TEST REPORT

Test Report No. : UL-EMC-RP12196502JD01A

Manufacturer	:	**Raspberry Pi (Trading) Limited**
Type of Equipment	:	**Electrical equipment for measurement**
Model No.	:	**Sense Hat**
Test Standard	:	**EN 61326-1:2013**
Test Result	:	**Complied**

1. This report may not be reproduced other than in full, except with the prior written approval of UL VS Limited.
2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.

Date of issue: 27 April 2018

Checked by:

Eric Phiri
Senior Test Engineer

Company Signatory :

Matthew Owen
EMC Service Lead

0644

This laboratory is accredited by UKAS.
The tests reported herein have been performed in accordance with its terms of accreditation.

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1. CUSTOMER DETAILS

Company Name:	Raspberry Pi (Trading) Limited
Address:	30 Station Road Cambridge CB1 2JH United Kingdom

2. SUMMARY OF TESTING

2.1. Test Specification

Reference:	EN 61326-1:2013
Title:	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements (IEC 61326-1:2012)

2.2. Summary of Test Results

Clause	Measurement Type	Applicability	Result
	EMISSIONS		
7	Mains terminal disturbance (DC Power Input / Output Ports)	No[1]	-
7	Mains terminal disturbance (AC Mains Input / Output Ports)	Yes	✓
7	Electromagnetic radiation disturbance	Yes	✓
7	Harmonic current emissions (AC Mains Input Port)	Yes[1]	✓
7	Voltage fluctuations and flicker (AC Mains Input Port)	Yes[1]	✓
	IMMUNITY		
6	Electrostatic discharge (ESD)	Yes	✓
6	EM field	Yes	✓
6	Voltage dip	Yes[1]	✓
6	Short interruptions	Yes[1]	✓
6	Burst	Yes[1]	✓
6	Surge	Yes[1]	✓
6	Conducted RF	Yes[1]	✓
6	Rated power frequency magnetic field	Yes	✓

Notes:

1. The EUT was DC powered directly by a supporting Raspberry Pi across a 40-pin connector (No DC cable used). For testing purposes, the EUT was considered part of the Raspberry Pi System, which was DC powered by an AC to DC power adapter.

KEY: ✓ = Complied ✗ = Did not comply

2.3. Location of Testing

All the measurements described in this report were performed at the premises of UL VS Ltd, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire RG24 8AH.

2.4. Deviations from Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above, nor from the requirements defined in the basic standards called up within it.

3. EQUIPMENT UNDER TEST (EUT)

3.1. Description of EUT

The EUT was an add-on board for Raspberry Pi, including a 8×8 RGB LED matrix, a five-button joystick and the following sensors: Gyroscope, Accelerometer, Magnetometer, Temperature, Barometric pressure and Humidity.

3.2. Identification of Equipment under Test (EUT)

ID#	Description	Brand Name	Model No	Serial No
E1	Add-on board for Raspberry Pi	Raspberry Pi	Sense Hat	40065114010118151532

3.3. Port Identification

Port	Description	Possible Length (m)	Type	Connector
P1.1	Enclosure	Not Applicable	Enclosure	Not Applicable
P1.2	DC Power Input and Signals	Directly connected to E1	DC Power Input / Signal	40-Pin GPIO Header

3.4. Operating Modes

Mode Reference	Definition
Normal Operation (Radiated Emissions Only)	The EUT was docked in a supporting Raspberry Pi, which was executing a Python-script for a continuous RGB colour changing on the 8×8 RGB LED matrix. All the sensors were active once the EUT was powered by the supporting Raspberry Pi.
Normal Operation	The EUT was docked in a supporting Raspberry Pi, which was executing a Python-script with the following program sequence: • The EUT was in continuous RGB colour changing on the 8×8 RGB LED matrix. • The EUT was providing all the sensor figures, which were displayed on a supporting Monitor connected to the supporting Raspberry Pi.

3.5. Configuration and Peripherals

Description:	Please refer to the Test Configuration and Photograph section for schematic drawing(s) and/or photograph(s) of the test configuration(s) employed in the course of testing.

3.6. Modifications

NOTE: No modifications were made to the EUT during the course of testing.

3.7. Additional Information Related to Testing

Equipment Category:	Electrical equipment for measurement
Intended Operating Environment:	Residential / Commercial / Light Industrial
Intended Installation:	Table top / Rack Mounted / Wall Mounted /
Cycle Time:	< 1s
Power Supply Requirement(s):	5 VDC and 3.3 VDC (supplied by the supporting Raspberry Pi)
Weight:	20 g
Dimensions:	56 x 66 x 14 mm
Equipment Class:	B
Hardware Version Number:	V1
Software Version Number:	V1
Highest Internally Generated Operating Frequency:	5235 MHz

4. SUPPORT EQUIPMENT

4.1. Identification of Support Equipment

Description	Manufacturer	Model No	Serial No
Single-Board Computer	Raspberry Pi	Raspberry Pi 3 Model B+	000000005633b9c5
AC to DC Power Adapter	Raspberry Pi	DSA-12CA-05	None Stated
Screen Monitor	ASUS	PA238	F4LMTF022693
Keyboard[1]	Microsoft	1366	0065806454108
Mouse[1]	Dell	MS111-P	None Stated

4.2. Interconnecting Cables

Cable Type	Shielded	Length (m)	Ferrite	Connection 1	Connection 2
HDMI	No	2.0	No	EUT	Screen Monitor
USB 3.0	No	2.0	No	EUT	Keyboard[1]
USB 3.0	No	1.8	No	EUT	Mouse[1]
2 Core	No	1.5	No	EUT	AC to DC Power Adapter
Direct connection				AC to DC Power Adapter	AC Mains Supply
3 Core	No	2.0	No	Screen Monitor	AC Mains Supply

Note:
1. The Keyboard and Mouse were used for initial configuration only.

5. MONITORING PERFORMANCE

5.1. Overview

Performance criteria were used to make a decision on whether the EUT passed or failed the applicable immunity tests. The following categories of performance criteria were defined for the measurements included within this test report.

5.2. Performance Criteria

Criteria	During and after the test
A	The equipment shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.
B	The equipment shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the equipment if used as intended.
C	Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

5.3. Monitoring EUT Performance During Testing

For the purposes of testing, the term "*operate as intended*" was defined as:	The EUT continued changing the colour of its 8×8 RGB LED matrix as per the Python Script sequence, executed on the supporting Raspberry Pi. The EUT continued providing all the sensor measured values, which were displayed on a supporting Monitor connected to the Raspberry Pi.
For the purposes of testing, an "*unintentional response*" was defined as:	An EMI phenomenon caused the EUT to: Stop changing the colour of its 8×8 RGB LED matrix as per the Python Script sequence. Stop providing any sensor values or the provided value was higher than ±10% of its initial stable value
Method used to determine whether user control functions and stored data were lost after the EMC exposure:	A functional check was performed before and after every test, which included checking the EUT was able to stop the Python script sequence once it was stopped in the auxiliary Raspberry Pi.
Method of assessment of level of performance or degradation of performance during and/or after EMC exposure:	The EUT's RGB LED matrix was visually monitored for any malfunction or cessation of the sequence in the Python Script. The reported sensors value from the EUT, were visually monitored on the supporting screen monitor for either any cessation of the reported value or a value higher than ±10% of its initial stable value.

6. MEASUREMENT UNCERTAINTY

6.1. Overview

No measurement can ever be perfect and those imperfections give rise to error. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement regarding the uncertainty of approximation.

Note that compliance is determined solely upon the results of compliance measurements and does not take into account measurement uncertainties. The measurement uncertainty values quoted in this report are for information only as they do not influence the associated test results.

6.2. Method of calculation

The methods used to calculate the uncertainties included within this test report are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the United Kingdom Accreditation Service (UKAS) is followed.

7. MEASUREMENTS, EXAMINATIONS AND DERIVED RESULTS

7.1. General Comments

7.1.1. This section contains the test result sheets for the measurements listed in Section ***2.2. Summary of Test Results*** (above).

7.1.2. The measurement uncertainties stated in the test result sheets were calculated in accordance with documented best practice and represent a confidence level of 95%. Where only confidence level is given, it has been demonstrated that the relevant items of test equipment used meet the specified requirements in the standard with at least this level of confidence.

7.1.3. Please refer to Section ***6. Measurement Uncertainty*** on page 10 for details of our treatment of measurement uncertainty.

RADIATED EMISSIONS - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 1
EUT:	Sense Hat	**TEMPERATURE:**	20 °C to 23 °C
TEST ENGINEER:	John Hernandez	**RELATIVE HUMIDITY:**	37 % to 45 %
DATE OF TEST:	12 Apr 2018	**ATMOSPHERIC PRESSURE:**	1004 mb to 1004 mb
FIELD TYPE:	Electric Field	**MEASUREMENT DISTANCE:**	3 Metres
UNCERTAINTY:	< 1 GHz: ± 4.65 dB > 1 GHz: ± 4.37 dB	**EQUIPMENT CLASS:**	Class B
MEASUREMENT UNITS:	dBµV/m	**TEST ENVIRONMENT:**	Test Site

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 55011: 2009 + A2: 2010
TITLE:	Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement

COMMENTS

None

DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	Not Applicable

MEASUREMENT RESULTS

No.	Frequency (MHz)	Polarisation	Detector	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Graph No.	Result
1	62.996	Vertical	Quasi-Peak	15.4	40.0	24.6	GPH\12196502JD01\001	Complied
2	84.582	Vertical	Quasi-Peak	13.4	40.0	26.6	GPH\12196502JD01\001	Complied
3	129.671	Vertical	Quasi-Peak	14.5	40.0	25.5	GPH\12196502JD01\001	Complied
4	174.151	Vertical	Quasi-Peak	20.4	40.0	19.6	GPH\12196502JD01\001	Complied
5	187.759	Vertical	Quasi-Peak	21.4	40.0	18.6	GPH\12196502JD01\001	Complied
6	246.480	Vertical	Quasi-Peak	29.6	47.0	17.4	GPH\12196502JD01\001	Complied
7	361.476	Horizontal	Quasi-Peak	27.0	47.0	20.0	GPH\12196502JD01\001	Complied
8	400.003	Horizontal	Quasi-Peak	32.3	47.0	14.7	GPH\12196502JD01\001	Complied
9	536.985	Horizontal	Quasi-Peak	27.0	47.0	20.0	GPH\12196502JD01\001	Complied
10	950.826	Vertical	Quasi-Peak	29.6	47.0	17.4	GPH\12196502JD01\001	Complied

TEST EQUIPMENT USED				
UL ID	**INSTRUMENT DESCRIPTION**	**MODEL NUMBER**	**CALIBRATION DUE**	**INTERVAL**
K0001	5 m Semi-Anechoic Chamber	N/A	12 Mar 2019	12
A2102	1+ GHz Mast Controller	Controller NCD	Calibration not required	N/A
M2009	Thermo-Hygrometer	608-H1	20 Jun 2018	12
G0543	Amplifier 9kHz - 1GHz	310N	15 Jun 2018	12
M1273	20 Hz to 26.5 GHz EMI Test Receiver	ESIB 26	08 May 2018	12
A2959	Trilog Broadband Antenna	VULB 9163	16 Nov 2018	12
C1411	1 metre RF cable	239-0088-1000	14 Mar 2019	12
C1409	5 m RF Cable	239-0088-5000	14 Mar 2019	12
C1407	15 m RF Cable	262-0941-15M0	14 Mar 2019	12
C1502	8 m RF Cable	104A	14 Mar 2019	12
A2935	Maturo 30 MHz to 1 GHz Mast	AM4.0	Calibration not required	N/A
A2936	Maturo 3 metre turntable	TT1.5WF	Calibration not required	N/A

CONDUCTED EMISSIONS - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 8
EUT:	Sense Hat	**TEMPERATURE:**	21 °C To 22 °C
TEST ENGINEER:	Bahar Kordi-Borojeni	**RELATIVE HUMIDITY:**	44 % To 39 %
DATE OF TEST:	16 Apr 2018	**ATMOSPHERIC PRESSURE:**	1013 mb To 1014 mb
UNCERTAINTY:	± 2.40 dB	**EQUIPMENT CLASS:**	Group 1 B
EUT CATEGORY:	Not Applicable	**MEASUREMENT METHOD:**	LISN (AC)
PORT UNDER TEST:	AC Power Input	**EUT SUPPLY VOLTAGE:**	230 VAC

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 55011: 2009 + A1: 2010
TITLE:	Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement

COMMENTS

None

DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	Not Applicable

MEASUREMENT RESULTS

No.	Frequency (MHz)	Line	Detector	Level (dBµV)	Limit (dBµV)	Margin (dB)	Graph No.	Result
1	0.150	Live	Quasi-Peak	49.3	66.0	16.7	GPH\12196502JD01\001	Complied
2	0.254	Neutral	Quasi-Peak	47.4	61.6	14.2	GPH\12196502JD01\001	Complied
3	0.636	Neutral	Quasi-Peak	41.9	56.0	14.1	GPH\12196502JD01\001	Complied
4	1.271	Neutral	Quasi-Peak	40.9	56.0	15.1	GPH\12196502JD01\001	Complied
5	1.856	Live	Quasi-Peak	42.0	56.0	14.0	GPH\12196502JD01\001	Complied
6	2.292	Live	Quasi-Peak	41.3	56.0	14.7	GPH\12196502JD01\001	Complied
7	3.408	Live	Quasi-Peak	38.8	56.0	17.2	GPH\12196502JD01\001	Complied
8	4.889	Neutral	Quasi-Peak	45.5	56.0	10.5	GPH\12196502JD01\001	Complied
9	6.581	Neutral	Quasi-Peak	46.7	60.0	13.3	GPH\12196502JD01\001	Complied
10	25.058	Neutral	Quasi-Peak	23.3	60.0	36.7	GPH\12196502JD01\001	Complied
11	0.168	Neutral	Average (CISPR)	42.7	55.1	12.4	GPH\12196502JD01\001	Complied
12	0.299	Neutral	Average (CISPR)	42.3	50.3	8.0	GPH\12196502JD01\001	Complied
13	0.632	Neutral	Average (CISPR)	41.3	46.0	4.7	GPH\12196502JD01\001	Complied
14	1.293	Live	Average (CISPR)	39.8	46.0	6.2	GPH\12196502JD01\001	Complied
15	1.896	Live	Average (CISPR)	36.8	46.0	9.2	GPH\12196502JD01\001	Complied
16	2.292	Live	Average (CISPR)	34.0	46.0	12.0	GPH\12196502JD01\001	Complied
17	3.417	Live	Average (CISPR)	38.7	46.0	7.3	GPH\12196502JD01\001	Complied
18	4.974	Neutral	Average (CISPR)	42.7	46.0	3.3	GPH\12196502JD01\001	Complied
19	6.531	Neutral	Average (CISPR)	42.4	50.0	7.6	GPH\12196502JD01\001	Complied
20	25.058	Live	Average (CISPR)	21.1	50.0	28.9	GPH\12196502JD01\001	Complied

TEST EQUIPMENT USED

UL ID	INSTRUMENT DESCRIPTION	MODEL NUMBER	CALIBRATION DUE	INTERVAL
K0008	Conducted Emissions / RF Immunity Laboratory	N/A	Calibration not required	N/A
M2013	Thermo-Hygrometer	608-H1	20 Jun 2018	12
N0612	Site 8 Test PC	Motherboard: Asus M4A88T-V EVO/USB3 RevX.0x	Calibration not required	N/A
M1263	R&S ESIB7 Test Receiver	ESIB7	13 Nov 2018	12
A1830	Pulse Limiter	ESH3-Z2	06 Apr 2019	12
C455	3 m RF Cable	RG142XX-001-RFIB	08 May 2018	12
A3019	Matched LISN Power Cable Assembly	None Stated	Calibrated as part of system	N/A
A649	Single Phase LISN	ESH3-Z5	31 May 2018	12

HARMONIC CURRENT EMISSIONS - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 6
EUT:	Sense Hat	**TEMPERATURE:**	23 °C to 23 °C
TEST ENGINEER:	Bahar Kordi-Borojeni	**RELATIVE HUMIDITY:**	43 % to 43 %
DATE OF TEST:	17 Apr 2018	**ATMOSPHERIC PRESSURE:**	1020 mb to 1020 mb
UNCERTAINTY:	± 4.28 %	**EQUIPMENT CLASS:**	Class A
THC (A):	0.04	**POHC (A):**	0.011
I-THD (%):	145.90	**POHC LIMIT (A):**	0.251

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 61000-3-2:2014
TITLE:	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

COMMENTS

None

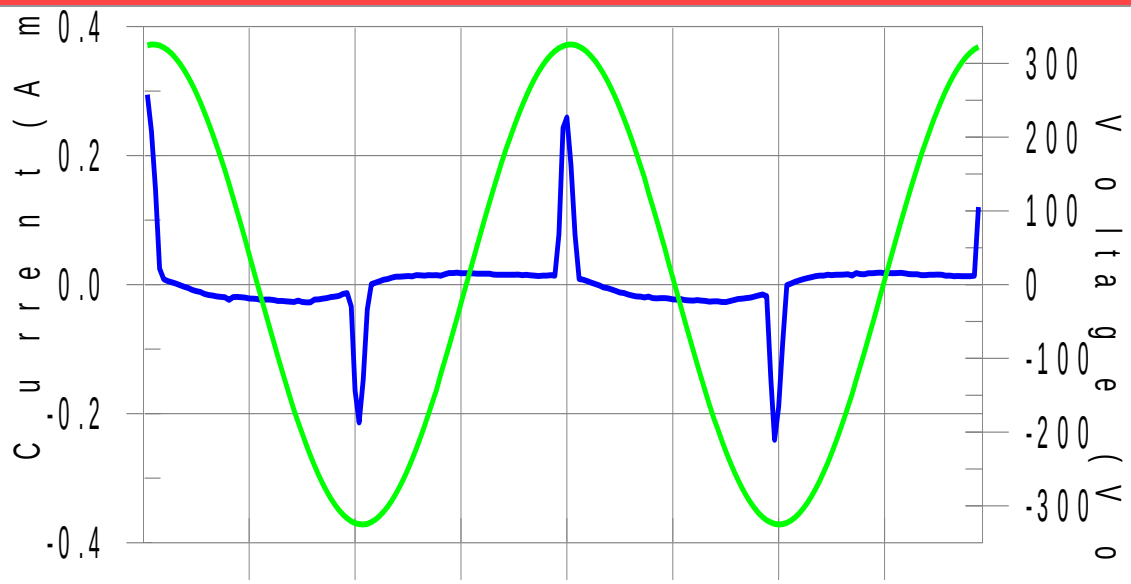
DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

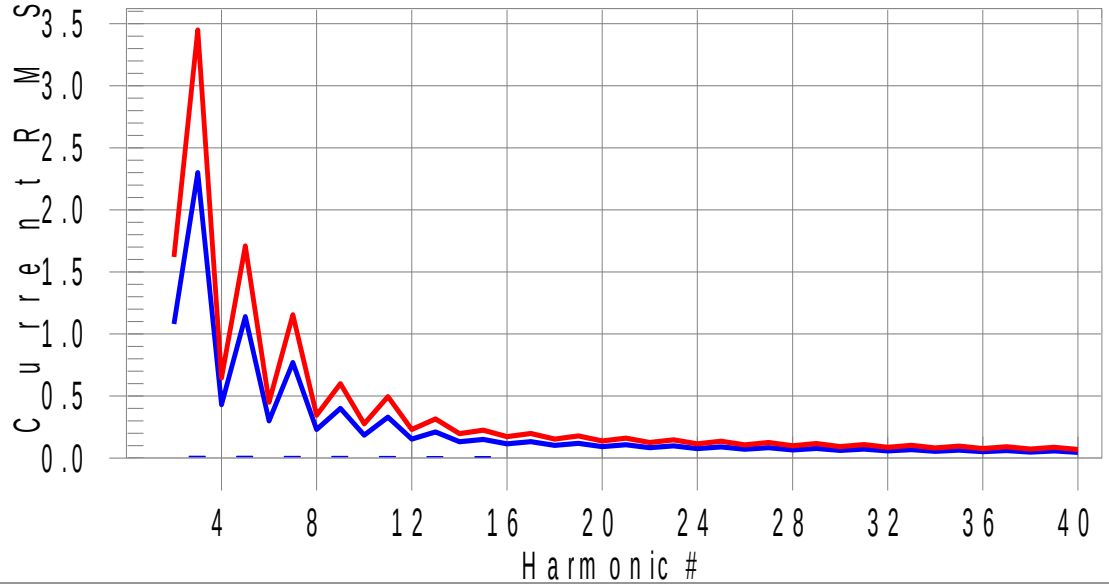
EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	Not Applicable

CURRENT AND VOLTAGE WAVEFORMS



HARMONICS AND CLASS A LIMIT LINE (EUROPEAN LIMITS)



HIGHEST PARAMETER VALUES DURING TEST

V_RMS (V):	230.09	**FREQUENCY (Hz):**	50
I_PEAK (A):	0.294	**I_RMS (A):**	0.054
I_FUND (A):	0.027	**CREST FACTOR:**	6.177
POWER (W):	5	**POWER FACTOR:**	0.444

MEASUREMENT RESULTS

Harm	Harms (Avg)	100% Limit	% of Limit	Harms (Max)	150% Limit	% of Limit	Result
2	0.001	1.08	N/A	0.003	1.620	N/A	Complied
3	0.015	2.30	0.7	0.017	3.450	0.50	Complied
4	0.001	0.43	N/A	0.002	0.645	N/A	Complied
5	0.015	1.14	1.3	0.016	1.710	1.00	Complied
6	0.001	0.30	N/A	0.001	0.450	N/A	Complied
7	0.014	0.77	1.9	0.016	1.155	1.30	Complied
8	0.001	0.23	N/A	0.001	0.345	N/A	Complied
9	0.014	0.40	3.4	0.015	0.600	2.40	Complied
10	0.001	0.18	N/A	0.001	0.276	N/A	Complied
11	0.013	0.33	3.8	0.014	0.495	2.70	Complied
12	0.000	0.15	N/A	0.001	0.230	N/A	Complied
13	0.012	0.21	5.5	0.012	0.315	3.90	Complied
14	0.000	0.13	N/A	0.001	0.197	N/A	Complied
15	0.010	0.15	6.9	0.011	0.225	4.90	Complied
16	0.000	0.12	N/A	0.000	0.173	N/A	Complied
17	0.009	0.13	6.9	0.010	0.198	4.90	Complied
18	0.000	0.10	N/A	0.000	0.153	N/A	Complied
19	0.008	0.12	6.7	0.008	0.178	4.70	Complied
20	0.000	0.09	N/A	0.000	0.138	N/A	Complied
21	0.007	0.11	6.2	0.007	0.161	4.30	Complied
22	0.000	0.08	N/A	0.000	0.125	N/A	Complied
23	0.006	0.10	5.6	0.006	0.147	3.80	Complied
24	0.000	0.08	N/A	0.000	0.115	N/A	Complied
25	0.004	0.09	N/A	0.004	0.135	N/A	Complied
26	0.000	0.07	N/A	0.000	0.107	N/A	Complied
27	0.003	0.08	N/A	0.003	0.125	N/A	Complied
28	0.000	0.07	N/A	0.000	0.099	N/A	Complied
29	0.002	0.08	N/A	0.003	0.116	N/A	Complied

MEASUREMENT RESULTS

Harm	Harms (Avg)	100% Limit	% of Limit	Harms (Max)	150% Limit	% of Limit	Result
30	0.000	0.06	N/A	0.000	0.092	N/A	Complied
31	0.002	0.07	N/A	0.002	0.109	N/A	Complied
32	0.000	0.06	N/A	0.000	0.086	N/A	Complied
33	0.001	0.07	N/A	0.001	0.102	N/A	Complied
34	0.000	0.05	N/A	0.000	0.081	N/A	Complied
35	0.001	0.06	N/A	0.001	0.096	N/A	Complied
36	0.000	0.05	N/A	0.000	0.077	N/A	Complied
37	0.000	0.06	N/A	0.001	0.091	N/A	Complied
38	0.000	0.05	N/A	0.000	0.073	N/A	Complied
39	0.001	0.06	N/A	0.001	0.087	N/A	Complied
40	0.000	0.05	N/A	0.000	0.069	N/A	Complied

TEST EQUIPMENT USED

UL ID	INSTRUMENT DESCRIPTION	MODEL NUMBER	CALIBRATION DUE	INTERVAL
K0006	Electrostatic Discharge and Fast Transient Laboratory	N/A	Calibration not required	N/A
M2010	Thermo-Hygrometer	608-H1	20 Jun 2018	12
N0604	Site 18 Harmonics and Flicker Desktop PC	0	Calibration not required	N/A
M1188	Signal Conditioning Unit - Lumped Impedance	CCN 1000-1	25 May 2018	12
M1780	Data Acquisition Card	PCI-6220	25 May 2018	12
S0588	AC Power Supply for Harmonics and Flicker Testing	TPS/M3000	03 Aug 2018	12

VOLTAGE FLUCTUATIONS AND FLICKER - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 6
EUT:	Sense Hat	**TEMPERATURE:**	23 °C to 22 °C
TEST ENGINEER:	Bahar Kordi-Borojeni	**RELATIVE HUMIDITY:**	43 % to 43 %
DATE OF TEST:	17 Apr 2018	**ATMOSPHERIC PRESSURE:**	1020 mb to 1020 mb
UNCERTAINTY:	± 3.39 %	**P_{lt} Limit:**	0.65
VOLTAGE:	230 V	**P_{st} Limit:**	1
FREQUENCY:	50 Hz		

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 61000-3-3: 2013
TITLE:	Electromagnetic compatibility (EMC) - Part 3: Limits - Section 3: Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection

COMMENTS

In accordance with Clause 6.1 of EN 61000-3-3:2013, Voltage Fluctuations and Flicker measurements need not be made on equipment unlikely to produce significant voltage fluctuations or flicker.

It was determined that this was the case for the EUT in this report; however, the measurement results are still summarised on this page for information purposes only.

DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	Not Applicable

PARAMETER VALUES RECORDED DURING TEST

Vrms at the end of the test (V):	230.01			
Highest dt (%)	0.00	**Test Limit (%):**	Refer to Note 1	
Time (ms) > dt:	0.0	**Test Limit (ms):**	500.0	Complied
Highest dc (%):	0.00	**Test Limit (%):**	3.30	Complied
Highest dmax (%):	0.00	**Test Limit (%):**	4.00	Complied

NOTES

1	Due to the low level of the measured voltage fluctuations (i.e., 0 %) induced on the supply by the EUT, there was no applicable limit for this parameter. The measurement software reported “N/A” in place of the specification limit.

TEST EQUIPMENT USED

UL ID	INSTRUMENT DESCRIPTION	MODEL NUMBER	CALIBRATION DUE	INTERVAL
K0006	Electrostatic Discharge and Fast Transient Laboratory	N/A	Calibration not required	N/A
M2010	Thermo-Hygrometer	608-H1	20 Jun 2018	12
N0604	Site 18 Harmonics and Flicker Desktop PC	0	Calibration not required	N/A
M1188	Signal Conditioning Unit - Lumped Impedance	CCN 1000-1	25 May 2018	12
M1780	Data Acquisition Card	PCI-6220	25 May 2018	12
S0588	AC Power Supply for Harmonics and Flicker Testing	TPS/M3000	03 Aug 2018	12

RADIATED IMMUNITY - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 10
EUT:	Sense Hat	**TEMPERATURE:**	20 °C to 20 °C
TEST ENGINEER:	John Hernandez & Bahar Kordi-borojeni	**RELATIVE HUMIDITY:**	48 % to 47 %
DATE OF TEST:	13 Apr 2018	**ATMOSPHERIC PRESSURE:**	1005 mb to 1006 mb
UNCERTAINTY:	± 2.56 dB	**DWELL TIME:**	2 s
PERFORMANCE CRITERIA:	Criterion A	**FREQUENCY RANGE:**	80 MHz to 6 GHz
LEVEL:	3 V/m	**SWEEP RATE:**	2.161×10^{-3} decades/s
STEP SIZE:	1% log of momentary frequency	**MODULATION:**	80% AM @ 1 kHz

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 61000-4-3: 2006 + A2: 2010 Incorporating corrigendum October 2009
TITLE:	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test

COMMENTS

The list of actual test frequencies used during these measurements is available on request.

DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	The EUT's RGB LED matrix was visually monitored for any modification or cessation of the Python Script sequence. The reported sensors value from the EUT, were visually monitored on the supporting screen monitor for either any cessation of the reported value or a value higher than ±10 % of its initial stable value.

MEASUREMENT RESULTS

No.	Frequency Band	Spot Frequency	Face	Antenna Polarisation	Level	Notes	Result
1	80 MHz to 1000 MHz	-	Front	Horizontal	3 V/m	-	Complied
2	1000 MHz to 6000 MHz	-	Front	Horizontal	3 V/m	-	Complied
3	80 MHz to 1000 MHz	-	Left	Horizontal	3 V/m	-	Complied
4	1000 MHz to 6000 MHz	-	Left	Horizontal	3 V/m	-	Complied
5	80 MHz to 1000 MHz	-	Rear	Horizontal	3 V/m	-	Complied
6	1000 MHz to 6000 MHz	-	Rear	Horizontal	3 V/m	-	Complied
7	80 MHz to 1000 MHz	-	Right	Horizontal	3 V/m	-	Complied
8	1000 MHz to 6000 MHz	-	Right	Horizontal	3 V/m	-	Complied
9	80 MHz to 1000 MHz	-	Front	Vertical	3 V/m	-	Complied
10	1000 MHz to 6000 MHz	-	Front	Vertical	3 V/m	-	Complied
11	80 MHz to 1000 MHz	-	Left	Vertical	3 V/m	-	Complied
12	1000 MHz to 6000 MHz	-	Left	Vertical	3 V/m	-	Complied
13	80 MHz to 1000 MHz	-	Rear	Vertical	3 V/m	-	Complied
14	1000 MHz to 6000 MHz	-	Rear	Vertical	3 V/m	-	Complied
15	80 MHz to 1000 MHz	-	Right	Vertical	3 V/m	-	Complied
16	1000 MHz to 6000 MHz	-	Right	Vertical	3 V/m	-	Complied

TEST EQUIPMENT USED

UL ID	INSTRUMENT DESCRIPTION	MODEL NUMBER	CALIBRATION DUE	INTERVAL
K0009	Radiated Immunity Test Chamber	N/A	05 Jan 2019	12
M2015	Thermo-Hygrometer	608-H1	20 Jun 2018	12
A1918	Camera System	Scout	Calibration not required	N/A
A1921	Camera System	Scout	Calibration not required	N/A
A1925	Hi Resolution Monitor	PVD1700DG	Calibration not required	N/A
A2057	80 MHz to 6 GHz Radiated Immunity Antenna	ATR80M6G	Calibrated as part of system	N/A
G0631	AR 700 MHz to 6 GHz Amplifier	100S1G6	Calibrated as part of system	N/A
G0632	Radiated Immunity System	MT06000A	07 Dec 2018	12
G0633	250 W 80 MHz to 1 GHz RF Amplifier	250W1000B	05 May 2018	12
C1412	1 metre RF cable	11-04-204	Calibrated as part of system	N/A
C1413	1 metre RF cable	239-0088-1000	Calibrated as part of system	N/A
C1309	1.2 m Andrews Cable	RG213/U MIL-C-170	Calibrated as part of system	N/A

ELECTROSTATIC DISCHARGE - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 6
EUT:	Sense Hat	**TEMPERATURE:**	22 °C to 22 °C
TEST ENGINEER:	Bahar Kordi-Borojeni	**RELATIVE HUMIDITY:**	44 % to 43 %
DATE OF TEST:	17 Apr 2018	**ATMOSPHERIC PRESSURE:**	1018 mb to 1018 mb
UNCERTAINTY:	95% confidence level	**AIR CONTACT LIMIT:**	8 kV
PERFORMANCE CRITERIA:	Criterion B	**DIRECT CONTACT LIMIT:**	4 kV

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 61000-4-2: 2009
TITLE:	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test

COMMENTS

None

DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	The EUT's RGB LED matrix was visually monitored for any modification or cessation of the Python Script sequence. The reported sensors value from the EUT, were visually monitored on the supporting screen monitor for either any cessation of the reported value or a value higher than ±10% of its initial stable value.

DIRECT CONTACT TO EUT

Test Points	No. Attempted	Test Voltage (kV)	Notes	Result
1	10	± 2.0	-	Complied
1	10	± 4.0	-	Complied

AIR GAP TO EUT

Refer to Note 1

POSITION TO OBJECT IN VICINITY OF EUT (HORIZONTAL COUPLING PLANE)

Test Points	No. Attempted	Test Voltage (kV)	Notes	Result
Front, Left, Rear, Right	10	± 2.0	-	Complied
Front, Left, Rear, Right	10	± 4.0	-	Complied

POSITION TO OBJECT IN VICINITY OF EUT (VERTICAL COUPLING PLANE)

Test Points	No. Attempted	Test Voltage (kV)	Notes	Result
Front, Left, Rear, Right	10	± 2.0	-	Complied
Front, Left, Rear, Right	10	± 4.0	-	Complied

NOTE(S)

1	Due to the all-metal construction of the EUT, air discharges were not applicable.

TEST EQUIPMENT USED

UL ID	INSTRUMENT DESCRIPTION	MODEL NUMBER	CALIBRATION DUE	INTERVAL
K0006	Electrostatic Discharge and Fast Transient Laboratory	N/A	Calibration not required	N/A
M2010	Thermo-Hygrometer	608-H1	20 Jun 2018	12
A2423	ESD Bench	N/A	Calibrated before use	N/A
A1420	Vertical Coupling Plane	N/A	Calibrated before use	N/A
A1934	Discharge Network	N/A	Calibrated before use	N/A
A1935	Discharge Carbon Brush	N/A	Calibrated before use	N/A
G090	ESD Simulator	NSG 435	04 Jan 2019	12

FAST TRANSIENTS - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 6
EUT:	Sense Hat	**TEMPERATURE:**	21 °C to 22 °C
TEST ENGINEER:	Bahar Kordi-Borojeni	**RELATIVE HUMIDITY:**	44 % to 45 %
DATE OF TEST:	17 Apr 2018	**ATMOSPHERIC PRESSURE:**	1018 mb to 1018 mb
UNCERTAINTY:	95% confidence level	**LEVEL:**	± 1.0 kV
PERFORMANCE CRITERIA:	Criterion B	**BURST PERIOD:**	300 ms
REPETITION RATE:	5.0 kHz	**BURST DURATION:**	15 ms
PULSE RISE TIME:	5 ns	**PULSE DURATION**	50 ns

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 61000-4-4: 2012
TITLE:	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test

COMMENTS

None

DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	The EUT's RGB LED matrix was visually monitored for any modification or cessation of the Python Script sequence. The reported sensors value from the EUT, were visually monitored on the supporting screen monitor for either any cessation of the reported value or a value higher than ±10% of its initial stable value.

TEST RESULTS

No	Port	Line Under Test	Test Voltage (kV)	Notes	Result
1	AC Power Input	Live	± 0.5	-	Complied
2	AC Power Input	Neutral	± 0.5	-	Complied
3	AC Power Input	Live and Neutral	± 0.5	-	Complied
4	AC Power Input	Live	± 1.0	-	Complied
5	AC Power Input	Neutral	± 1.0	-	Complied
6	AC Power Input	Live and Neutral	± 1.0	-	Complied

TEST EQUIPMENT USED

UL ID	INSTRUMENT DESCRIPTION	MODEL NUMBER	CALIBRATION DUE	INTERVAL
K0006	Electrostatic Discharge and Fast Transient Laboratory	N/A	Calibration not required	N/A
M2010	Thermo-Hygrometer	608-H1	20 Jun 2018	12
G0625	EMC Transient Immunity Generator	IMU4000	08 Mar 2019	12

CONDUCTED IMMUNITY - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 8
EUT:	Sense Hat	**TEMPERATURE:**	20 °C to 21 °C
TEST ENGINEER:	Kordi-borojeni, Bahar	**RELATIVE HUMIDITY:**	46 % to 44 %
DATE OF TEST:	16 Apr 2018	**ATMOSPHERIC PRESSURE:**	1011 mb to 1013 mb
UNCERTAINTY:	± 3.35 dB	**DWELL TIME:**	1.5 s
PERFORMANCE CRITERIA:	Criterion A	**FREQUENCY RANGE:**	0.15 to 80 MHz
LEVEL:	3 V_{rms}	**SWEEP RATE:**	2.881x10^{-3} decades/s
STEP SIZE:	1% log of momentary frequency	**MODULATION:**	80% AM @ 1 kHz

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 61000-4-6: 2009
TITLE:	Electromagnetic compatibility (EMC) Part 4-6: Testing and measurement techniques - Immunity disturbances, induced by radio-frequency fields

COMMENTS

The list of actual test frequencies used during these measurements is available on request.

DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	The EUT's RGB LED matrix was visually monitored for any modification or cessation of the Python Script sequence. The reported sensors value from the EUT, were visually monitored on the supporting screen monitor for either any cessation of the reported value or a value higher than ±10 % of its initial stable value.

MEASUREMENT RESULTS

No.	Line Under Test	Coupling Method	Frequency Band	Spot Frequency	Level	Notes	Result
1	AC Mains Input	CDN	0.15 to 80 MHz	-	3 V_{rms}	-	Complied

TEST EQUIPMENT USED

UL ID	INSTRUMENT DESCRIPTION	MODEL NUMBER	CALIBRATION DUE	INTERVAL
K0008	Conducted Emissions / RF Immunity Laboratory	N/A	Calibration not required	N/A
M2013	Thermo-Hygrometer	608-H1	20 Jun 2018	12
A312	CDN	M2	04 Jan 2019	12
C1071	RF Cable	FA21A1030M5050	Calibrated before use	N/A
N0545	Site 8 PC with Schaffner C3 Immunity Software	450	Calibration not required	N/A
M1163	Power Meter 10 kHz - 2 GHz	CPW 9670	28 Jul 2018	12
G047	9 kHz to 1.04 GHz frequency range	SMY01	10 Aug 2018	12
G0629	150 W Power Amplifier 0.01-400 MHz	VBA400-150	Calibrated as part of system	N/A
C172	RF Cable	UFA210A-1-1181-70x70	Calibrated before use	N/A
C356	RF Cable	UFA210A-1-1181-70x70	Calibrated as part of system	N/A
C323	RF Cable	UFA 210A-1-0788-50x50	Calibrated as part of system	N/A
C1093	RF Cable	293-3362	Calibrated as part of system	N/A
C301	RF Cable	UFA 210A-1-0590-50x50	Calibrated as part of system	N/A
C1091	RF Cable	293-3362	Calibrated as part of system	N/A
C1256	2 m RF Cable	N/A	Calibration not required	N/A
A1291	DC3400 Directional Coupler	DC3400	Calibrated before use	N/A
A1025	50 Ohm Terminator	612-192	Calibrated before use	N/A
A1163	Attenuator 6dB	53-6-34	Calibrated as part of system	N/A

VOLTAGE DIPS AND INTERRUPTIONS - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 6
EUT:	Sense Hat	**TEMPERATURE:**	21 °C to 22 °C
TEST ENGINEER:	Bahar Kordi-borojeni	**RELATIVE HUMIDITY:**	44 % to 45 %
DATE OF TEST:	17 Apr 2018	**ATMOSPHERIC PRESSURE:**	1018 mb to 1018 mb
UNCERTAINTY:	95% confidence level	**PERFORMANCE CRITERIA:**	Criterion B & C
NOMINAL VOLTAGE:	230 V	**POWER SUPPLY TYPE:**	AC Mains

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 61000-4-11: 2004
TITLE:	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests

COMMENTS

None

DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	The EUT's RGB LED matrix was visually monitored for any modification or cessation of the Python Script sequence. The reported sensors value from the EUT, were visually monitored on the supporting screen monitor for either any cessation of the reported value or a value higher than ±10% of its initial stable value.

MEASUREMENT RESULTS

No.	Line Under Test	Phenomena Type	Reduction (%)	Performance Criteria	Test Voltage (V)	Period of Reduction (ms)	Result
1	AC Power Input	Dip	100	Criterion B	0	10	Complied
2	AC Power Input	Dip	100	Criterion B	0	20	Complied
3	AC Power Input	Dip	30	Criterion C	161	500	Complied
4	AC Power Input	Interrupt	100	Criterion C	0	5000	Complied

TEST EQUIPMENT USED

UL ID	INSTRUMENT DESCRIPTION	MODEL NUMBER	CALIBRATION DUE	INTERVAL
K0006	Electrostatic Discharge and Fast Transient Laboratory	N/A	Calibration not required	N/A
M2010	Thermo-Hygrometer	608-H1	20 Jun 2018	12
G0625	EMC Transient Immunity Generator	IMU4000	08 Mar 2019	12

SURGE TRANSIENTS - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 7
EUT:	Sense Hat	**TEMPERATURE:**	22 °C to 21 °C
TEST ENGINEER:	Bahar Kordi-borojeni	**RELATIVE HUMIDITY:**	48 % to 49 %
DATE OF TEST:	18 Apr 2018	**ATMOSPHERIC PRESSURE:**	1027 mb to 1023 mb
UNCERTAINTY:	95% confidence level	**PERFORMANCE CRITERIA:**	Criterion B
LIMIT - DIFF. MODE:	± 0.5 kV	**LIMIT - COMMON MODE:**	± 1.0 kV
GEN IMP - DIFF MODE:	2 Ω	**GEN IMP - COMMON MODE:**	12 Ω
PULSE RISE TIME:	1.2 µs	**PULSE DURATION:**	50 µs
PRIMARY PROTECTION:	Not stated	**SECONDARY PROTECTION:**	Not stated
REPETITION TIME:	20 s		

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 61000-4-5: 2014
TITLE:	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test

COMMENTS

None

DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	The EUT's RGB LED matrix was visually monitored for any modification or cessation of the Python Script sequence. The reported sensors value from the EUT, were visually monitored on the supporting screen monitor for either any cessation of the reported value or a value higher than ±10% of its initial stable value.

MEASUREMENT RESULTS

No.	Line Description	Mode	Line Under Test	Test Voltage (kV)	Phase Angle	Result
1	AC Power Input	Differential	Live to Neutral	± 0.5	0°, 90°, 180°, 270°	Complied
2	AC Power Input	Common	Live to Earth	± 0.5	0°, 90°, 180°, 270°	Complied
3	AC Power Input	Common	Neutral to Earth	± 0.5	0°, 90°, 180°, 270°	Complied
4	AC Power Input	Common	Live to Earth	± 1.0	0°, 90°, 180°, 270°	Complied
5	AC Power Input	Common	Neutral to Earth	± 1.0	0°, 90°, 180°, 270°	Complied

TEST EQUIPMENT USED

UL ID	INSTRUMENT DESCRIPTION	MODEL NUMBER	CALIBRATION DUE	INTERVAL
K0007	Surges Test Laboratory	N/A	Calibration not required	N/A
M2012	Thermo-Hygrometer	608-H1	20 Jun 2018	12
G0616	EMC Combination Transient Generator	IMU3000	13 Nov 2018	12
N0597	Surge Notebook PC	W540	Calibration not required	N/A

MAGNETIC FIELDS - TEST RESULTS

This test is covered by the scope of UL VS's UKAS Accreditation under ISO/IEC 17025: 2005.

GENERAL INFORMATION

JOB NUMBER:	12196502JD01	**TEST SITE ID:**	Site 6
EUT:	Sense Hat	**TEMPERATURE:**	22 °C to 22 °C
TEST ENGINEER:	Bahar Kordi-Borojeni	**RELATIVE HUMIDITY:**	43 % to 43 %
DATE OF TEST:	17 Apr 2018	**ATMOSPHERIC PRESSURE:**	1020 mb to 1020 mb
PERFORMANCE CRITERIA:	Criterion A	**UNCERTAINTY:**	±0.08 A/m
LEVEL:	1 A/m	**EXPOSURE TIME:**	2 mins

TEST SPECIFICATION DETAILS

The EUT has been configured and tested in accordance with the methods and procedures detailed within the following basic standard:

REFERENCE:	EN 61000-4-8: 2010
TITLE:	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test

COMMENTS

None

DEVIATIONS FROM TEST SPECIFICATION

There were no deviations from the test configuration and measurement arrangements defined in the test specification (identified above).

EUT RELATED

OPERATING MODE:	Normal Operation
FUNCTION(S) MONITORED:	The EUT's RGB LED matrix was visually monitored for any modification or cessation of the Python Script sequence. The reported sensors value from the EUT, were visually monitored on the supporting screen monitor for either any cessation of the reported value or a value higher than ±10% of its initial stable value.

MEASUREMENT RESULTS

No.	Level (A/m)	Frequency (Hz)	EUT Orientation	Result
1	3	50	Front to Back	Complied
2	3	50	Left to Right	Complied
3	3	50	Top to Bottom	Complied
4	3	60	Front to Back	Complied
5	3	60	Left to Right	Complied
6	3	60	Top to Bottom	Complied

TEST EQUIPMENT USED

UL ID	INSTRUMENT DESCRIPTION	MODEL NUMBER	CALIBRATION DUE	INTERVAL
K0006	Electrostatic Discharge and Fast Transient Laboratory	N/A	Calibration not required	N/A
M2010	Thermo-Hygrometer	608-H1	20 Jun 2018	12
M1188	Signal Conditioning Unit - Lumped Impedance	CCN 1000-1	25 May 2018	12
M1780	Data Acquisition Card	PCI-6220	25 May 2018	12
S0588	AC Power Supply for Harmonics and Flicker Testing	TPS/M3000	03 Aug 2018	12
A100	Helmholtz Coil Load Resistance	001	Calibrated as part of system	N/A
M1345	Digital Multimeter	73III	10 Aug 2018	12
A095	Helmholtz Coils	001	Calibrated before use	N/A
M1237	ELT - 400	ELT - 400	29 Nov 2018	12
M1238	B-Field Sensor 1Hz....400kHz	G-001	29 Nov 2018	12

8. PHOTOGRAPHS OF EUT

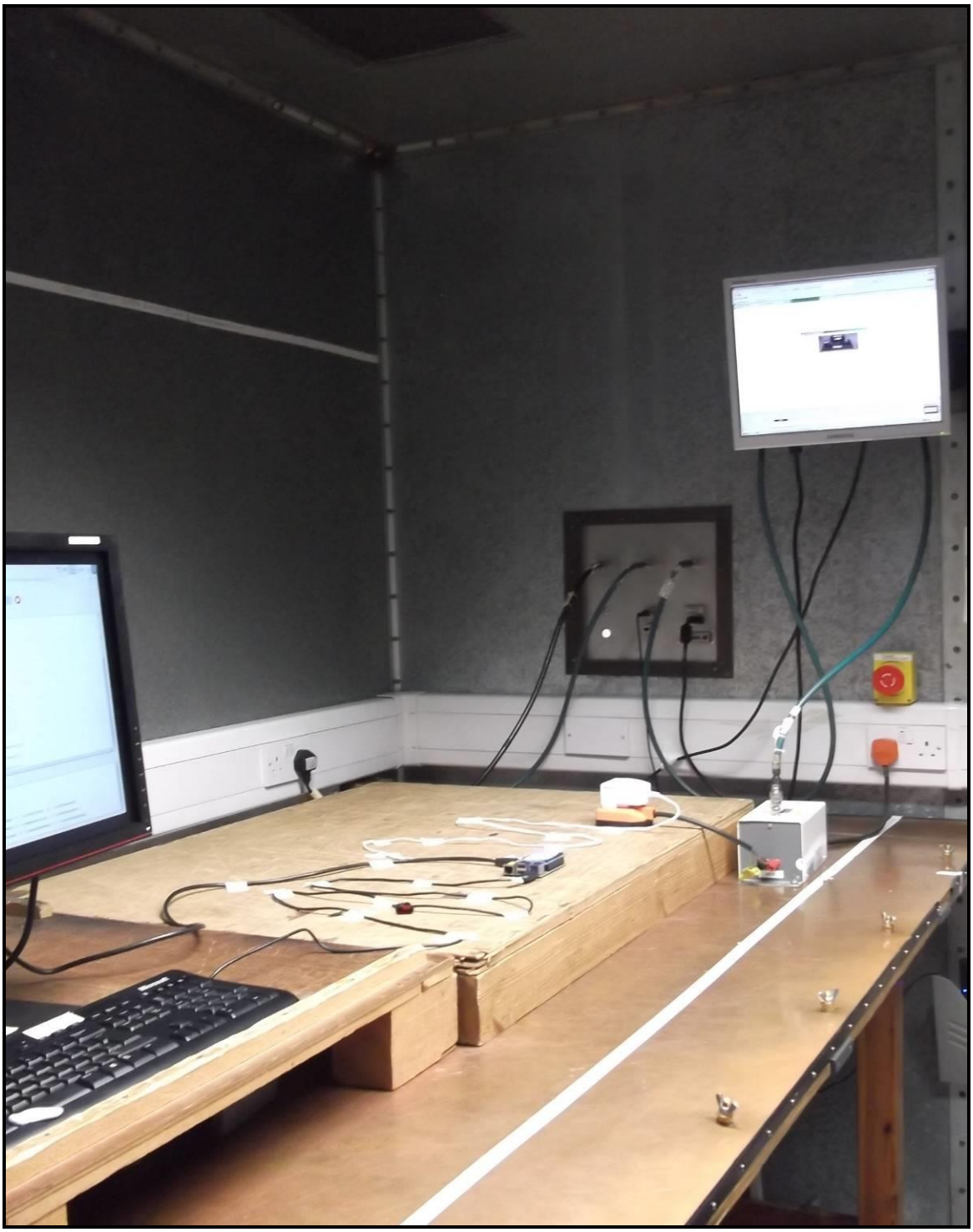
This section contains the following photographs:

Photo Reference Number	Title
PHT\12196502JD01\001	Test Configuration Photograph - Conducted Emissions 001
PHT\12196502JD01\002	Test Configuration Photograph - Conducted Emissions 002
PHT\12196502JD01\003	Test Configuration Photograph - Conducted Immunity 001
PHT\12196502JD01\004	Test Configuration Photograph - Conducted Immunity 002
PHT\12196502JD01\005	Test Configuration Photograph - EFT - VDI 001
PHT\12196502JD01\006	Test Configuration Photograph - EFT - VDI 002
PHT\12196502JD01\007	Test Configuration Photograph - Harmonics _ Flicker
PHT\12196502JD01\008	Test Configuration Photograph - Magnetic Immunity 001
PHT\12196502JD01\009	Test Configuration Photograph - Magnetic Immunity 002
PHT\12196502JD01\010	Test Configuration Photograph - Magnetic Immunity 003
PHT\12196502JD01\011	Test Configuration Photograph - Magnetic Immunity 004
PHT\12196502JD01\012	Test Configuration Photograph - Radiated Emissions 001
PHT\12196502JD01\013	Test Configuration Photograph - Radiated Emissions 002
PHT\12196502JD01\014	Test Configuration Photograph - Radiated Immunity 001
PHT\12196502JD01\015	Test Configuration Photograph - Radiated Immunity 002
PHT\12196502JD01\016	Test Configuration Photograph - Radiated Immunity 003
PHT\12196502JD01\017	Test Configuration Photograph - Surge

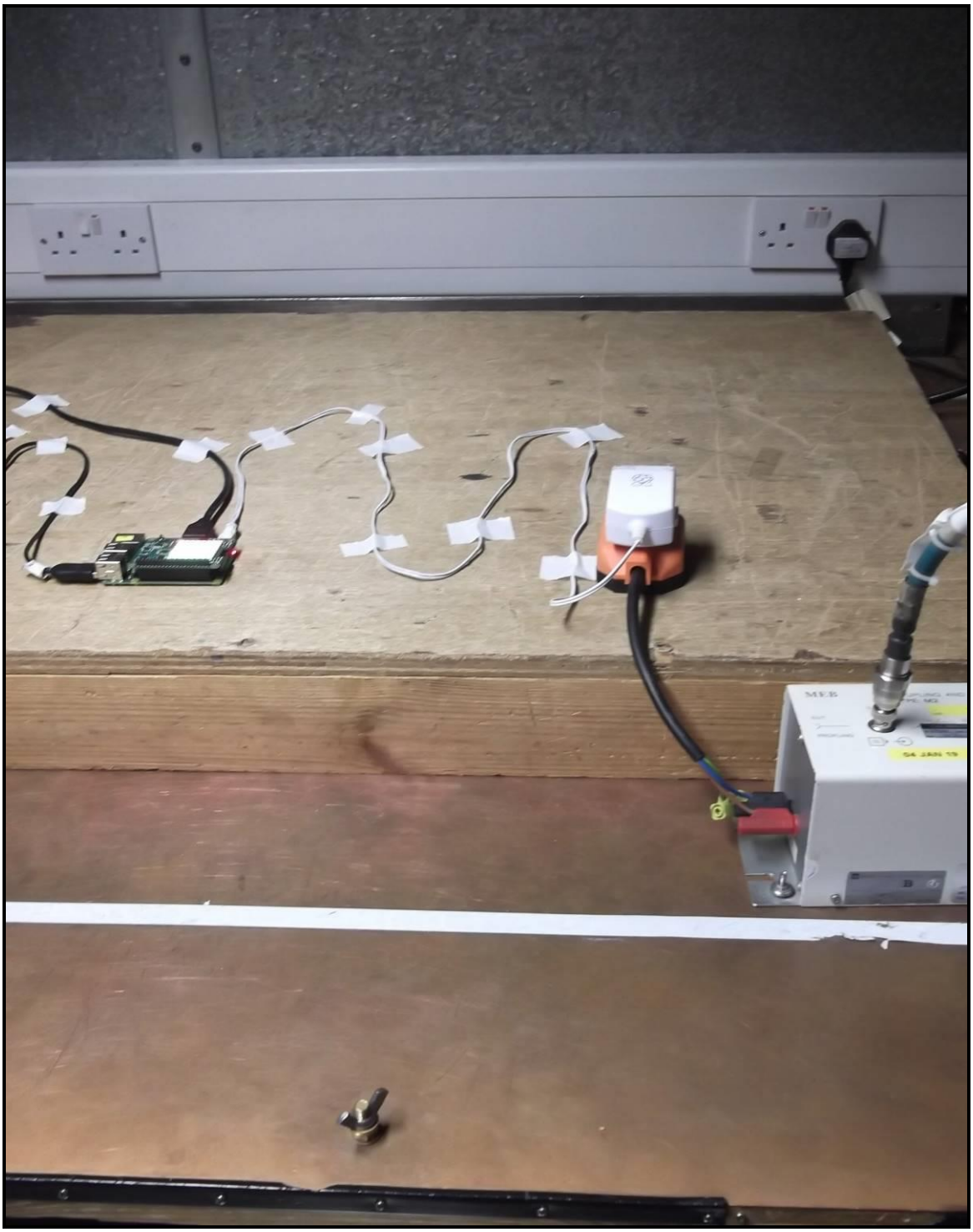
PHT\121965O2JD01\001 - Test Configuration Photograph - Conducted Emissions 001

PHT\121196502JD01\002 - Test Configuration Photograph - Conducted Emissions 002

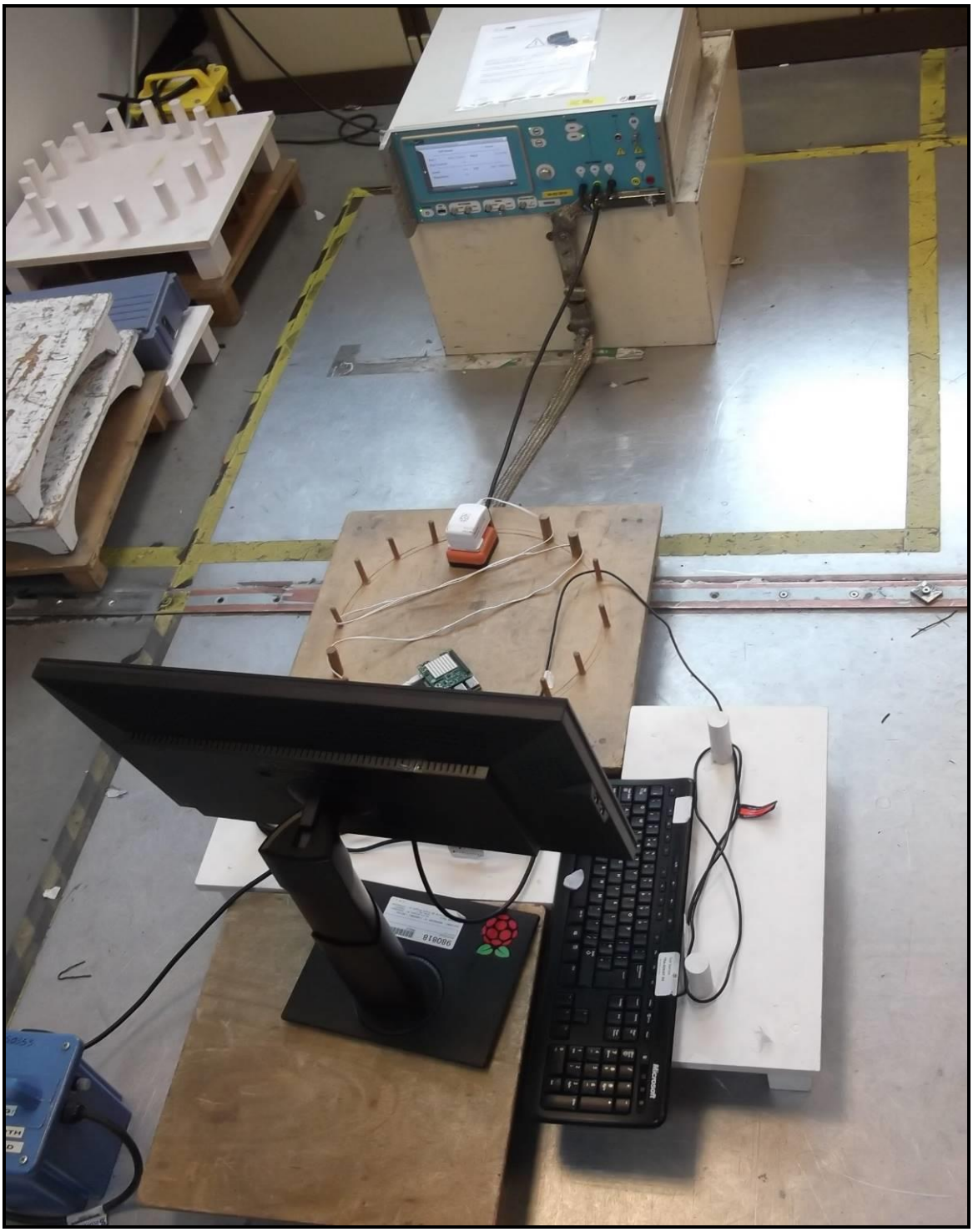
PHT\121965O2JD01\003 - Test Configuration Photograph - Conducted Immunity 001



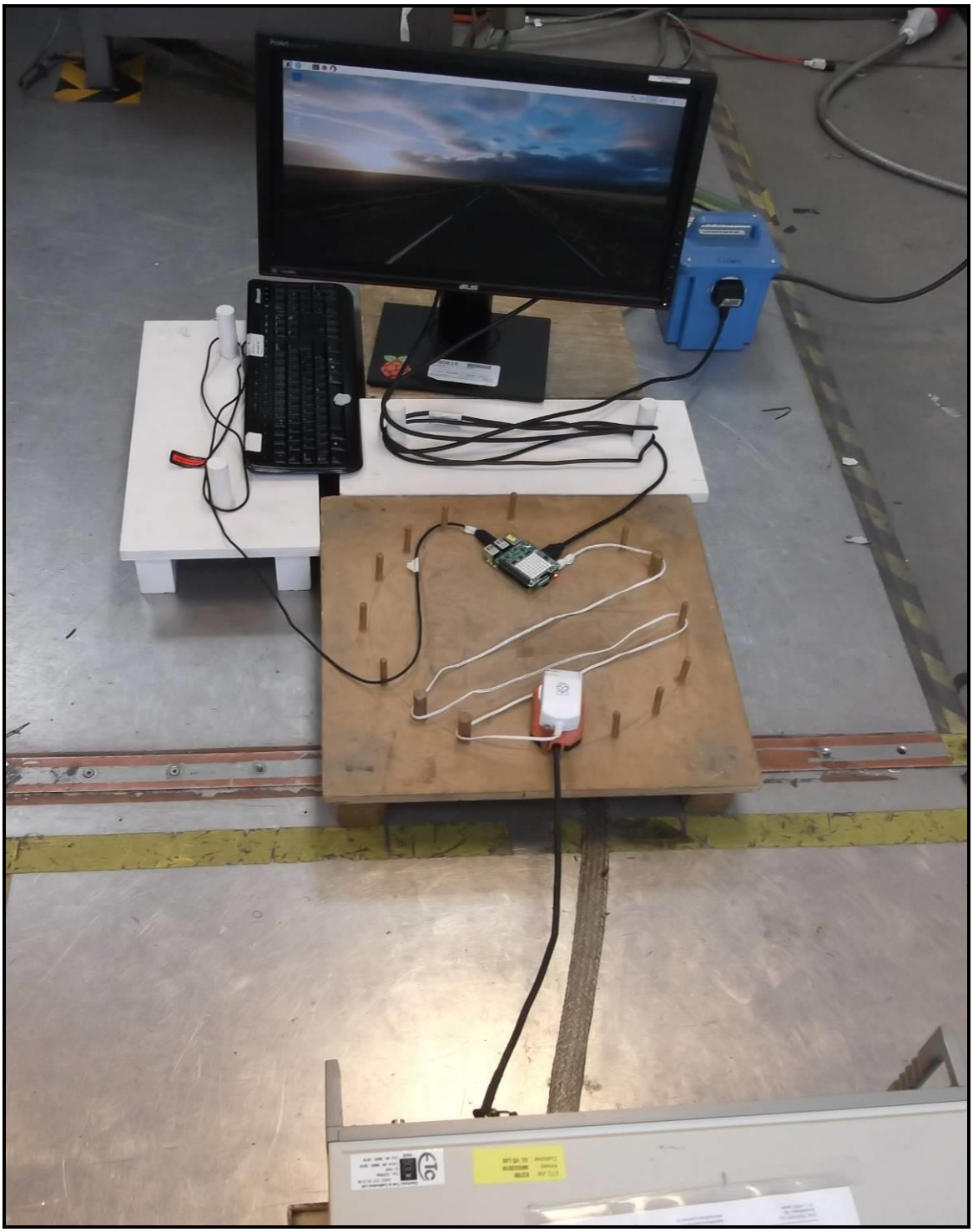
PHT\121196502JD01\004 - Test Configuration Photograph - Conducted Immunity 002



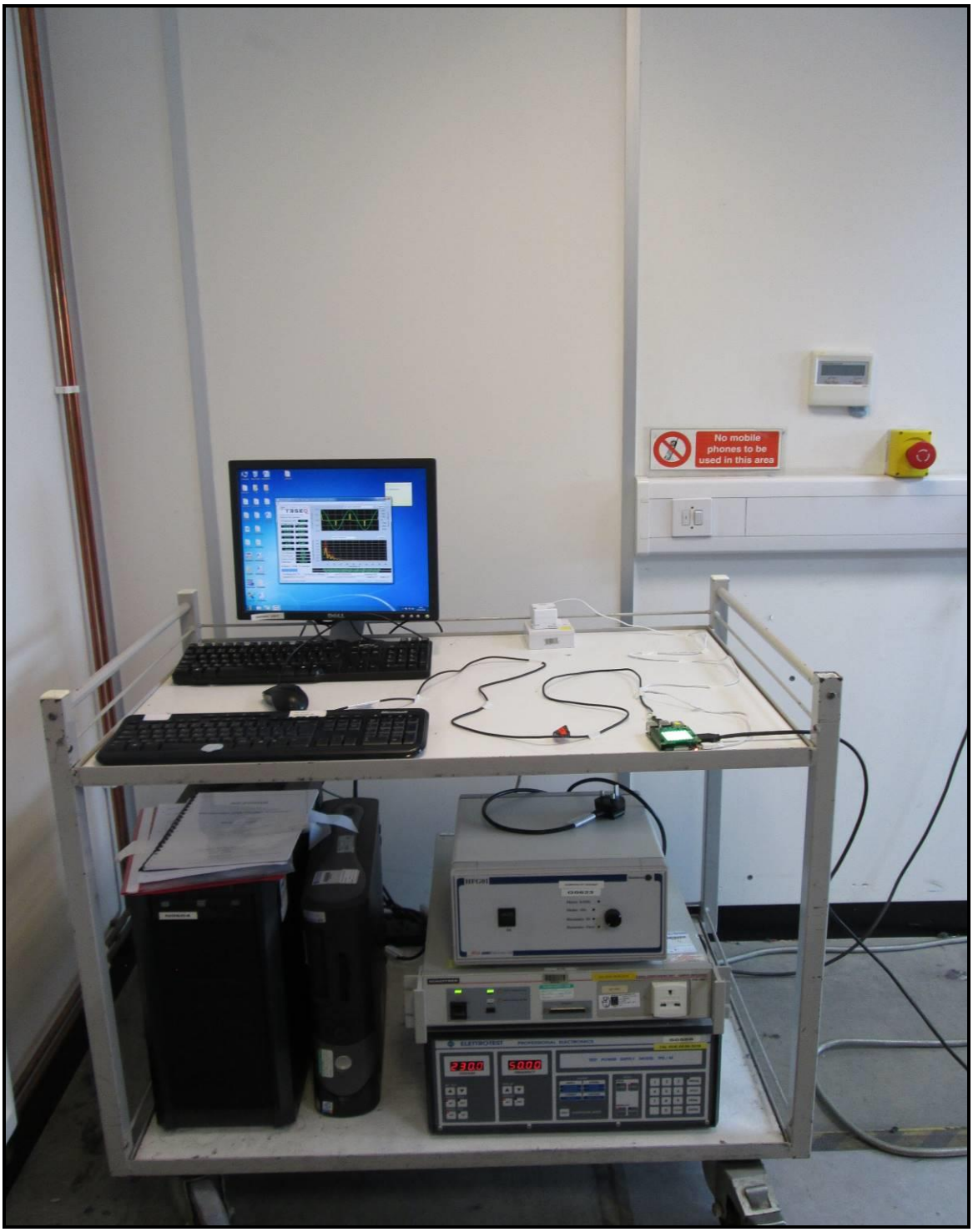
PHT\121965O2JD01\005 - Test Configuration Photograph - EFT - VDI 001



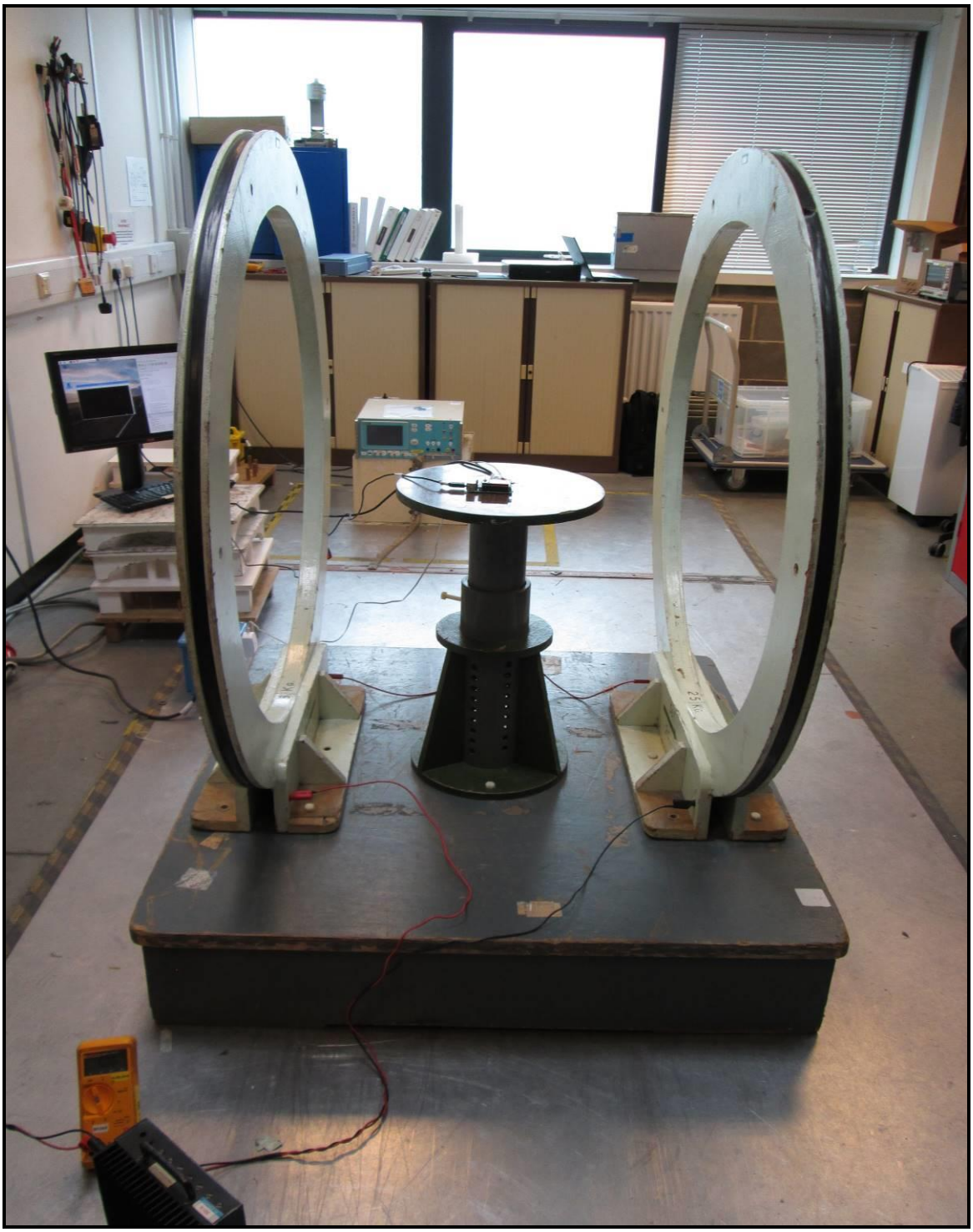
PHT\121965O2JD01\006 - Test Configuration Photograph - EFT - VDI 002



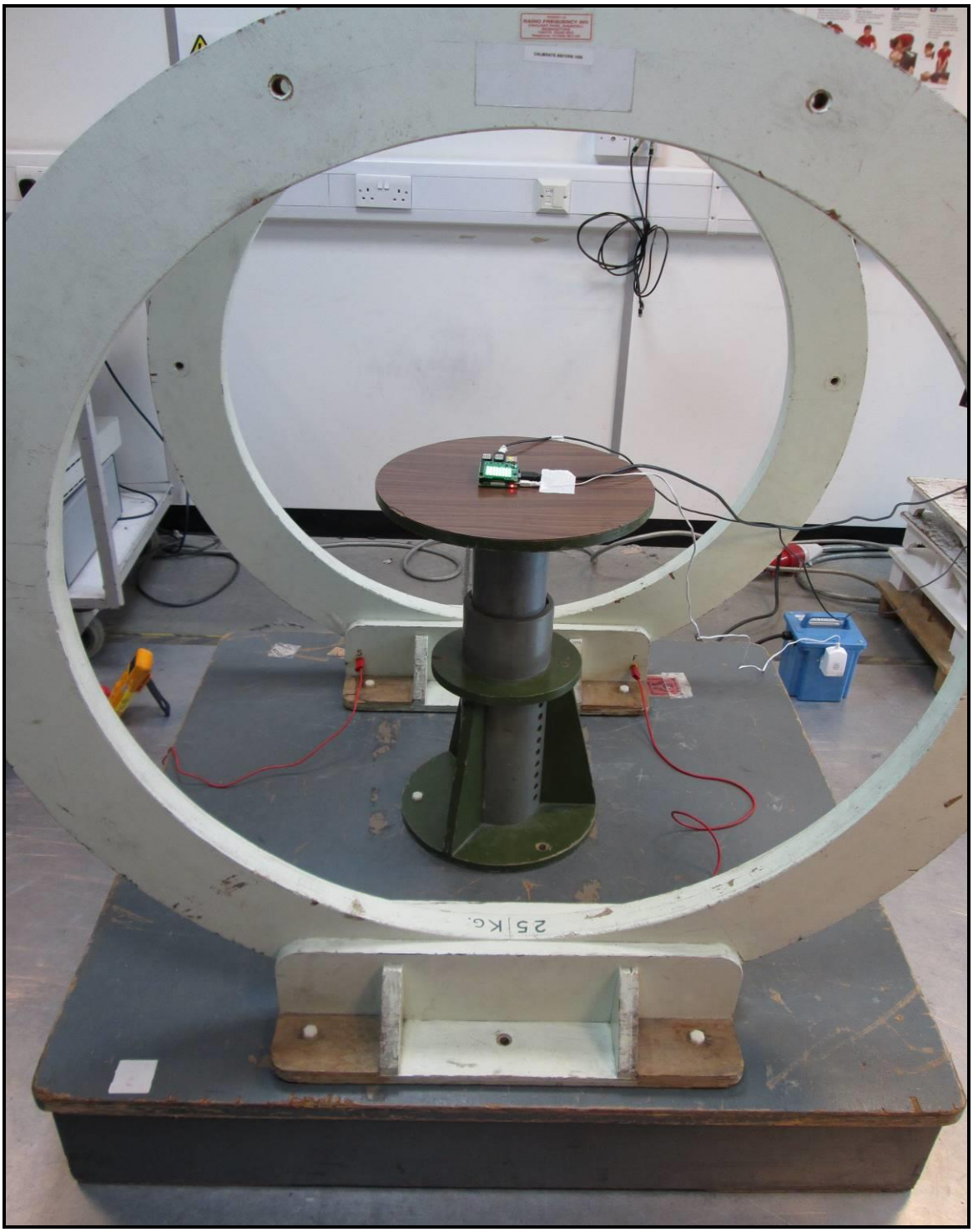
PHT\121965O2JD01\007 - Test Configuration Photograph - Harmonics _ Flicker



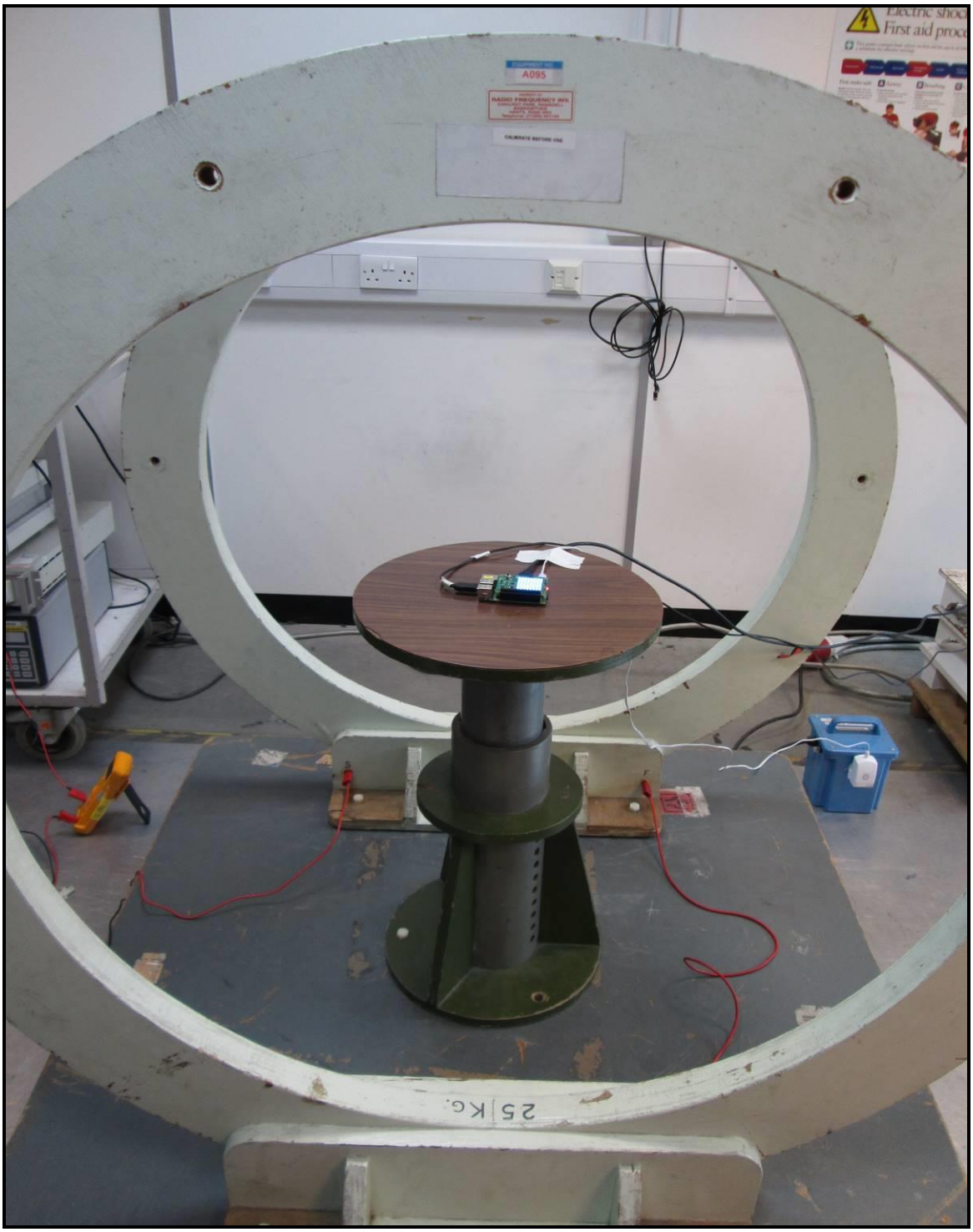
PHT\121196502JD01\008 - Test Configuration Photograph - Magnetic Immunity 001



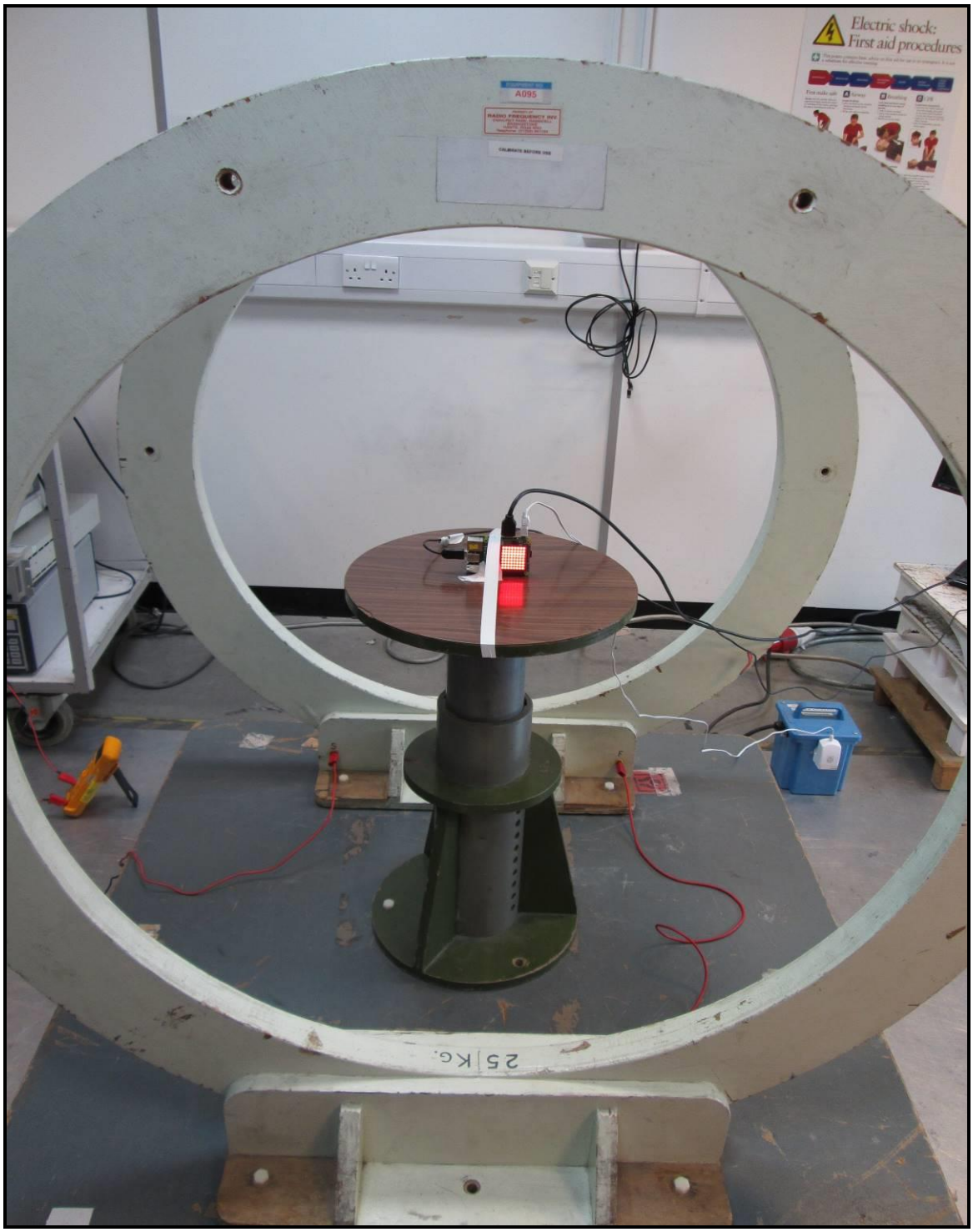
PHT\121196502JD01\009 - Test Configuration Photograph - Magnetic Immunity 002



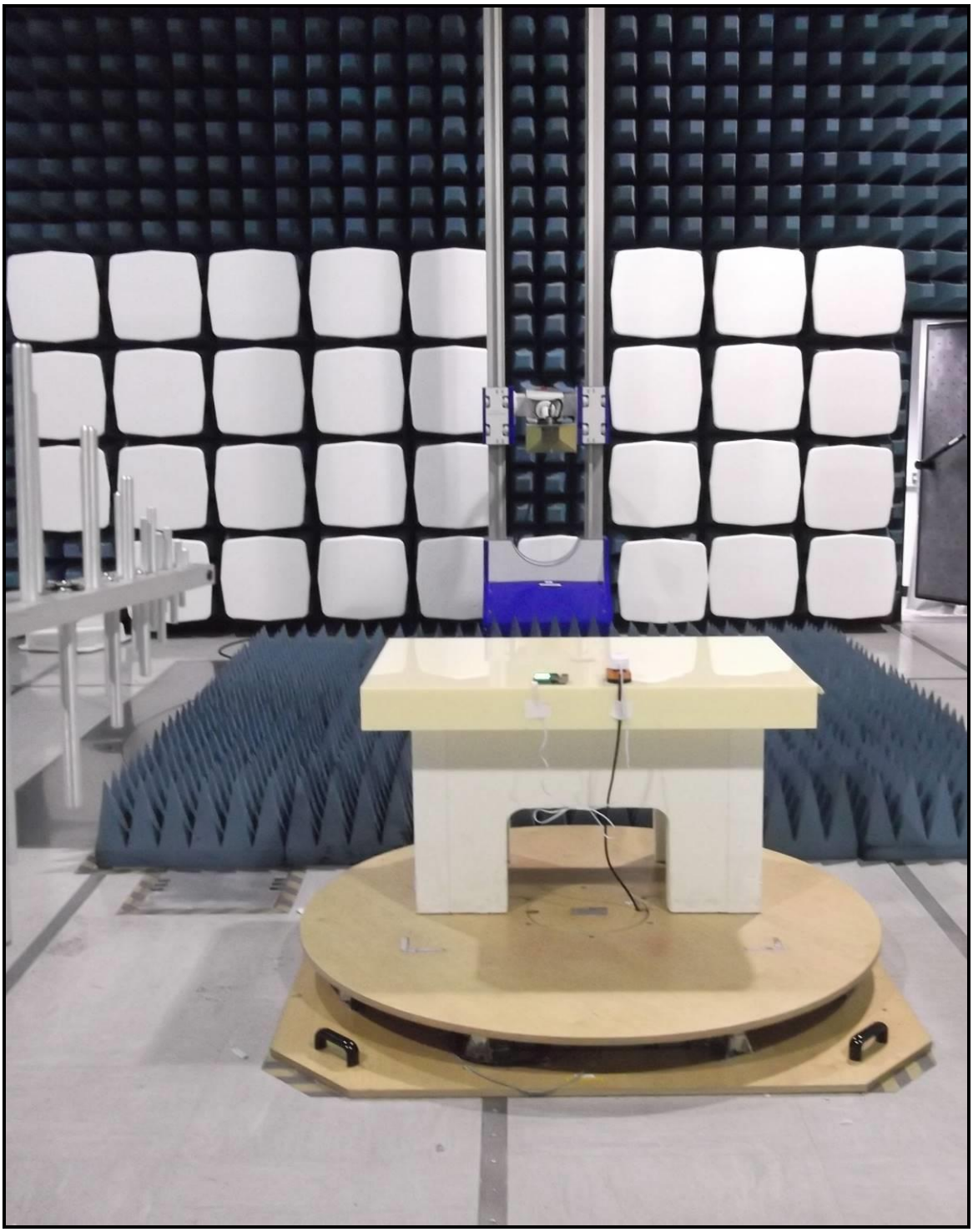
PHT\121965O2JD01\010 - Test Configuration Photograph - Magnetic Immunity 003



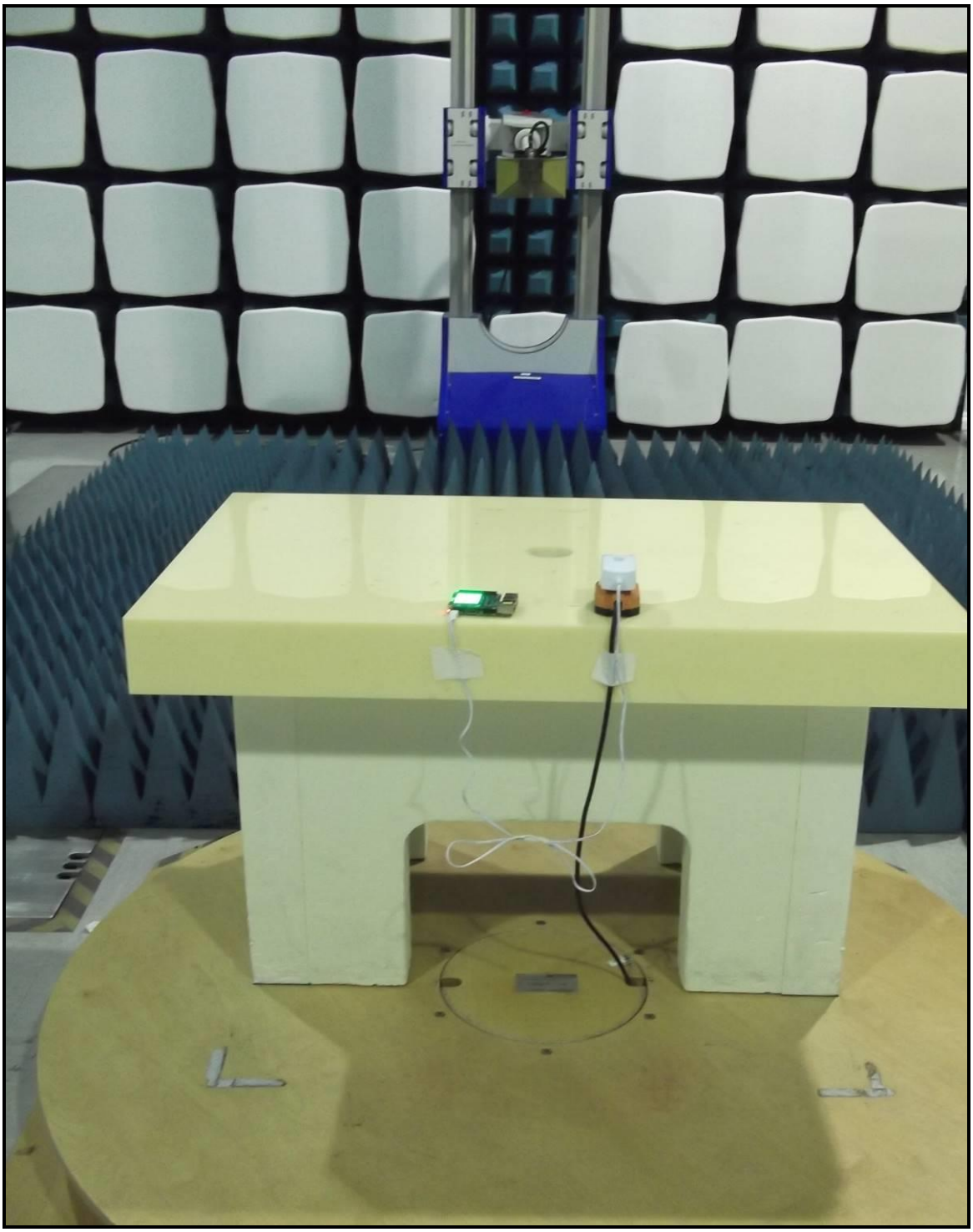
PHT\121965O2JD01\011 - Test Configuration Photograph - Magnetic Immunity 004



PHT\121965O2JD01\012 - Test Configuration Photograph - Radiated Emissions 001

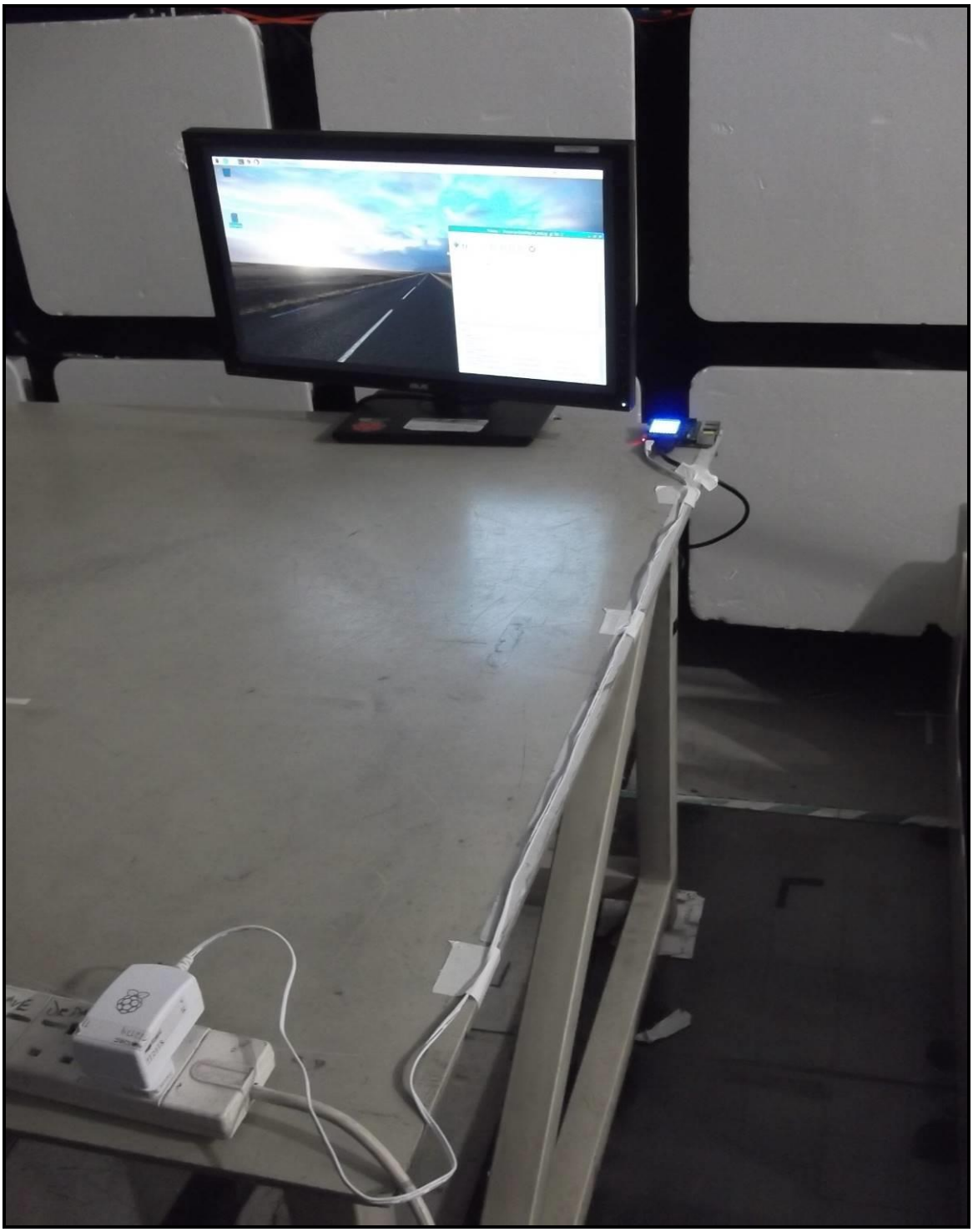


PHT\121196502JD01\013 - Test Configuration Photograph - Radiated Emissions 002



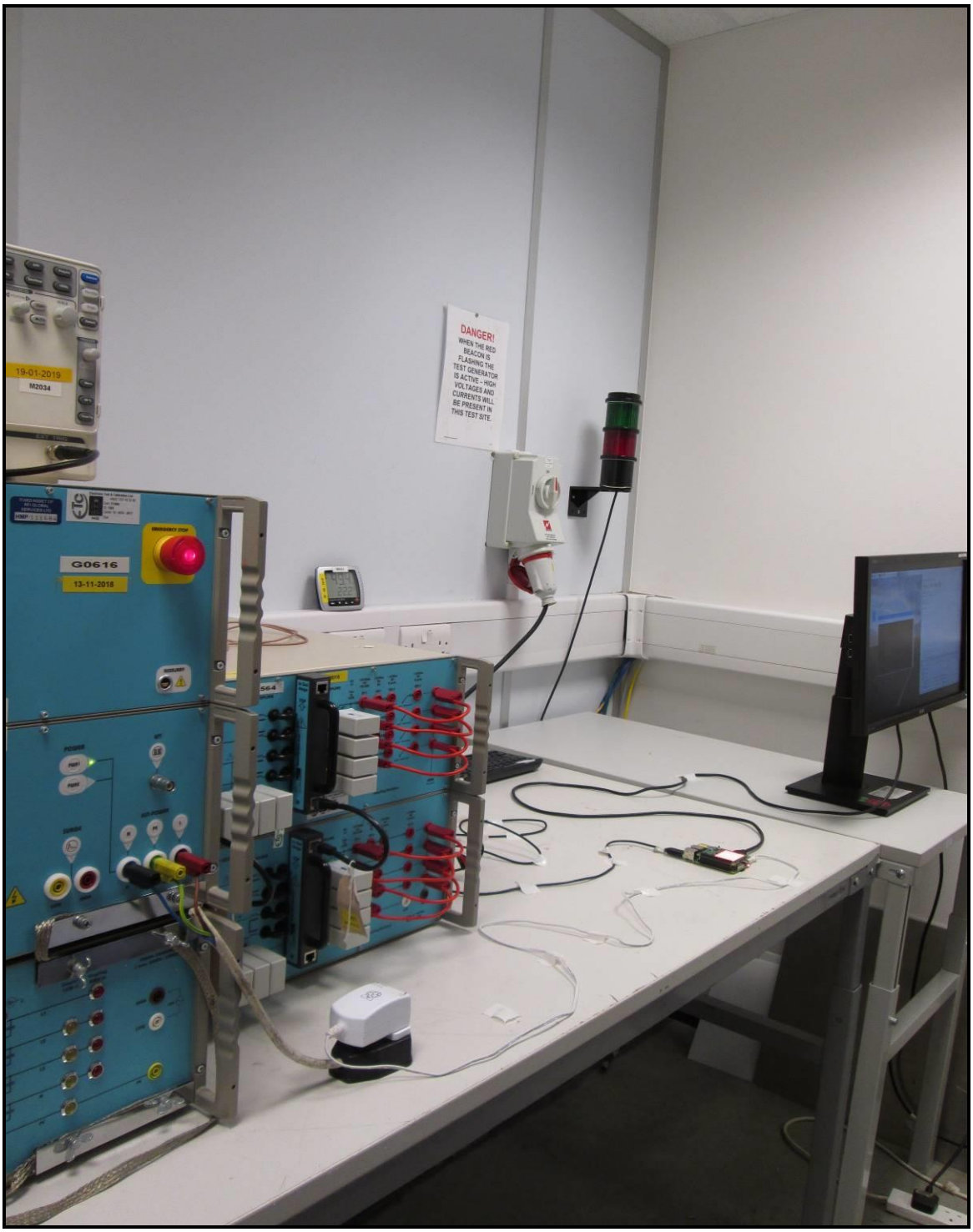
PHT\121965O2JD01\014 - Test Configuration Photograph - Radiated Immunity 001

PHT\121965O2JD01\015 - Test Configuration Photograph - Radiated Immunity 002



PHT\121965O2JD01\016 - Test Configuration Photograph - Radiated Immunity 003

PHT\121196502JD01\017 - Test Configuration Photograph - Surge

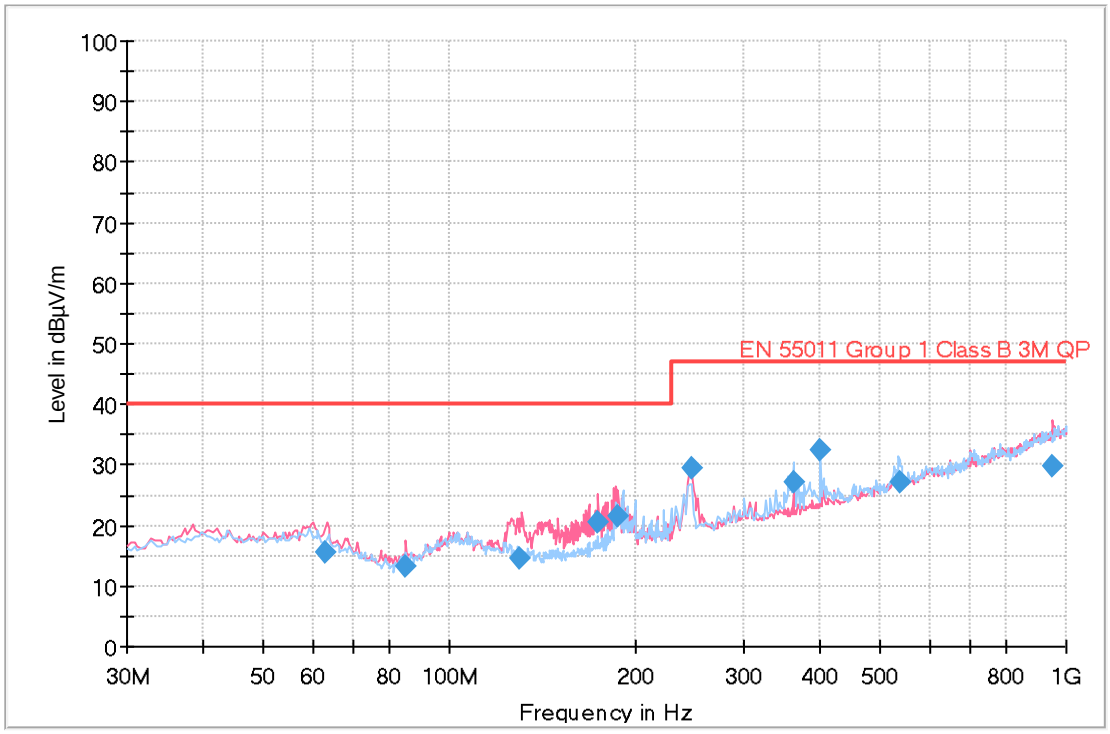


9. GRAPHICAL TEST RESULTS

9.1. This section contains the graphical results for the measurements listed in Section ***2.2. Summary of Test Results*** (above).

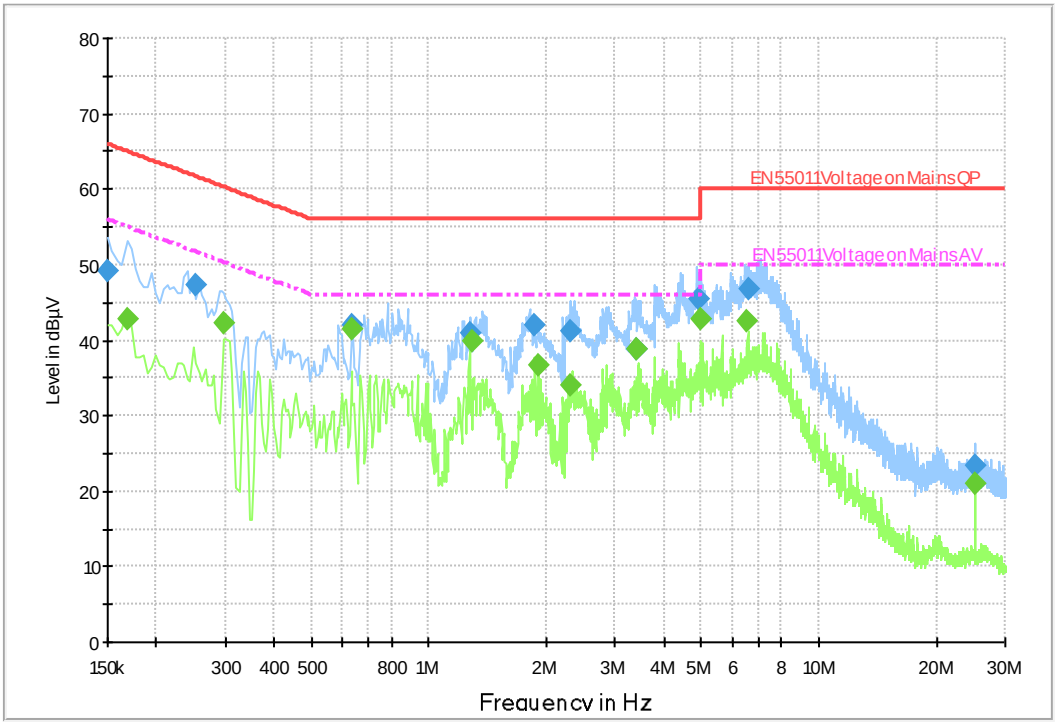
Graph Reference Number	Title
GPH\12196502JD01\001	Radiated Emissions (30 MHz to 1 GHz)
GPH\12196502JD01\002	Conducted Emissions (150 kHz to 30 MHz)

GPH\12196502JD01\001 - Radiated Emissions (30 MHz to 1 GHz)



GPH\12196502JD01\002 - Conducted Emissions (150 kHz to 30 MHz)

EN55032 Class B Voltage with 2-Line-LISN scans with A3019 cable



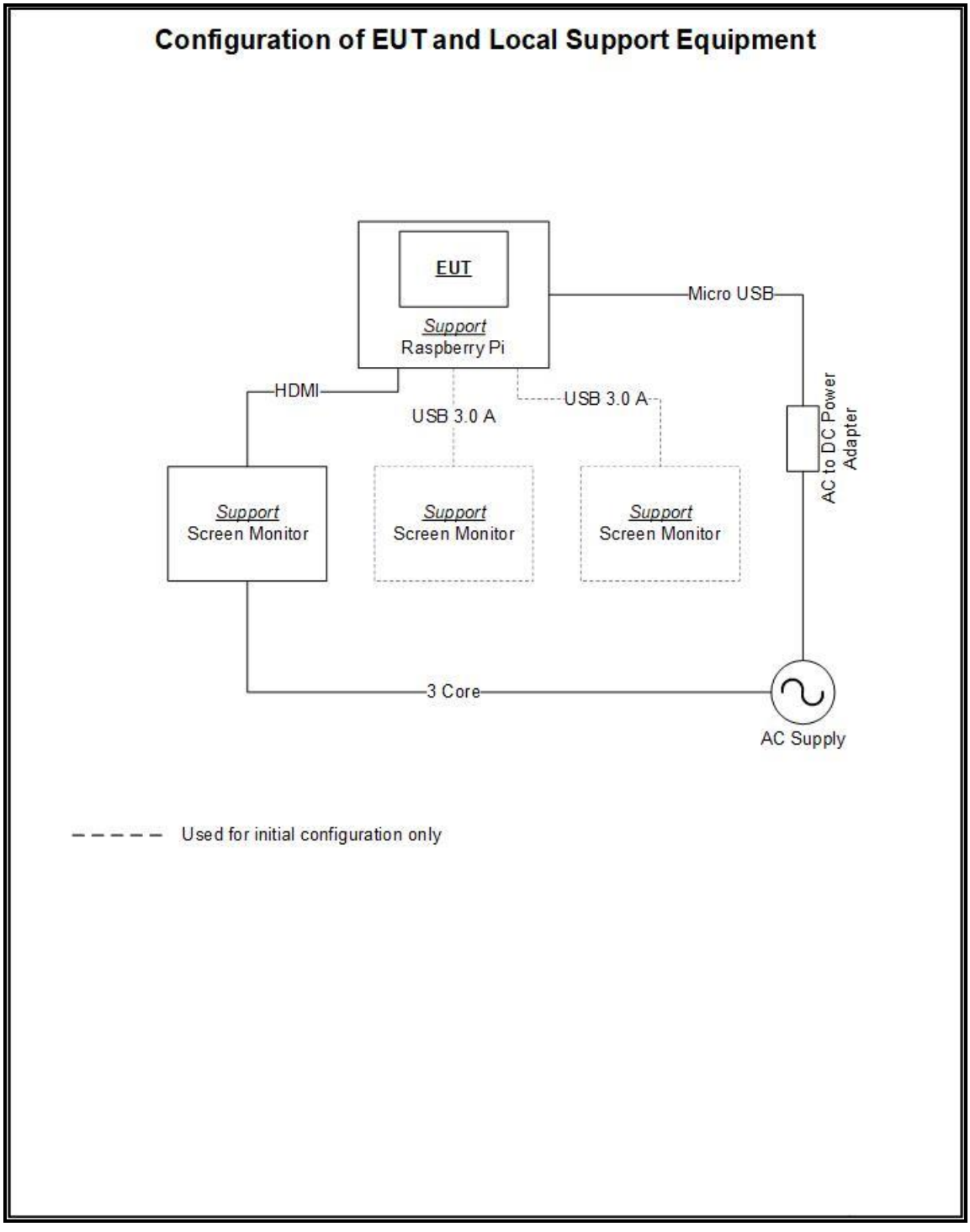
10. TEST CONFIGURATION DRAWING

10.1. This section contains the Test Configuration Drawings for the measurements listed in Section 7: Measurements, Examinations and Derived Results.

Test Configuration Reference Number	Title
DRG\12196502JD01\001	EUT Test Point Photograph, ESD Point 1
DRG\12196502JD01\002	Schematic diagram of the EUT, support equipment and interconnecting cables used for the test

DRG\12196502JD01\001 - EUT Test Point Photograph, ESD Point 1

DRG\12196502JD01\002 - Schematic diagram of the EUT, Support Equipment and Interconnecting Cables Used for the Test



11. REPORT REVISION HISTORY

11.1. This section contains the report revision history.

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version.