

Report No.: SEWM2304000111RG10  
Rev.: 01  
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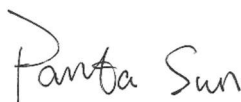


## RF-Emission Test Report

**Application No.:** SEWM2304000111RG  
**Applicant:** Shenzhen Tinno Mobile Technology Corp.  
**Manufacturer:** Shenzhen Tinno Mobile Technology Corp.  
**Product Name:** Smart Phone  
**Model No.(EUT):** U680AA, U680AC  
**FCC ID:** XD6U680AA  
**Standards:** ANSI C63.19-2011  
CFR 47 FCC Part 20  
**Date of Receipt:** 2023-04-17  
**Date of Test:** 2023-05-20 to 2022-05-20  
**Date of Issue:** 2023-05-23  
**Test conclusion:** **PASS \***

\* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Authorized Signature:

  
Panta Sun

Wireless Laboratory Manager



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SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.  
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## REVISION HISTORY

| Revision Record |         |            |          |          |
|-----------------|---------|------------|----------|----------|
| Version         | Chapter | Date       | Modifier | Remark   |
| 01              |         | 2023-05-23 |          | Original |
|                 |         |            |          |          |
|                 |         |            |          |          |



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## TEST SUMMARY

| Frequency Band               | HAC RF Emission Test result* | M-rating |
|------------------------------|------------------------------|----------|
| WCDMA Band II                | E-Field dB(V/m) /            | M4       |
| WCDMA Band IV                | E-Field dB(V/m) /            | M4       |
| WCDMA Band V                 | E-Field dB(V/m) /            | M4       |
| LTE Band 2                   | E-Field dB(V/m) /            | M4       |
| LTE Band 4                   | E-Field dB(V/m) /            | M4       |
| LTE Band 5                   | E-Field dB(V/m) /            | M4       |
| LTE Band 7                   | E-Field dB(V/m) /            | M4       |
| LTE Band 12                  | E-Field dB(V/m) /            | M4       |
| LTE Band 14                  | E-Field dB(V/m) /            | M4       |
| LTE Band 30                  | E-Field dB(V/m) /            | M4       |
| LTE Band 66                  | E-Field dB(V/m) /            | M4       |
| WI-FI(2.4GHz)                | E-Field dB(V/m) 28.26        | M4       |
| WI-FI(5GHz)                  | E-Field dB(V/m) /            | M4       |
| <b>HAC Rate Category: M4</b> |                              |          |

### Note:

- 1) This portable wireless equipment has been shown to be hearing-aid compatible under the above rated category, specified in ANSI/IEEE Std.C63.19-2011 and had been tested in accordance with the specified measurement procedures, Hear-Aid Compatibility is based on the assumption that all production units will be designed electrically identical to the device tested in this report. Test results reported herein relate only to the item(s) tested and are for North American Bands only.
- 2) \*- HAC RF Emission Test for low power exemption according to ANSI C63.19-2011 and HAC RF Emission rating is M4 (Refer to Section 9.3 for details).

**Reviewed by**

*Well Wei*

Well Wei

**Prepared by**

*Nick Hu*

Nick Hu



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# 1 General Information

## 1.1 Introduction

The purpose of the Hearing Aid Compatibility is to enable measurements of the near electric fields generated by wireless communication devices in the region controlled for use by a hearing aid in accordance with ANSI-C63.19-2011

The purpose of this standard is to establish categories for hearing aids and for WD (wireless communications devices) that can indicate to health care practitioners and hearing aid users which hearing aids are compatible with which WD, and to provide tests that can be used to assess the electromagnetic characteristics of hearing aids and WD and assign them to these categories. The various parameters required, in order to demonstrate compatibility and accessibility are measured. The design of the standard is such that when a hearing aid and WD achieve one of the categories specified, as measured by the methodology of this standard, the indicated performance is realized.

In order to provide for the usability of a hearing aid with a WD, several factors must be coordinated:

a) Radio frequency (RF) measurements of the near-field electric fields emitted by a WD to categorize these emissions for correlation with the RF immunity of a hearing aid.

Hence, the following are measurements made for the WD:  
RF E-Field emissions

The measurement plane is parallel to, and 1.5cm in front of, the reference plane.

Applications for certification of equipment operation under part 20, that a manufacturer is seeking to certify as hearing aid compatible, as set forth in §20.19 of that part, shall include a statement indication compliance with the test requirements of §20.19 and indicating the appropriate U-rating for the equipment. The manufacturer of the equipment shall be responsible for maintaining the test results.

## 1.2 Details of Client

|               |                                                                                    |
|---------------|------------------------------------------------------------------------------------|
| Applicant:    | Shenzhen Tinno Mobile Technology Corp.                                             |
| Address:      | TINNO HQ Building, Tongfa South Road Nanshan District Shenzhen, Guangdong Province |
| Manufacturer: | Shenzhen Tinno Mobile Technology Corp.                                             |
| Address:      | TINNO HQ Building, Tongfa South Road Nanshan District Shenzhen, Guangdong Province |



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### 1.3 Test Location

|                |                                                                                                                        |
|----------------|------------------------------------------------------------------------------------------------------------------------|
| Company:       | SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.                                                               |
| Address:       | South of No. 6 Plant, No. 1, Runsheng Road, Suzhou Industrial Park, Suzhou Area, China (Jiangsu) Pilot Free Trade Zone |
| Post code:     | 215000                                                                                                                 |
| Test Engineer: | Leon Liu                                                                                                               |

### 1.4 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **A2LA (Certificate No. 6336.01)**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 6336.01.

• **Innovation, Science and Economic Development Canada**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0120.

IC#: 27594.

• **FCC –Designation Number: CN1312**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized as an accredited testing laboratory.

Designation Number: CN1312.

Test Firm Registration Number: 717327



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## 1.5 General Description of EUT

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                  |                                                      |             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|-------------|
| Device Type:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | portable device                                                                                                                  |                                                      |             |
| Exposure Category:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | uncontrolled environment / general population                                                                                    |                                                      |             |
| Product Name:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Smart Phone                                                                                                                      |                                                      |             |
| FCC ID:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | XD6U680AA                                                                                                                        |                                                      |             |
| Product Phase:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Identical Prototype                                                                                                              |                                                      |             |
| IMEI:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 861745060002092                                                                                                                  |                                                      |             |
| Hardware Version:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | V1.0                                                                                                                             |                                                      |             |
| Software Version:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | U680AAV01.02.10                                                                                                                  |                                                      |             |
| Antenna Type:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Integrated                                                                                                                       |                                                      |             |
| Device Operating Configurations :                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                  |                                                      |             |
| Modulation Mode:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>WCDMA:</b> QPSK, 16QAM(HSPA+);<br><b>LTE:</b> QPSK, 16QAM, 64QAM<br><b>WIFI:</b> DSSS, OFDM; <b>BT:</b> GFSK, π/4DQPSK, 8DPSK |                                                      |             |
| Device Class:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | B                                                                                                                                |                                                      |             |
| HSDPA UE Category:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 10                                                                                                                               | HSUPA UE Category                                    | 7           |
| DC-HSDPA UE Category:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 24                                                                                                                               |                                                      |             |
| Power Class                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3, tested with power control "all 1"(WCDMA Band II / WCDMA Band IV / WCDMA Band V)                                               |                                                      |             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3, tested with power control Max Power(LTE Band 2/5/7/12/14/30/66(4))                                                            |                                                      |             |
| Frequency Bands:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Band                                                                                                                             | Tx (MHz)                                             | Rx (MHz)    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | WCDMA Band II                                                                                                                    | 1850 -1910                                           | 1930 – 1990 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | WCDMA Band IV                                                                                                                    | 1710 – 1755                                          | 2110 – 2155 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | WCDMA Band V                                                                                                                     | 824 – 849                                            | 869 – 894   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | LTE Band 2                                                                                                                       | 1850 – 1910                                          | 1930 – 1990 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | LTE Band 4                                                                                                                       | 1710 - 1755                                          | 2110 - 2155 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | LTE Band 5                                                                                                                       | 824 – 849                                            | 869 – 894   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | LTE Band 7                                                                                                                       | 2500 – 2570                                          | 2620 – 2690 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | LTE Band 12                                                                                                                      | 699 – 716                                            | 729 – 746   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | LTE Band 14                                                                                                                      | 788 – 798                                            | 758 – 768   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | LTE Band 30                                                                                                                      | 2305 – 2315                                          | 2350 – 2360 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | LTE Band 66                                                                                                                      | 1710 – 1780                                          | 2110 – 2200 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Bluetooth                                                                                                                        | 2400~2483.5                                          | 2400~2483.5 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Wi-Fi 2.4G                                                                                                                       | 2402~2472                                            | 2402~2472   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Wi-Fi 5G                                                                                                                         | 5150~5250                                            | 5150~5250   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                  | 5250~5350                                            | 5250~5350   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                  | 5470~5725                                            | 5470~5725   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                  | 5725~5835                                            | 5725~5835   |
| RF Cable:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <input checked="" type="checkbox"/> Provided by the pplicant <input type="checkbox"/> Provided by the laboratory                 |                                                      |             |
| Battery Information:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Model:                                                                                                                           | 516793                                               |             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Normal Voltage:                                                                                                                  | 3.87V                                                |             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Rated capacity:                                                                                                                  | 5850mAh                                              |             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Manufacturer:                                                                                                                    | Huizhou Ganfeng Lienergy Battery Technology Co.,Ltd. |             |
| <p>Note: *Since the above data and/or information is provided by the client relevant results or conclusions of this report are only made for these data and/or information, SGS is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.</p> <p>Remark:<br/>As above information is provided and confirmed by the applicant. SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information.</p> |                                                                                                                                  |                                                      |             |

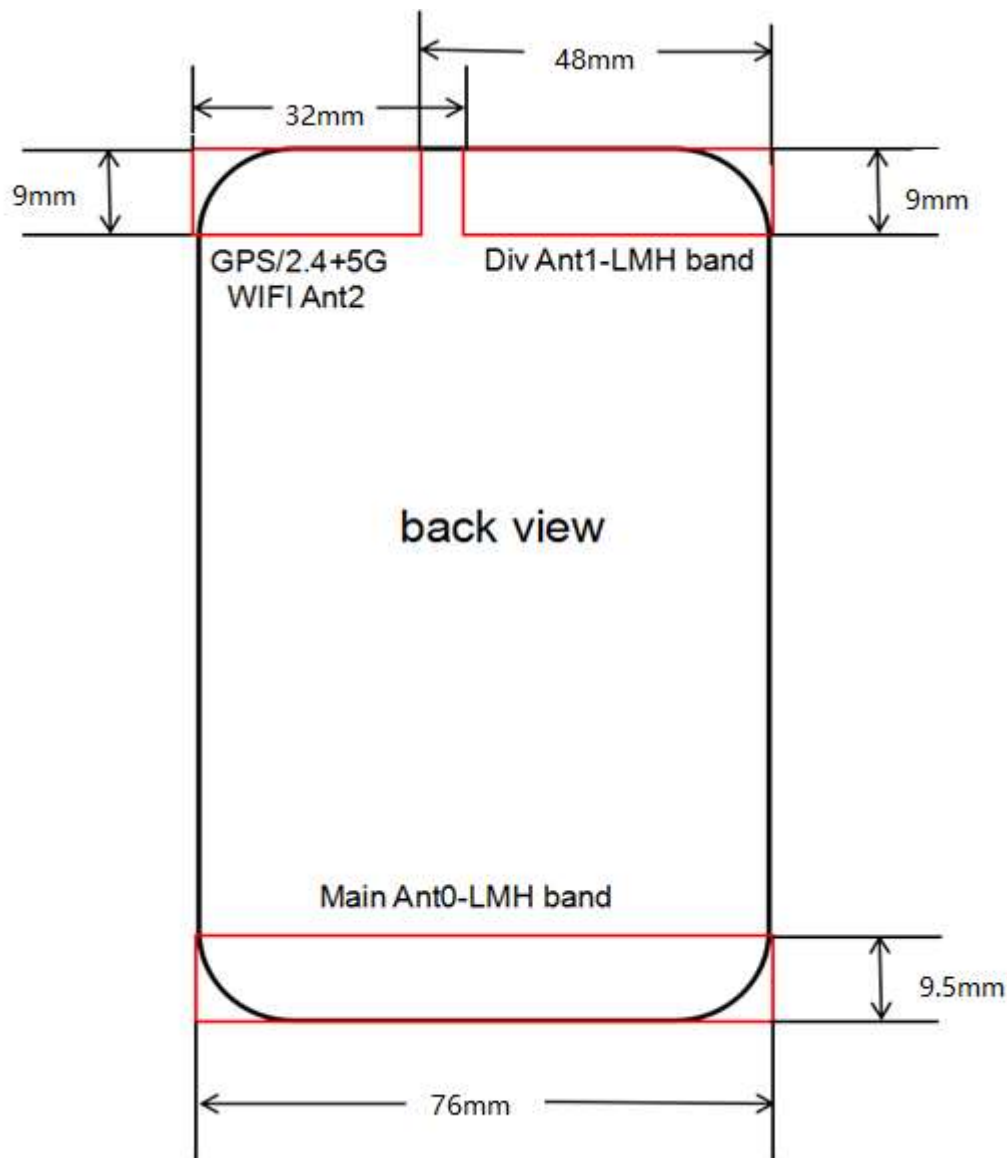


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### 1.5.1 DUT Antenna Locations



Note:

- 1) The diversity Antenna does not support transmitter function.

### 1.5.2 List of air interfaces/frequency bands

| Air Interface | Band (MHz)  | Type | ANSI C63.19 Tested | Simultaneous Transmitter | Name of Voice Service | Power Reduction |
|---------------|-------------|------|--------------------|--------------------------|-----------------------|-----------------|
| WCDMA         | Band II     | VO   | Yes                | BT, Wi-Fi                | CMRS Voice            | NA              |
|               | Band IV     |      |                    |                          |                       | NA              |
|               | Band V      |      |                    |                          |                       | NA              |
|               | HSPA        | VD   | Yes                | BT, Wi-Fi                | NA                    | NA              |
| LTE (FDD)     | Band 2      | VD   | Yes                | BT, Wi-Fi                | VoLTE Google Duo*     | NA              |
|               | Band 4      |      |                    |                          |                       | NA              |
|               | Band 5      |      |                    |                          |                       | NA              |
|               | Band 7      |      |                    |                          |                       | NA              |
|               | Band 12     |      |                    |                          |                       | NA              |
|               | Band 14     |      |                    |                          |                       | NA              |
|               | Band 30     |      |                    |                          |                       | NA              |
|               | Band 66     |      |                    |                          |                       | NA              |
|               | Band 71     |      |                    |                          |                       | NA              |
| Wi-Fi         | 2.4GHz&5GHz | VD   | Yes                | WWAN                     | VOWIFI Google Duo*    | NA              |
| BT            | 2450        | DT   | No                 | WWAN                     | NA                    | NA              |

VO: Legacy Cellular Voice Service from Table 7.1 in 7.4.2.1 of ANSI C63.19-2011

DT: Digital Transport (no voice)

VD: IP Voice Service over Digital Transport

For protocols not listed in Table 7.1 of ANSI C63.19-2011 or the ANSI C63.19-2011 VoLTE interpretation, the average speech level of -20 dBm0 should be used.



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## 1.6 Test Specification

| Identity           | Document Title                                                                                                |
|--------------------|---------------------------------------------------------------------------------------------------------------|
| CFR 47 FCC Part 20 | §20.19 Hearing aid-compatible mobile handsets.                                                                |
| ANSI C63.19-2011   | American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices |
| KDB 285076 D01     | HAC Guidance v05r01                                                                                           |

## 1.7 ANSI C63.19-2011 limits

| Emission Categories | E-field emissions dB(V/m) |           |
|---------------------|---------------------------|-----------|
|                     | < 960 MHz                 | > 960 MHz |
| Category M1         | 50-55                     | 40-45     |
| Category M2         | 45-50                     | 35-40     |
| Category M3         | 40-45                     | 30-45     |
| Category M4         | <40                       | <30       |

Table 1: Telephone near-field categories in linear units

## 2 Calibration certificate

|                   |                           |
|-------------------|---------------------------|
| Temperature       | Min. = 18°C, Max. = 25 °C |
| Relative humidity | Min. = 30%, Max. = 70%    |

Table 2: The Ambient Conditions



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### 3 HAC (T Coil) Measurement System

#### 3.1 Measurement System Diagram for SPEAG Robotic

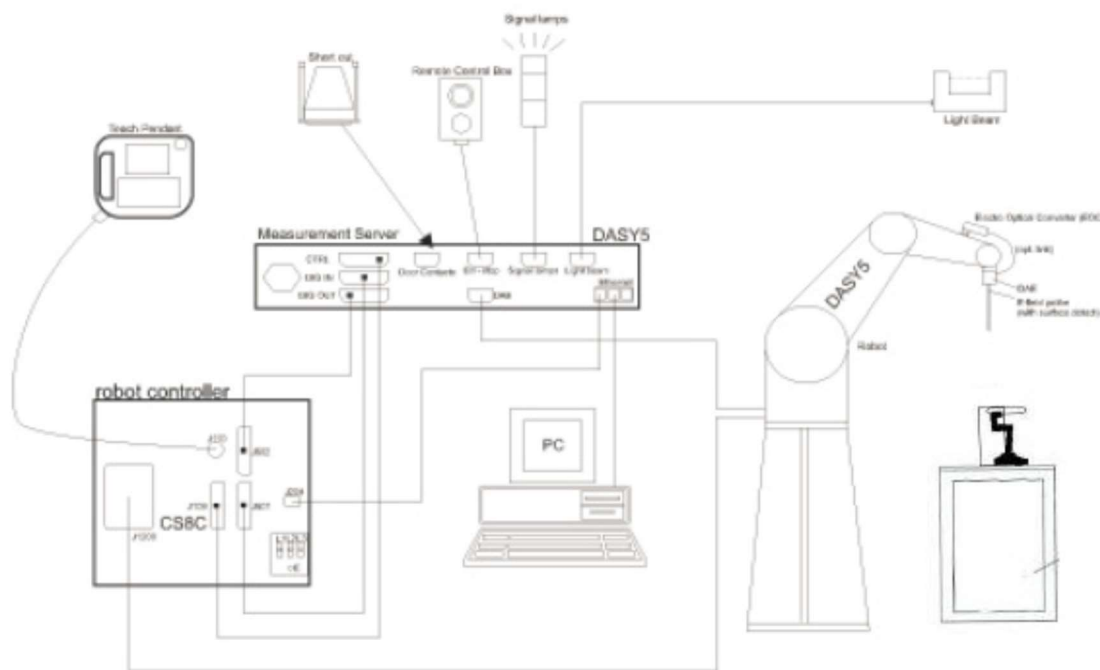


Fig. 1. The SPEAG Robotic Diagram

The DASY5 system for performing compliance tests consists of the following items:

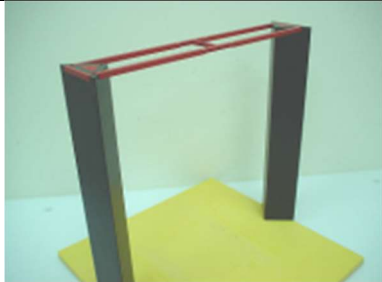
- A standard high precision 6-axis robot (Stabile RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- An Audio Magnetic probe.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7.
- DASY5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The Test Arch SAM phantom
- The device holder for handheld mobile phones.
- Validation dipole kits allowing to validate the proper functioning of the system.

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### 3.2 E-Field Probe

|               |                                                                                                                            |                                                                                     |
|---------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Construction  | One dipole parallel, two dipoles normal to probe axis<br>Built-in shielding against static charges PEEK enclosure material |  |
| Calibration   | In air from 100 MHz to 6.0 GHz<br>(absolute accuracy $\pm 6.0\%$ , $k=2$ )                                                 |                                                                                     |
| Frequency     | (extended to 20 MHz for MRI),<br>Linearity: $\pm 0.2$ dB (100 MHz to 6 GHz)                                                |                                                                                     |
| Directivity   | $\pm 0.2$ dB in air (rotation around probe axis)<br>$\pm 0.4$ dB in air (rotation normal to probe axis)                    |                                                                                     |
| Dynamic Range | 2 V/m to > 1000 V/m; Linearity: $\pm 0.2$ dB                                                                               |                                                                                     |
| Dimensions    | Tip diameter: 8 mm<br>Distance from probe tip to dipole centers: 2.5 mm                                                    | EF3DV3 E-Field Probe                                                                |

### 3.3 Test Arch

|             |                                                                                                                        |                                                                                       |
|-------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Description | Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot. |  |
| Dimensions  | length: 370 mm<br>width: 370 mm<br>height: 370 mm                                                                      |                                                                                       |

### 3.4 Phone Holder

|             |                                                                                                |                                                                                       |
|-------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Description | Supports accurate and reliable positioning of any phone<br>Effect on near field $< \pm 0.5$ dB |  |
|-------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|



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## 4 Measurement uncertainty evaluation

| Uncertainty Component                    | Uncertainty Value (%)                       | Probability Distribution | Divisor    | ci<br>€ | Standard Uncertainty<br>€ (%) |
|------------------------------------------|---------------------------------------------|--------------------------|------------|---------|-------------------------------|
| <b>Measurement system</b>                |                                             |                          |            |         |                               |
| Probe calibration                        | ±5.1                                        | N                        | 1          | 1       | ±5.1                          |
| Axial isotropy                           | ±4.7                                        | R                        | $\sqrt{3}$ | 1       | ±2.7                          |
| Sensor position                          | ±16.5                                       | R                        | $\sqrt{3}$ | 1       | ±9.5                          |
| Boundary effect                          | ±2.4                                        | R                        | $\sqrt{3}$ | 1       | ±1.4                          |
| Phantom Boundary Effect                  | ±7.2                                        | R                        | $\sqrt{3}$ | 1       | ±4.1                          |
| Linearity                                | ±4.7                                        | R                        | $\sqrt{3}$ | 1       | ±2.7                          |
| Scaling with PMR calibration             | ±10.0                                       | R                        | $\sqrt{3}$ | 1       | ±5.8                          |
| System Detection limit                   | ±1.0                                        | R                        | $\sqrt{3}$ | 1       | ±0.6                          |
| Readout Electronics                      | ±0.3                                        | N                        | 1          | 1       | ±0.3                          |
| Response time                            | ±0.8                                        | R                        | $\sqrt{3}$ | 1       | ±0.5                          |
| Integration time                         | ±2.6                                        | R                        | $\sqrt{3}$ | 1       | ±1.5                          |
| RF ambient conditions                    | ±3.0                                        | R                        | $\sqrt{3}$ | 1       | ±1.7                          |
| RF reflection                            | ±12.0                                       | R                        | $\sqrt{3}$ | 1       | ±6.9                          |
| Probe positioner                         | ±1.2                                        | R                        | $\sqrt{3}$ | 1       | ±0.7                          |
| Probe positioning                        | ±4.7                                        | R                        | $\sqrt{3}$ | 1       | ±2.7                          |
| Extrapolation and interpolation          | ±1.0                                        | R                        | $\sqrt{3}$ | 1       | ±0.6                          |
| <b>Related to test samples</b>           |                                             |                          |            |         |                               |
| Device Positioning Vertical              | ±4.7                                        | R                        | $\sqrt{3}$ | 1       | ±2.7                          |
| Device Positioning Lateral               | ±1.0                                        | R                        | $\sqrt{3}$ | 1       | ±0.6                          |
| Device Holder and Phantom                | ±2.4                                        | R                        | $\sqrt{3}$ | 1       | ±1.4                          |
| Power drift                              | ±5.0                                        | R                        | $\sqrt{3}$ | 1       | ±2.9                          |
| <b>Phantom and Setup Related</b>         |                                             |                          |            |         |                               |
| Phantom Thickness                        | ±2.4                                        | R                        | $\sqrt{3}$ | 1       | ±1.4                          |
| Combined Std. Uncertainty                | $u'_c = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$ |                          |            |         | ±16.3                         |
| Expanded Std. Uncertainty on Power (K=2) |                                             |                          |            |         | ±32.6                         |
| Expanded Std. Uncertainty on Field (K=2) |                                             |                          |            |         | ±16.3                         |

Table 3: Measurement uncertainties for RF



### 5 RF Emission Measurements Reference and Plane

Fig.3 illustrate the references and reference plane that shall be used in a typical EUT emissions measurement. The principle of this section is applied to EUT with similar geometry. Please refer to Appendix C for the setup photographs.

- ◆ The area is 5 cm by 5 cm.
- ◆ The area is centered on the audio frequency output transducer of the EUT.
- ◆ The area is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the EUT handset, which, in normal handset use, rest against the ear.
- ◆ The measurement plane is parallel to, and 10 mm in front of, the reference plane.



Fig.3 WD reference and plane for RF emission measurements

## 6 System Verification Procedure

### 6.1 System Check

Place a dipole antenna meeting the requirements given in ANSI C63.19-2011 in the position normally occupied by the WD. The dipole antenna serves as a known source for an electrical and magnetic output. Position the E-field probe so that the following occurs:

- The probes and their cables are parallel to the coaxial feed of the dipole antenna
- The probe cables and the coaxial feed of the dipole antenna approach the measurement area from opposite directions
- The center point of the probe element(s) are 15 mm from the closest surface of the dipole elements.

Scan the length of the dipole with the E-field probe and record the two maximum values found near the dipole ends. Average the two readings and compare the reading to the expected value in the calibration certificate or the expected value in this standard.

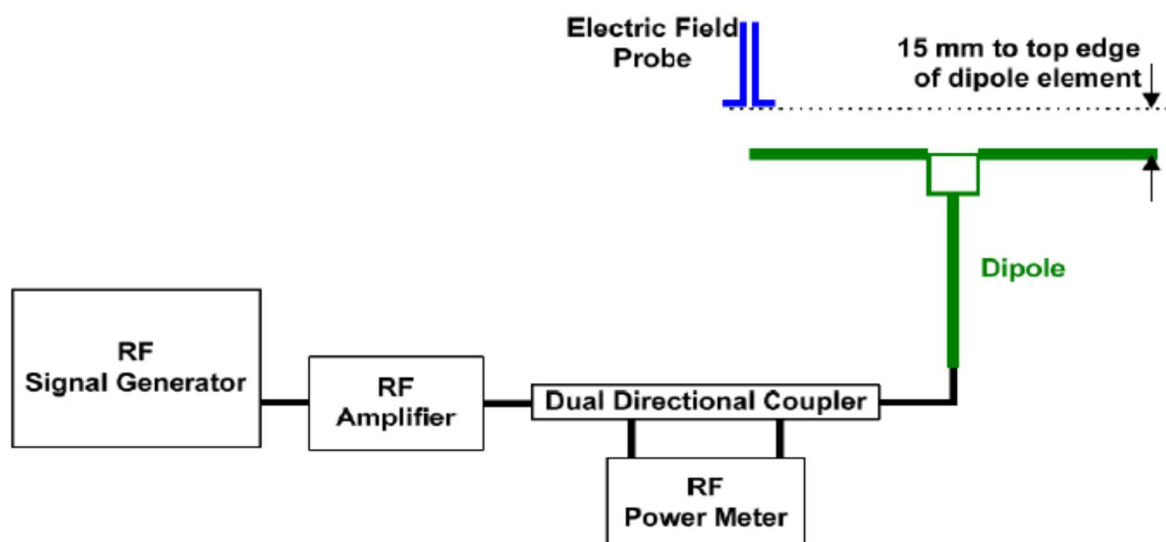


Fig.4 System verification

### 6.2 System Check Result

| Mode | Frequency (MHz) | Input Power (mW) | E-Field 1 (V/m) | E-Field 2 (V/m) | Average Value (V/m) | Target Value (V/m) | Deviation (%) | Limit (%) | Test Date  |
|------|-----------------|------------------|-----------------|-----------------|---------------------|--------------------|---------------|-----------|------------|
| CW   | 2450            | 100              | 86              | 86.91           | 91.14               | 89.025             | 3.52          | ±18       | 2023-05-20 |

**Note:**

- \* Please refer to the appendix A for detailed measurement data and plot.
- \*\* Target value is provided by SPEAD in the calibration certificate of specific dipoles.
- \*\*\* Deviation (%) = 100 \* (Measured value minus Target value) divided by Target value.
- \*\*\*\* ANSI C63.19 requires values within ± 18% are acceptable.



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## 7 Modulation Interference Factor

The HAC Standard ANSI C63.19-2011 defines a new scaling using the Modulation Interference Factor (MIF). For any specific fixed and repeatable modulated signal, a modulation interference factor (MIF, expressed in dB) may be developed that relates its interference potential to its steady-state rms signal level or average power level. This factor is a function only of the audio-frequency amplitude modulation characteristics of the signal and is the same for field-strength and conducted power measurements. It is important to emphasize that the MIF is valid only for a specific repeatable audio-frequency amplitude modulation characteristic. Any change in modulation characteristic requires determination and application of a new MIF.

The Modulation Interference factor (MIF, in dB) is added to the measured average E-field (in dBV/m) and converts it to the RF Audio Interference level (in dBV/m). This level considers the audible amplitude modulation components in the RF E-field. CW fields without amplitude modulation are assumed to not interfere with the hearing aid electronics.

Modulations without time slots and low fluctuations at low frequencies have low MIF values, TDMA modulations with narrow transmission and repetition rates of few 100 Hz have high MIF values and give similar classifications as ANSI C63.19-2011.

ER3D, EF3D and EU2D E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. DASY52 is therefore using the indirect measurement method according to ANSI C63.19-2011 which is the primary method. These near field probes read the averaged E-field measurement. Especially for the new high peak-to-average (PAR) signal types, the probes shall be linearized by PMR calibration in order to not overestimate the field reading. Probe Modulation Response (PMR) calibration linearizes the probe response over its dynamic range for specific modulations which are characterized by their UID and result in an uncertainty specified in the probe calibration certificate. The MIF is characteristic for a given waveform envelope and can be used as a constant conversion factor if the probe has been PMR calibrated.

The evaluation method for the MIF is defined in ANSI C63.19-2011 section D.7. An RMS demodulated RF signal is fed to a spectral filter (similar to an A weighting filter) and forwarded to a temporal filter acting as a quasi-peak detector. The averaged output of these filtering is scaled to a 1 kHz 80% AM signal as reference. MIF measurement requires additional instrumentation and is not well suited for evaluation by the end user with reasonable uncertainty.

It may alternatively be determined through analysis and simulation, because it is constant and characteristic for a communication signal. DASY52 uses well-defined signals for PMR calibration. The MIF of these signals has been determined by simulation and it is automatically applied.

The MIF measurement uncertainty is estimated as follows, declared by HAC equipment provider SPEAG, for modulation frequencies from slotted waveforms with fundamental frequency and at least 2 harmonics within 10 kHz:

1. 0.2 dB for MIF: -7 to +5 dB
2. 0.5 dB for MIF: -13 to +11 dB
3. 1 dB for MIF: > -20 dB

MIF values applied in this test report were provided by the HAC equipment provider of SPEAG, and the worst values for all air interface are listed below to be determine the Low-power Exemption.

| SPEAG UID | UID version | Communication system                  | MIF(dB) |
|-----------|-------------|---------------------------------------|---------|
| 10021     | DAC         | GSM-FDD (TDMA,GMSK)                   | 3.63    |
| 10025     | DAC         | EDGE-FDD (TDMA, 8PSK, TN 0)           | 3.75    |
| 10460     | AAA         | UMTS-FDD (WCDMA, AMR)                 | -25.43  |
| 10225     | AAA         | UMTS-FDD (HSPA+)                      | -20.39  |
| 10169     | CAE         | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK) | -15.63  |
| 10170     | CAE         | LTE-FDD (SC-FDMA,1RB, 20 MHz,16-QAM)  | -9.76   |
| 10172     | CAG         | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK) | -1.62   |
| 10173     | CAG         | LTE-TDD (SC-FDMA,1RB, 20 MHz,16-QAM)  | -1.44   |



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|       |     |                                                   |        |
|-------|-----|---------------------------------------------------|--------|
| 10061 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)         | -2.02  |
| 10077 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps)    | 0.12   |
| 10427 | AAB | IEEE 802.11n (HT Green eld, 150 Mbps, 64-QAM)     | -13.44 |
| 10069 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)         | -3.15  |
| 10616 | AAB | IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle) | -5.57  |



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## 8 HAC Measurement Procedure

The evaluation was performed with the following procedure:

- Confirm the proper operation of the field probe, probe measurement system, and other instrumentation and the positioning system.
- Position the WD in its intended test position.
- Set the WD to transmit a fixed and repeatable combination of signal power and modulation characteristic that is representative of the worst case (highest interference potential) encountered in normal use. Transiently occurring start-up, changeover, or termination conditions, or other operations likely to occur less than 1% of the time during normal operation, may be excluded from consideration.
- The center subgrid shall be centered on the T-Coil mode perpendicular measurement point or the acoustic output, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm grid, which is contained in the measurement plane, refer to illustrated in Figure 3. If the field alignment method is used, align the probe for maximum field reception.
- Record the reading at the output of the measurement system.
- Scan the entire 50 mm by 50 mm region in equally spaced increments and record the reading at each measurement point. The distance between measurement points shall be sufficient to assure the identification of the maximum reading.
- Identify the five contiguous subgrids around the center subgrid whose maximum reading is the lowest of all available choices. This eliminates the three subgrids with the maximum readings. Thus, the six areas to be used to determine the WD's highest emissions are identified.
- Identify the maximum reading within the nonexcluded subgrids identified in step g).
- Convert the maximum reading identified in step h) to RF audio interference level, in, V/m, by taking the square root of the reading and then dividing it by the measurement system transfer function, established in 5.5.1.1. Convert the result to dB(V/m) by taking the base-10 logarithm and multiplying it by 20.

Indirect measurement method

Replacing step i) of 5.5.1.2, the RF audio interference level in dB(V/m) is obtained by adding the MIF (in dB) to the maximum steady-state rms field-strength reading, in dB(V/m), from step h). Use this result to determine the category rating.

- Compare this RF audio interference level with the categories in Clause 8 and record the resulting WD category rating.

- For the T-Coil mode M-rating assessment, determine whether the chosen perpendicular measurement point is contained in an included subgrid of the first scan. If so, then a second scan is not necessary. The first scan and resultant category rating may be used for the T-Coil mode M rating.

Otherwise, repeat step a) through step i), with the grid shifted so that it is centered on the perpendicular measurement point. Record the WD category rating.



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## 9 HAC RF Measurement Results

### 9.1 Max Tune-up

| Frequency Band |         | Tune-up (dBm) |
|----------------|---------|---------------|
| WCDMA          | Band V  | 24.00         |
|                | Band IV | 24.00         |
|                | Band II | 24.00         |
|                | HSPA    | 22.50         |
| FDD LTE        | Band 2  | 24.50         |
|                | Band 4  | 24.50         |
|                | Band 5  | 25.00         |
|                | Band 7  | 24.00         |
|                | Band 12 | 25.00         |
|                | Band 14 | 25.00         |
|                | Band 30 | 24.00         |
|                | Band 66 | 24.50         |

| Mode        |                | Tune-up (dBm) |
|-------------|----------------|---------------|
| 2.4GHz WLAN | 802.11b        | 20.00         |
|             | 802.11g        | 19.00         |
|             | 802.11n-HT20   | 19.00         |
| 5G WLAN     | 802.11a        | 19.00         |
|             | 802.11n-HT20   | 19.00         |
|             | 802.11n-HT40   | 19.00         |
|             | 802.11ac-VHT20 | 19.00         |
|             | 802.11ac-VHT40 | 19.00         |
|             | 802.11ac-VHT80 | 19.00         |



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## 9.2 Conducted RF Output Power

| Mode            | Channel | Frequency(MHz) | Data Rate(Mbps) | Average Power (dBm) | Tune up |
|-----------------|---------|----------------|-----------------|---------------------|---------|
| 802.11b         | 1       | 2412           | 1               | 19.46               | 20.00   |
|                 | 6       | 2437           |                 | 19.26               | 20.00   |
|                 | 11      | 2462           |                 | 19.35               | 20.00   |
| 802.11g         | 1       | 2412           | 6               | 18.00               | 19.00   |
|                 | 6       | 2437           |                 | 18.05               | 19.00   |
|                 | 11      | 2462           |                 | 18.03               | 19.00   |
| 802.11n<br>HT20 | 1       | 2412           | 6.5             | 17.95               | 19.00   |
|                 | 6       | 2437           |                 | 17.84               | 19.00   |
|                 | 11      | 2462           |                 | 17.93               | 19.00   |



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### 9.3 Low-power Exemption

According to ANSI C63.19-2011, a RF air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is  $\leq 17$  dBm for any of its operation modes.

| Air Interface (Ant) | Max Average Antenna Input Power (dBm) | Worst Case | Power + | C63.19 test |
|---------------------|---------------------------------------|------------|---------|-------------|
|                     |                                       | MIF (dB)   | MIF(dB) | required    |
| WCDMA               | 24                                    | -25.43     | -1.43   | No          |
| WCDMA - HSPA        | 22.5                                  | -20.39     | 2.11    | No          |
| LTE - FDD           | 25                                    | -9.76      | 15.24   | No          |
| 802.11a             | 19                                    | -2.02      | 16.98   | No          |
| 802.11b             | 20                                    | -2.02      | 17.98   | Yes         |
| 802.11g             | 19                                    | 0.12       | 19.12   | Yes         |
| 802.11n-HT20        | 19                                    | -13.44     | 5.56    | No          |
| 802.11n-HT40        | 19                                    | -13.44     | 5.56    | No          |
| 802.11ac-VHT20      | 19                                    | -5.57      | 13.43   | No          |
| 802.11ac-VHT40      | 19                                    | -5.57      | 13.43   | No          |
| 802.11ac-VHT80      | 19                                    | -5.57      | 13.43   | No          |

#### General Note:

1. According to ANSI C63.19 2011-version, for the air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is  $\leq 17$  dBm for any of its operating modes.
2. HAC RF rating is M4 for the air interface which meets the low power exemption.
3. Select mode testing with high MIF in the same frequency band.



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## 9.4 HAC RF Emission Test Results

| Band      | Test Mode | Channel | Frequency (MHz) | MIF (dB) | Audio Interference Level (dBV/m) | Margin to the next Level (dBV/m) | Power Drift (dB) | Category |
|-----------|-----------|---------|-----------------|----------|----------------------------------|----------------------------------|------------------|----------|
| WiFi 2.4G | 802.11g   | 1       | 2412            | 0.12     | 28.25                            | 1.75                             | 0.01             | M4       |
| WiFi 2.4G | 802.11g   | 6       | 2437            | 0.12     | 28.26                            | 1.74                             | -0.04            | M4       |
| WiFi 2.4G | 802.11g   | 11      | 2462            | 0.12     | 28.20                            | 1.80                             | 0.06             | M4       |

**Remark:**

- The detail RF Emission results please refer to appendix B.



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## 10 Equipment list

| Equipment                                                                | Manufacturer  | Model          | Serial Number | Calibration Date | Due date of calibration |
|--------------------------------------------------------------------------|---------------|----------------|---------------|------------------|-------------------------|
| <input checked="" type="checkbox"/> Software                             | SPEAG         | DASY52 52.10.4 | NA            | NCR              | NCR                     |
| <input checked="" type="checkbox"/> DAE                                  | SPEAG         | DAE4           | 1324          | 2022-10-17       | 2023-10-16              |
| <input checked="" type="checkbox"/> E-Field Probe                        | SPEAG         | EF3DV3         | 4051          | 2022-06-10       | 2023-06-09              |
| <input checked="" type="checkbox"/> Validation Kits                      | SPEAG         | CD2450V3       | 1044          | 2022-05-25       | 2023-05-24              |
| <input checked="" type="checkbox"/> Test Arch SD HAC                     | SPEAG         | NA             | NA            | NCR              | NCR                     |
| <input checked="" type="checkbox"/> Universal Radio Communication Tester | R&S           | CMW500         | 111637        | 2022-09-16       | 2023-09-15              |
| <input checked="" type="checkbox"/> Signal Generator                     | R&S           | SMB100A        | 182393        | 2023-02-06       | 2024-02-05              |
| <input checked="" type="checkbox"/> Preamplifier                         | Qiji          | YX28980933     | 202104001     | NCR              | NCR                     |
| <input checked="" type="checkbox"/> Power Sensor                         | Keysight      | U2002H         | MY5639004     | 2022-09-16       | 2023-09-15              |
| <input checked="" type="checkbox"/> Power Sensor                         | Agilent       | U2002H         | MY48200110    | 2022-11-23       | 2023-11-22              |
| <input checked="" type="checkbox"/> Coaxial low pass filter              | Mini-Circuits | VLF-2500(+)    | NA            | NCR              | NCR                     |
| <input checked="" type="checkbox"/> Coaxial low pass filter              | Microlab Fxr  | LA-F13         | NA            | NCR              | NCR                     |
| <input checked="" type="checkbox"/> DC POWER SUPPLY                      | SAKO          | SK1730SL5A     | NA            | NCR              | NCR                     |
| <input checked="" type="checkbox"/> Humidity and Temperature Indicator   | Funade        | Funade         | 692020268168  | 2022-09-16       | 2023-09-15              |

Note:

- All the equipments are within the valid period when the tests are performed.

---END---



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