

Report on the FCC and IC Testing of:

Apple Inc, Model: A2304

In accordance with FCC 47 CFR Part 15,
ISED RSS 247 & ISED RSS-GEN
(Simultaneous Transmissions)

Prepared for: Apple Inc.
One Apple Park Way Cupertino,
California 95014 USA

FCC ID: BCGA2304

IC: 579C-A2304



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Document 75945250-15 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Jon Kenny	Senior Engineer	Authorised Signatory	28 November 2019

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15, ISED RSS-247 and ISED RSS-GEN (Simultaneous Transmission). The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Malik Mohammad	28 November 2019	
Testing	Cristian Onaca	28 November 2019	
Testing	Faisal Malyar	28 November 2019	
Testing	Ahmad Javid	28 November 2019	
Testing	Jay Balendrarajah	28 November 2019	

FCC Accreditation

90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation

12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15: 2018, ISED RSS-247: Issue 2 (2017-02) and ISED RSS-GEN: Issue 5 A1 (2019-03) for the tests detailed in section 1.3.



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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	28 November 2019

Table 1

1.2 Introduction

Applicant	Apple Inc.
Manufacturer	Apple Inc.
Model Number(s)	A2304
Serial Number(s)	C02ZK00YNRQ8 and C02Z1006N5VL
Hardware Version(s)	REV 1.0
Software Version(s)	19A583 and 19A507
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15: (2018) ISED RSS-247: Issue 2 (2017-02) ISED RSS-GEN Issue 5 A1 (2019-03)
Order Number	0540176069
Date	25-February-2019
Date of Receipt of EUT	18-October-2019
Start of Test	18-October-2019
Finish of Test	29-October-2019
Name of Engineer(s)	Malik Mohammad, Cristian Onaca, Jay Balendrarah, Ahmad Javid and Faisal Malyar
Related Document(s)	ANSI C63.10 (2013)



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Parts 15, ISED RSS-247 and ISED RSS-GEN (Simultaneous Transmission) is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	FCC Part 15	RSS-247	RSS-GEN			
Configuration and Mode: CoTX - 5GHz main, 2.4GHz Aux & BDR						
2.1	15.247 (d), 15.407 (b) and 15.209	5.5 and 6.2	8.9 and 8.10	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	ANSI C63.10

Table 2



1.4 Product Information

1.4.1 Technical Description

The Equipment Under Test (EUT) was a rack mounted computer, with Bluetooth, Bluetooth Low Energy and 802.11 a/b/g/n/ac capabilities in the 2.4 GHz and 5 GHz bands.

1.5 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme.

The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Model: A2304: Serial Number: C02Z1006N5VL			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2304: Serial Number: C02ZK00YNRQ8			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.7 Test Location

TÜV SÜD conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: CoTX – 5 GHz main, 2.4 GHz Aux & BDR		
Radiated Spurious Emissions (Simultaneous Transmission)	Malik Mohammad, Cristian Onaca, Jay Balendrarajah, Ahmad Javid and Faisal Malyar	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom



2 Test Details

2.1 Radiated Spurious Emissions (Simultaneous Transmission)

2.1.1 Specification Reference

FCC 47 CFR Parts 15, Clause 15.247 (d), 15.407 (b) and 15.209
ISED RSS 247, Clause 5.5 and 6.2
ISED RSS GEN, Clause 8.9 and 8.10

2.1.2 Equipment Under Test and Modification State

A2304, S/N: C02ZK00YNRQ8 - Modification State 0
A2304, S/N: C02Z1006N5VL - Modification State 0

2.1.3 Date of Test

18-October-2019 to 29-October-2019

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clauses 6.3, 6.5 and 6.6.

Plots for average measurements were taken in accordance with ANSI C63.10 using an average (RMS) detector and max hold trace to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.5.

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dBuV/m) when compared to the relevant limits outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

For frequencies > 18 GHz, the measurement distance was reduced to 1 meter and the limit line was increased by $20 \cdot \log(3/1) = 9.54$ dB.

2.1.5 Environmental Conditions

Ambient Temperature 21.0 - 23.0 °C
Relative Humidity 45.0 - 62.7 %

2.1.6 Test Results

CoTX - 5 GHz main and 2.4 GHz Aux & BDR

The EUT was configured for simultaneous transmission in the following mode of operation:

Technology	Frequency Band (MHz)	Channel Frequency (MHz)
802.11n - 20 MHz Bandwidth	U-NII 2c	5500
802.11b	2400 MHz to 2483.5 MHz	2442
Bluetooth	2400 MHz to 2483.5 MHz	2480

Table 5 - Modes of Operation

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
38.2	23.8	40	16.2	QP	240	187	Vertical	N/A
168.1	31.7	44	12.3	QP	15	142	Horizontal	N/A
408.4	31.5	46	14.5	QP	340	100	Horizontal	N/A
969.5	37.9	54	16.1	QP	188	100	Vertical	N/A

Table 6 - 30 MHz to 1 GHz Emissions Results

All other emissions that were detected are within the unrestricted bands and are therefore at least 20 dB from the applicable test limit.

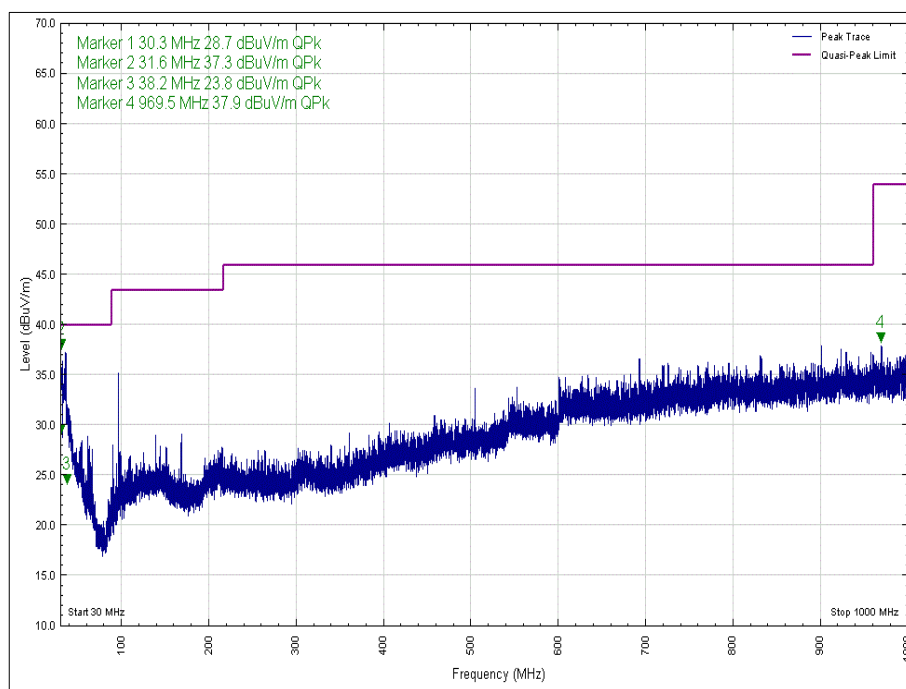


Figure 1 - 30 MHz to 1 GHz - Vertical

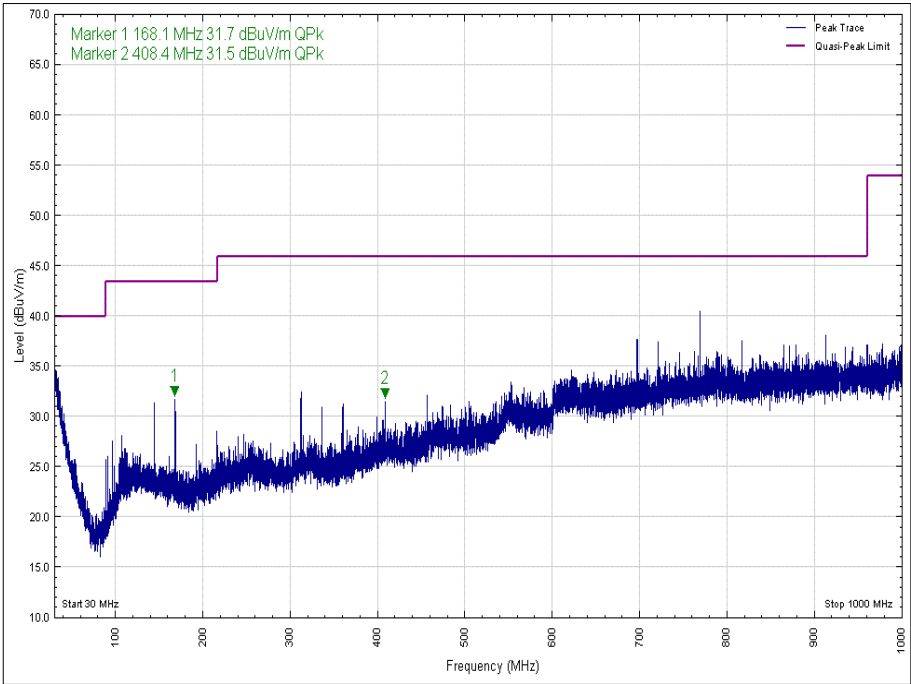


Figure 2 - 30 MHz to 1 GHz - Horizontal

Frequency (GHz)	Result (dB μ V/m)		Limit (dB μ V/m)		Margin (dB)	
	Peak	Average	Peak	Average	Peak	Average
4884.3	-	44.0	-	54.0	-	10.0
5041.8	-	42.0	-	54.0	-	12.0

Table 7 - 1 GHz to 40 GHz Emissions Results

All other emissions that were detected were below 20 dB of the limit.

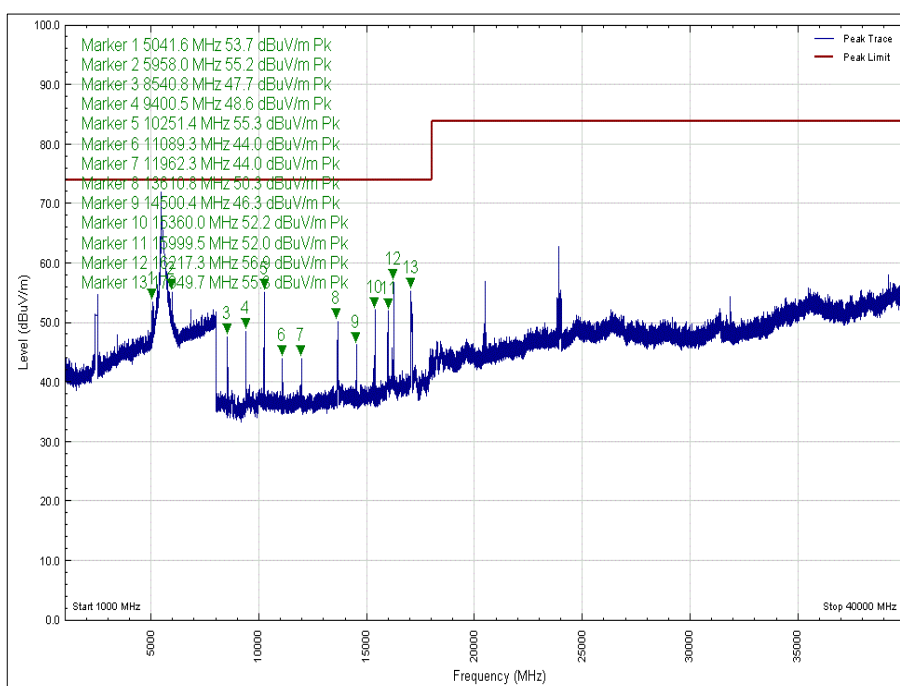


Figure 3 – 1 GHz to 40 GHz - Horizontal

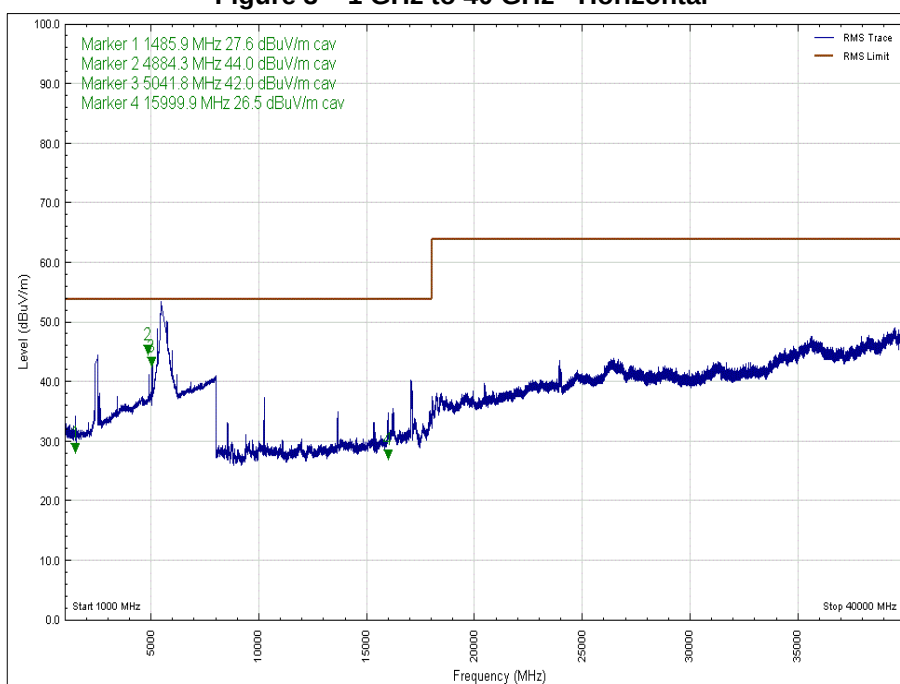


Figure 4 – 1 GHz to 40 GHz – Horizontal

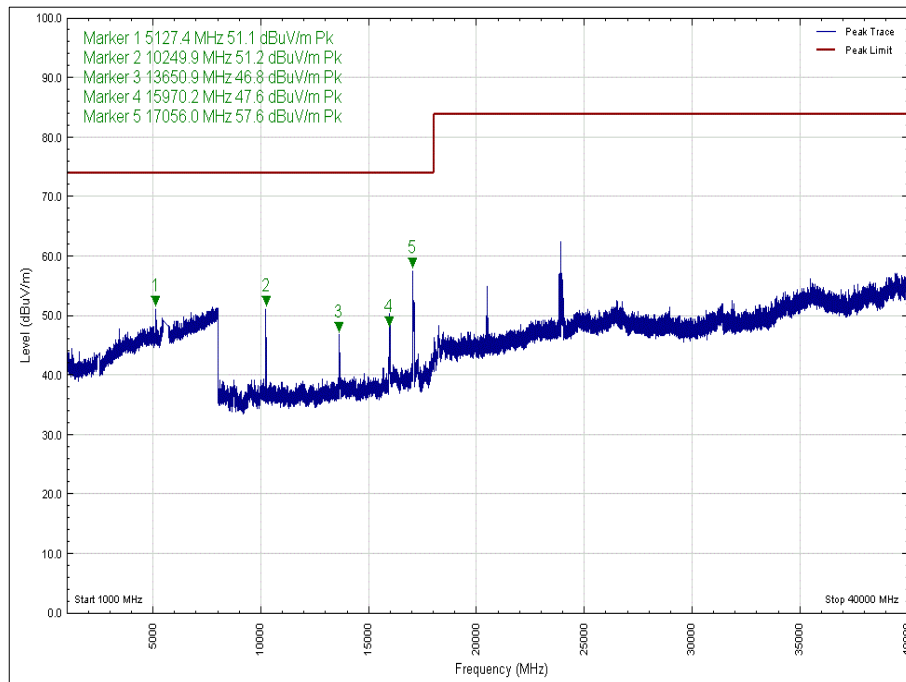


Figure 5 – 1 GHz to 40 GHz – Vertical

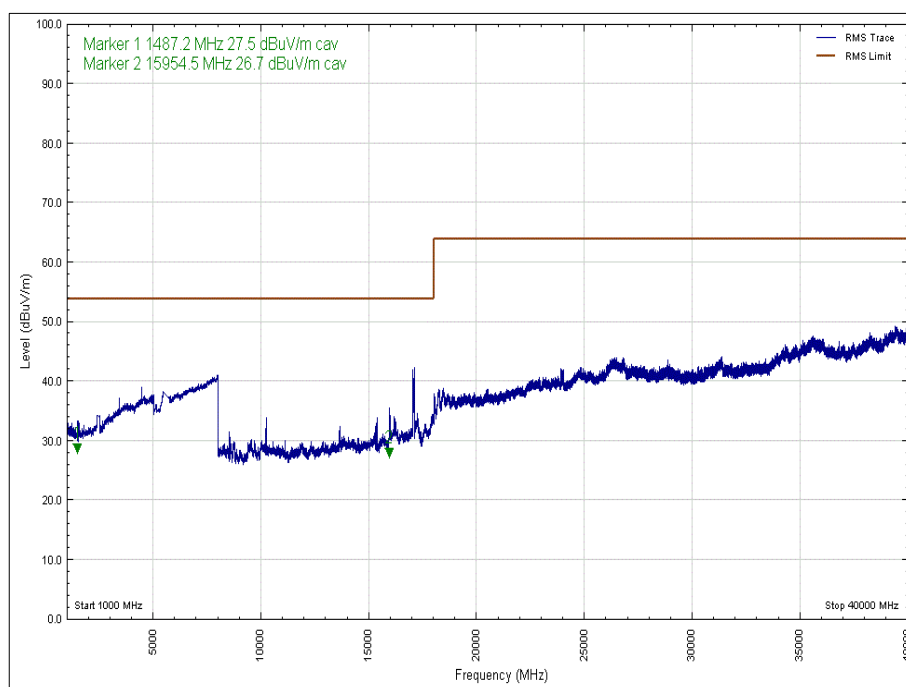


Figure 6 – 1 GHz to 40 GHz - Vertical



Limit Clause

The least stringent limit from the applicable rule parts was used to determine compliance for Radiated Emissions testing of multiple transmission sources.

Specification and Clause	Limit
FCC Part 15.247 (d)	-20 dBc
FCC Part 15.407 (b)	-27 dBm (EIRP) / 68.2 dBµV/m at 3 m
FCC Part 15.209 (Within restricted bands listed in 15.205)	Peak: 74 dBµV/m at 3 m Average 54 dBµV/m at 3 m
ISED RSS-247, Clause 5.5	-20 dBc
ISED RSS-247, Clause 6.2	-27 dBm (EIRP) / 68.2 dBµV/m at 3 m
ISED RSS-GEN, Clause 8.9 (Within restricted bands listed in clause 8.8)	Peak: 74 dBµV/m at 3 m Average 54 dBµV/m at 3 m

Table 8 - Limit Table

2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5 and RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	O/P Mon
Pre-Amplifier	Phase One	PS04-0086	1533	12	08-Feb-2020
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	HYGROPALM 1	2338	12	15-Nov-2019
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	14-Nov-2020
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	11-Dec-2019
High Pass Filter (4GHz)	K&L Microwave	11SH10-4000/X18000-0/0	4599	12	05-Sep-2020
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	05-Mar-2020
Mast Controller	Maturo GmbH	NCD	4810	-	TU
Tilt Antenna Mast	Maturo GmbH	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
8 - 18 GHz pre amp	Wright Technologies	PS06-0061	4971	12	07-Dec-2019



Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5066	12	01-Oct-2020
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5067	12	01-Oct-2020
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5068	12	01-Oct-2020
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5069	12	01-Oct-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	11-Nov-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	06-Oct-2020
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5095	12	04-Dec-2019
Cable (18 GHz)	Rosenberger	LU7-071-1000	5102	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	05-Dec-2019
Cable (18 GHz)	Rosenberger	LU7-071-1000	5105	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	06-Oct-2020
EmX Emissions Software	TUV SUD	EmX	5125	-	Software
1.5m 40GHz RF Cable	Scott Cables	KPS-1501-2000-KPS	5127	6	11-Dec-2019
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	11-Mar-2020
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5216	12	11-Mar-2020
3 GHz High pass filter	Wainwright	WHKX12-2580-3000-18000-80SS	5219	12	15-Feb-2020

Table 9

TU – Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment



3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Radiated Spurious Emissions (Simultaneous Transmission)	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 10

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2007, clause 4.4.3 and 4.5.1.