">• Quantitative measurements• Parametric Compliance Tests• Eye height and eye width measurements |

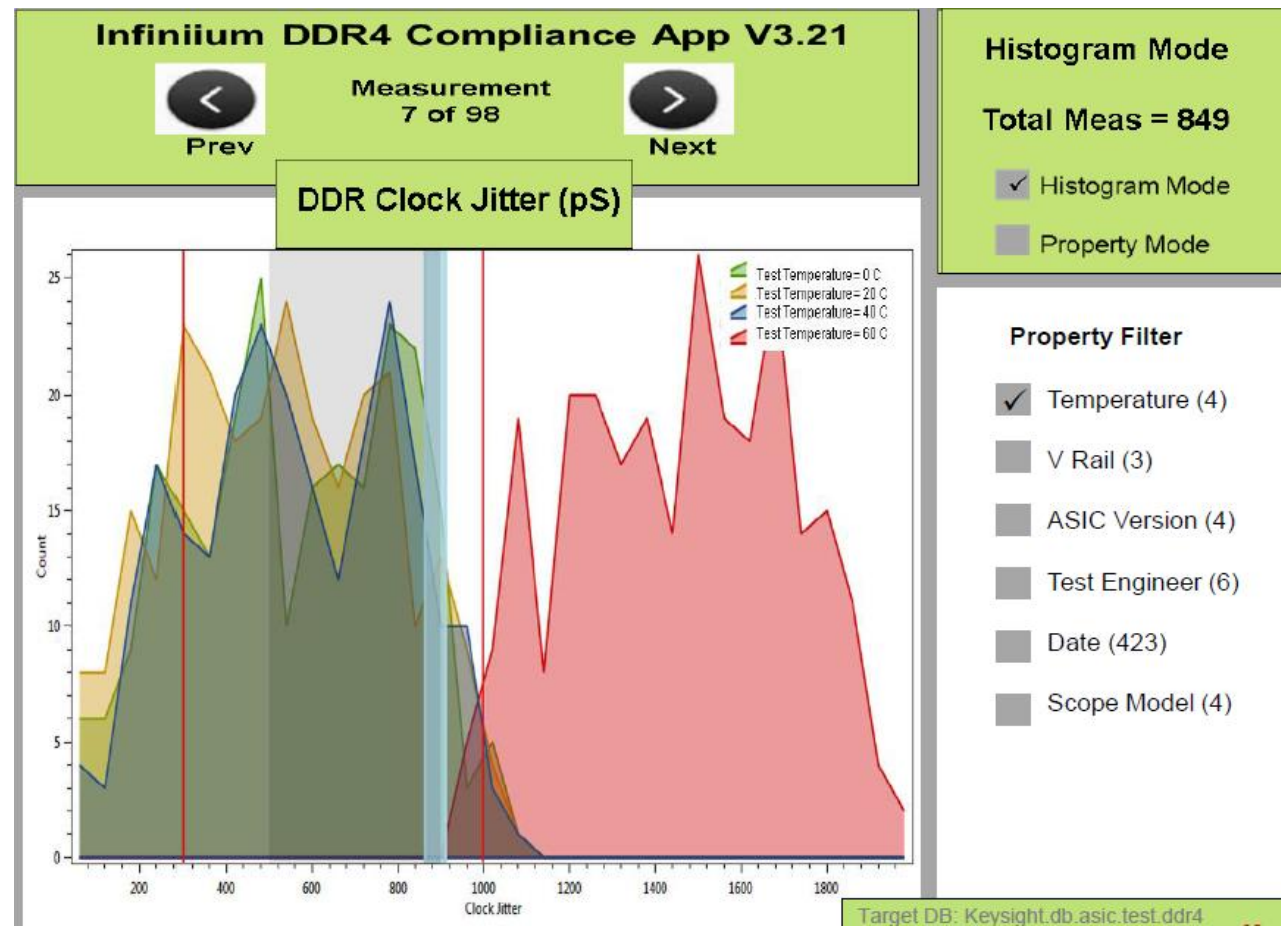


Cloud Analysis Engine

KS8400A Result Viewer Software

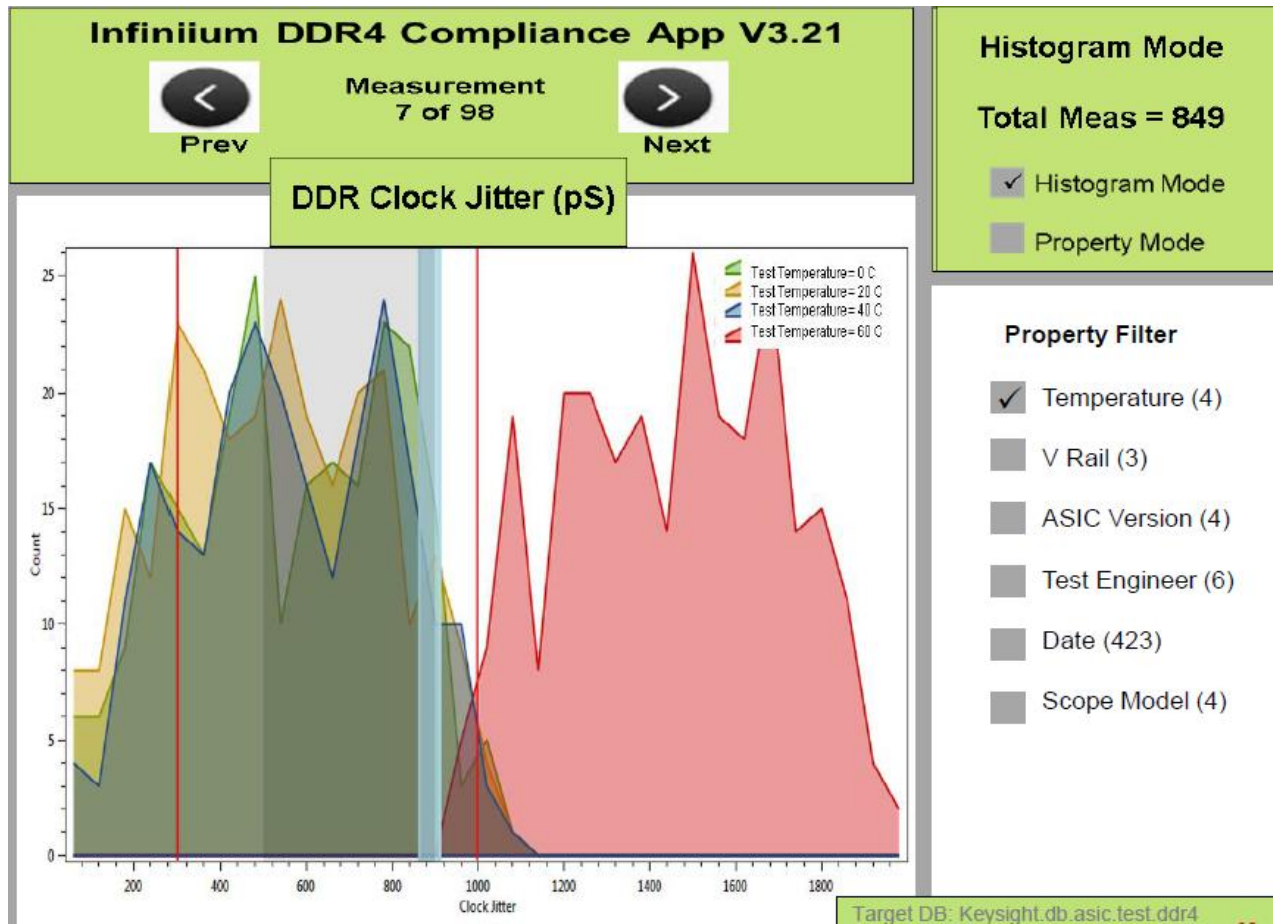


Histogram (ASIC Filter Applied)

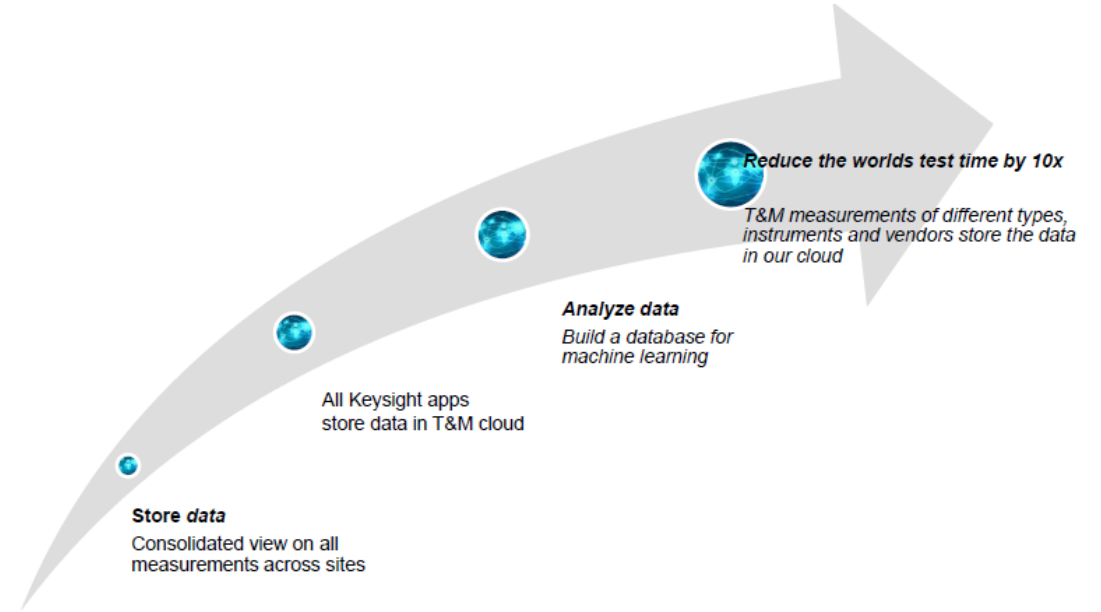


Cloud Analysis Engine

Histogram (Test Temperature Filter Applied)



Defining The Future of test



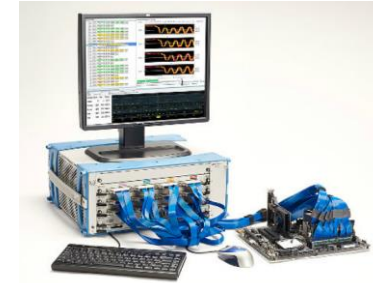
Keysight Logic Analyzer Portfolio



16860A Series Portables

- Up to 1.4 Gb/s state data rate
- Up to 700 MHz clock rate
- Up to 5 GHz timing
- Up to 10 GHz qtr ch timing (select models)
- 34, 68, 102, or 136 channels
- Up to 128 M deep memory
- Starting at \$12,200
- **Optimized for general purpose applications and low speed memory applications**

If you need...
**Faster,
Wider,
Deeper,
and/or modular
form factor**



U4164A Modular Systems

- Up to 4 Gb/s state data rate
- Up to 2.5 GHz clock rate
- Up to 5 GHz timing
- Up to 10 GHz qtr ch timing
- 136 ch module with up to 408 channels on a single time base
- Up to 400 M deep memory
- Starting at \$25,000
- **Optimized for DDR4/LPDDR4 high speed memory applications (incl ONFi)**

Agenda

通信芯片中的主要测试项

1. AP与外设的互联
2. 存储
3. **BP/Modem的各项测试**
4. PA/FEM的测试
5. Wireless Connectivity的测试
6. 功耗测试



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路设计和测试



Valid until 3/29 and will update upon joining group

Broadest Multi-Format Coverage

Optimize your multi-device manufacturing test



Consistent repeatability of standard-based X-Series measurement applications



SCPI-controlled PXIe OBTEXT/E6630A compatible



Cellular

- LTE-Advanced FDD/TDD, LTE FDD/TDD
- HSPA+, W-CDMA
- 1xEV-DO, cdma2000
- GSM/EDGE/EDGE Evo
- TD-SCDMA/TD-HSPA
- DECT
- PHS

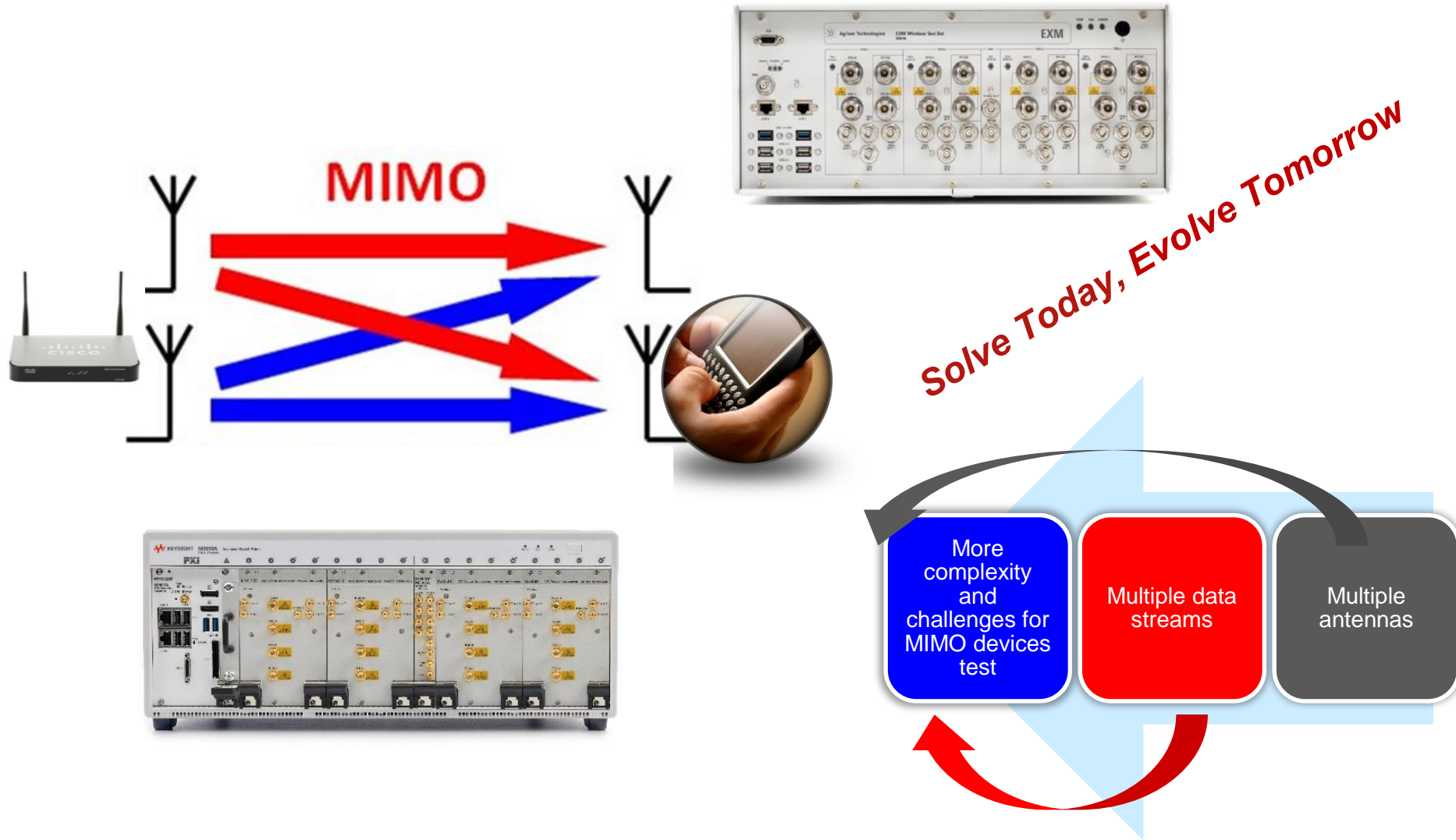
Wireless Connectivity

- WLAN 802.11a/b/g/n/j/p/ac
- Bluetooth 1.0 to 4.1
- Multi-Satellite GNSS: GPS, Galileo, GLONASS, Beidou, SBAS, QZSS
- Mobile WiMAX
- Digital video, FM, ZigBee

MIMO (2x2, 3x3, 4x4) & carrier aggregation

- Switched MIMO for manufacturing test
- True MIMO (multi-TRX) for design validation
- LTE-A CA Inter- and intra-band

Comprehensive test solutions for MIMO



Modem

Overcome 4x4 MIMO and 3CC/4CC Test Challenges

Key technologies

- Key features of LTE-A that contribute to higher DL throughput



Test challenges

- Complicated test scenarios
 - Non-3GPP test case plans, up to 200 cases
 - All kinds of band combinations for 2CC/3CC/4CC
 - Fading scenarios required
 - LTE CA I-RAT handover
 - Multi-antenna, MIMO switch
- Need test automation to improve efficiency

Keysight Solution

E7515A UXM application provides an easy way to configure new features required by Hisilicon to reach higher data rates.



Advantage

Stable IP date throughput test capability

- Flexible for 4x4 MIMO / I-RAT / nCA case configurations
- Strong handover capability from LTE to UMTS ahead Anritus8475B
- Embedded, flexible 3GPP and non-3GPP fading

Skynet plug in for test case automation

- Friendly UI accepted by customers to improve test efficiency
- Customized test cases and cost effective solution versus Anritsu MD8475B and R&S CMW500

External U-Link/T1255A to improve multi antenna configurations

- UXM Integrated U-Link box for MIMO/CA combinations

Modem

Overcome VoLTE Battery Performance Test Challenges

Key technologies

VoLTE Battery Test is very important, driven by operators

Extended battery life during a VoLTE call has become one of the leading competitive differentiators for operators to provide more qualified VoLTE service.

It is very important for device manufacturers to pre-qualify their devices before sending to operators' inter-operative test lab.

Test challenges

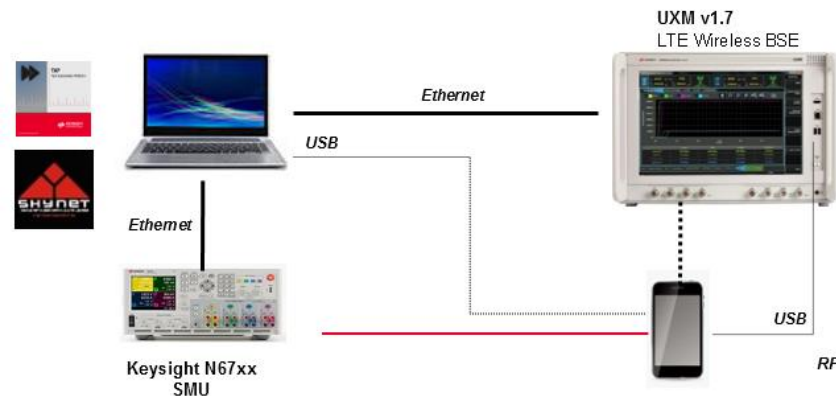
- Troubleshoot VoLTE functionality in real network
- Precise measurement of power consumption in VoLTE scenario
- Correct IMS registration and identify protocol issue in VoLTE
- Compliance with CMCC VoLTE test cases
- Test automation SW for VoLTE test cases

Keysight Solution

Test automation and associated tools to address measurement automation controls for chipset, devices and carrier acceptance.

SOLUTION ARCHITECTURE

- E7515A UXM Wireless Test Set
- E5515C 8960 Series 10 Wireless Test Set
- N6705B DC Power Supply
- E6569B IMS/SIP Server/Client



Agenda

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5. Wireless Connectivity的测试
6. 功耗测试



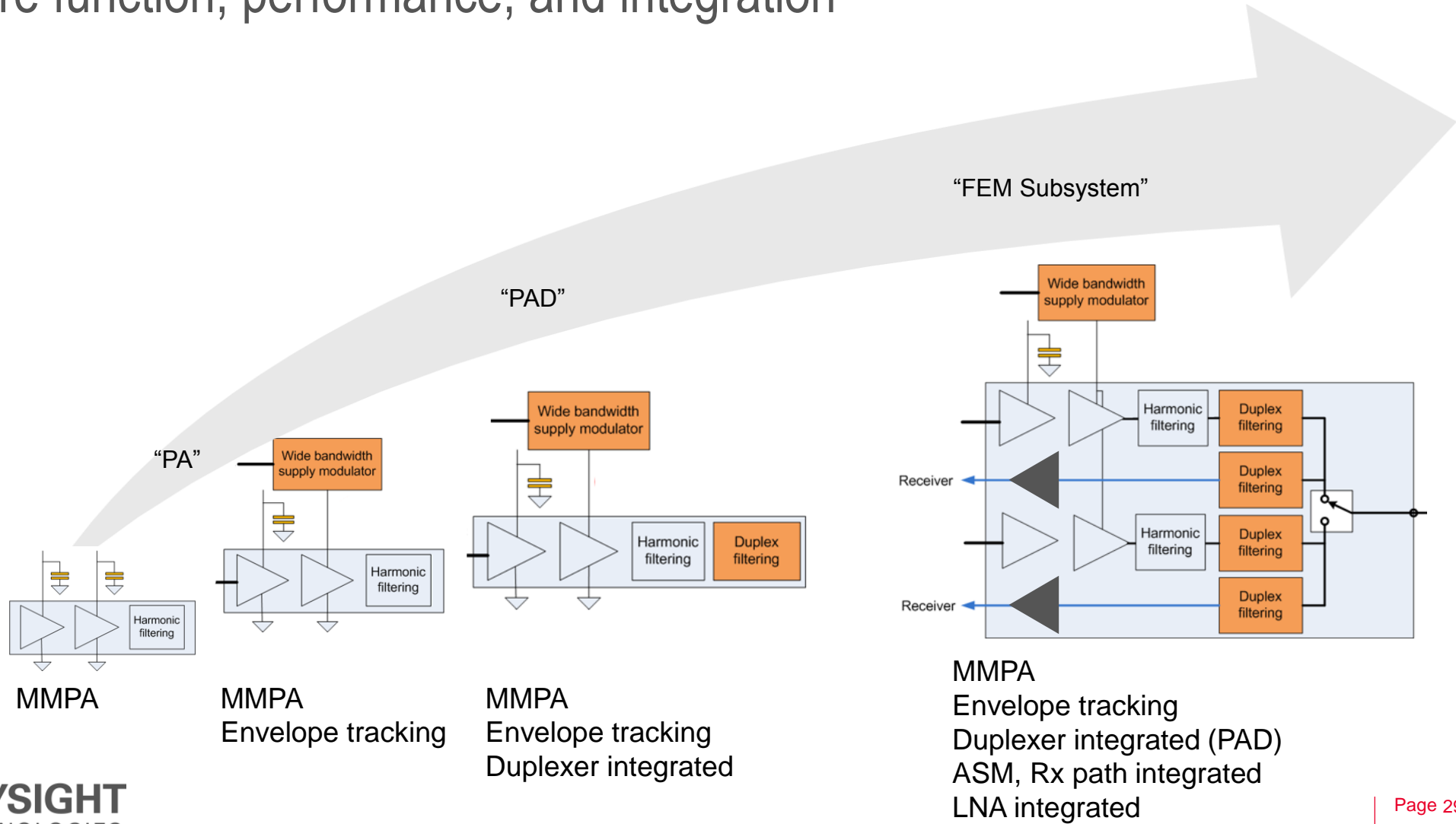
读书群:高速上数字电
路设计和测试



Valid until 3/29 and will update upon joining group

RF PA/FEM Evolution

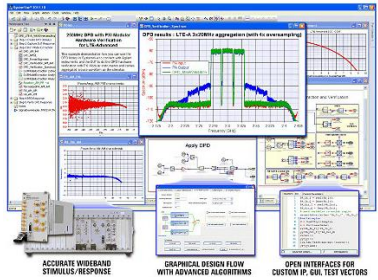
More function, performance, and integration



RF Power Amplifier Test - Wideband DPD Solution

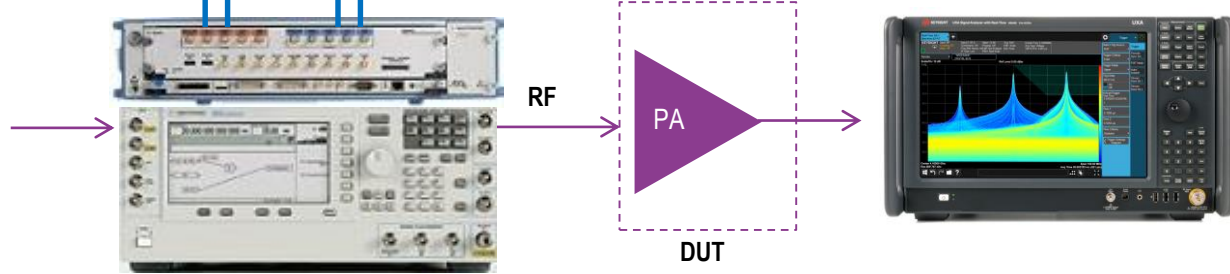
SystemVue

W1716EP SystemVue
Digital Pre-Distortion
Builder



Wideband IQ Inputs
(PSG Rear Panel)

$I\bar{I}$ $Q\bar{Q}$



M8190A AWG + E8267D PSG

Wideband DPD solution for
PA Test enabling by WLAN
and LTE applications

Signal Analyzer

Wideband PA Test Use Case

- DPD support only
- For wideband signal, such as 80MHz or 160MHz WLAN
- For wideband LTE BTS PA Test

Wideband Signal Generation

- Up to 2GHz bandwidth
- Automatic calibration including spectrum flatness and IQ calibration.
- Automatic or manual adjustment

Wideband signal Analysis

- the required bandwidth depends on customers' DPD algorithms
- UXA support up to 1 GHz*
- PXA support up to 510 MHz
- Support I/Q data capture
- X-Series measurement application is needed for I/Q calibration

Agenda

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路设计和测试



Valid until 3/29 and will update upon joining group

Wireless Connectivity

无线互联

Up to 10 meters: Wireless Personal Area Network(WPAN)

- *WiMedia*
- *Bluetooth*
- *NFC*
- *802.11 ad*
- *UWB*
- *Zigbee*
- *RFID*

Up to 100 meters: Wireless Local Area Network(WLAN)

- *WLAN 802.11ac*
- *WLAN IEEE 802.11 a/b/g/h/j/p/n*

Up to 500 meters: Wireless Local Area Network(WLAN)

- *WLAN 802.11ay (20Gbps)*

Up to 50 kilometers: Wireless Metropolitan Area Network(WMAN)

- *802.11ah sub-1GHz extended range WLAN*
- *Fixed and Mobile WiMAX™*
- *802.11af “White-Fi” WLAN in TV White Space*
- *And more are being defined*

NFC测试方案_T3100S

EMV

- EMV L1 DP
PICC/Mobile
- EMV L1 DP PCD
- EMV L1 RF
PICC/Mobile
- EMV L1 RF PCD



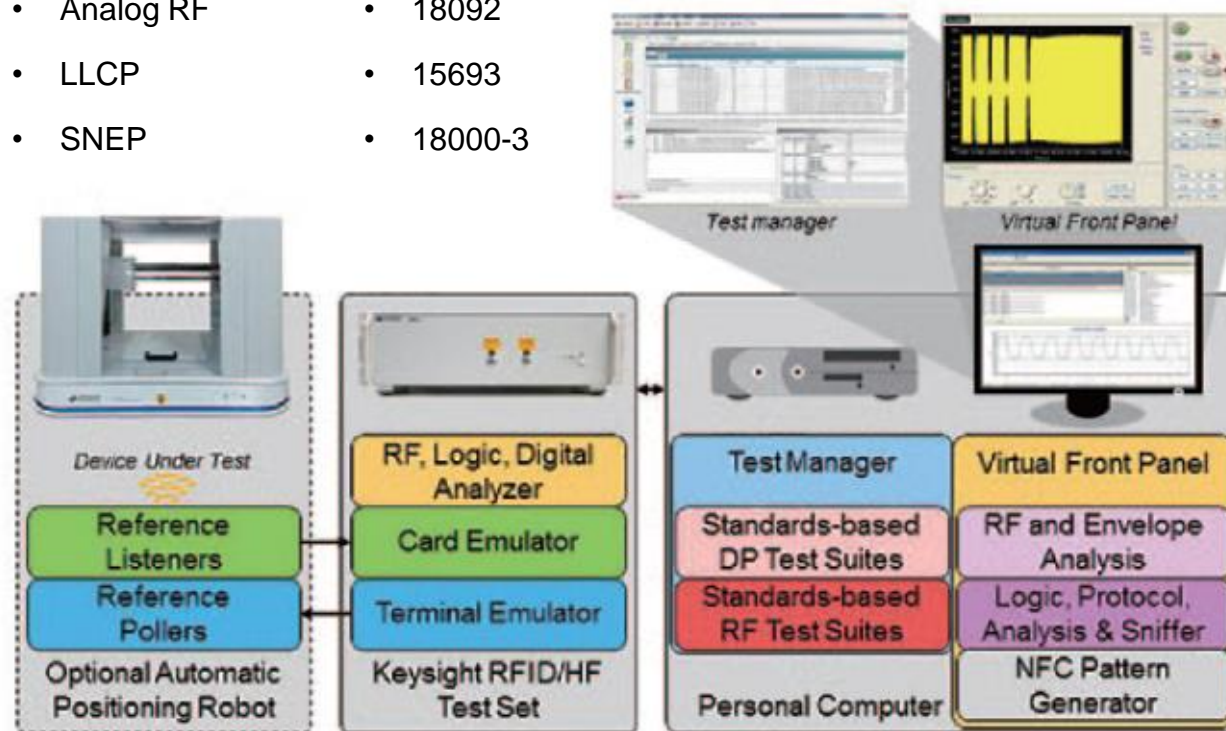
FIME®

NFC Forum

- Digital Protocol
- Analog RF
- LLCP
- SNEP

ISO/IEC

- 14443 A/B
- 18092
- 15693
- 18000-3



T3100S 测试系统的组件

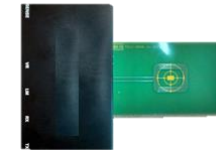
NFC 基础测试方案（用于生产或研发）

Test system based on:

- DSOX3014T InfiniiVision X-Series Oscilloscope
- 33512B Function/Arbitrary Waveform Generator
- Poller/Listener/Calibration combo antenna/coil (Keysight or user supplied)
- Keysight automated NFC compliance and debug test application, callable from user's test executive
- External PC

Test strategy:

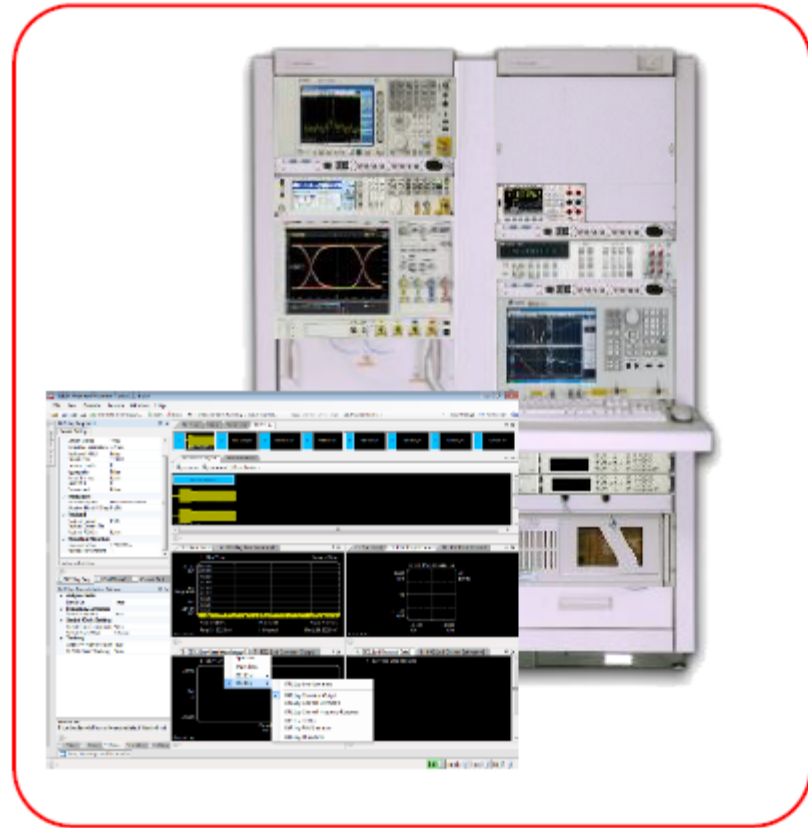
- Pass/Fail tests with minimal reporting
 - ✓ Check functionality
 - ✓ Test time target < 1 min
 - ✓ Parametric test results also available
- Additional tests for audit testing and failure analysis



Keysight 行走在无人区的技术：

- 基于示波器的低价位方案

802.11ay Test Solution for R&D/DVT



Customer challenge

Design verification test system on 802.11ay at early design stage

- *60~75GHz mmWave band*
- *4GHz BW for signal generation and analysis*
- *Test IF signal for 802.11ay*
- *Integrated with customer existing mmWave WLAN test system*

How it resolves customer test challenge

- *Provides integrated HW and SW solution on 802.11ay Tx and Rx test with up to 75GHz frequency range.*
- *Customized Test system that covers both RF and IF test needs with 4GHz BW*
- *WWC that support 11ay signal generation and analysis, as well as backward compatible SCPI*

Keysight 行走在无人区的技术：

- 频谱分析仪支持高达5GHz的中频输出
- 超过5GHz带宽的10-bit ADC示波器

Agenda

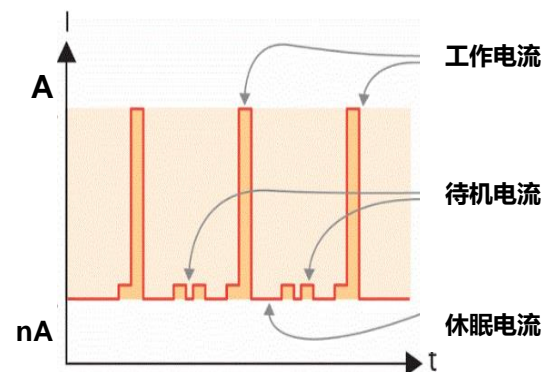
通信芯片中的主要测试项

1. AP与外设的互联
2. 存储
3. BP/Modem的各项测试
4. PA/FEM的测试
5. Wireless Connectivity的测试
6. **功耗测试**

便携电子产品耗电测量的挑战

设备耗电特性：大范围变化的动态电流，频率有的高达KHz

- 更高的电流测量精度
 - 微安 (uA) 级休眠电流，甚至纳安 (nA) 级漏电流
- 动态电流变化范围大：
 - 从微安级休眠电流到百毫安甚至安培级发射电流
 - 针对不同范围电流都能提供连续，准确的测量
 - 脉冲宽度窄，一般在几百微秒至毫秒
- 高采样速率和长时间的连续测量
 - 更快的采样速率，获取电流脉冲细节



www.ti.com

200-mA, Lo

FEATURES

- Very Low Dropout:
 - 43 mV at $I_{OUT} = 50$ mA, V
 - 85 mV at $I_{OUT} = 100$ mA,
 - 175 mV at $I_{OUT} = 200$ mA
- 2% Accuracy
- Low I_Q : 31 μ A
- Available in Fixed-Output V to 4.8 V
- High PSRR: 68 dB at 1 kHz



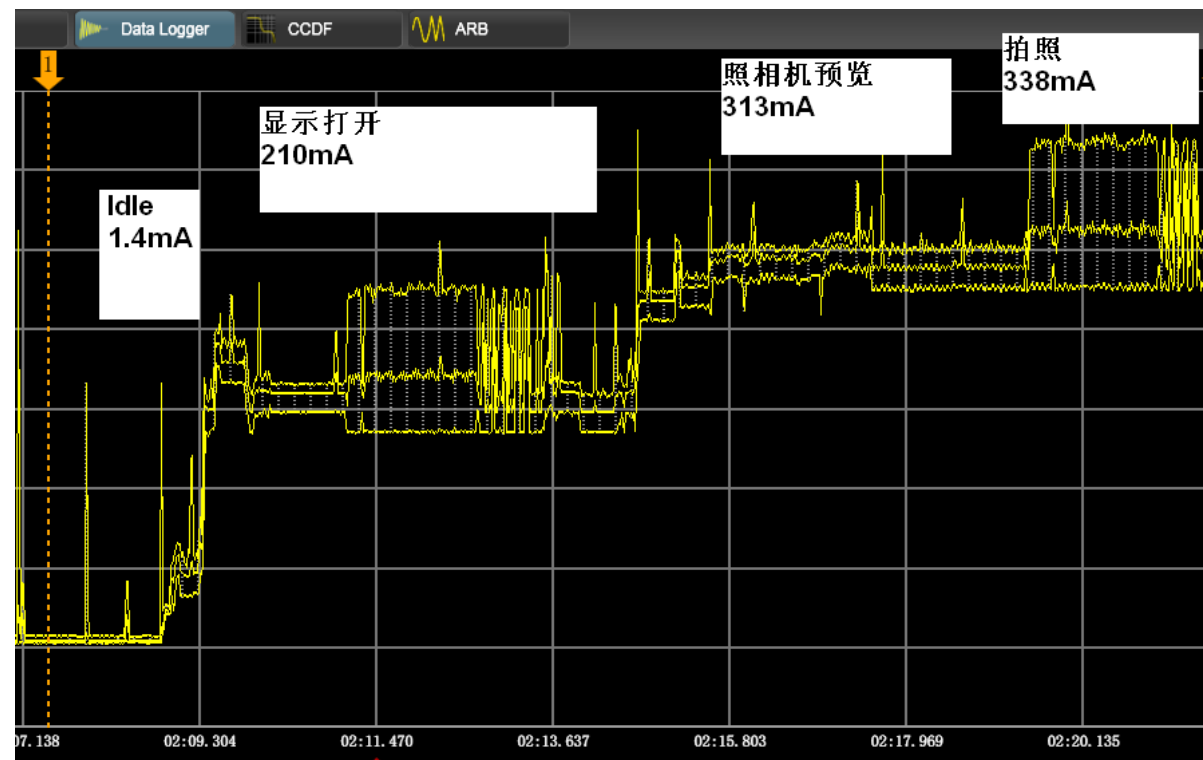
显示屏亮度对耗电的影响?

发射功率对耗电的影响?

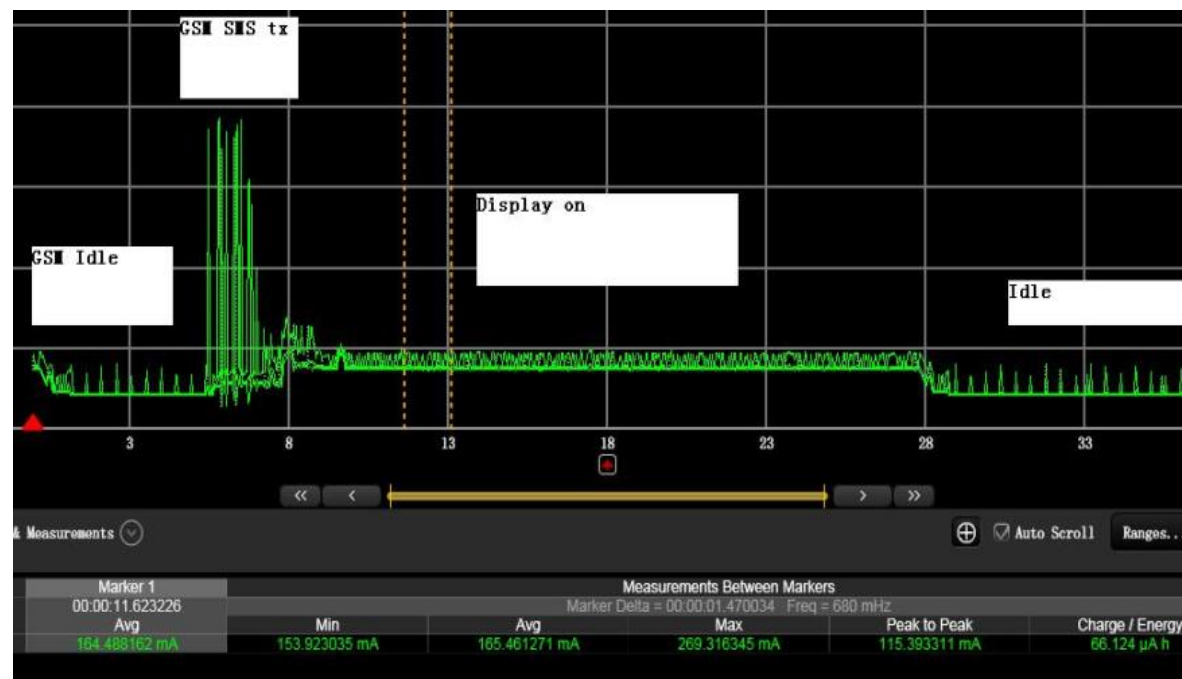


设置->初始设置->亮度调节 : 0,1.....6

拍一张照片消耗多少电？



接收一条SMS信息耗多少电？



您知道你的手机发送一条SMS信息、发一条QQ信息，拍一张照片，打1分钟电话，上一个网页都消耗多少电量吗？

Your solutions

Design and Verification Solutions



Keysight CX3300 Series device current waveform analyzers

- Industry's lowest current measurements down to 100 pA to analyze sleep mode abnormalities
- Ideal for low-power IoT, chipset, or device measurements
- Max. bandwidth: 200 MHz - capture sharp current spikes and quick transient effects
- Current range: 100 pA to 10 A
- Max. sampling rate: 1 GSa/s



Keysight N6705B DC power analyzer and N6781A/N6785A source measure unit

- Gain insights of your DUT power consumption in minutes (without writing a single line of code)
- Visualize current drain from nA to A in one pass
- Performs wide dynamic range current measurements using patented seamless current ranging technology and gapless measurement sweep
- Plug in the SMU modules to N6700B modular system for automated test



Keysight InfiniiVision oscilloscope (3000 X-Series, 4000 X-Series, 6000 X-Series) with N2820A high-sensitivity current probe

- Essential troubleshooting tool for any engineer or technician
- Measure wide range of current from 50 μ A to 5 A
- Probing with the Make-Before-Break connector

Manufacturing Solutions



Keysight 34465A/34470A Truevolt digital multimeters

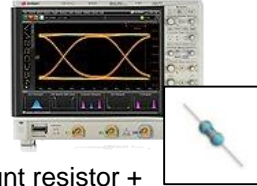



- Most basic tool to measure current consumption and voltage
- Measure high active mode current and ensure current drops below a certain level during sleep mode
- Cost-effective
- Current range: 1 μ A to 10 A





Keysight 34972A multi channel LXI DAQ & shunt resistor

- Low-cost per channel solution
- Ideal for multi-point, multi-DUT high volume production test
- Easy setup with built-in AC/DC current channels (with 34901A module)

Current Waveform Measurement positioning: Oscilloscope & Probes

| Positioning | Precision | Accuracy | Bandwidth | Product |
|-------------|--------------|----------|---------------------|---|
| Standard | > 1 mA | 2% | Widest (100MHz+) | <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Shunt resistor + Oscilloscope</p> <p style="border: 1px solid red; padding: 2px;">\$0.1 + Scope</p> </div> <div style="text-align: center;">  <p>Clamp-on current probe</p> <p style="border: 1px solid red; padding: 2px;">From \$500 to \$10k + Scope</p> </div> </div> |
| In-depth | > 50 μ A | 2% | Wide (3 MHz) |  <p>N2820A High Sensitivity Current Probe</p> <p style="border: 1px solid red; padding: 2px;">\$3k or \$4k + Scope</p> |
| Deep-dive | > 150 pA | < 1% | Wider (200 MHz) |  <p>CX3300A Device Current Waveform Analyzer</p> <p style="border: 1px solid red; padding: 2px;">From \$40k to \$90k</p> |

Power/Current Measurement positioning: DC Power Analyzer

| Positioning | Precision | Bandwidth | Sourcing function | Product |
|----------------------------|-----------|-----------|------------------------------|--|
| Source + Measurement | > 20 nA | < 30 kHz | Yes (20 W with N6781A) |  <p>N6705B DC power analyzer N6781A SMU x2</p> <p>\$7.6k + \$11.6k</p> |
| Measurement Only | > 150 pA | < 200 MHz | No |  <p>CX3300A Device Current Waveform Analyzer</p> <p>From \$40k to \$90k</p> |

如何选择正确的探头测量小信号

用N2820A电流探头(1:300)测试手机耗电

N2820A特性

- 量程和动态范围由所使用的前端附件决定
 - 最小可测电流：500nA
 - 最大可测电流：5 A
 - 动态范围最大超过 20,000:1
- 带宽
 - 3 MHz 全局通道
 - 500 kHz 局部细节放大通道
- 前端连接部分可更换阻值: 20 m Ω , 100 m Ω 以及用户自定义模块
- 新的自动测量项目 – 特定时间范围内的电流消耗 (AmpH)
- 兼容InfiniiVision 3kX, 4kX, 6kX 以及 Infiniium S, 9k, 9kX/Q/Z (with N5449A)

N2820A 双通道



- 500 mW
- 50 μ A - 2.2 A
- \pm 1% tolerance
- For higher sensitivity, bandwidth and lower noise
- Order N2824A for replacement head

100 m Ω



Wireless Charger Testing Total Solution

| Keysight Offering | Recommended Models | Qty | RAT Ref. | Remark | |
|----------------------------|--|-------------------------|----------------|--|--|
| VNA | <ul style="list-style-type: none"> VNA Selection: | | | | |
| VNA For Compliance? | Low-power | High-power | | | |
| Yes | <ul style="list-style-type: none"> E5072A/(245 or 285)/006 or E5071C/240 (require manually calculation) or Equivalent E5061B/3L5/005/006 or E5063A/205/006 | E5072A/(245 or 285)/006 | 1 | 4.1.2 4.6.2 | <ul style="list-style-type: none"> RAT Compliance: E5072A, E5071C (equivalent E5061B/E5063A) Opt.006 support: E5072A, E5061B, E5063A Require manually calculation: E5071C, E5080A |
| No | <ul style="list-style-type: none"> E5072A/(245 or 285)/006 or E5061B/3L5/005/006 (LCR/VNA in one) or E5063A/205/006 (Economic) or E5071C/240 (require manually calculation) or E5080A/245 (require manually calculation) <p>If need accurate Z measurement or high Q (>100): We can further sell either E4990A/010 (or 020 to also cover NFC @13.56MHz) or 16047E fixture to use with E5061B For high-volume test, we can add 42941-60002 SMA probe head to raise the throughput</p> | | | | |
| Attenuator | 2x 8493A Coaxial Fixed Attenuator (to protect the VNA inputs from excessive input power) (Optional) | 2 | 4.6.2 | | |
| Cal Kit | 1x Ecal 85093C (stated in 4.1.2) or cheaper mechanical cal kit 85033E (stated in 4.6.2) | 1 | 4.1.2 4.6.2 | | |
| Cables | <ul style="list-style-type: none"> 2x 11500F or Z5623A-K20 (RG316 Cables without Chokes, Maximum length: 3 meters, SMA(m)) 7x 11500F or Z5623A-K20 (RG36 SMA Coax Cable, slim and flexible cable should be used to wind cable around choke 5 times) | 2 7 | 4.1.2 4.6.2 | Totally 9 SMA(m) cables | |
| Adaptors | 2x 1250-1744, N (m) to SMA (f) adaptors | 2 | 4.1.2 | | |
| Torque Wrench | 1x 8710-1761, SMA torque wrench | 1 | 4.1.2 | | |
| Function Gen | 1x 33510B (dual channel) Function Generator | 1 | 4.3.2 | | |
| Digital Multimeter | 1x U1270 Series Handheld DMM (Recommend U1273A OLED, or U1273AX, U1272A) | 1 | 4.3.2 4.6.2 | | |
| Oscilloscopes | 1x DSOX3014T (at least 100 MHz bandwidth and 2 Giga Samples/Second resolution) for all current measurement Recommended: If also need RCE measurement, then D(M)SOX4024A or above is required) | 1 | 4.3.2 4.6.2 | 4.3.2 need better scope, can upselling D(M)SOX4024A or D(M)SOS054A for efficiency test and good PI performance and it's better than Tek's MSO4014B and TCP0030 probe | |
| AC Current Probe | 2x N2893A 100MHz/15A AC/DC Current Probe (rated at least 5 Amps RMS at 6.78 MHz, bandwidth 50 MHz or more) | 2 | 4.6.2 | May need accessories using with different scopes | |
| HV Diff Probe | 2x HV Diff Probe - N2790A, 100 MHz, 50:1/500:1, ±1,400V, HV Diff Probe | 2 | 4.6.2 | | |
| De-skew Fixture | 1x U1880A Power measurement de-skew fixture for voltage and current probes (or cheaper custom-made de-skew fixture that consists of just one 10-Ω resistor and a BNC-to-grabber adapter) | 1 | 4.6.2 | | |

Q&A



读书群:高速上数字电
路设计和测试



Valid until 3/29 and will update upon joining group