Technical Note 1501

MicW i436 on iPhone 6 / iPhone 6 Plus basedReal Time Analyzers (RTA)

1. Introduction

With new iPhone 6 and iPhone 6 Plus being released in October 2014, the iPhone based real time analyzer is becoming industrial standard measurement devices. MicW i436 microphone for iPhonesthus becomes popular in the sound measurement community due to itsspecialty and compatibility. In thisTechnical Notes , we will evaluate the performance of i436 on iPhone 6 and iPhone 6 Plus from following aspects:

1) Measurement Range
2) Calibration
3) Frequency Responses
4) Frequency Response Data Compensation
5) Applications and comparisons

Fig. 1 iPhone RTA system consists of iPhone 6 (or 6+), i436 and APP software

2. Hardwareand Software

The following hardwares and softwareswere used in the measurement:

1) MicW i436 microphones
2) iPhone 6 (model A1549)
3) iPhone 6 Plus (model A1524)
4) SigScopePro 4.4 (r1044)

3. Measurement Range

The measurement range is the range of sound pressure levels that the iPhoneRTA system can measure.

3.1 The minimum sound pressure level of the iPhone 6 RTA system

The iPhone6 RTA system's minimum SPL was measured in BSWA anechoic chamber. The background noise level of the chamber is 16 dBA. The measurements were taken at three Gain settings in the software

Fig.2 Gain settings in the software

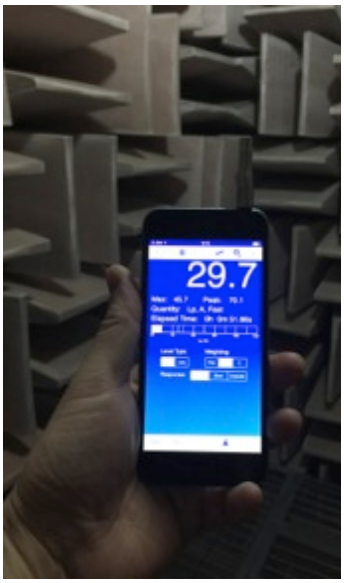

Fig. 3 Measurements in anechoic chamber

3.2 The maximum sound pressure levels

The maximum SPL of the iPhone system was measuredby using BSWA high pressure calibrator CA905 which can generate 170 dB sound sources in a small cavity.

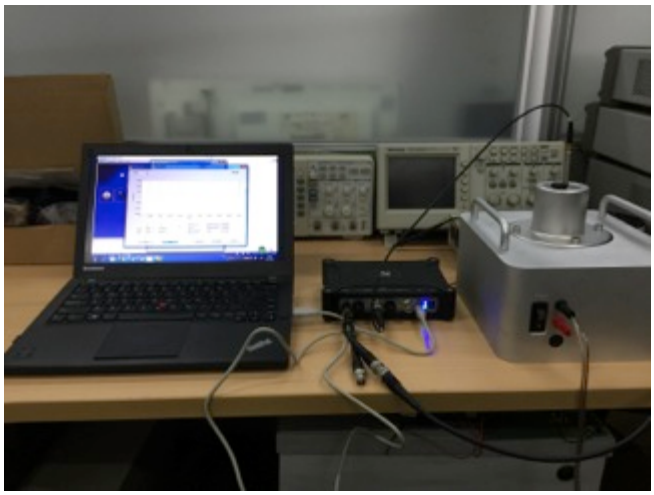

Fig. 4 Setup for Maximum SPL testing.

Thesignal starts to distort when the SPL reaches 130 dB.

3.3 The results of measurement ranges at different Gain Settings

The results are shown in Table 1.

Software Gain Setting	Minimum SPL (dBA)	Maximum SPL (dB)
Low	43	128
Middle	33	110
High	30	90

Table 1 Measurement Ranges for Phone 6 based RTA with i436

4. Frequency Responses of iPhone 6 based RTA with i436

The frequency responseswere tested in the BSWA anechoic chamber. The testing methodfollows standard IEC 61094- 8. The final result is the average of 5 trials of tests using i436. The differences between iPhone 6 and iPhone 6 plus are smaller than 0.2dB.

Fig. 5 Measurement setup for testing the frequency response

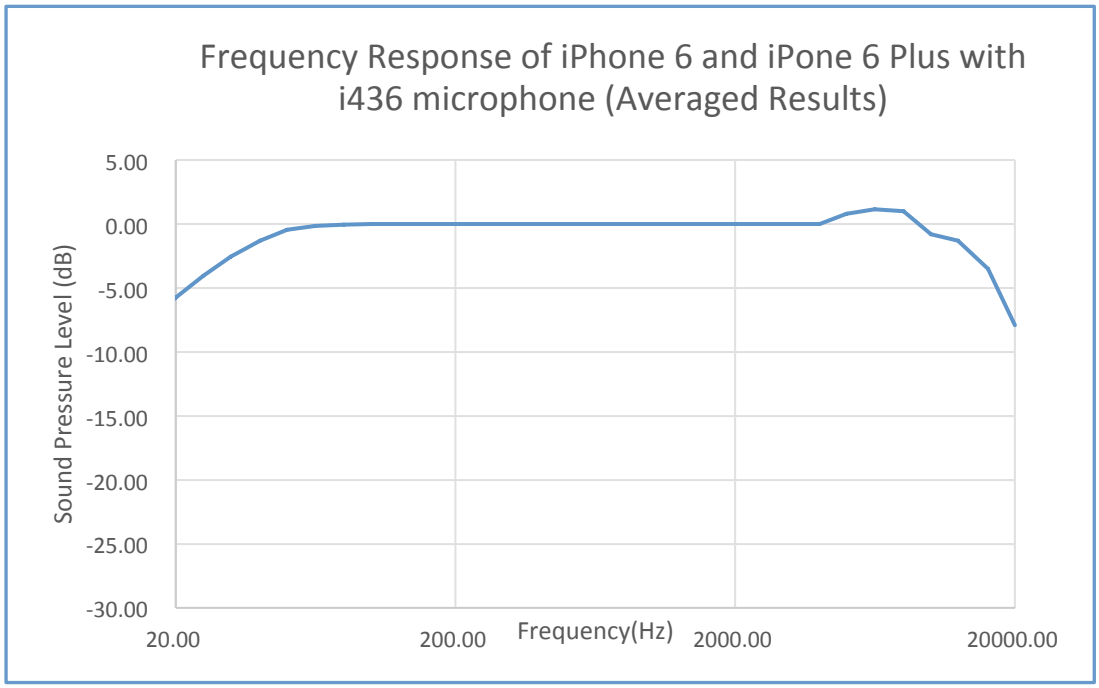

Fig. 6 Frequency Responses for iPhone 6 and iPhone 6 + with i436

Upload the frequency response data to SigScopePro APP, and the APP has the function to compensate the measurement data.

Fig. 5 Compensate Frequency Response Data to the APP

Frequency (Hz)	Corrections (dB)
20	-5.77
25	-4.07
31.5	-2.57
40	-1.30
50	-0.47
63	-0.17
80	-0.03
100	0.00
125	0.00
160	0.00
200	0.00
250	0.00
315	0.00
400	0.00
500	0.00
630	0.00
800	0.00
1000	0.00
1250	0.00
1600	0.00
2000	0.00
2500	0.00
3150	0.00
4000	0.00
5000	0.80
6300	1.15
8000	1.01
10000	-0.78
12500	-1.29
16000	-3.51
20000	-7.91

Table 2 Frequency Response data for iPhone 6 and iPhone 6 + with i436

5. Calibration

To calibrate MicW i436, the app requires the sensitivity of i436microphonethat is already given in User's Manual. The unit of the sensitivity is mV/Pa. The iPhone 6 and iPhone 6 Plus have internal amplification circuits, the amplification factor of iPhones was measured by using BSWA CA114 Sound Level Calibrator (94.0 dB at 1000 Hz) and resultis1.28.

Fig 7. Sensitivity of the each i436 in User's Manual

Steps to calibrate the iPhone 6 based RTA:

(1) Read the sensitivity value in User's Manual. Forexample, the sensitivity is 7.4 mV/Pa in Fig. 7,.

(2) Calculate the input sensitivity by multiplyingthe amplification factor 1.28 and sensitivity.
Forexample, The Input Sensitivity = 7.4 x 1.28 = 9.47 mV/Pa

(3) Input 0.00947 (V/Pa) into APP as shown in Fig.8.

(4) Press < on the upper right.

Fig. 8 Input Sensitivity inAPP

6. Applications [6]

An independent study was conducted in University of Kentucky to compareiPadmini based RTAwith i436andLMS SCADAS system. The results are shown in Fig9 and Fig10.

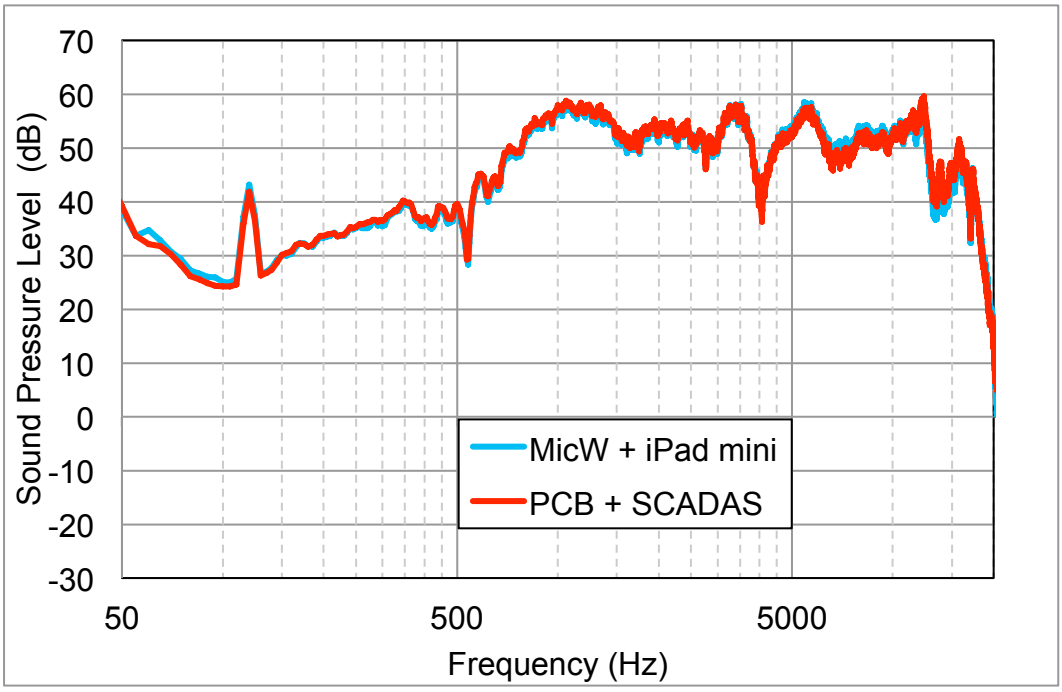

Fig. 9 Comparison of iPad mini using i436 with LMS SCADAS using PCB microphone for white noise in the anechoic chamber.

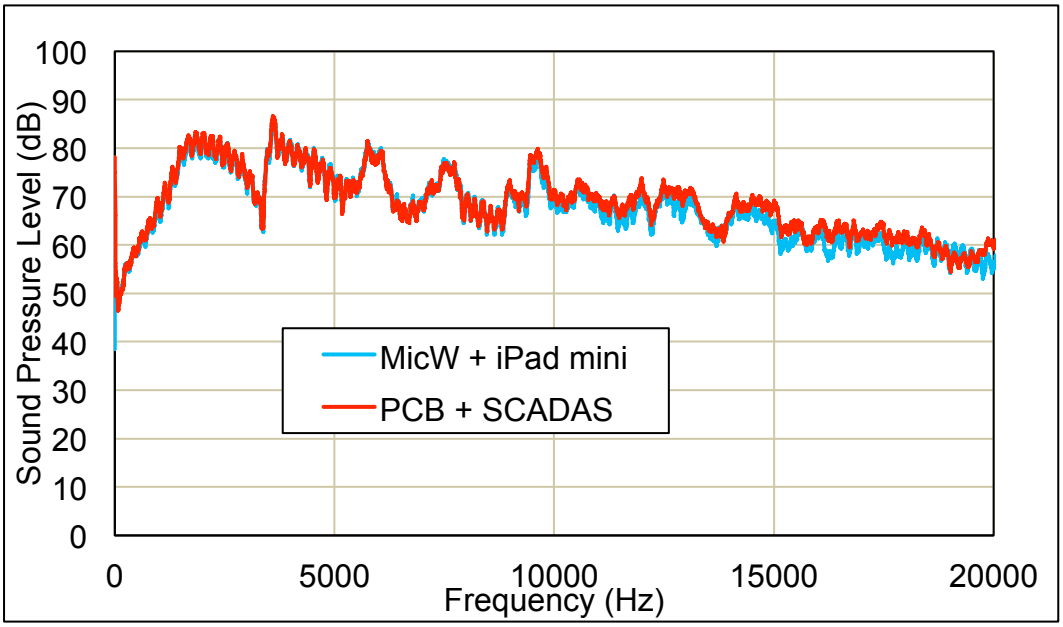

Fig. 10 Comparison of iPad mini using i436 with LMS SCADAS using PCB microphone at 0.5 m from the exhaust of Hardy-Davis motorbike.

References

[1] IEC 61094-1: 1991, Measurement microphones - Part 1: Specifications for laboratory standard microphones
[2] IEC 61094-4: 1995, Measurement microphones - Part 4: Specifications for working standard microphones
[3] IEC 61094-6: 2004, Measurement microphones - Part 6: Electrostatic actuators for determination of frequency response
[4] IEC 61672-1 2002, Electroacoustics- Sound Level Meters
[5] IEC 61094-1: 1991, Measurement microphones - Part 8:Methods for determining the free-field sensitivity of working standard microphones by comparison.
[6] Gong Cheng and Ruimeng Wu, 2014, Data Acquisition for the iPad. Vibro-Acoustics Consortium Meeting, the University of Kentucky.