Demonstrating V93000 WSMX-HR Analog Performance Requirement in TWS Application

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Advantest

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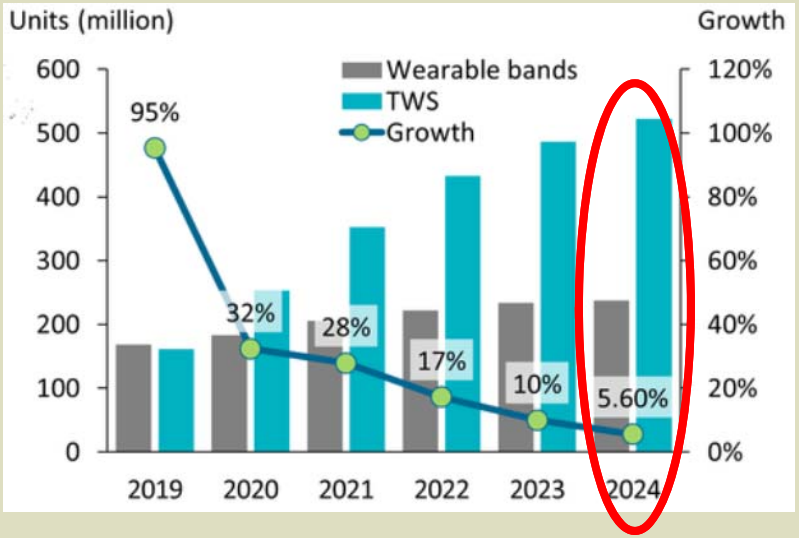
Contents

- True Wireless Stereo (TWS) Introduction
- WSMX-HR / Audio precision Specification Introduction
- WSMX-HR AWG / AP Performance Comparison
- WSMX-HR Digitizer / AP Performance Comparison
- Conclusion

What We Know about TWS…

- **True Wireless Stereo(TWS)**
- **Wearable bands and TWS expected to grow 30%**
  - 760 million units by 2024
- **What we know**

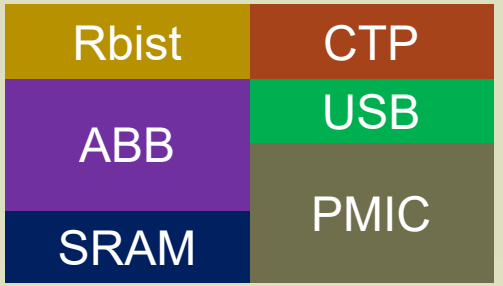


Application
- earbuds

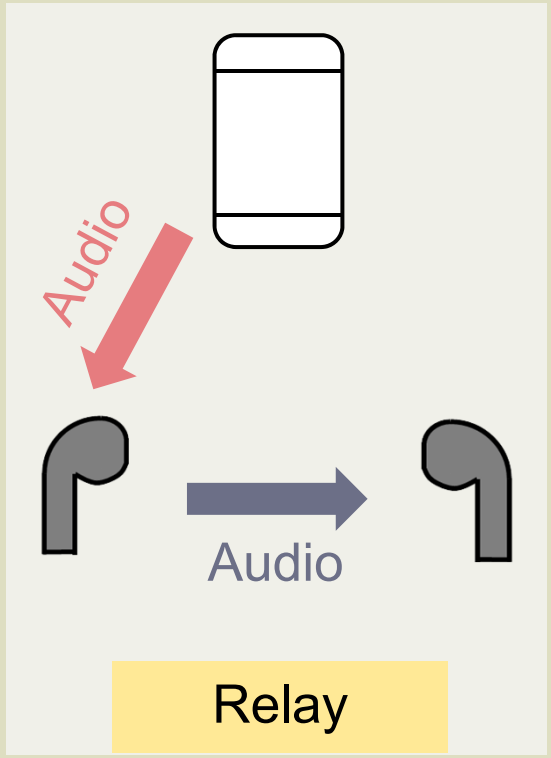
Bluetooth connection

Allowing all user behavior

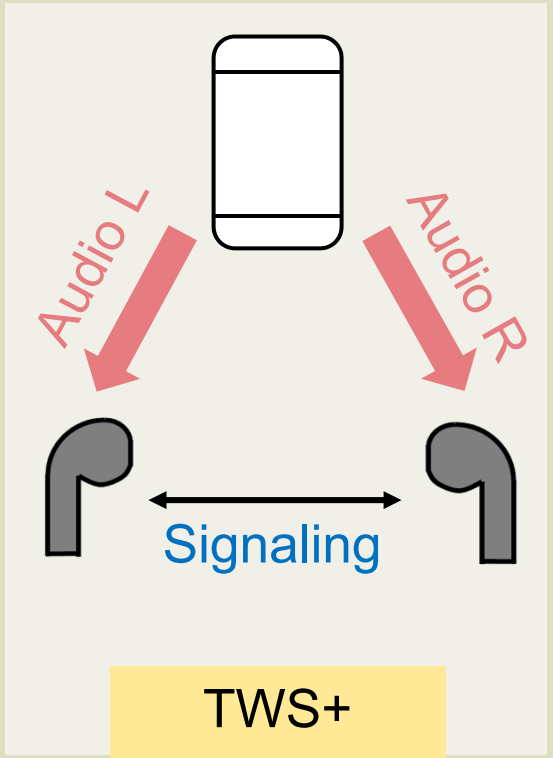
- **Feature rich integrated devices with core functionality**
  - Power management, Audio, Rbist, CapTouch…



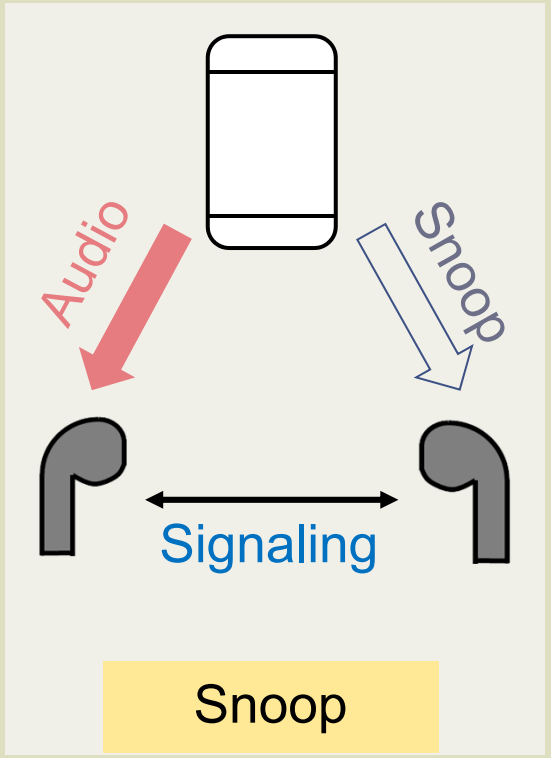
How does TWS Works?



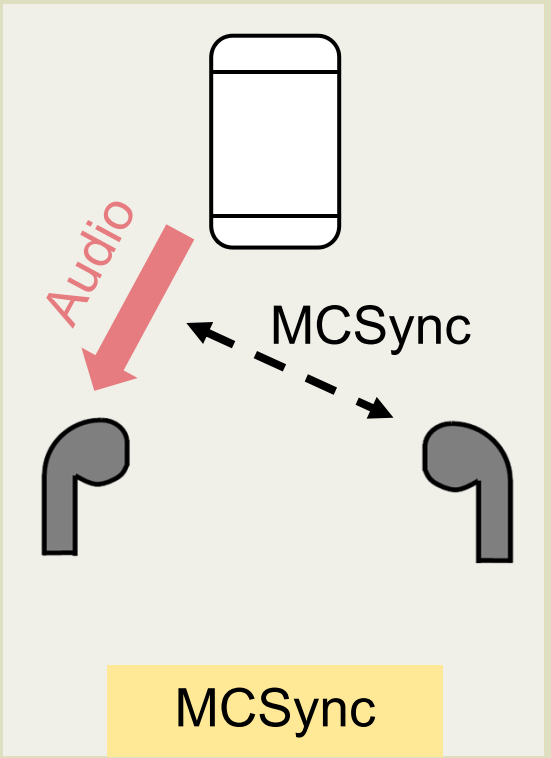
Relay



TWS+



Snoop



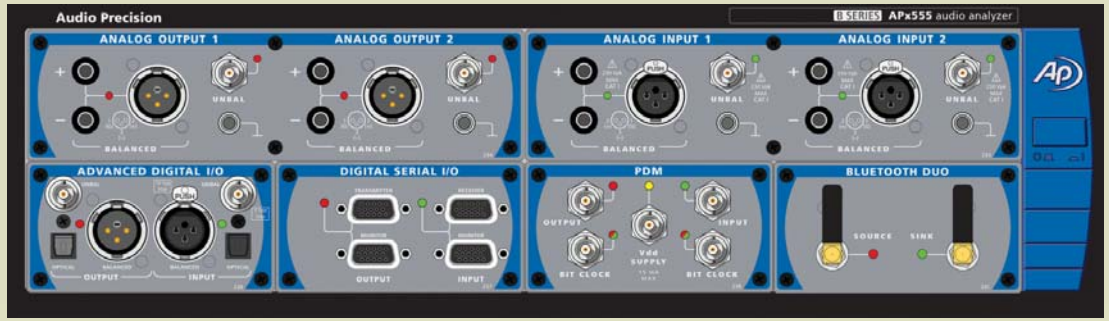
MCSync

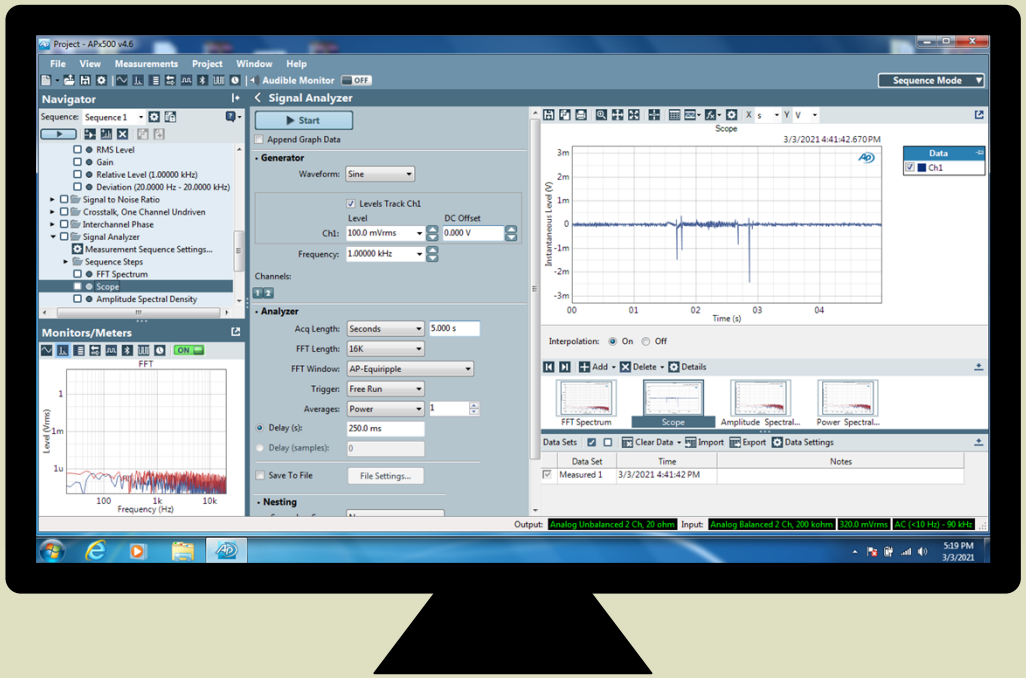
Instrument

- Audio Precision(AP)
- V93000 WSMX – AWG
- V93000 WSMX – Digitizer

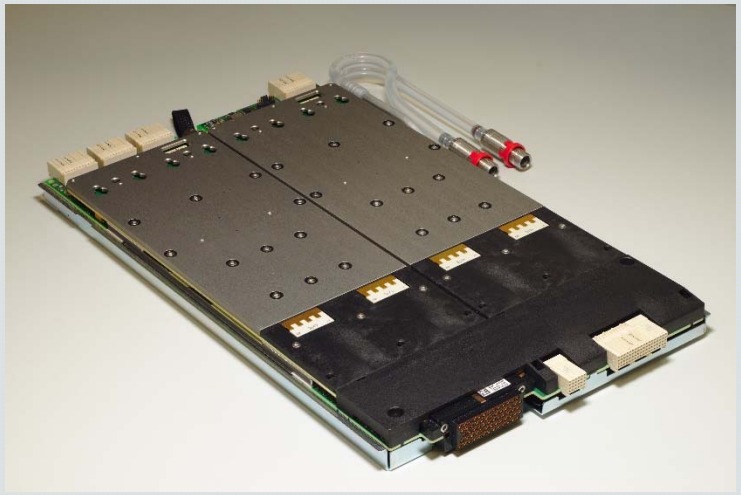
Audio Precision

- **APx audio measurement software offers:**
  - Multi-mode UI
  - Code-free automation
  - Host of application-specific software options
- **Test of speakers, headphones and microphones**





WSMX – High Resolution



- *32 instruments per card*
- *16 Units per Wave Scale MX card*
- *All can be used in parallel, independent, full pattern controlled*
- *64 bidirectional analog pogos incl. PMU*

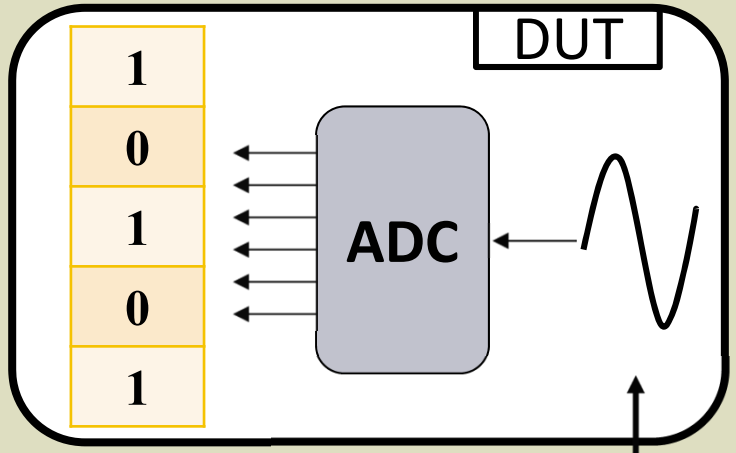
- **Advantest V93000**
- **WaveScale Mixed Signal card**
- **High Resolution Unit:**
  - High Resolution AWG
  - High Resolution Digitizer
- **Resolution 24 bits**
- **PMU Per Pogo**
- **Test Processor Controlled Synchronization**
- **Large Memory Pool**
- **Hardware Signal Processing Unit (SPU)**

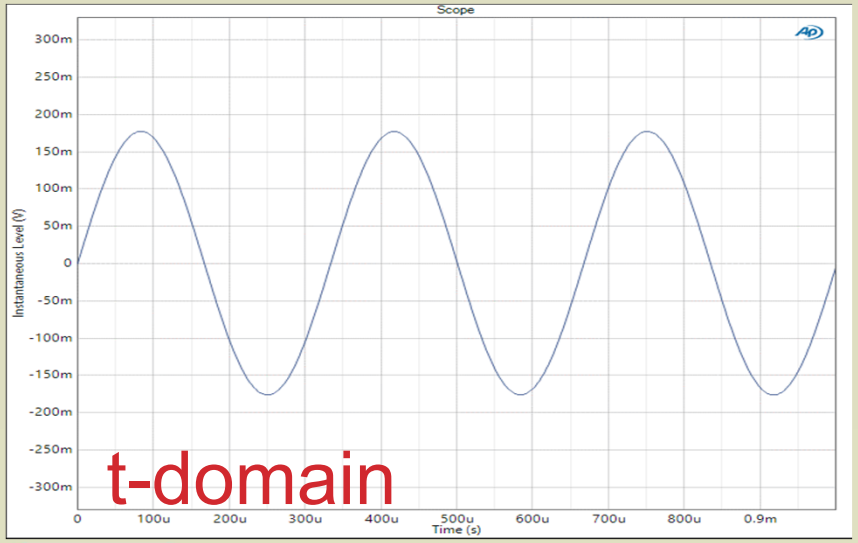
V93000 Capabilities

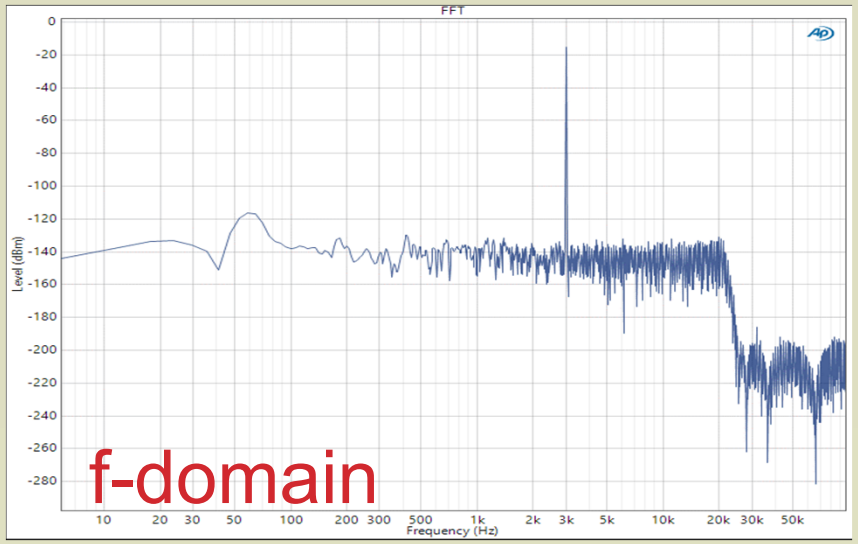
- Audio Uplink : WSMX – AWG
- Audio Downlink : WSMX – Digitizer

Bluetooth 5.0 - Audio Uplink

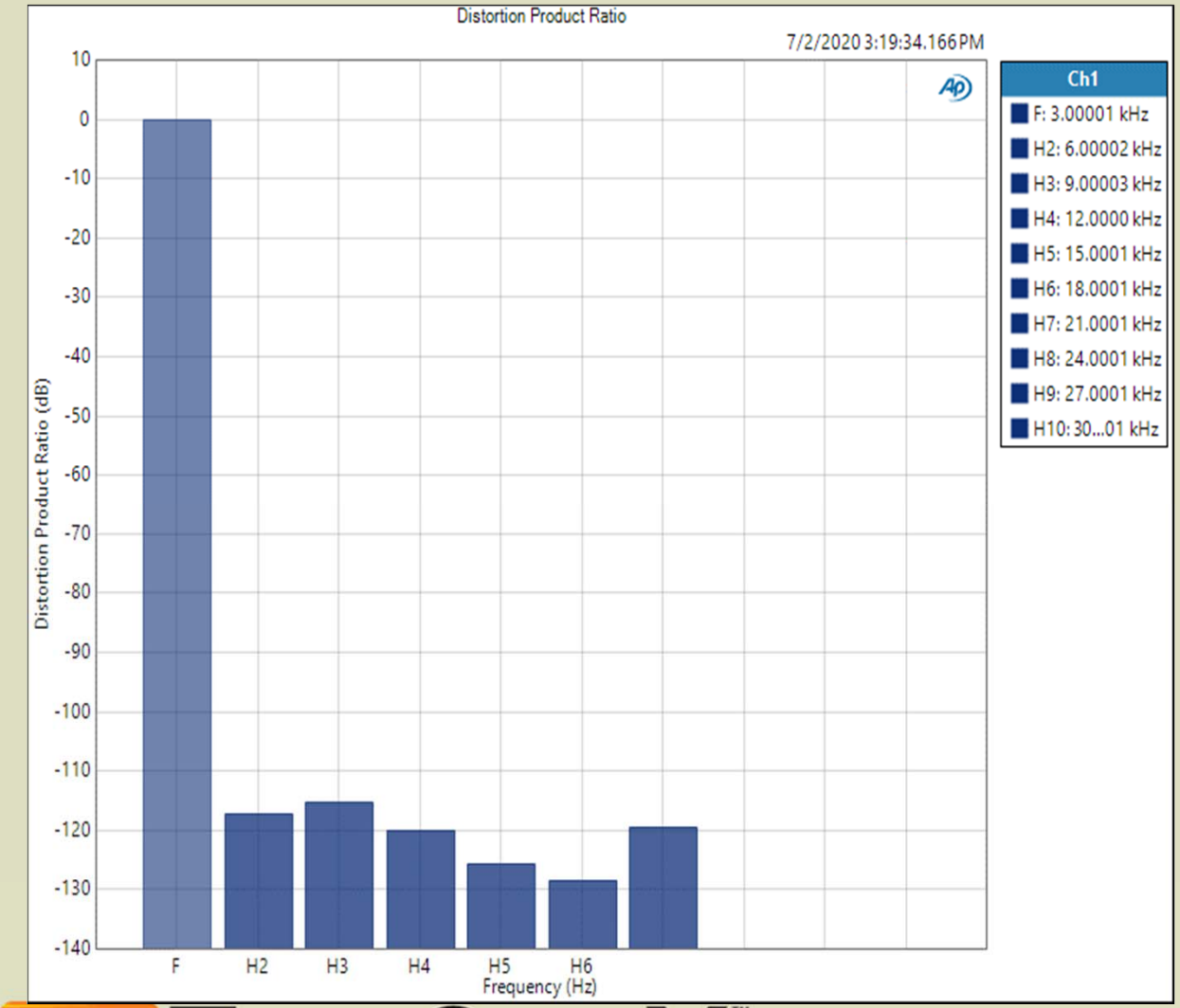
- **ADC Testing**
  - ATE source 3.0KHz sine wave into device
  - AWG - M=31, N=2048, Fs=198.194Kbps

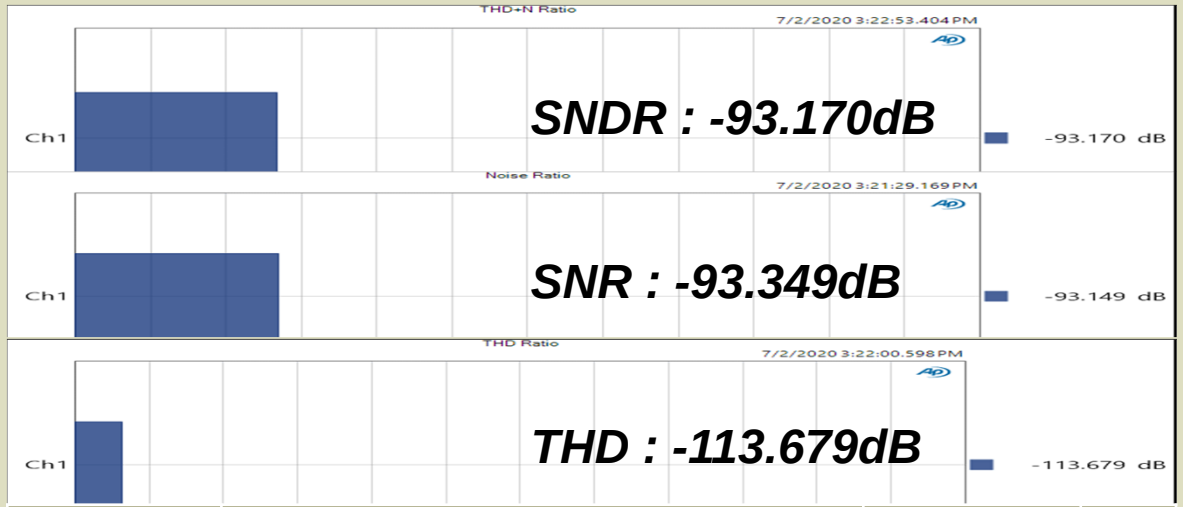






WSMX High AWG Performance





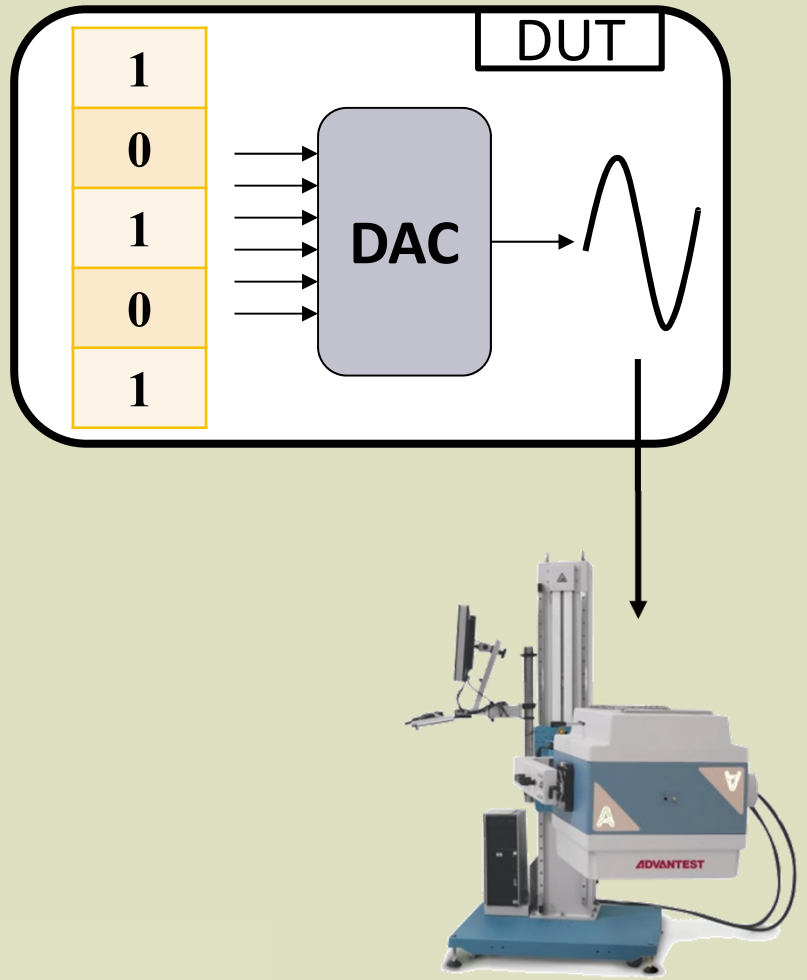
	V93K_WSMX_HR			Low Limit	
	Min	Mean	Max		
Power_R	15.641	15.6422	15.643	**13**	**dB**
SNDR_R	90.27183	91.0693	91.44067	**70**	**dB**
SNR_R	90.84101	91.6513	92.25831	**70**	**dB**
THD_R	98.78689	100.5284	104.8499	**70**	**dB**
Power_L	15.586	15.5873	15.588	**13**	**dB**
SNDR_L	89.20728	90.23899	91.4149	**70**	**dB**
SNR_L	89.78676	90.76061	91.8401	**70**	**dB**
THD_L	97.8842	99.81186	101.717	**70**	**dB**

Bluetooth 5.0 - Audio Downlink

- **DAC Testing**
  - ATE measure 1.5KHz sine waveform from device
  - Digitizer - M=9, N=1024, Fs=170.667Kbps

- **Different Signal Level**
  - 0dB (large signal)
  - n20dB (middle signal)
  - n60dB (small signal)

- **Correlation**
  - Audio Precision
  - WSMX - Digitizer



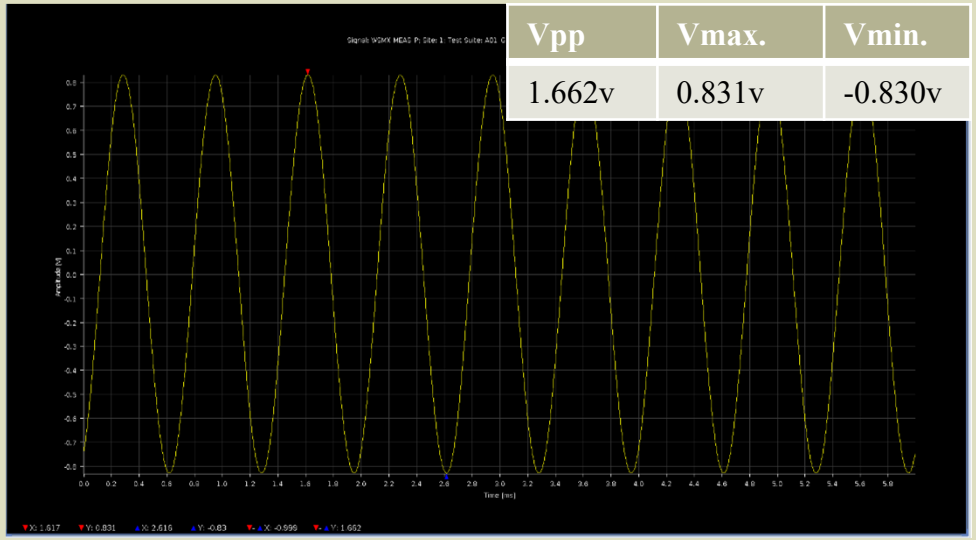
Large Signal (0dB) Spectrum Comparison

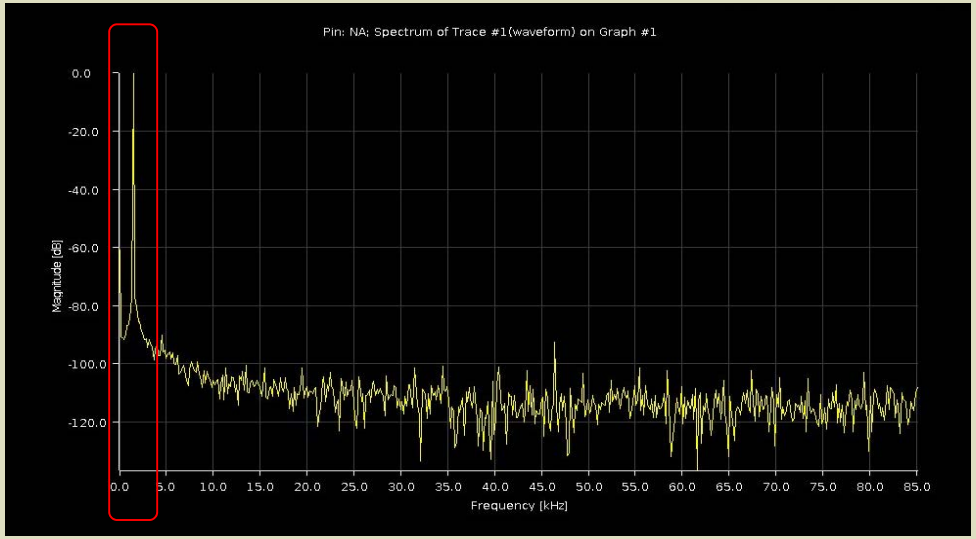
V93000
WSMX-HR

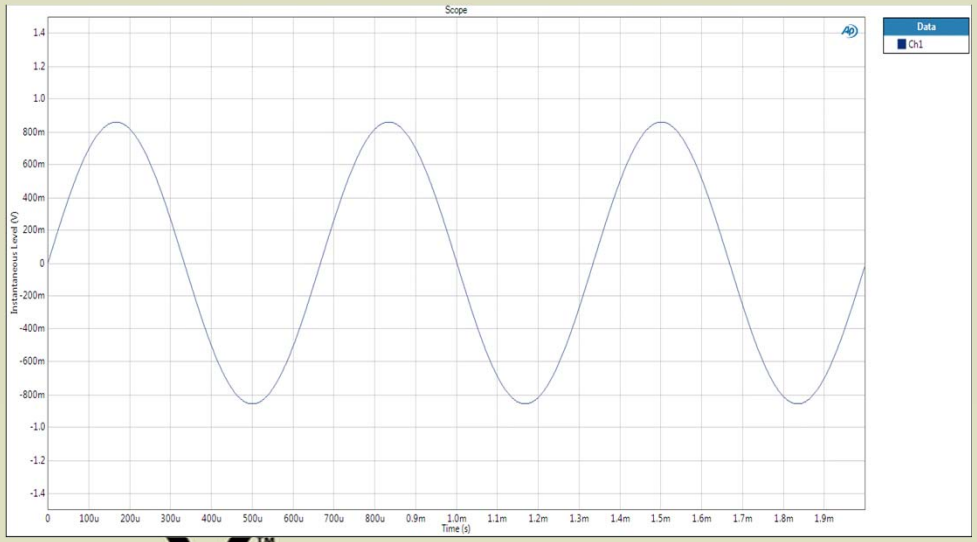
vs.

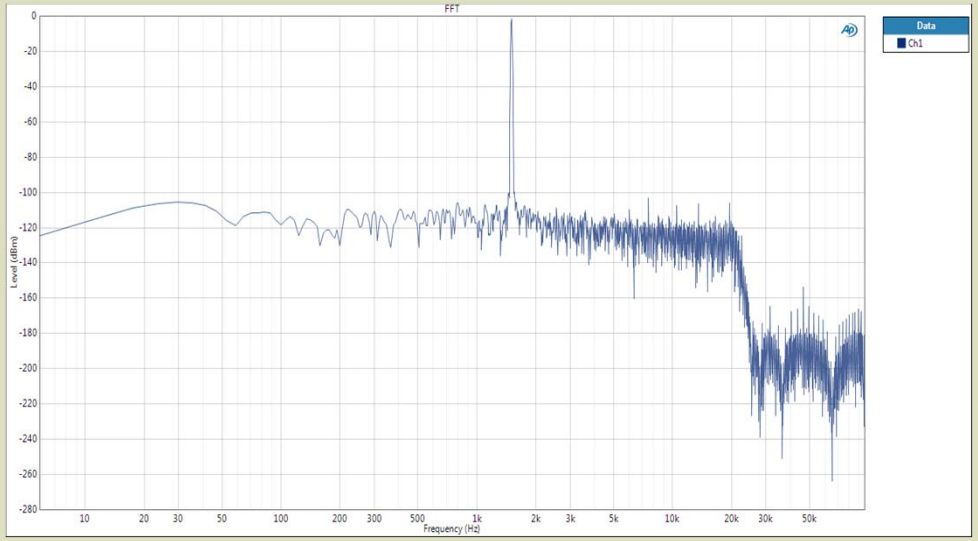
Audio Precision

Vpp	Vmax.	Vmin.
1.662v	0.831v	-0.830v

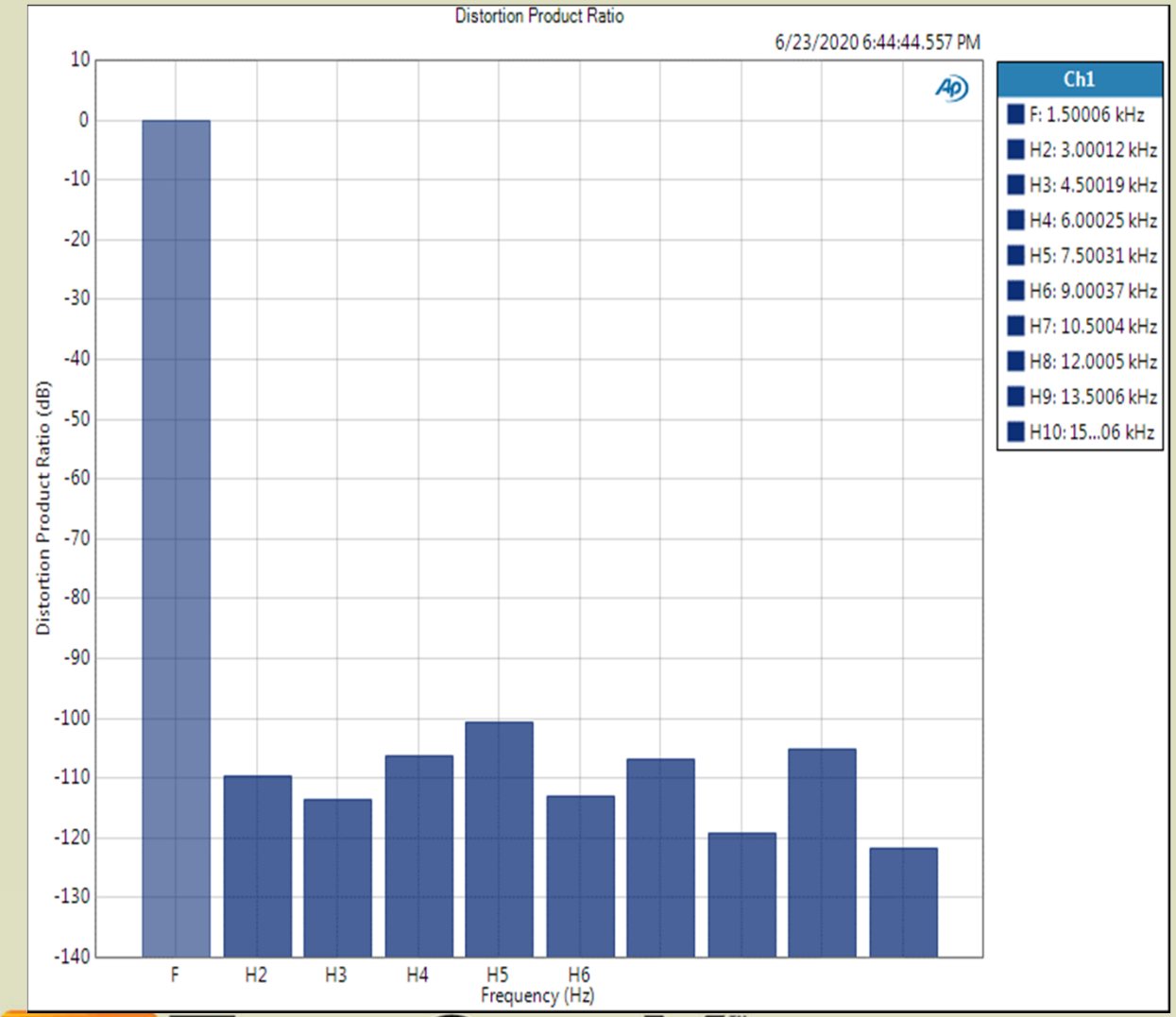








WSMX High DGT Performance on 0dB



	V93K_WSMX_HR			Low Limit	
	Min	Mean	Max		
Amp_R	1.682233	1.682356	1.682555	**1.512**	**V**
SNDR_R	86.2026	87.79694	90.17361	**83**	**dB**
SNR_R	87.08188	88.98564	91.6065	**83**	**dB**
THD_R	93.43525	94.11056	95.6861	**83**	**dB**
Amp_L	1.677691	1.677843	1.67811	**1.512**	**V**
SNDR_L	86.94852	88.70863	90.50706	**83**	**dB**
SNR_L	87.7717	90.36318	92.07784	**83**	**dB**
THD_L	90.9283	94.16579	95.68551	**83**	**dB**

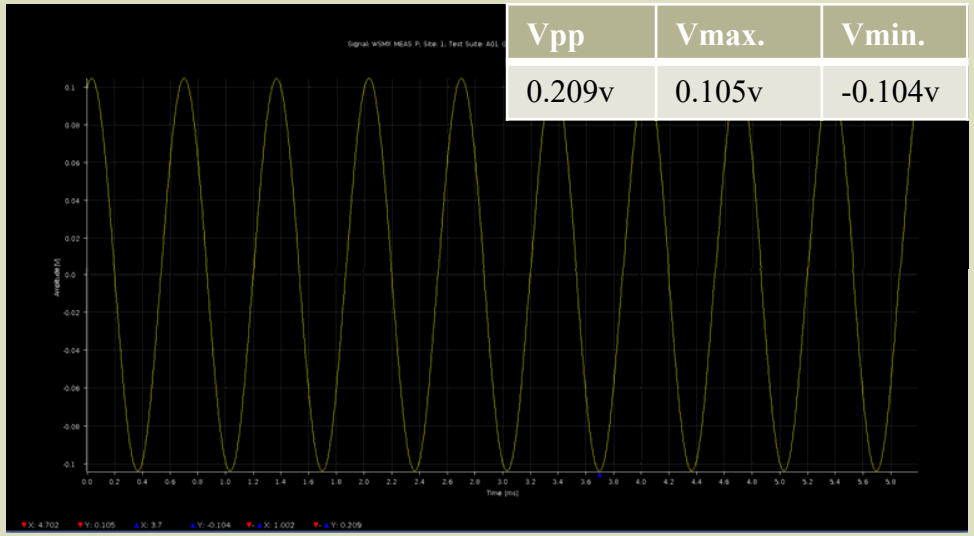
Middle Signal (-20dB) Spectrum Comparison

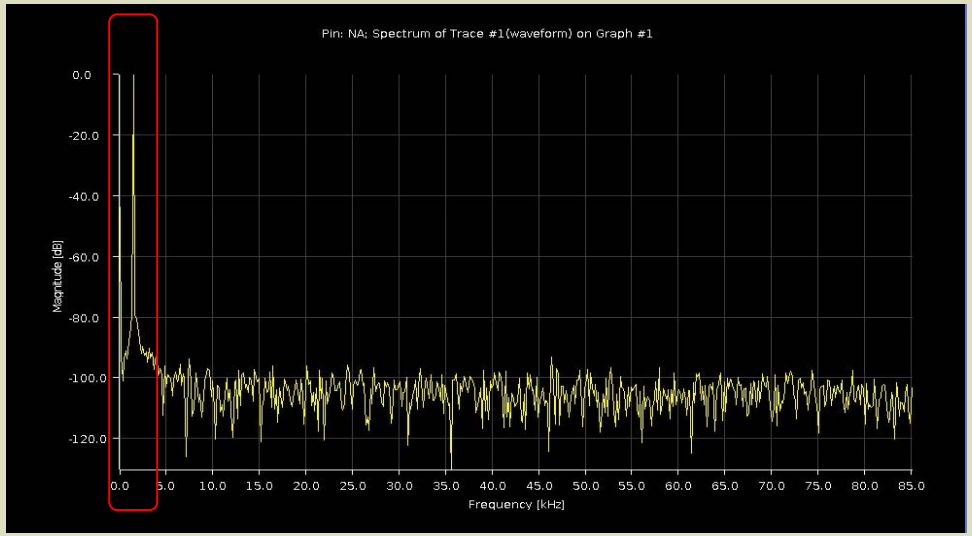
V93000
WSMX-HR

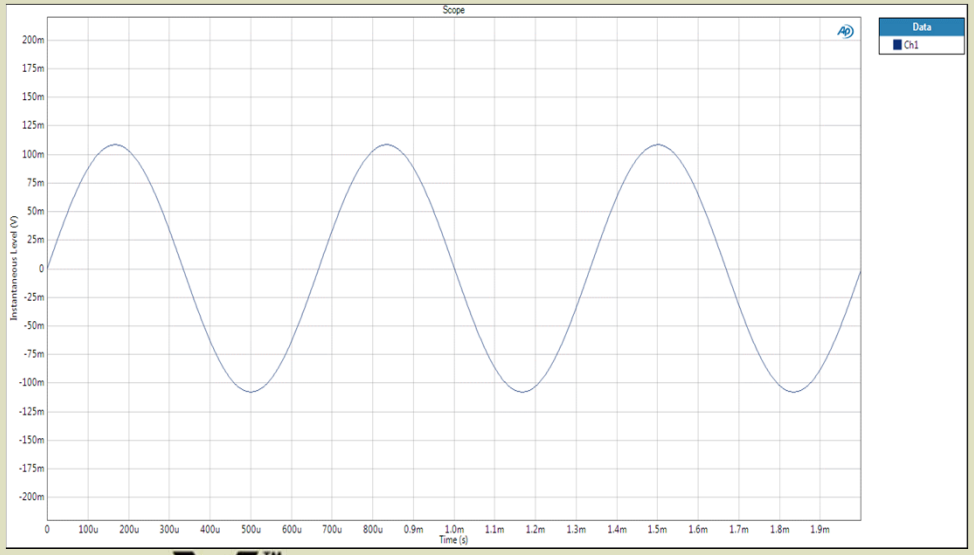
vs.

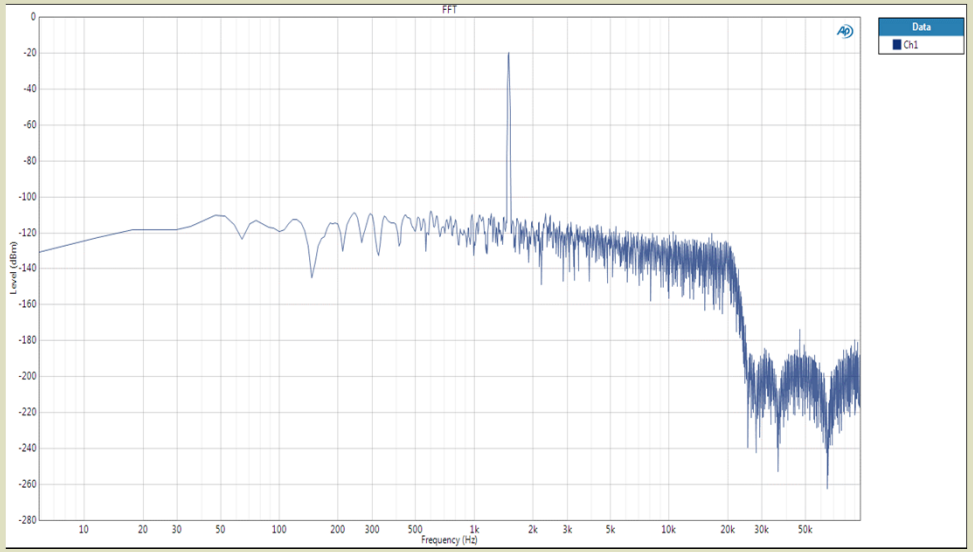
Audio Precision

Vpp	Vmax.	Vmin.
0.209v	0.105v	-0.104v

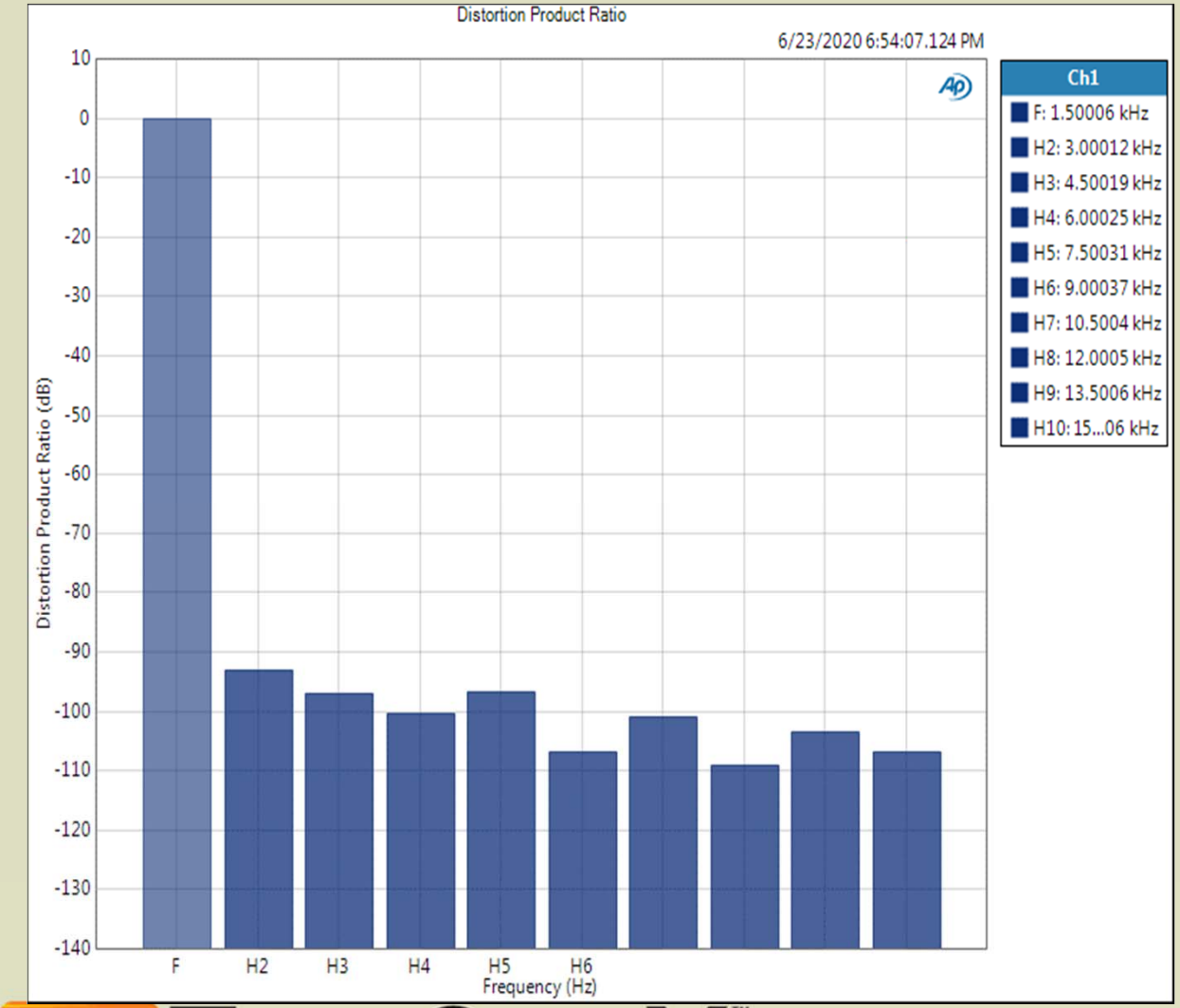


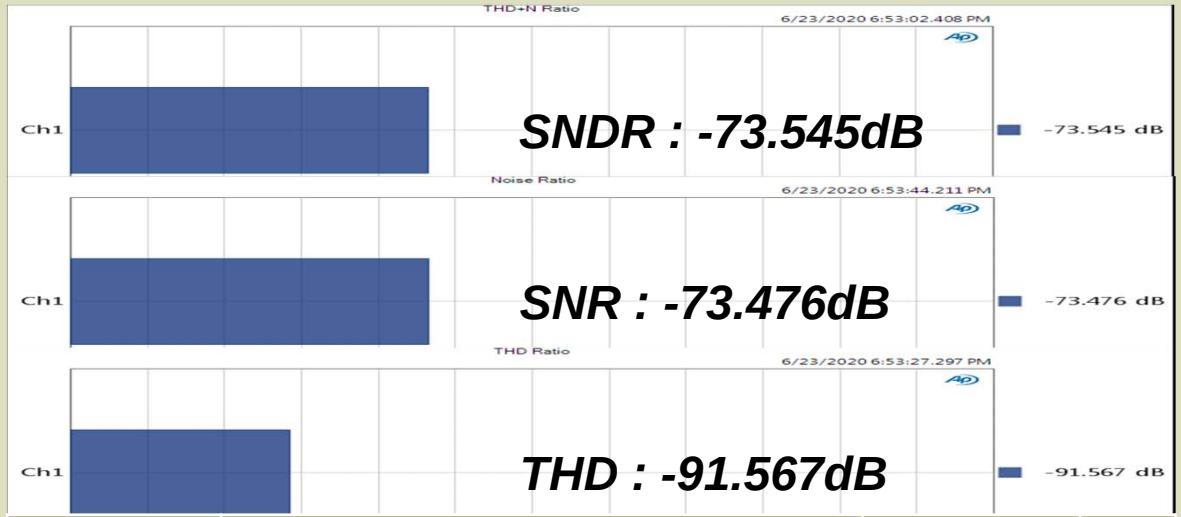






WSMX High DGT Performance on n20dB





	V93K_WSMX_HR			Low Limit	
	Min	Mean	Max		
Amp_R	211.7445	211.7812	211.8265	**190**	**mV**
SNDR_R	82.59983	83.84383	84.75608	**60**	**dB**
SNR_R	84.56491	86.42253	88.05903	**70**	**dB**
THD_R	86.32362	87.4983	89.50347	**60**	**dB**
Amp_L	211.2202	211.2414	211.2759	**190**	**mV**
SNDR_L	82.99688	83.98183	85.61329	**60**	**dB**
SNR_L	85.53556	86.61816	87.62829	**70**	**dB**
THD_L	85.06956	87.56681	89.91699	**60**	**dB**

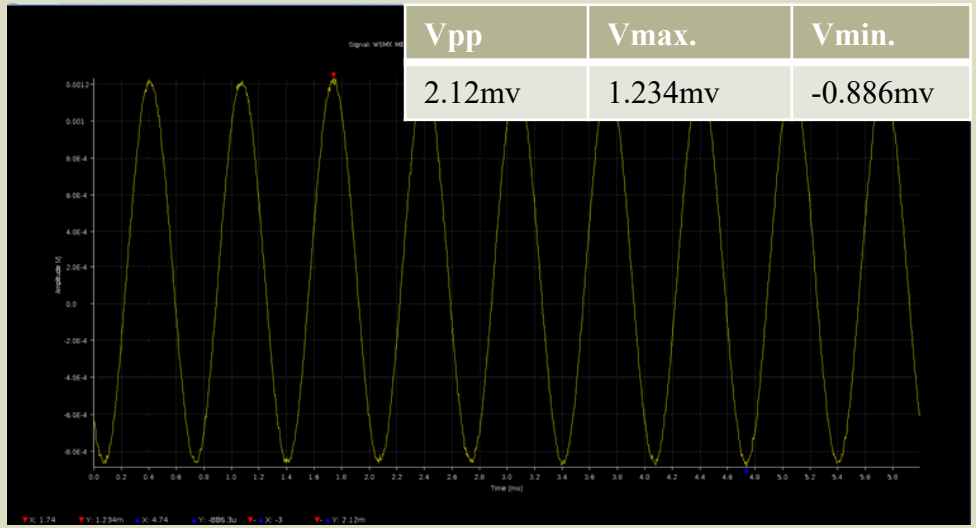
Small Signal (-60dB) Spectrum Comparison

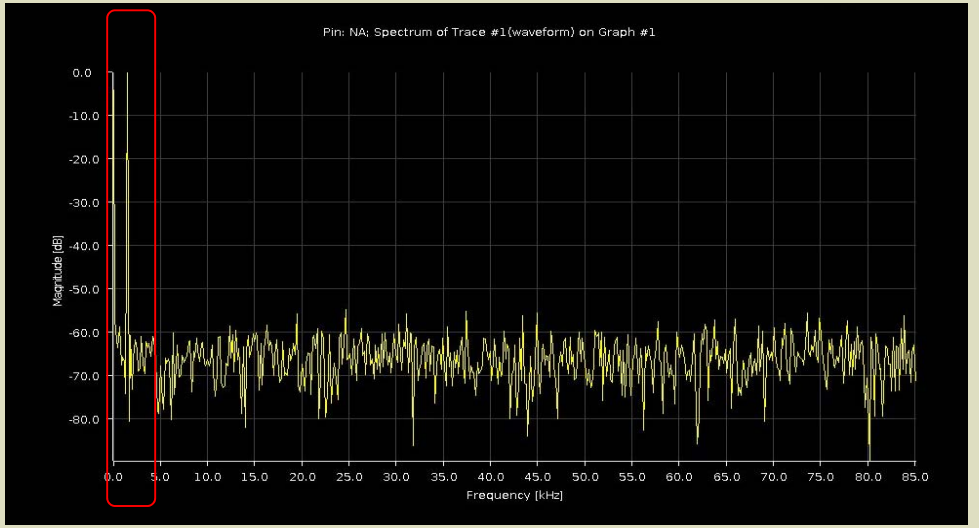
V93000
WSMX-HR

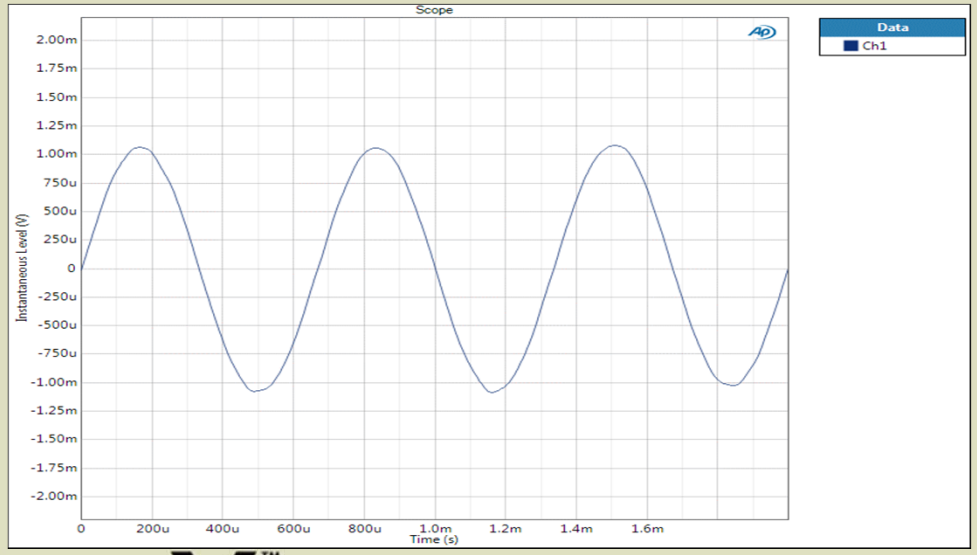
vs.

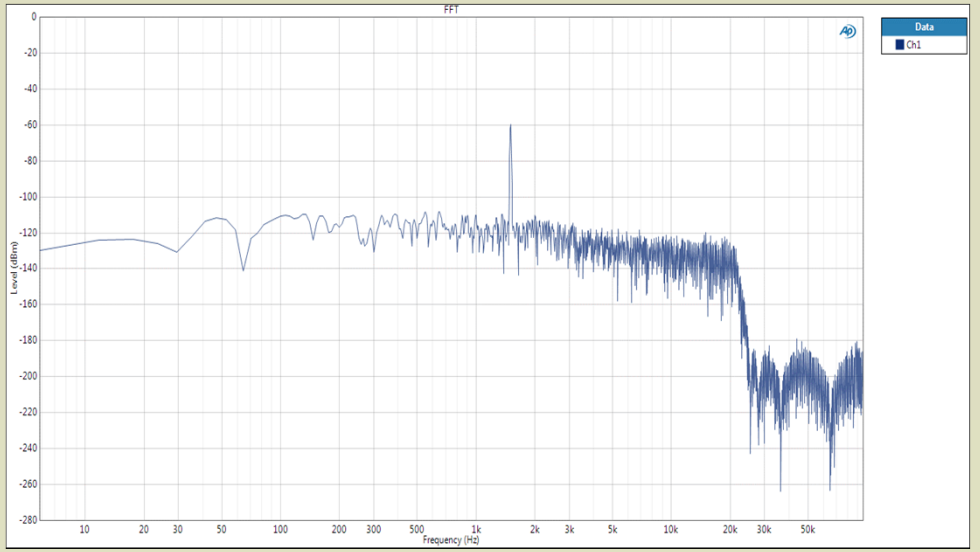
Audio Precision

Vpp	Vmax.	Vmin.
2.12mv	1.234mv	-0.886mv

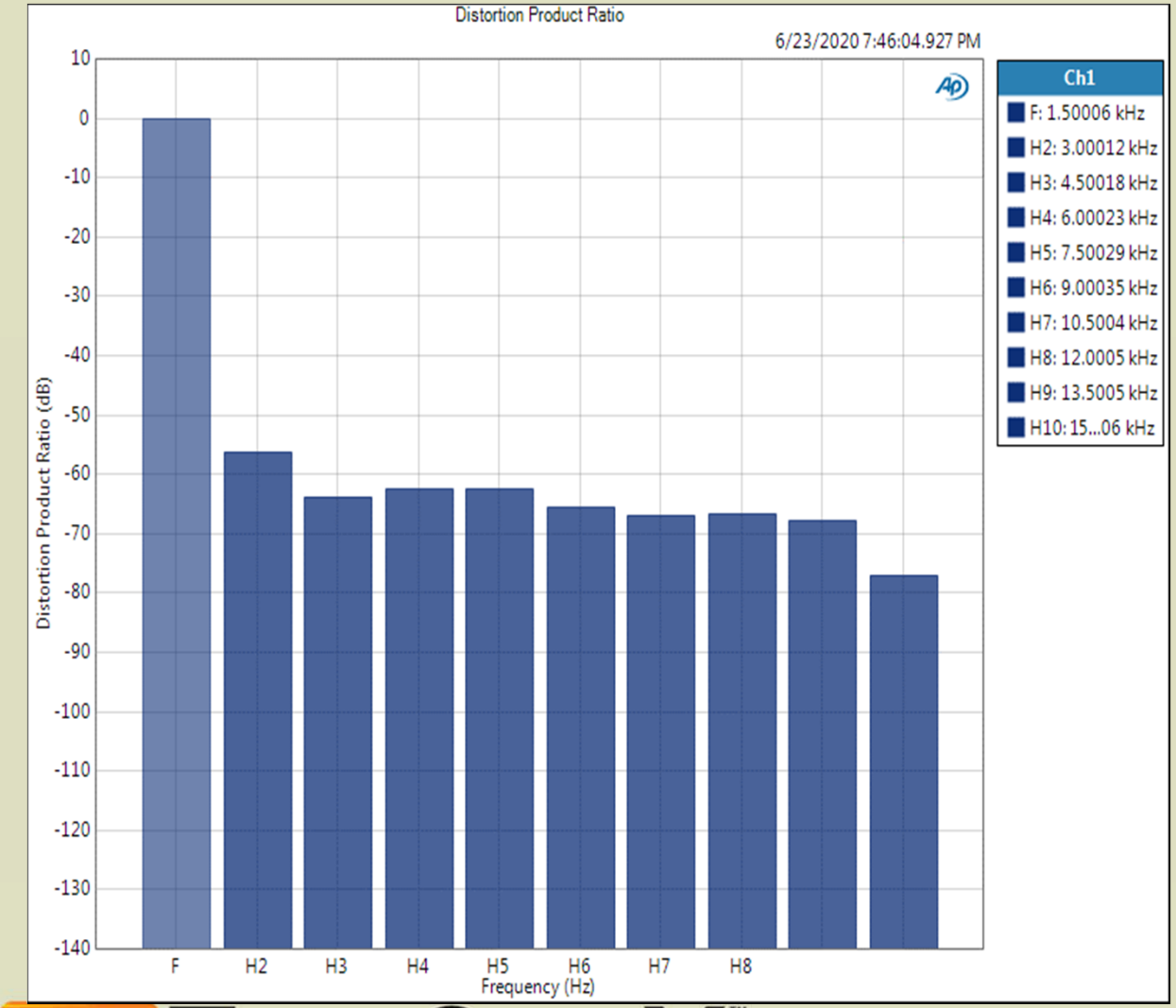


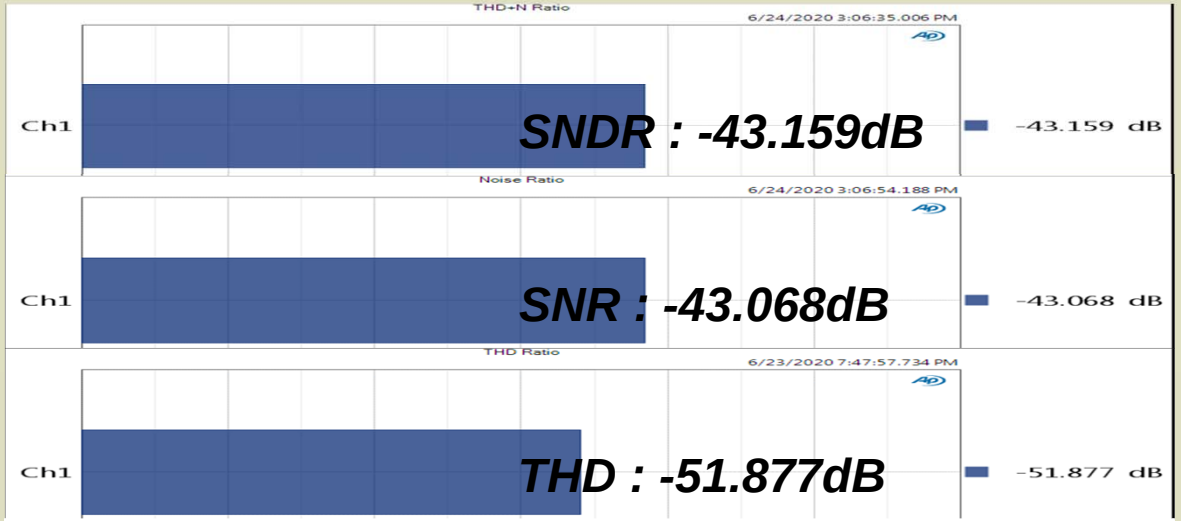






WSMX High DGT Performance on n60dB





	V93K_WSMX_HR			Low Limit	
	Min	Mean	Max		
Amp_R	2.137868	2.147223	2.155338	**1.9**	**mV**
SNDR_R	44.64748	45.53917	46.3938	**30**	**dB**
SNR_R	47.10799	47.9964	49.17725	**30**	**dB**
THD_R	47.36558	49.34108	51.15564	**30**	**dB**
Amp_L	2.134799	2.147254	2.160254	**1.9**	**mV**
SNDR_L	44.28059	45.41702	46.55007	**30**	**dB**
SNR_L	45.59814	47.38402	48.52138	**30**	**dB**
THD_L	48.25945	49.92332	50.92882	**30**	**dB**

Conclusion

- **V93000 WSMX HR demonstrate high analog performance especially for high quality and low noise TWS headphone products.**

	Audio Uplink	Low Limit	Audio Downlink	Low Limit	Unit
SNDR	91.0693	70	87.796	83	dB
SNR	92.25831	70	88.985	83	dB
THD	104.8499	70	94.11	83	dB
Noise floor	~135		~110		dB
In-band Harmonic	<115		<105		dB

Reference

- https://www.ap.com/analyzers-accessories/apx52x/
- http://emilymacgyfu.blogspot.com/2019/09/tws-true-wireless-stereo.html
- https://www.telecomlead.com/telecom-statistics/wearable-bands-and-tws-earbud-to-grow-32-canalys-97423
- https://www.apple.com/tw/shop

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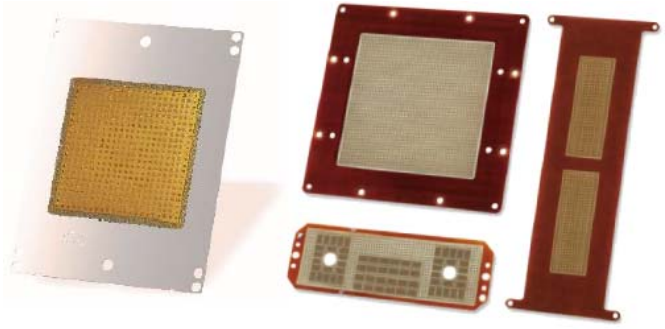
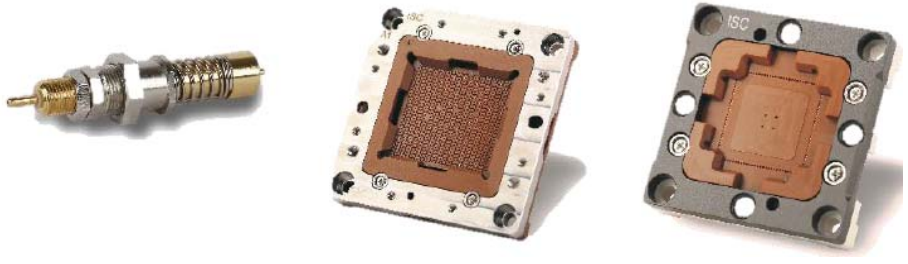


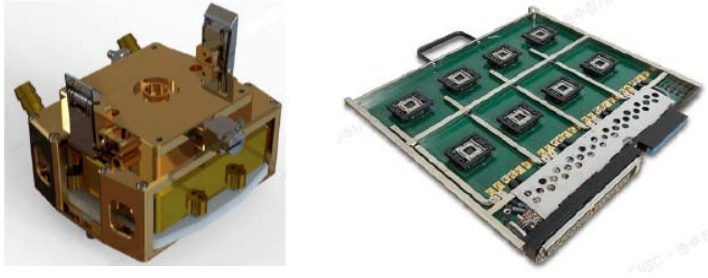
POGO SOCKET SOLUTIONS

- Excellent gap control & long lifespan
- High bandwidth & low contact resistance



THERMAL CONTROL UNIT

- Extreme active temperature control
- Safety auto shut-down temperature monitoring of the device & thermal control unit
- Full FEA analysis & Price competitiveness



BURN-IN SOLUTIONS

- Direct inserting on the board without soldering
- Higher performance BIB solution

CONTACT
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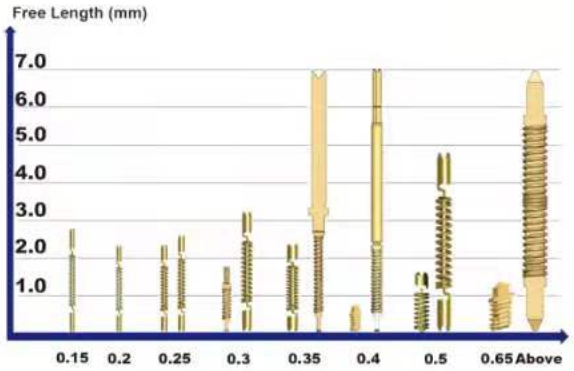
IWIN Co., Ltd. The test probe for high signal integrity at extremely high speed test

Spring probe by stamping



250 kinds of spring probe pin

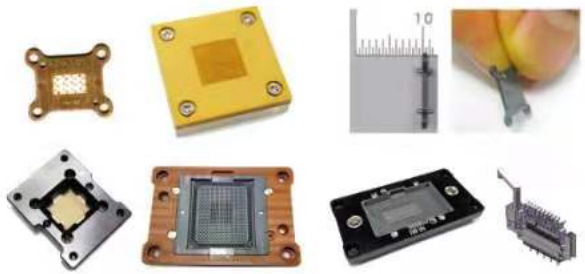
300 kinds of test socket (44,000 Pin count socket possible)

One piece spring probe

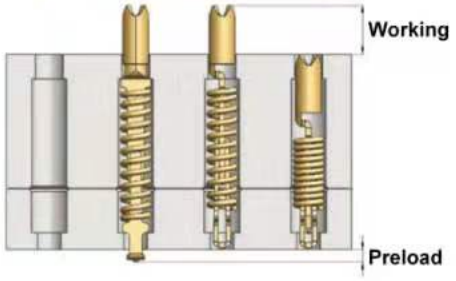
Three piece spring probe

High speed product → 0.63mm free length spring probe pin available

Finest Pitch → 0.15mm Pitch



Spring probe by stamping

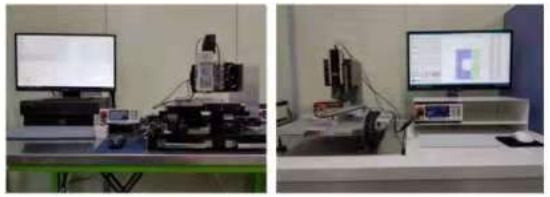


Patented

Pitch(mm)	Free Length(mm)	Current Carrying(Amps)
0.15/0.2/0.25	2.17~	0.5~
0.3	1.5~	1.5~
0.35	2.08~	1.8~
0.4	0.8~	2.5~
0.5	1.5~	3.0~
0.65	1.13~	9.0~
0.8	3.14~	3.0~

Automation

Pin assembly and Quality control



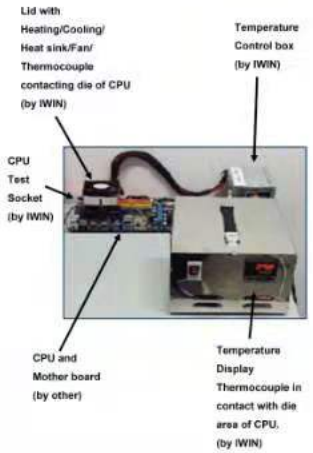
Top Figure: Socket CRES, Force, Stroke test

Bottom Figure: Data displayed

Top Figure: Socket CRES test

Bottom Figure: Data display 5,903 pins socket

Socket and Lid



Pin assembly

(Fully automated machines)

- Stamped piece parts attached to a reel fed into the assembly machine

- Assembled pins can be attached to a reel, or, supply in separate for socket assembly.

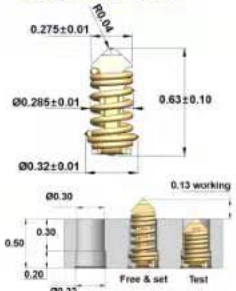
Spring probe pins for High speed

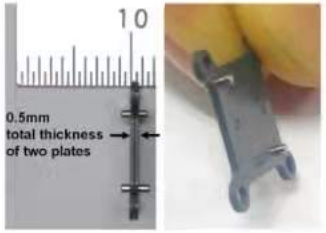
Extremely short spring probes by stamping

One piece spring probe

Three piece spring probe

Design approach





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