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The Department has undertaken to review the test methodology and performance claims of the technology contained in a product designed to reduce electromagnetic energy, specifically in the microwave bandwidth, which is known to travel up the cable of corded devices such as headphones and ear phones when connected to cellular mobile phones and devices such as laptops, tablets and desktop computers that have the facility to transmit digital audio and telecommunication via cable to such headset receivers.

The Performance Tests of the anti-radiation technology contained in a product branded as HARD and designated as RadF3 technology by the manufacturer and developer of the technology.

1. INTRODUCTION

This report presents the performance tests of the RadF3 Technology to investigate the effectiveness of the technology when used with corded headphone devices in accordance with the claims of the developer.

2. TEST DESCRIPTION

2.1 Test Unit

The RadF3 technology based on a unique formulation of CCTO crystals which manifest molecular dipole activity when suspended in a discrete gelatinous formula, is contained within a sealed rectangular polycarbonate case of xyz dimensions (see figure 1)

A 4cm cable terminating in a 3.5mm diameter 4 pole industry standard jack plug protrudes from one end of the case, whilst a port for a jack socket for a similar jack plug is situated at the opposite end of the case.

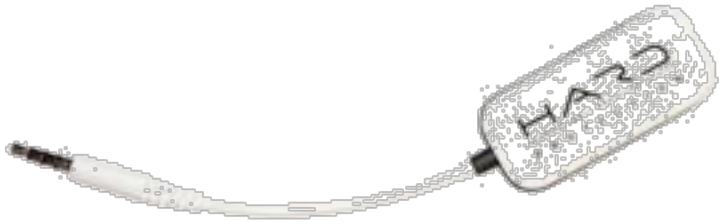

Figure 1 HARD Unit

2.2 Test Organisations

The tests were jointly carried out by Professor Shujun Zhang from the Department of Computing and Technology and Dr Yiran Shi of Jilin University, China.

2.3 Tests and Results

The spectrum analyzer is RIGOL's DSA1030A. This is a digital medium-frequency model. The specification of this spectrum is listed in Table 1.

The signal generator is a Keysight N5172B. The specification of this signal generator is listed in Table 2.

Table 1: the specification of the spectrum for the tests

Model	RIGOL's DSA1030A
Frequency range	9khz to 3ghz
Displayed average noise level (danl)	148 dbm
Decibels relative to the carrier/hz (dbc/hz)	88
Accuracy	≤1.0db
RBW (hz)	10

Table 2: the specification of the signal generator for the tests

Model	Keysight N5172B
Signal frequency range	9kHz - 3 GHz

Output power	-144 dbm to 26 dbm at 1GhZ
Phase noise	-122 dBc/Hz at 20 kHz frequency offset at 1GHz
Frequency conversion	Less than 800 us
Harmonic power	Less than -35dBc at 1GHz
IQ internal/external modulation bandwidth	120 MHz to 200 MHz
Non-harmonic	-72 dbc at 1GHz

The mobile phones selected for testing with the RadF3 technology are:

Smart Phones: iPhone6, iPhone 8, iPhone X, Huawei series (early models), Huawei Mate 10, Huawei P20, OPP and Vivo.

The two midrange cell phones OPPO and VIVO were selected for their known high performances capabilities in relation to photos and music, popular with young people with low incomes.

Four different performance tests were undertaken in precise laboratory conditions to evidence the following:

Test 1:

To test and evidence electromagnetic energy generated from each of a selection of mobile cellular phones traveling up the cord of a set of earpieces without passing through the RadF3 device, known as HARD. The test rig is shown in Figure 2.

The mobile phones are placed about 1.0m away from the spectrum analyser and connected via an earphone attached to the antenna of the spectrum analyser. During the test, a technician is positioned approximately 50 meters away from the spectrum analyser (outside the building) with a second mobile phone with which he communicates with the selected mobiles under test conditions.

The results of Test 1 are that: - (Figure 3):

1) The spectrum displays the normal sound signals of 20Hz-20kHz.
2) The significant strong signal is displayed at 1.94GHz.
3) The louder the technician's voice, the stronger the signal at 1.94 Hz.
4) An interesting test result is that for iPhone 6, Huawei early models, OPPO and Vivo models, no significant strong signals are detected, but the significant strong signals are detected for the models of iPhone 8, iPhone X, Huawei Mate 10 and Huawei P20.

5) The interesting fact is that for the phones without the significant strong signals (iPhone 6, Huawei early models, OPPO and Vivo models), all have separate sockets for battery charger and earphones, whilst for phones with the

significant strong signals (iPhone 8, iPhone X, Huawei Mate 10 and Huawei P20), they have an integrated socket for both battery charger and earphones.

6) However, it must be noted that this dichotomy between strong and weaker signal variation between the older and younger models of cellphone could also be down to a function of the generation capability of the model and the communications frequency transmitted by the service provider of these phones at any given time. Such frequencies can and do change at different times of the day and in different geographical locations around the country. The ability of the technology under test to reduce the strong signals is not affected by such variations in signal strength but to test for specific signal strength in laboratory conditions it was also necessary to test with a signal generator.

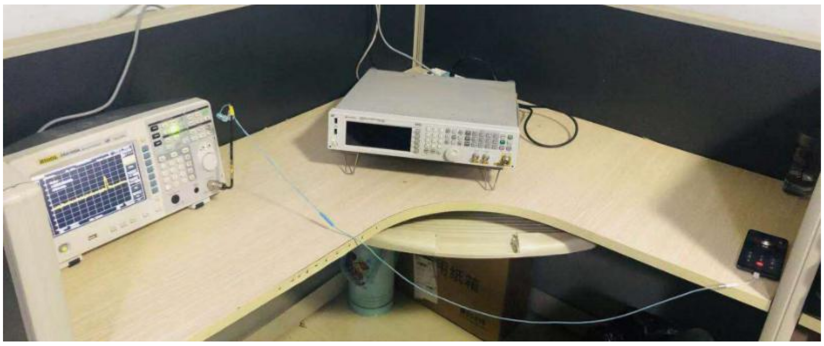

Figure 2 Test bed

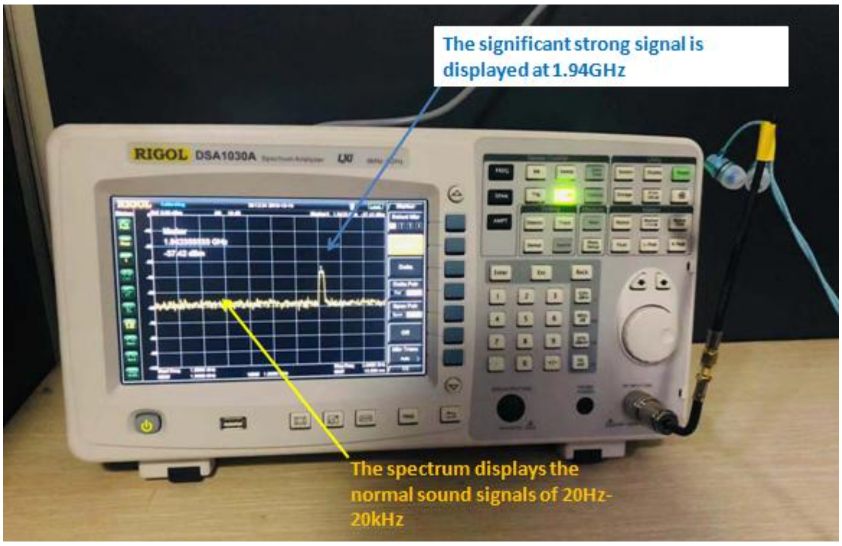

Figure 3 The results of Test 1

Test 2:

To then test the same electromagnetic energy detected from the selected mobiles in test one by replicating the same procedure utilised in that text with the mobile phone connected to a cord of a set of earpieces attached to the RadF3 unit. The other test conditions are the same for Test 1. The rig is shown in Figure 4.

The results of Test 2 are that (Figure 5):

1) The spectrum displays the normal sound signals of 20Hz-20kHz.
2) The significant strong signal is now not displayed (detected) at 1.94GHz though some weak signals can be observed.

Figure 4 Test bed for Test 2

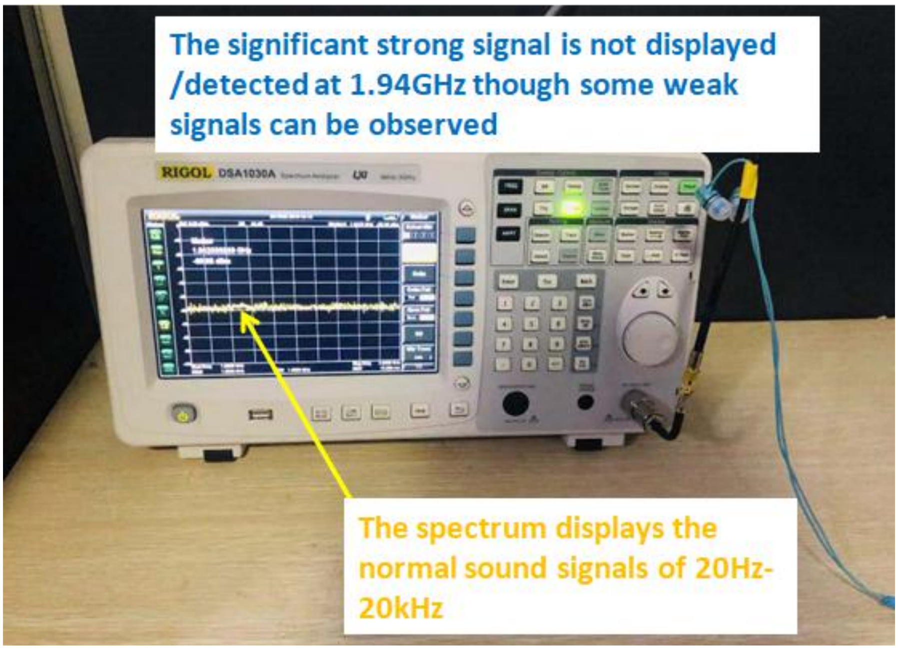

Figure 5 Test results for Test 2

Test 3:

To test electromagnetic energy from a signal generator travelling up the cord of a set of earpieces when not connected via the HARD RadF3 unit.

The spectrum and signal generator are connected. All connected parts between the spectrum and the signal generator are placed in a shielded box, in effect a Faraday cage, as shown in Figure 6. The signal generator is set to produces a 2.6GHz signal. The result for Test 3 is that the spectrum clearly displays 2.6GHz signals, as shown in Figure 7.

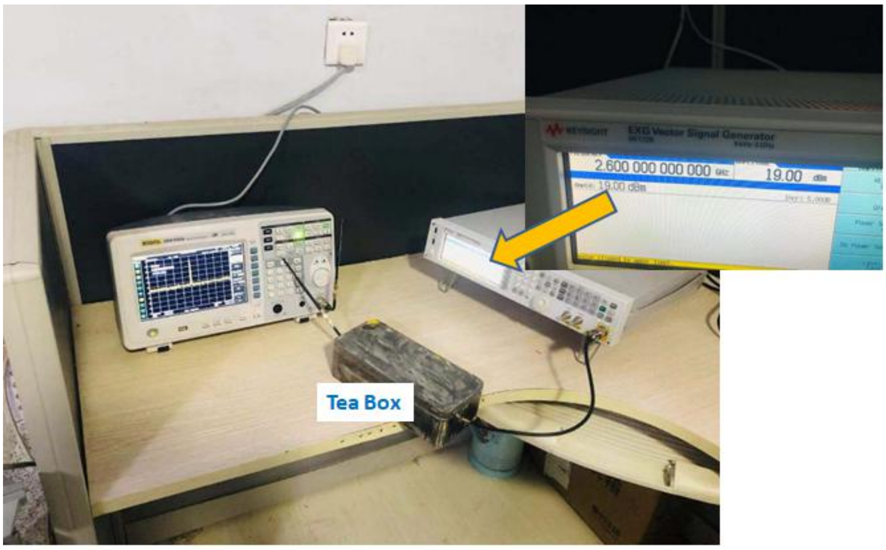

Figure 6 the test bed for Test 3

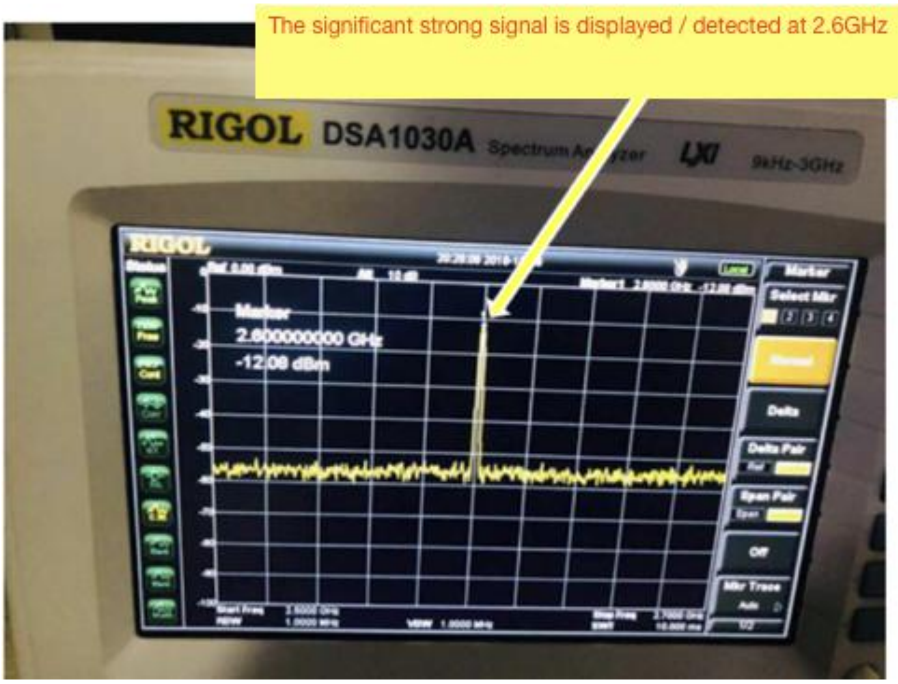

Figure 7 the test results for Test 3

Test 4:

The test is replicated under the same conditions with the HARD RadF3 unit shielded in a metal box. As stated all other test conditions are the same as for Test 3, as shown in Figure 8.

The results for Test 4 being that the spectrum analyser does not now display 2.6GHz signals, as shown in Figure 9.

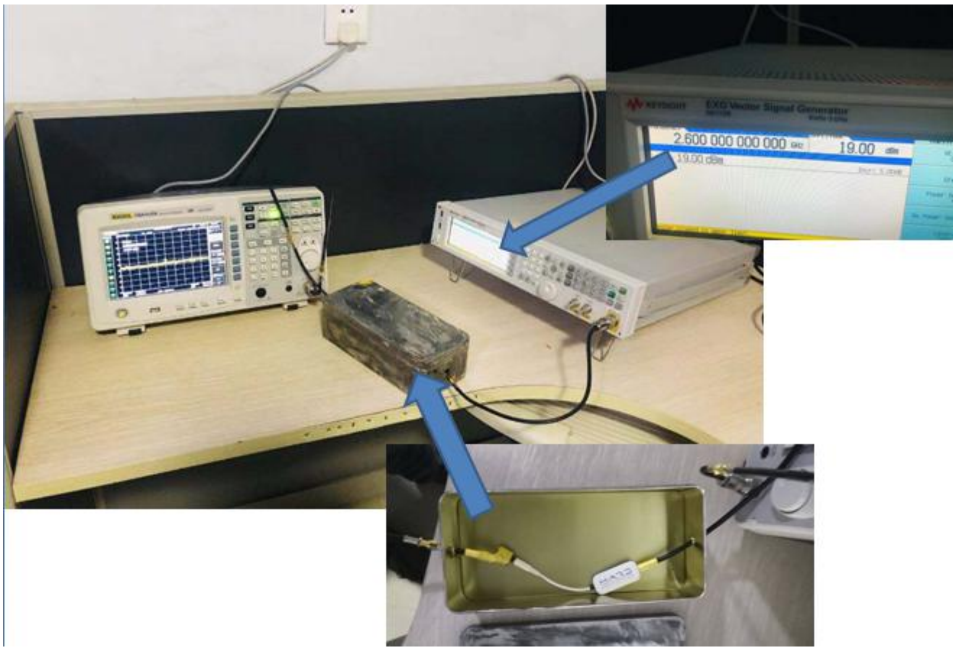

Figure 8 the test bed for Test 4

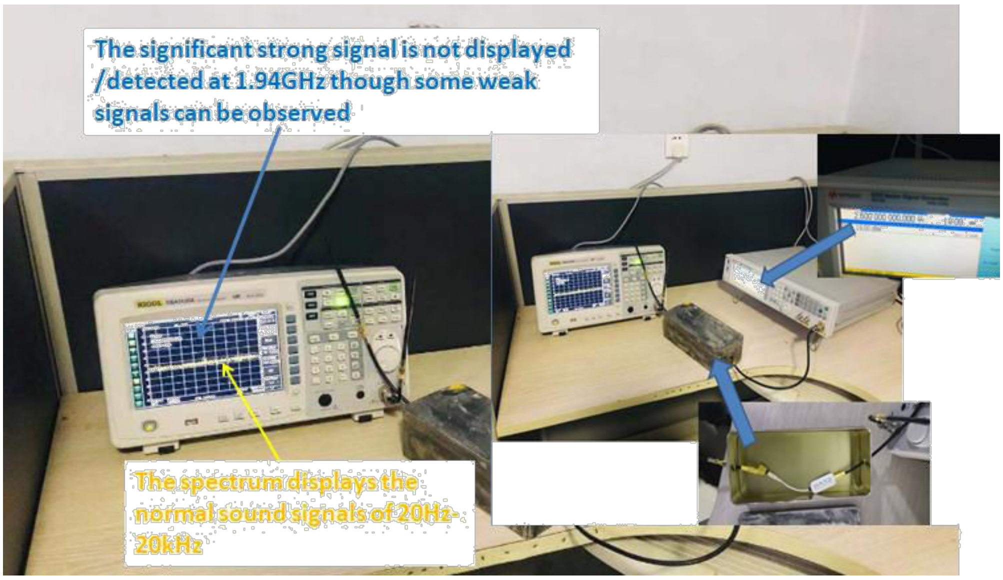

Figure 9 the test results for Test 4

3. **Conclusion**

The results of our tests clearly show that the RadF3 technology contained in the HARD Unit absorbs the electromagnetic energy, within microwave frequencies, which travel up the cord of a set of earphones from a phone to the user.

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Testing Clarification

In 2016 we started work on the technology which underpins the H.A.R.D. device, designed to absorb microwave radiation which travels up the cord of earphones and headphones when used with wireless devices such as mobile cell phones, laptop and tablets. One of the sets of criteria was that the product needed to be effective across a wide spectrum of frequencies and be future proofed in order to be used with devices which used ever-increasing microwave frequency levels.

Our laboratory tests clearly demonstrated that our technology was highly effective and by application of precise sintering of the CCTO would handle higher frequencies. The dipole action of the technology works at a molecular level and therefore easily absorbed the higher frequencies that we expected to be deployed by technology and telecoms companies in the future.

We tested the technology at frequencies up to 20 GHz but our calculations showed that it would handle much higher frequencies. We handed examples of our H.A.R.D. device to the Business and Technology Department of the University of Gloucestershire, who have a specialisation in advanced technology and cyber security, with their own X rated facilities. The devices were sent to them with a guide to the recommended testing procedures, which included frequencies up to 20 GHz. With this guide as the framework, the H.A.R.D. technology and the device itself were tested by the University and their results published, which clearly demonstrated the efficacy of our technology.

Background

All mobile phones emit electromagnetic frequency, more commonly known as microwaves, and these are attenuated by metal objects (see manufacturers' warnings about carrying cases with metal parts) and this will include the metal components of corded earpieces. Corded earpieces are frequently recommended, including by mobile phone manufacturers, as a way of distancing the mobile phone from the human body.

We contend that as corded earpieces and headphones contain metal parts, including a continuous metal core from the jack plug to the speakers then electromagnetic frequency will travel up the cable and into the audio canal when the ear buds are placed in the ear.

Purpose

1. To find out if electromagnetic frequency travels up the cable of the ear pieces from the mobile phone and, if so, to measure it.

2. To assess the effect of plugging a Cool Call into the phone and then plugging the earpieces into the Cool Call unit and then to measure any effect.

Methodology

A standard corded earpiece was connected to the mobile phone via the 3.5mm jack socket and the earbud end was then linked to the antenna of a Spectrum Analyser. The mobile phone was then used to dial voicemail; though any call to a landline or mobile phone could have been made.

The Spectrum Analyser displayed electromagnetic frequency on the screen in the form of a 'spike'. From our research we know that mobile phones use a wide range of frequencies and switch between them constantly - in a later process we used a signal generator to produce electromagnetic frequency at specific wavelengths and measured these.

Next we plugged a Cool Call unit into the mobile phone jack socket and plugged the same earpiece into Cool Call, thereby inserting Cool Call between the phone and the earpiece. The test was replicated exactly as above and there was no evidence of a signal on the Spectrum Analyser at 2.150 GHz.

Having demonstrated that the mobile phone generated a signal that was registered on the Spectrum Analyser when the earpiece cable was attached to the antenna and that using Cool Call eliminated this signal, we needed to test Cool Call throughout the signal range of a mobile phone and up to 20 GHz. For this we used a signal generator to create a signal and ran a coaxial cable to a Faraday cage box and internally wired this directly to a matched antenna in order to achieve zero attenuation. The signal was detected by the antenna on the Spectrum Analyser in the same way that it was detected when a mobile phone was used.

Yours sincerely,

Nick Battersby
Managing Director