

## TEST REPORT

|                                  |                                                                                                       |
|----------------------------------|-------------------------------------------------------------------------------------------------------|
| Report Number                    | 200500063SEL-EMC1                                                                                     |
| Applicant Name/Address           | Sungshin Hasco, Ltd<br>65, Gongdan 7-ro, Jillyang-eup, Gyeongsan-si, Gyeongbuk-do, South Korea, 38465 |
| Test Sample Description          |                                                                                                       |
| - Product .....                  | Digital Manifold Gauge                                                                                |
| - Model and/or Brand name .....  | MDM008A                                                                                               |
| - Variant model name.....        | -                                                                                                     |
| - Manufacturer Name / Address .. | Sungshin Hasco, Ltd<br>65, Gongdan 7-ro, Jillyang-eup, Gyeongsan-si, Gyeongbuk-do, South Korea, 38465 |
| - Rating(s) .....                | DC 6 V                                                                                                |
| Receipt of sample(s)             | 12 May 2020                                                                                           |
| Date of Test                     | 29 Jun. 2020                                                                                          |
| Test Method(s)                   | FCC Part 15 Subpart B(Class B)                                                                        |
| Test Results & Uncertainty       | See EMC Results Conclusion                                                                            |
| Issue date                       | 07 Jul. 2020                                                                                          |

Note 1. The results shown in this test report refer only to the sample(s) tested.

Note 2: This report shall not be reproduced except in full, without the written approval of Intertek.

Note 3: This laboratory is not accredited for the test results marked as \*.

Tested by;



Name: Harry Jeon  
EMC Engineer

Approved by;



Name: Rina Bae  
EMC Technical Manager

**Intertek ETL SEMKO Korea Ltd.**



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## SECTION 2 EMC RESULTS CONCLUSION (WITH JUSTIFICATION)

We tested the Digital Manifold Gauge, Model: MDM008A, to determine if it was in compliance with the relevant US standard as marked on the test report.

We found that the unit met the requirement of FCC Part 15 Subpart B, ICES-003 Issue 6 standards when tested as received.

| Test Items                                                                                             | Applied Standards     | Results                             |                          |                                     |                                     |
|--------------------------------------------------------------------------------------------------------|-----------------------|-------------------------------------|--------------------------|-------------------------------------|-------------------------------------|
|                                                                                                        |                       | Comply                              | Not Comply               | N/A                                 | See Note                            |
| Disturbance Voltage                                                                                    | FCC Part 15 Subpart B | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| Radiated disturbance<br>(Below 1 GHz)                                                                  | FCC Part 15 Subpart B | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Radiated disturbance<br>(Above 1 GHz)                                                                  | FCC Part 15 Subpart B | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| Note 1) When determining the test conclusion, the Measurement Uncertainty of test has been considered. |                       |                                     |                          |                                     |                                     |

### Measurement Uncertainty

|                    |                                                 |                                                        |
|--------------------|-------------------------------------------------|--------------------------------------------------------|
| Conducted Emission | 150 kHz – 30 MHz                                | $U = 3.3$ [dB]                                         |
|                    | (Confidence level approximately 95 %, $k = 2$ ) |                                                        |
| Radiated Emissions | 9 kHz – 30 MHz                                  | $U = 4.5$ [dB]                                         |
|                    | 30 MHz – 1 000 MHz                              | Horizontal: $U = 4.3$ [dB]<br>Vertical: $U = 4.5$ [dB] |
|                    | 1 GHz – 6 GHz                                   | Horizontal: $U = 5.6$ [dB]<br>Vertical: $U = 5.4$ [dB] |
|                    | 6 GHz – 18 GHz                                  | Horizontal: $U = 5.8$ [dB]<br>Vertical: $U = 5.8$ [dB] |
|                    | (Confidence level approximately 95 %, $k = 2$ ) |                                                        |
|                    |                                                 |                                                        |

## SECTION 3 TEST ENVIRONMENT AND CONDITIONS

### Test Environment

| Test Item                             | Test Site           | Test date<br>(MM-DD) | Temp<br>(°C)   | Humidity<br>(% R.H.) | Pressure<br>(kPa) |
|---------------------------------------|---------------------|----------------------|----------------|----------------------|-------------------|
| Disturbance Voltage                   | Shielded<br>Room #2 | -                    | -              | -                    |                   |
| Radiated disturbance<br>(Below 1 GHz) | 10 m<br>chamber     | 06-29                | $23.2 \pm 0.5$ | $38.7 \pm 0.5$       | -                 |
| Radiated disturbance<br>(Above 1 GHz) | 10 m<br>chamber     | 06-29                | $23.3 \pm 0.5$ | $38.8 \pm 0.5$       |                   |



## SECTION 4 EUT INFORMATION

|                                    |                        |
|------------------------------------|------------------------|
| <b>Equipment Under Test (EUT):</b> | Digital Manifold Gauge |
| <b>Model:</b>                      | MDM008A                |
| <b>Variant Model:</b>              | -                      |
| <b>Serial No.:</b>                 | -                      |
| <b>Rated Voltage:</b>              | DC 6 V                 |
| <b>Tested Voltage:</b>             | DC 6 V                 |
| <b>Maximum clock frequency:</b>    | 2 480 MHz              |
| <b>Variant model information:</b>  | -                      |



## SECTION 5 TEST CONFIGURATION, OPERATION MODE AND SET-UP

### Test Ancillary Equipment

| Equipment                    | Model No. | Serial No.  | Manufacturer                  | ETC. |
|------------------------------|-----------|-------------|-------------------------------|------|
| Digital Manifold Gauge       | MDM008A   | -           | Sungshin Hasco, Ltd           | EUT  |
| Temperature Sensor Clamp X 2 | -         | -           | Sungshin Hasco, Ltd           | EUT  |
| Smart Phone                  | SM-G981N  | R3CN5066PCV | Samsung Electronics Co., Ltd. | -    |

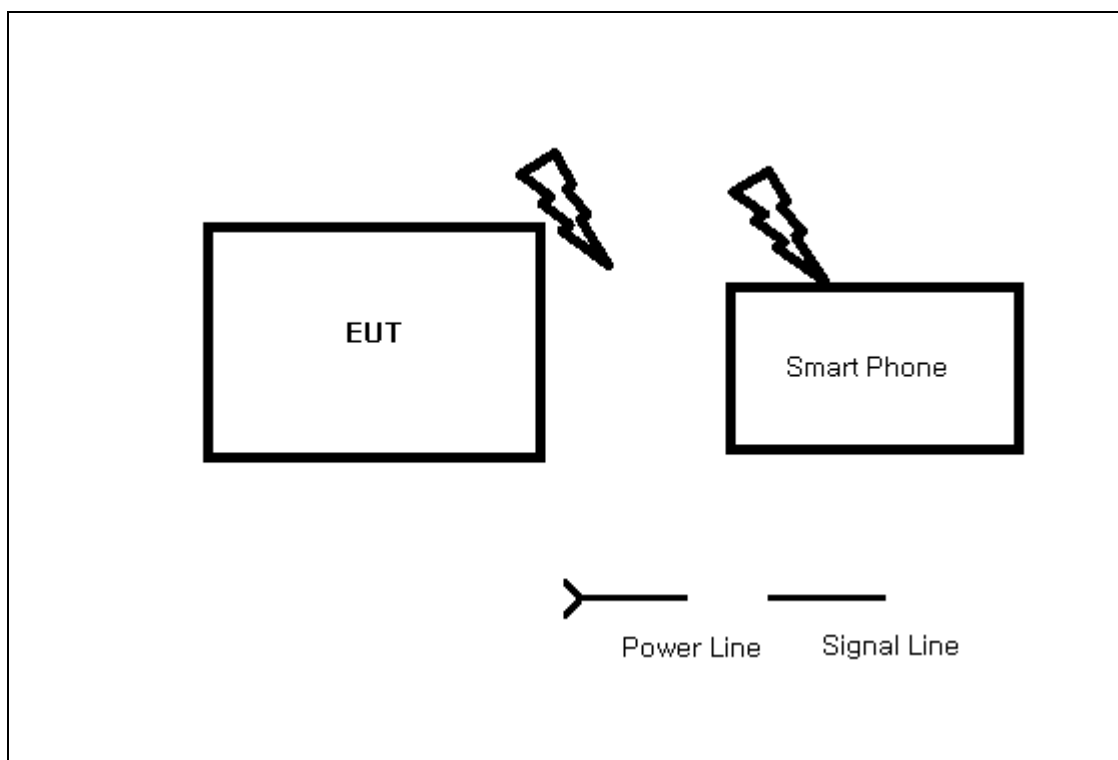
### Used cable description

| Start                  |            | END                          |          | CABLE      |            |              |
|------------------------|------------|------------------------------|----------|------------|------------|--------------|
| Name                   | I/O Port   | Name                         | I/O Port | Length (m) | Shield     | With Ferrite |
| Digital Manifold Gauge | K-TYPE X 2 | Temperature Sensor Clamp X 2 | K-TYPE   | 1.2        | Unshielded | No           |
| (EUT)                  | -          | Smart Phone                  | -        | -          | -          | -            |

### Test Operation Mode

- Operating Mode: A states that connect the smartphone and Bluetooth to run the “Microdam” app to check operation.

### Test Setup





## SECTION 6 EMISSION

### Radiated disturbance test

#### Test Method and Summary

Test standard: FCC Part 15 Subpart B

#### Used Test Equipment

| Control No. | Equipment         | Manufacturer | Model No. | Serial No. | Next Cal.  | Cal Int. |
|-------------|-------------------|--------------|-----------|------------|------------|----------|
| EMC002      | EMI Test Receiver | R & S        | ESU26     | 100590     | 2021.01.02 | 1Y       |
| EMC025      | Biconilog (Type7) | ETS-Lindgren | 3142E     | 00203547   | 2021.02.25 | 2Y       |
| EMC074      | AMP               | R & S        | SCU-01D   | 1904843    | 2021.06.22 | 1Y       |

#### Operating Environment

Test Voltage: DC 6 V

#### Test Setup and Procedure

The EUT along with its peripherals were placed on a non-conducted table with a height of 0.8 m in height table above the reference ground plane.

Rotate the EUT from 0° to 360° and position the receiving antenna at heights from 1 m to 4 m above the reference ground plane continuously to determine associated with higher emission levels and record them.

The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

For measurements above 1 GHz, place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response.

The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal.

The final measurement antenna elevation shall be that which maximizes the emissions.

**Limits**

- The test frequency range of Radiated Disturbance measurements are listed below.

| Highest frequency generated or used in the device or on which the device operates or tunes (MHz) | Upper frequency of measurement range (MHz)                                      |
|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Below 108                                                                                        | 1 000                                                                           |
| 108 – 500                                                                                        | 2 000                                                                           |
| 500 – 1 000                                                                                      | 5 000                                                                           |
| Above 1 000                                                                                      | 5 <sup>th</sup> harmonic of the highest frequency or 40 GHz, whichever is lower |

(1) Limit for Radiated Emission below 1 000 MHz

| Frequency range (MHz) | Class A Equipment (10 m distance) Quasi-peak (dBμV/m) | Class B Equipment (3 m distance) Quasi-peak (dBμV/m) |
|-----------------------|-------------------------------------------------------|------------------------------------------------------|
| 30 to 88              | 39.0                                                  | 40                                                   |
| 88 to 216             | 43.5                                                  | 43.5                                                 |
| 216 to 960            | 46.4                                                  | 46                                                   |
| 960 to 1 000          | 49.5                                                  | 54                                                   |

Note 1) The lower limit shall apply at the transition frequency.

Note 2) Additional provisions may be required for cases where interference occurs.

Note 3) According to 15.109(g), as an alternative to the radiated emission limit shown above, digital devices may be shown to comply with the standards (CISPR), Pub. 22 shown as below.

Note 4) Result (dBμV/m) = Reading (dBμV) + Corr. (Ant. Factor (dB/m) + Cable Loss (dB) – Amp. Gain (dB))

Result: QuasiPeak, Reading: Receiver reading value, Corr.: Correction Factor

Margin = Limit – Result

| Frequency range (MHz) | Class A Equipment (10 m distance) Quasi-peak (dBμV/m) | Class B Equipment (10 m distance) Quasi-peak (dBμV/m) |
|-----------------------|-------------------------------------------------------|-------------------------------------------------------|
| 30 to 230             | 40                                                    | 30                                                    |
| 230 to 1 000          | 47                                                    | 37                                                    |

(2) Limits for Radiated Emission above 1 000 MHz at a measuring distance of 3 m

| Frequency (GHz) | Class A Equipment |                  | Class B Equipment |                  |
|-----------------|-------------------|------------------|-------------------|------------------|
|                 | Peak (dBμV/m)     | Average (dBμV/m) | Peak (dBμV/m)     | Average (dBμV/m) |
| 1 to 40         | 80                | 60               | 74                | 54               |

Note 1) Result (dBμV/m) = Reading (dBμV) + Corr. (Ant. Factor (dB/m) + Cable Loss (dB) – Amp. Gain (dB))

Result: Final value, Reading: Receiver reading value, Corr.: Correction Factor

Margin = Limit – Result

Note 2) If measured at a distance other than 3 m, apply the following formula to compensate the measured value.

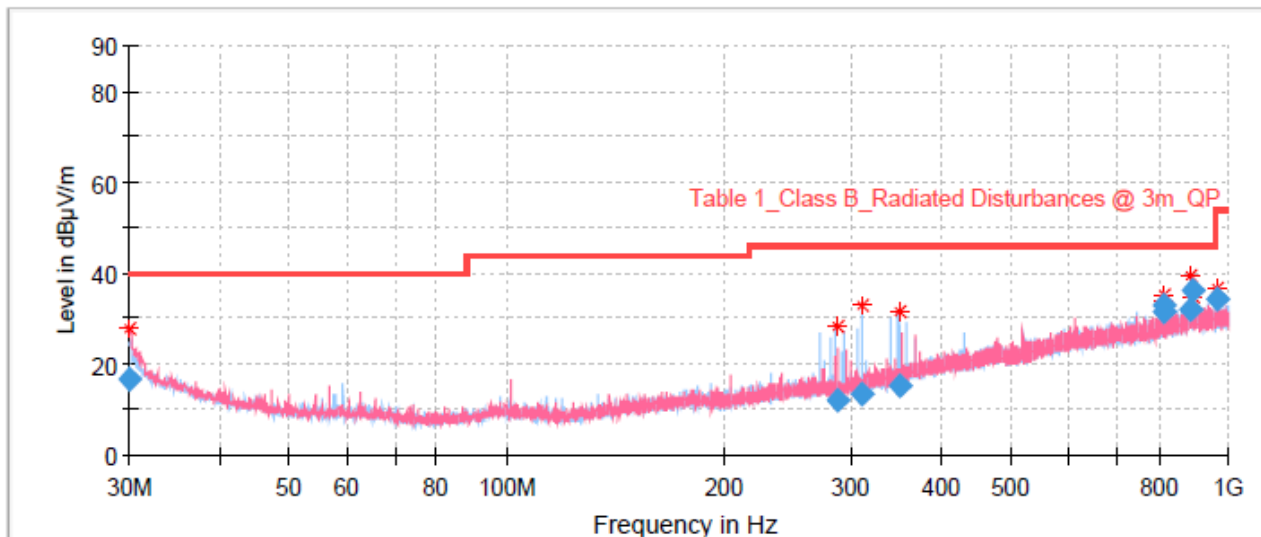
$E_m = E_{dm} + 20 \cdot \log(d/3)$  (d: Measured distance)

$E_m$ : Result of measured distance correction,  $E_{dm}$ : Measured value



## Test Data

[1 GHz Below]



## Final Result

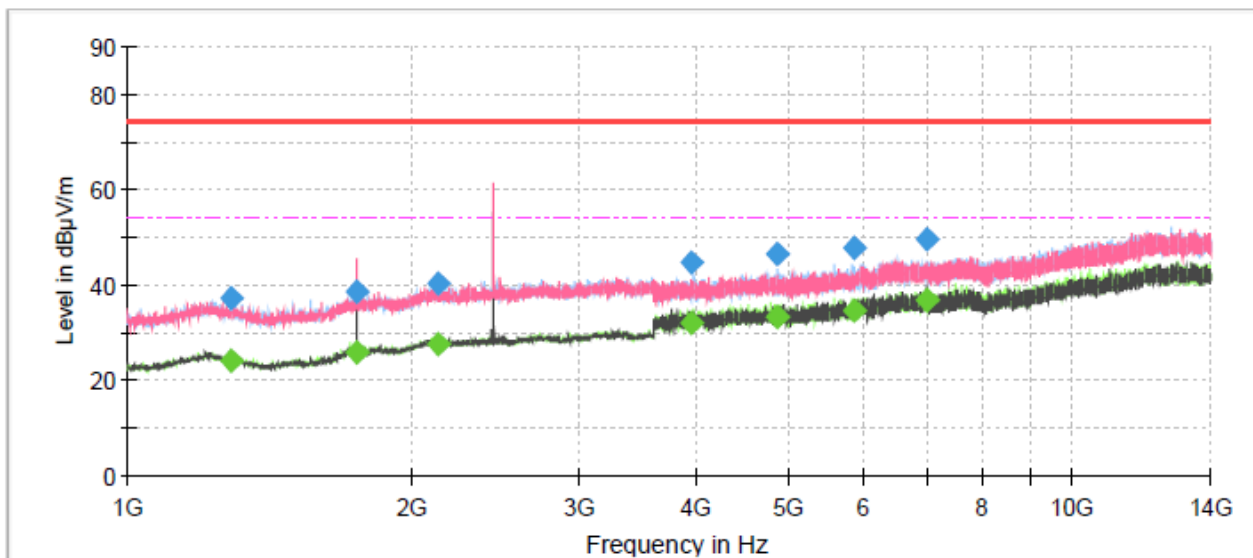
| Frequency (MHz) | QuasiPeak (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|-----------------|--------------------|----------------|-------------|-------------|-----|---------------|------------|
| 30.03           | 16.50              | 40.00          | 23.50       | 105.0       | V   | 164.00        | -5.82      |
| 286.43          | 12.19              | 46.00          | 33.81       | 300.0       | H   | 228.00        | -8.01      |
| 310.74          | 13.40              | 46.00          | 32.60       | 100.0       | H   | 29.00         | -7.15      |
| 349.58          | 15.32              | 46.00          | 30.68       | 100.0       | H   | 68.00         | -5.27      |
| 811.88          | 32.79              | 46.00          | 13.21       | 290.0       | H   | 3.00          | 4.74       |
| 813.32          | 31.70              | 46.00          | 14.30       | 105.0       | V   | 0.00          | 4.79       |
| 888.44          | 32.21              | 46.00          | 13.79       | 194.0       | H   | 145.00        | 6.34       |
| 892.52          | 36.30              | 46.00          | 9.70        | 400.0       | H   | 0.00          | 6.40       |
| 964.26          | 34.14              | 54.00          | 19.86       | 390.0       | H   | 149.00        | 6.65       |





[1 GHz Above]

Result of measured distance correction 3.6 m



| Frequency<br>[MHz] | MaxPeak<br>[dB(uV)/m] | CAverage<br>[dB(uV)/m] | Limit<br>[dB(uV/m)] | Margin<br>[dB] | Height<br>[cm] | Pol. | Azimuth<br>[deg] | Corr.<br>[dB] |
|--------------------|-----------------------|------------------------|---------------------|----------------|----------------|------|------------------|---------------|
| 1289.48            | 38.99                 |                        | 74.00               | 35.01          | 100.0          | H    | 160.0            | -2.6          |
| 1289.48            |                       | 25.69                  | 54.00               | 28.31          | 100.0          | H    | 160.0            | -2.6          |
| 1747.78            | 40.34                 |                        | 74.00               | 33.66          | 225.0          | V    | 333.0            | -1.6          |
| 1747.78            |                       | 27.45                  | 54.00               | 26.55          | 225.0          | V    | 333.0            | -1.6          |
| 2125.57            | 41.78                 |                        | 74.00               | 32.22          | 110.0          | H    | 146.0            | 0.8           |
| 2125.57            |                       | 29.11                  | 54.00               | 24.89          | 110.0          | H    | 146.0            | 0.8           |
| 3953.87            |                       | 33.73                  | 54.00               | 20.27          | 111.0          | V    | 188.0            | 3.8           |
| 3953.87            | 46.47                 |                        | 74.00               | 27.53          | 111.0          | V    | 188.0            | 3.8           |
| 4865.38            | 47.92                 |                        | 74.00               | 26.08          | 111.0          | H    | 83.0             | 4.9           |
| 4865.38            |                       | 34.95                  | 54.00               | 19.05          | 111.0          | H    | 83.0             | 4.9           |
| 5872.58            |                       | 36.39                  | 54.00               | 17.61          | 225.0          | H    | 26.0             | 6.7           |
| 5872.58            | 49.25                 |                        | 74.00               | 24.75          | 225.0          | H    | 26.0             | 6.7           |
| 7010.25            |                       | 38.41                  | 54.00               | 15.59          | 111.0          | V    | 238.0            | 9.1           |
| 7010.25            | 51.24                 |                        | 74.00               | 22.76          | 111.0          | V    | 238.0            | 9.1           |

\* The 2.4 GHz band is the EUT's radio operating frequency.



## Disturbance Voltage test

### Test Method and Summary

Test standard : FCC Part 15 Subpart B

### Used Test Equipment

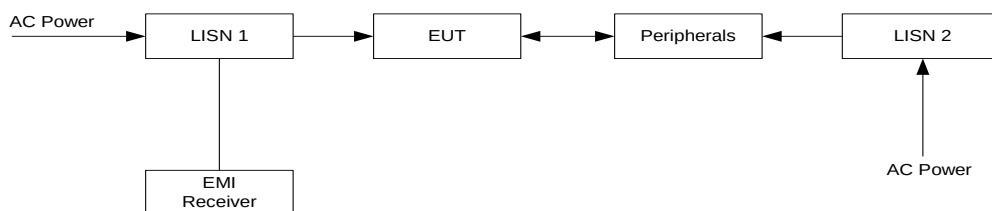
| Control No. | Equipment          | Manufacturer | Model No. | Serial No. | Next Cal.  | Cal Int. |
|-------------|--------------------|--------------|-----------|------------|------------|----------|
| EMC004      | EMI Test Receiver  | R & S        | ESR7      | 101560     | 2021.01.02 | 1Y       |
| EMC007      | Two-Line V-Network | R & S        | ENV216    | 101982     | 2020.10.15 | 1Y       |

### Operating Environment

Test Voltage: -

### Test Setup and Procedure

#### Disturbance Voltage Test at Mains Terminal:



The EUT along with its peripherals were placed on a 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 m space from a vertical reference plane. The EUT was connected to power mains through a line impedance stabilization network (LISN), which provided 50 characteristic coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled.

### Limits

| Frequency range<br>(MHz) | Limits dB(μV) |          |         |          |
|--------------------------|---------------|----------|---------|----------|
|                          | Quasi-peak    |          | Average |          |
|                          | Class A       | Class B  | Class A | Class B  |
| 0.15 to 0.50             | 79            | 66 to 56 | 66      | 56 to 46 |
| 0.50 to 5                | 73            | 56       | 60      | 46       |
| 5 to 30                  |               | 60       |         | 50       |

Note 1) The lower limit shall apply at the transition frequencies.

Note 2) The limit decreases linearly with the logarithm of the frequency in the range (0.15 ~ 0.5) MHz.

Note 3) Result (dBμV) = Reading (dBμV) + Corr. (Insertion Loss (dB) + Cable Loss (dB))

Result: QuasiPeak/CAverage, Reading: Receiver reading value, Corr.: Correction Factor

Margin = Limit – Result



Report No.: 200500063SEL-EMC1

**Test Data**

N/A



## SECTION 7 APPENDIX I

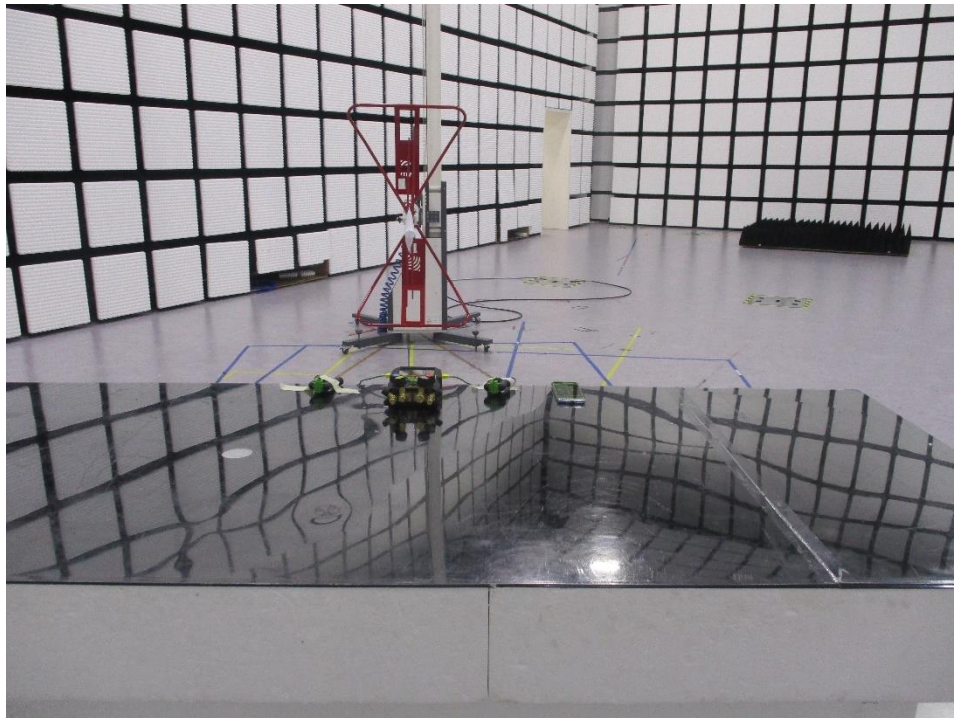
### Photographs of Test Configurations

N/A

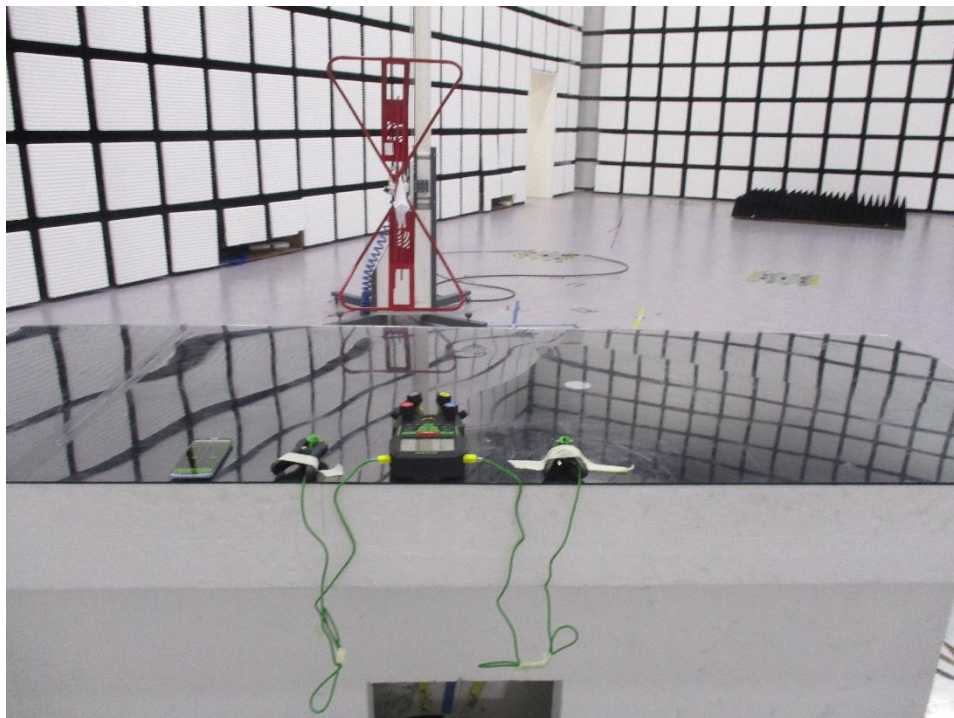
Disturbance Voltage Test

N/A

Disturbance Voltage Test

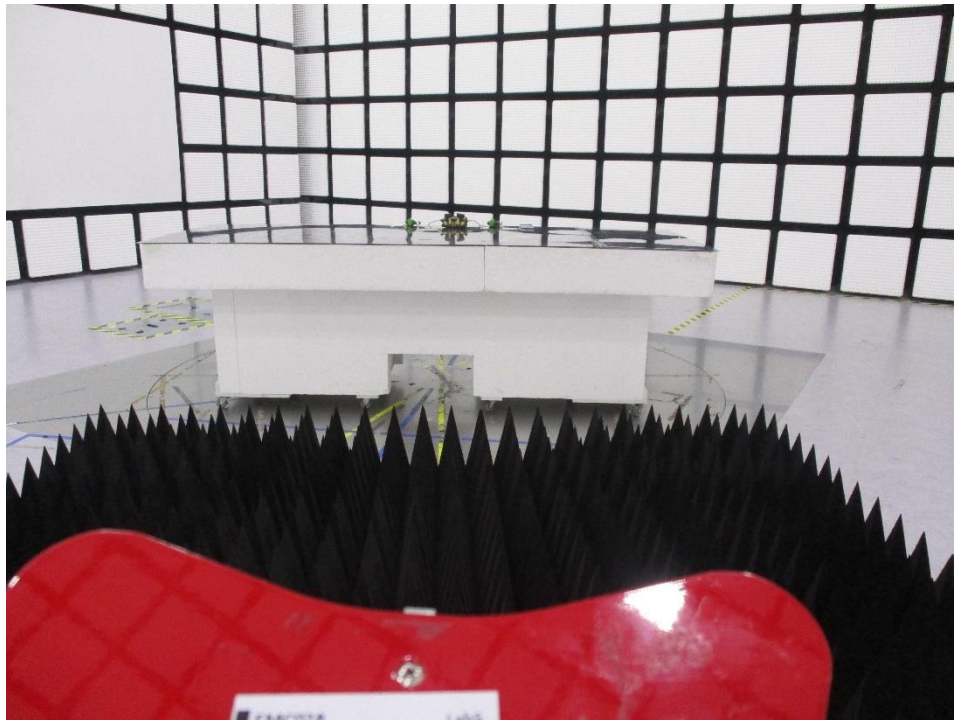


Radiated disturbance (30 MHz ~ 1 GHz)

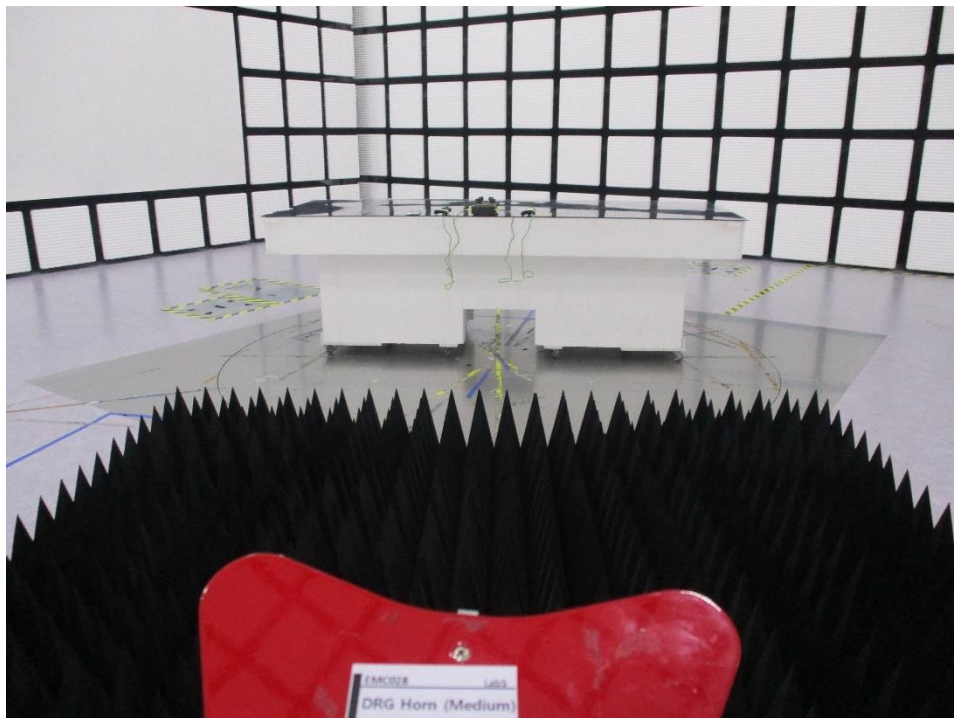


Radiated disturbance (30 MHz ~ 1 GHz)





Radiated disturbance (Above 1 GHz)



Radiated disturbance (Above 1 GHz)



## SECTION 8 APPENDIX II

### Photographs of EUT



Front



Rear



Temperature Sensor Clamp

- E N D -