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智能可穿戴设备的“芯”测试解决方案

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Outline

- What are Smart Wearable Devices?
- HVM Test Challenges of Smart Wearable Devices
- V93000 Test Solutions
- Summary

What are Smart Wearable Devices?

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Smart Wearable Devices

Smart Headphones

Smart Watch

Smart Bracelet

Smart Glasses

Smart Shoes

Smart Clothing

Source: Internet

Market Trends

Source: IDC

- **Smart watches**, **smart bracelets** and **smart headphones** account for more than 90% of the wearable market share.
- It is estimated that in 2022, the domestic wearable device market will ship more than 160 million units, with a year-on-year growth of 18.5%.

Features and Technology Trends

Lightweight, small size

- Higher chip integration.
- Advanced chip package technology. e.g. SIP, WLCSP

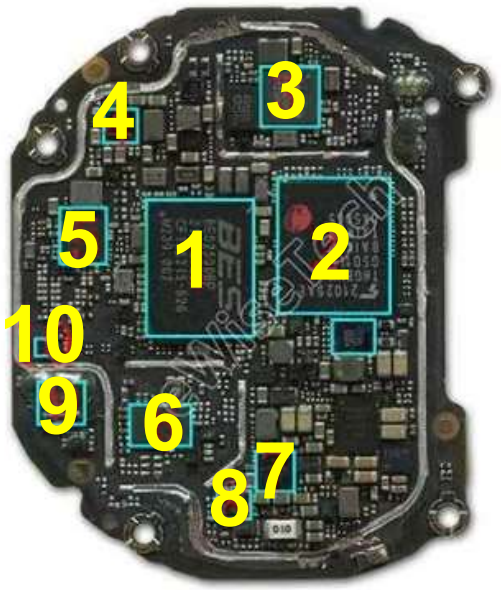
Use a variety of wireless technologies to provide rich connectivity

- Bluetooth 5.2/5.3
- Wi-Fi5/6
- GNSS – Beidou/GPS
- LTE-Cat1/Cat4, 5G

Low power consumption

- Advanced power management technology
- Advanced chip process
- RTOS (real-time operating system)

Typical wearable device structure

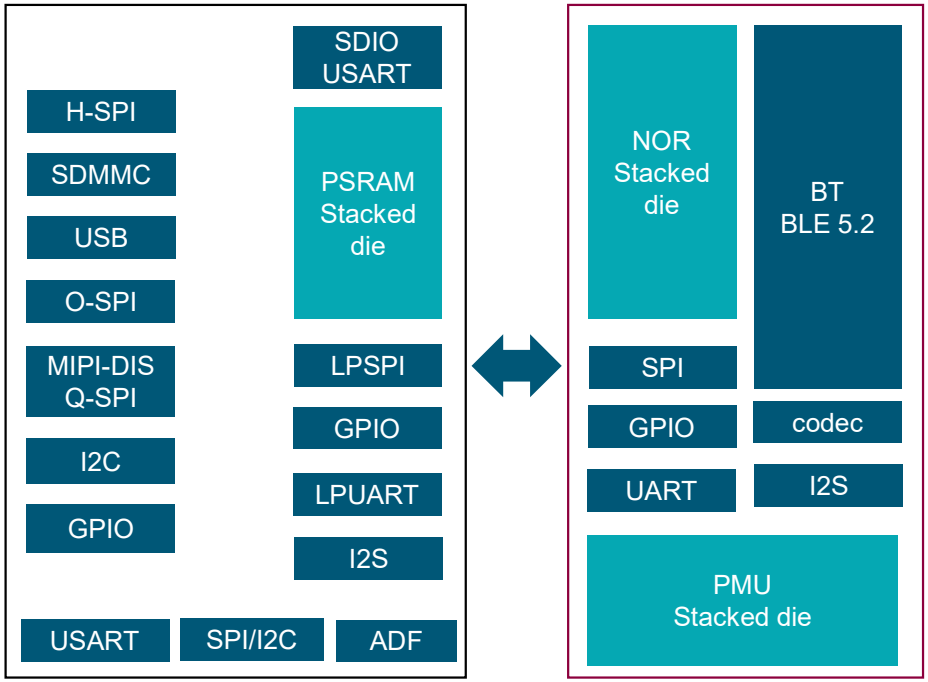


1	Bluetooth chip (master chip)
2	4GB flash chip
3	Wi-Fi chip
4	AMOLED display power chip
5	NFC control chip
6	GNSS chip
7	Battery management chip
8	Power meter chip
9	Gyro accelerometer chip
10	Electronic compass chip

Source: eWisetech

Typical Master Chip of Wearable Devices

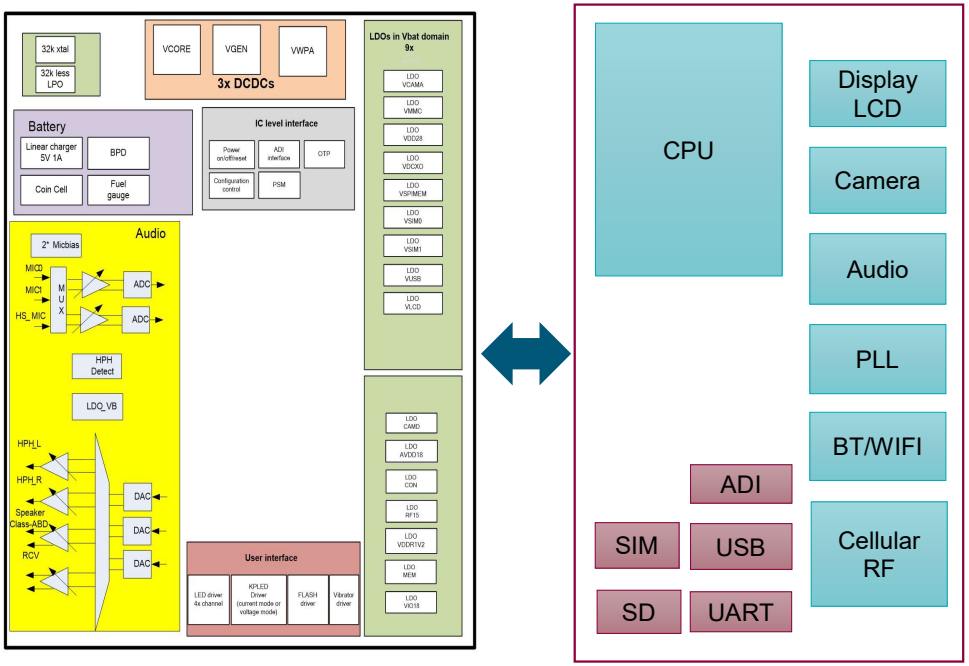
Bluetooth SIP



A Die
(MCU + PSRAM)

B Die
(BT+ Codec + NOR + PMU)

Cellular SIP



A Die
(Audio + PMU)

B Die
(BT/WiFi + Cellular + CPU)

HVM Test Challenges of Smart Wearable Devices

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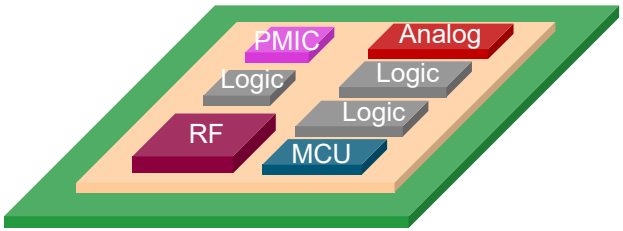
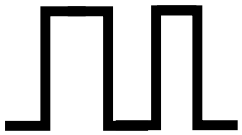
HVM Test Challenges of Master Chip



- **High Integration with multi-function dies/IPs,** wireless, MCU, ADC/DAC, PMU
- **Diverse RF connectivity,** Bluetooth 5.2/5.3,Wi-Fi6, Beidou, LTE,5G
- **Low power PMIC integrated,** lower voltage & leakage, high DC accuracy e.g. shipping mode current 2uA
- **Low Cost,** high test efficiency & multi-site
- **Advanced package requires RFCP coverage,** RFCP is needed for SIP KGD & WLCSP

Typical Test Items

	DC Test	Digital Test	Analog Test	RF Test
Test Items	Open short Power short LDO Leakage Current Trim	SCAN BIST	INL/DNL/SNR/THD SNDR/SFDR/HD3	TX: Power/OIP3/ACPR/EVM RX: Gain/NF/EVM/IIP2/IIP3/ Sensitivity

V93000 Test Solutions

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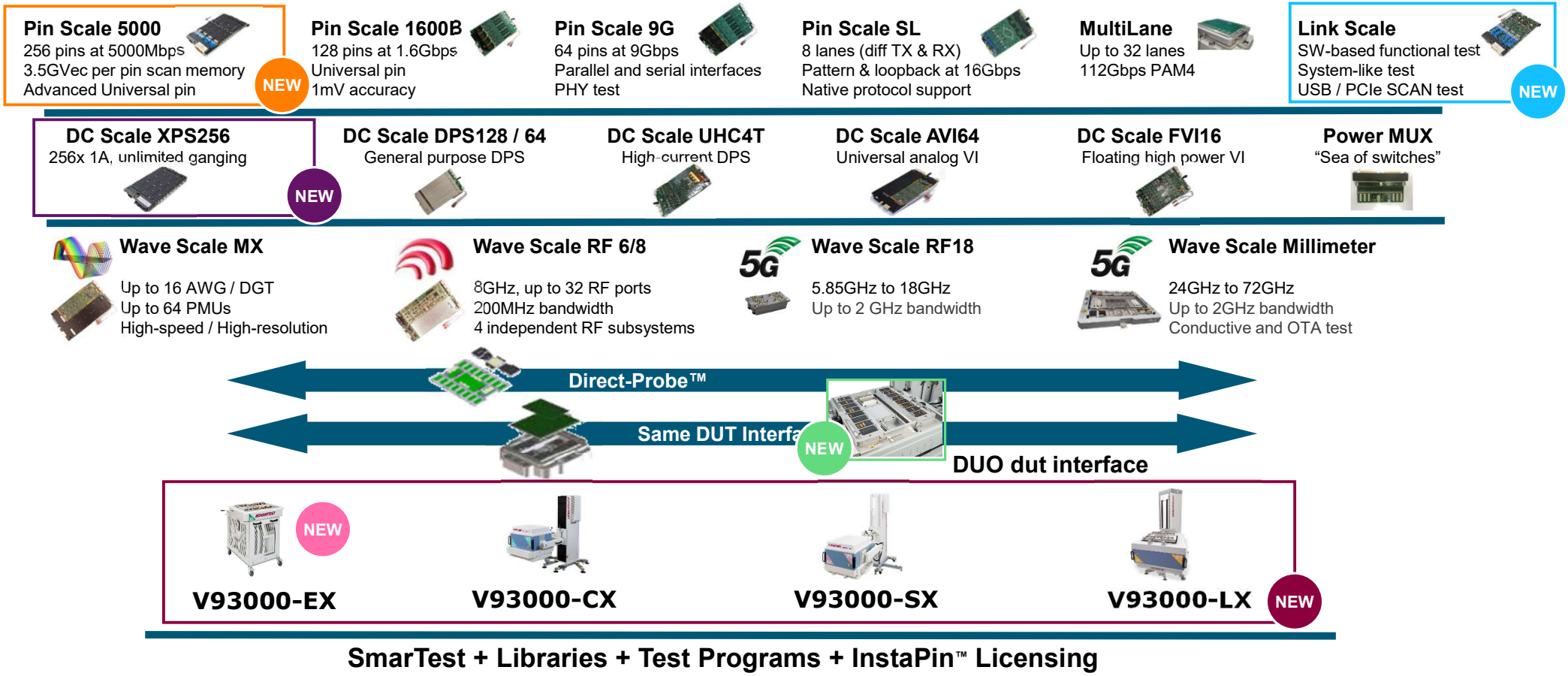
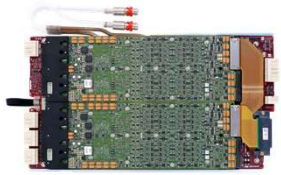
V93000 EXA Scale – Expanding the Single Scalable Platform



Challenge1- High Integration with multi-function dies/IPs
V93000 Single Platform Covering Wide Test Functions



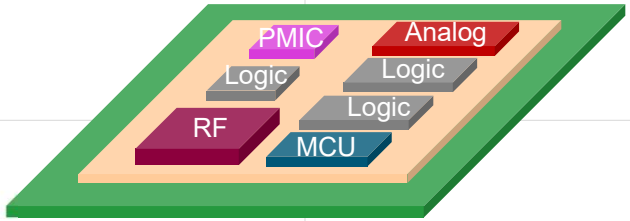
DPS128/64
128/64 pins
-2.5V to +7V
1.0A@2.5V, 0.5A@7V

XPS256
256 pins
-2.5V to +7V
1.0A@2.5V, 0.6A@7V

DC tests
- OS, power short
- LDO
- Leakage
- Current
- Trim

RF tests
- TX: Power/OIP3/ACPR/EVM
- RX: Gain/NF/IIP3/IIP2/EVM/ sensitivity

Wave Scale RF
10MHz - 8GHz
Up to 32 RF ports
200 MHz bandwidth
4 Independent AWG/DGT

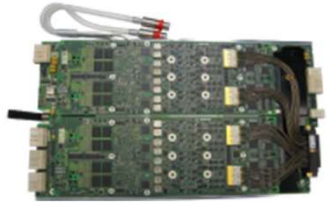


Pin Scale 1600/B
128 pins at 1.6G
1mV accuracy
Universal pin

Pin Scale 5000
256 pins at 5000Mbps
± 500µV accuracy
3.5Gvec per pin scan memory
Universal pin

Digital tests
- Scan
- MBIST
- Efuse

ADC/DAC Test
- INL/DNL
- SNR/THD
- SNDR
- SFDR



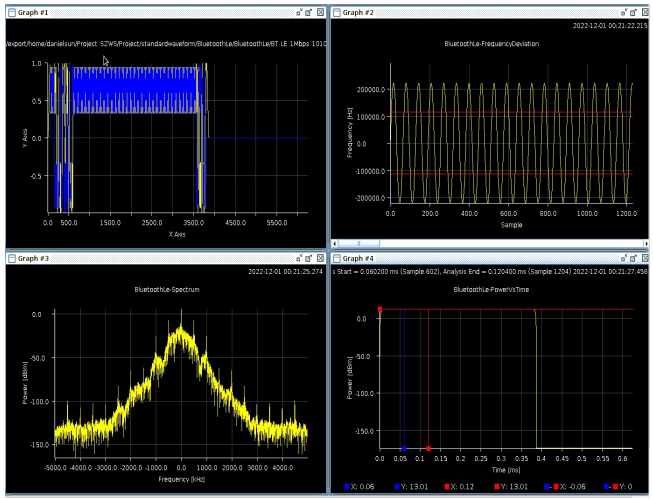
Wave Scale MX
up to 16 AWG/Digitizer
Up to 64 PMUs

Challenge2- **Diverse RF connectivity**

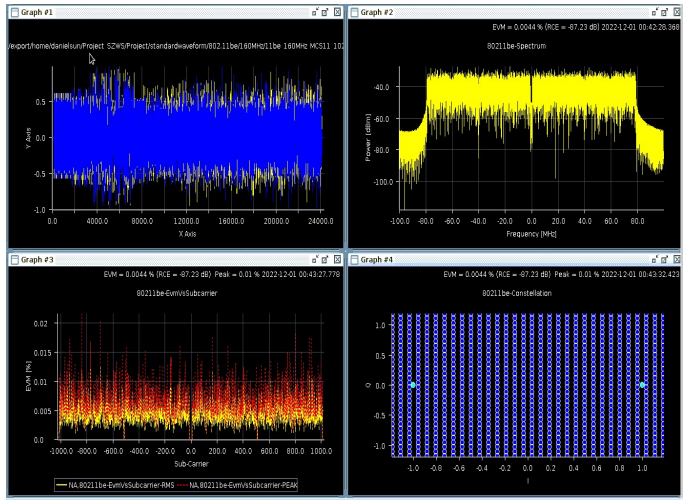
V93000 Demodulation Capability Can Cover Diverse RF Standards

V93000 Demodulation Capability

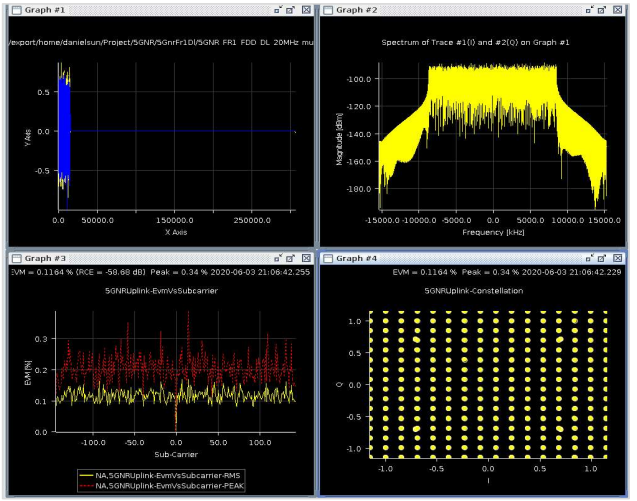
Bluetooth® Wi Fi 6™ Wi Fi 7™ zigbee Wi Fi 6E™ UWB NB-IoT LTE™ 5G ...



BluetoothLe, 1Mbps, 10101010



Wi-Fi7 1024QAM, 160MHz Bandwidth



5G downlink, 256QAM, 100MHz Bandwidth

Challenge3 - Low power PMIC integrated

V93000 Digital Card and DPS Card Can Cover High Precision Low Current/Voltage Measurement

PS5000

NEW

- **256 pins at 5000Mbps**
- **3.5GVec scan per pin**
- **Best-in Class Universal Pin**
  - PPMU: Current Clamp, Kelvin Sense & Gang, enables low power DPS capability at digital pin.
  - BADC accuracy ± 500μV (-1.5V to +6.5V)

XPS256

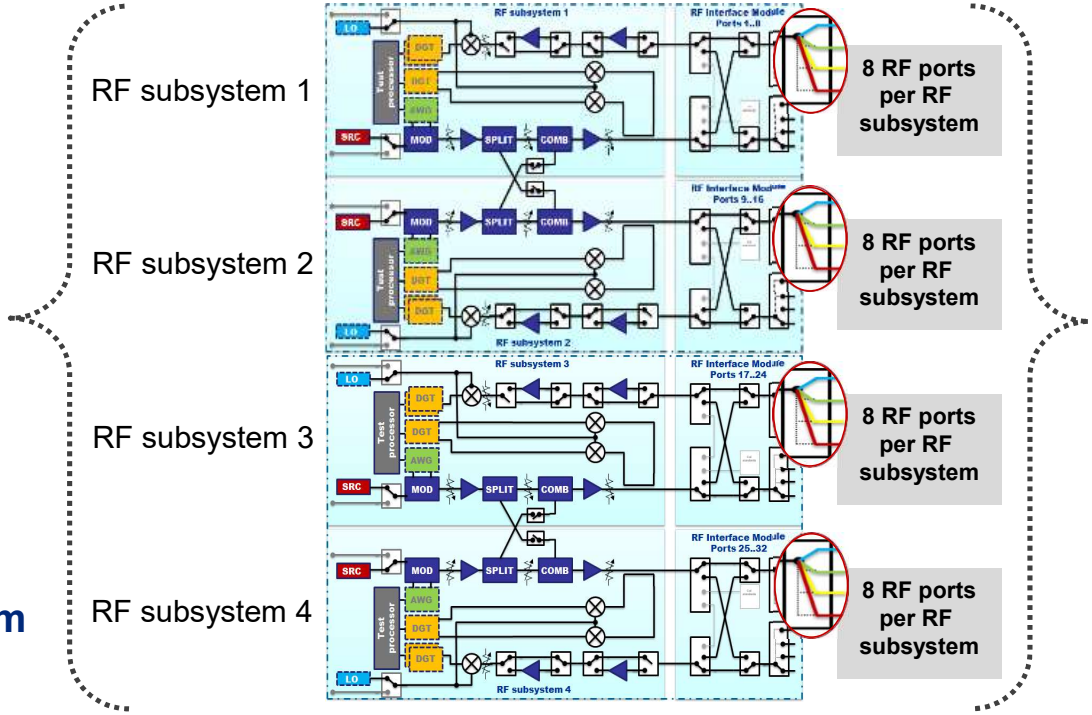
NEW

- **256 pins with 1A**
- **Full four quadrant VI capabilities for embedded PMIC test**
- **High accuracy force & measure**
  - ± 150μV voltage (10μV resolution)
  - ± 50nA current (100pA resolution)

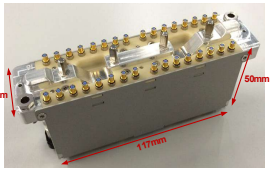
Challenge4 - **Low Cost**
V93000 WSRF Sufficient Resources Can Support High Count multi-site

4 Indepedent RF subsystems per card

License from 1/4 card = 1 subsystem



RF interface module



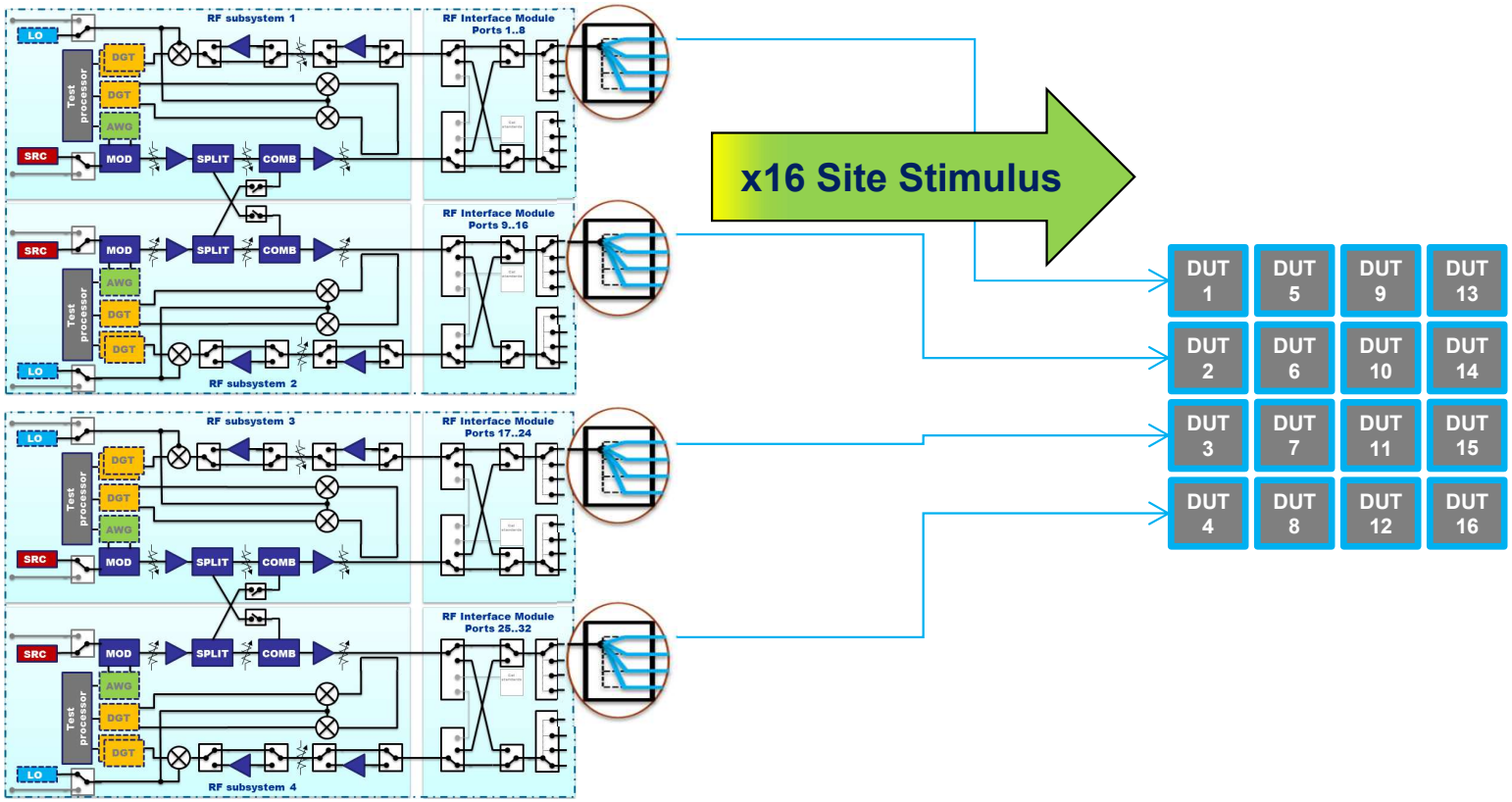
200MHz BW

10MHz – 8GHz

4 Independent RF Subsystems / 32 Bi-Directional RF Ports

Challenge4 - **Low Cost**

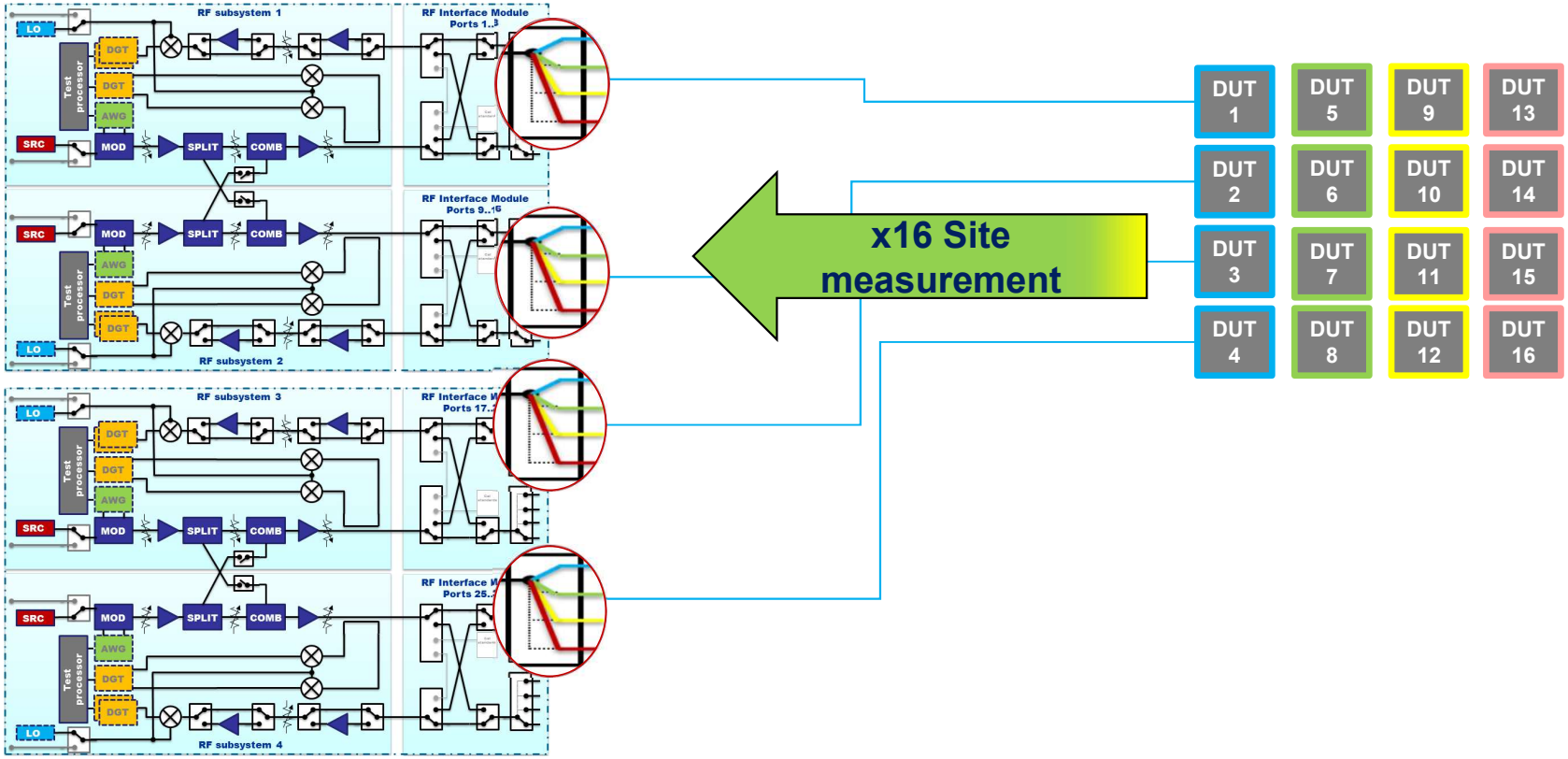
V93000 WSRF Sufficient Resources Can Support High Count multi-site



16 site full parallel Rx test

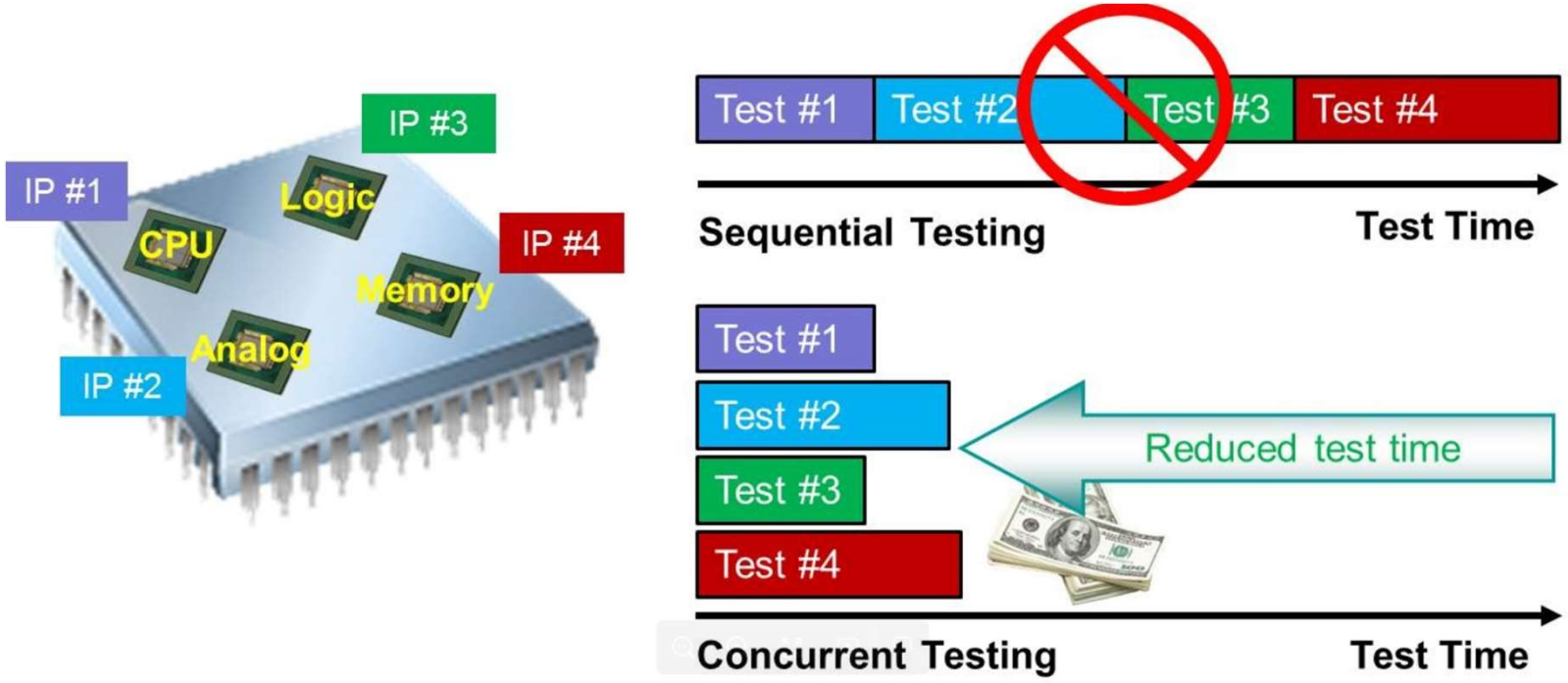
Challenge4 - **Low Cost**

V93000 WSRF Sufficient Resources Can Support High Count multi-site



Site-interlace for 16 site TX

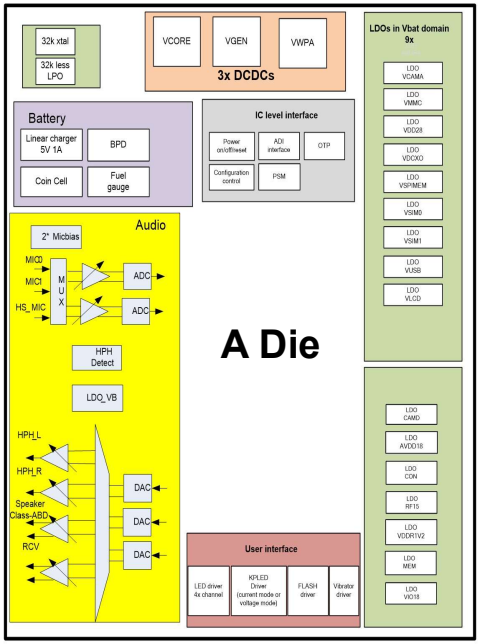
Challenge4 - **Low Cost**
V93000 CCT (Concurrent Test) Feature Can Improve Test Efficiency

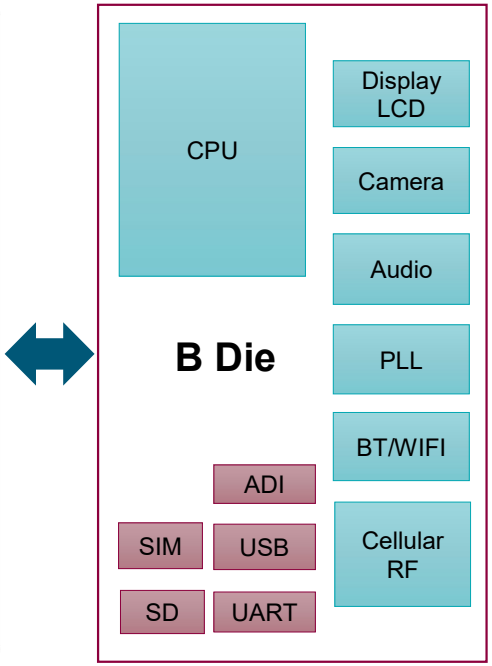


CCT: Parallel test execution of multiple cores at the die level or multiple dies at the package level.

Challenge4 - **Low Cost**
V93000 CCT (Concurrent Test) Feature Can Improve Test Efficiency

Case study: Parallel testing for both dies for independent items





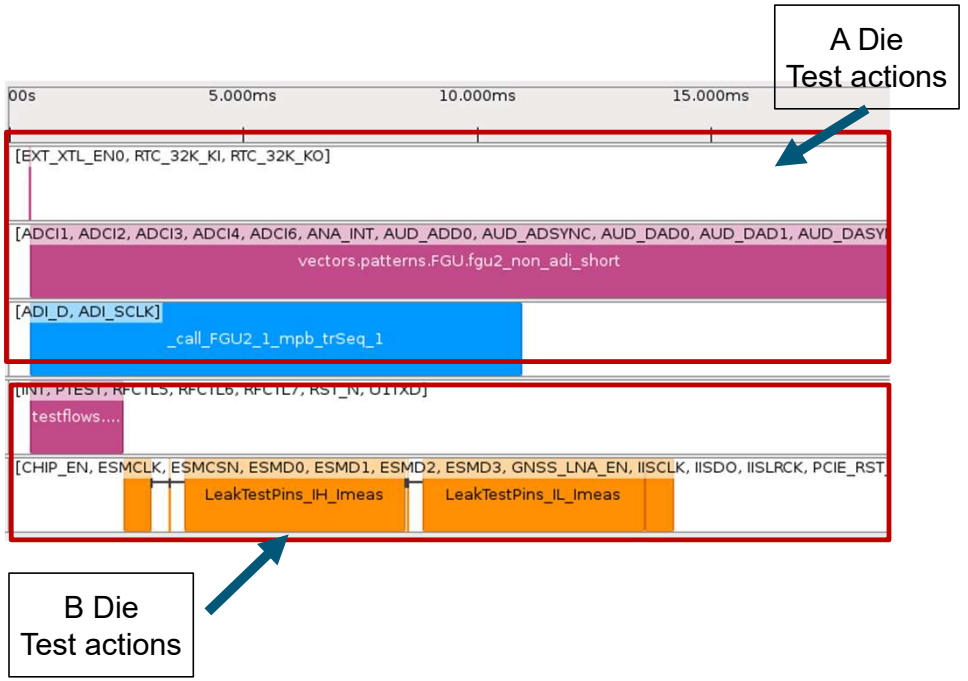
(DC + Digital + Analog)

test time=2013.08ms

(DC + Digital + Analog + RF)

test time=401.339ms

Without CCT test time=2414.419ms

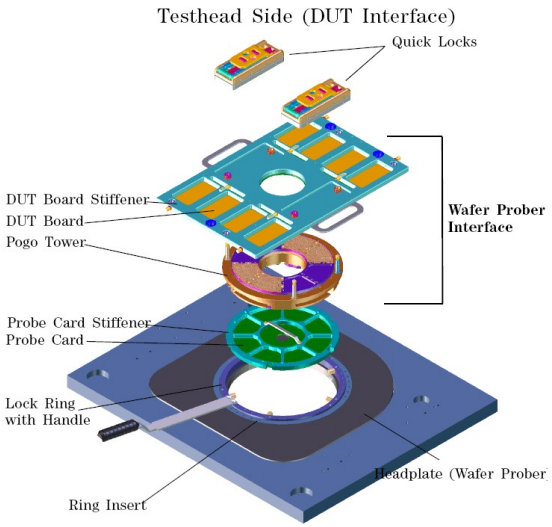


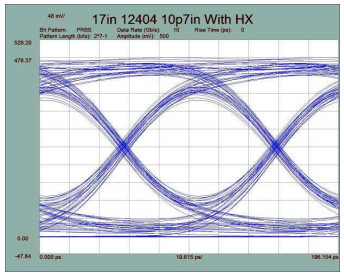
With CCT test time=2208.568ms

Reduce test time by 8.5%

Challenge5 - Advanced package requires RFCP coverage
V93000 Direct Probe Provide Reliable Solutions to RFCP

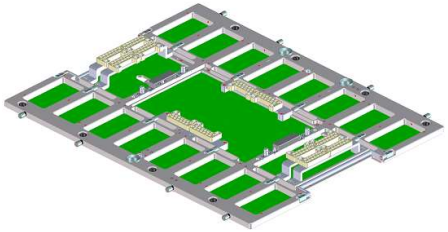
Traditional Probe Solution

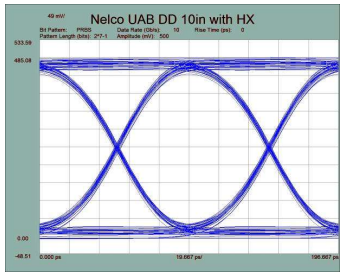




V93000 Direct Probe Solution

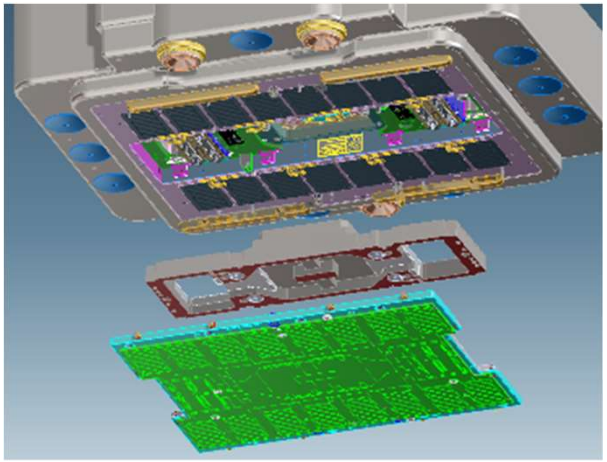
- Simpler Structure
- Signal Integrity
- Bigger Application Area



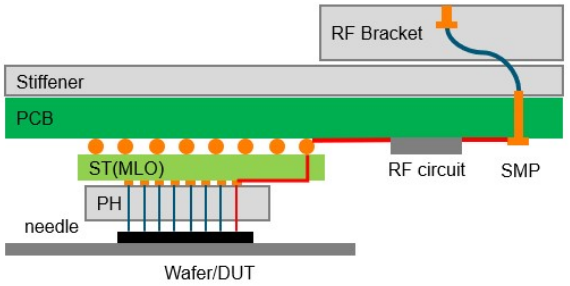


Challenge5 - **Advanced package requires RFCP coverage**
V93000 Direct Probe Provide Reliable Solutions to RFCP

V93000 direct probe solution for wafer test



V93000 direct probe solution overview



RF direct probe solution signal flow

Summary

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Summary

- Smart watches, smart bracelets and smart headphones account for more than 90% of the wearable market share.
- Master chips are the key component of wearable devices. Most of them use advanced packing technology (e.g. SIP, WLCSP …).They are highly integrated with multi-function dies/IPs, and support diverse RF connectivity, as well as integrated low-power PMIC. These characteristics bring great challenges to high volume mass production.
- V93000 has total solutions for such high-integrated RF devices for wafer test and package test, the hardware and software not only cover the test requirements but also can support multi-site and concurrent test for reducing cost of test.

Full test coverage for wearable devices from Advantest V93000

Thank You!

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For questions contact: daniel.sun@advantest.com