# FCC and ISED Test Report

## Jotron AS
## EPIRB, Model: Tron 40VDR AIS

## In accordance with FCC 47 CFR Part 80, FCC 47 CFR Part 2, ISED RSS-287 and ISED RSS-GEN (121.5 MHz Homer)

Add value.
Inspire trust.

Prepared for: Jotron AS
Ringdalskogen 8,
3270 Larvik,
Norway

FCC ID: VRV40VDRAIS IC: 2131A-40VDRAIS

## COMMERCIAL-IN-CONFIDENCE

Document 75950873-05 Issue 02

| SIGNATURE | | | |
|---|---|---|---|
| | | | |
| **NAME** | **JOB TITLE** | **RESPONSIBLE FOR** | **ISSUE DATE** |
| Matthew Russell | RF Team Leader | Authorised Signatory | 21 January 2022 |

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 80, FCC 47 CFR Part 2, ISED RSS-287 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

| RESPONSIBLE FOR | NAME | DATE | SIGNATURE |
|---|---|---|---|
| Testing | Neil Rousell | 21 January 2022 | |
| Testing | Graeme Lawler | 21 January 2022 | |

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

ISED 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 80: 2019, FCC 47 CFR Part 2: 2019, ISED RSS-287: Issue 2 (2014-03) and ISED RSS-GEN: Issue 5 (2018-04) + A2 (2021-02) 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 | 12 January 2022 |
| 2 | Second Issue to include section reference for Manufacturer Declared Model | 21 January 2022 |

**Table 1**

## 1.2 Introduction

| | |
|---|---|
| Applicant | Jotron AS |
| Manufacturer | Jotron AS |
| Model Number(s) | Tron 40VDR AIS |
| Serial Number(s) | 00039 and 00041 |
| Hardware Version(s) | Rev: 2020 |
| Software Version(s) | Rev 1.2 |
| Number of Samples Tested | 2 |
| Manufacturer Declared Variant | Tron 40AIS (Refer to Section 1.4) |
| Test Specification/Issue/Date | FCC 47 CFR Part 80: 2019<br>FCC 47 CFR Part 2: 2019<br>ISED RSS-287: Issue 2 (2014-03)<br>ISED RSS-GEN: Issue 5 (2018-04) + A2 (2021-02) |
| Order Number<br>Date | P42335<br>22-December-2020 |
| Date of Receipt of EUT | 23-February-2021 |
| Start of Test | 29-April-2021 |
| Finish of Test | 09-June-2021 |
| Name of Engineer(s) | Neil Rousell and Graeme Lawler |
| Related Document(s) | ANSI C63.26: 2015<br>RTCM 11000.4 with Amd1 (July 17, 2016) |

## 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 80, FCC 47 CFR Part 2, ISED RSS-287 and ISED RSS-GEN is shown below.

| Section | Specification Clause | | | | Test Description | Result | Comments/Base Standard |
|---|---|---|---|---|---|---|---|
| | Part 80 | Part 2 | RSS-287 | RSS-GEN | | | |
| Configuration and Mode: 121.5 MHz Homer | | | | | | | |
| 2.1 | 80.205 | 2.1049 | - | 6.7 | Bandwidths | Pass | |
| 2.2 | 80.209 | 2.1055 | 7.4.2 | 6.11 | Transmitter Frequency Tolerances | Pass | |
| 2.3 | 80.211 | 2.1051 | 7.9 | 6.13 | Spurious Emissions at Antenna Terminals | Pass | |
| 2.4 | 80.211 | 2.1053 | 7.9 | 6.13 | Radiated Spurious Emissions | Pass | |
| 2.5 | 80.1061 | 2.1047 | 7.4.1 | - | Modulation Characteristics | Pass | |
| 2.6 | 80.215 | 2.1046 | 7.4.3 | 6.12 | Transmitter Power | Pass | |
| 2.7 | 80.1061 | - | 7.4.5 | - | Spectrum Characteristics | Pass | |

**Table 2**

## 1.4 Manufacturer Declared Variant

Larvik: 07.12.2021

# Statement of Conformity

Jotron AS hereby states that the Tron 40AIS is a variant of the Tron 40VDR AIS. Testing performed on the Tron 40VDR AIS should in most cases cover Tron 40AIS testing.

On behalf of Jotron AS:

---

Frank Løke
Certification Manager
Jotron AS

## 1.5 Application Form

### Equipment Description

| | |
|---|---|
| Technical Description:<br>*(Please provide a brief description of the intended use of the equipment including the technologies the product supports)* | COSPAS-SARSAT 406 MHz Satellite Emergency Position-Indication Radio Beacon |
| Manufacturer: | Jotron AS |
| Model: | Tron 40VDR AIS |
| Part Number: | 103171 |
| Hardware Version: | Rev: 2020 |
| Software Version: | Rev 1.2 |
| FCC ID of the product under test – see guidance here | VRV40VDRAIS |
| IC ID of the product under test – see guidance here | 2131A-40VDRAIS |

### Intentional Radiators

| | | | | | | |
|---|---|---|---|---|---|---|
| Technology | EPIRB | | | | | |
| Frequency Range (MHz to MHz) | 406.031 MHz,<br>161.975 - 162.025 MHz,<br>121.5 MHz | | | | | |
| Conducted Declared Output Power (dBm) | 35.5 dBm (406 MHz)<br>31.4 dBm (162 MHz)<br>19.2 dBm (121.5 MHz) | | | | | |
| Antenna Gain (dBi) | - | | | | | |
| Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz) | 25 KHz (406 MHz)<br>25 KHz (162 MHz)<br>25 KHz (121.5 MHz) | | | | | |
| Modulation Scheme(s) (e.g GFSK, QPSK etc) | Phase modulation 1.1 rad (406 MHz)<br>GMSK/FM (162 MHz)<br>AM Homing (121.5 MHz) | | | | | |
| ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices) | 16K0G1D (406.031 MHz)<br>16K0GXW (162 MHz)<br>3K20A3X (121.5 MHz) | | | | | |
| Bottom Frequency (MHz) | 121.5 MHz | | | | | |
| Middle Frequency (MHz) | - | | | | | |
| Top Frequency (MHz) | 406.031 MHz | | | | | |

### Un-intentional Radiators

| | |
|---|---|
| Highest frequency generated or used in the device or on which the device operates or tunes | 406.031 MHz |
| Lowest frequency generated or used in the device or on which the device operates or tunes | 121.5 MHz |
| Class A Digital Device (Use in commercial, industrial or business environment) ☒<br>Class B Digital Device (Use in residential environment only) ☐ | |

### AC Power Source

| | | |
|---|---|---|
| AC supply frequency: | - | Hz |

| | | |
|---|---|---|
| Voltage | - | V |
| Max current: | - | A |
| Single Phase ☐ Three Phase ☐ | | |

## DC Power Source

| | | |
|---|---|---|
| Nominal voltage: | - | V |
| Extreme upper voltage: | - | V |
| Extreme lower voltage: | - | V |
| Max current: | - | A |

## Battery Power Source

| | | |
|---|---|---|
| Voltage: | 7.2 | V |
| End-point voltage: | 5 | V *(Point at which the battery will terminate)* |
| Alkaline ☐ Leclanche ☐ Lithium ☒ Nickel Cadmium ☐ Lead Acid* ☐ **(Vehicle regulated)* | | |
| Other ☐ Please detail: | | |

## Charging

| | |
|---|---|
| Can the EUT transmit whilst being charged | Yes ☐ No ☒ |

## Temperature

| | | |
|---|---|---|
| Minimum temperature: | -20 | °C |
| Maximum temperature: | +55 | °C |

## Cable Loss

| | | |
|---|---|---|
| Adapter Cable Loss (Conducted sample) | - | dB |

## Antenna Characteristics

| | | | | | |
|---|---|---|---|---|---|
| Antenna connector ☐ | | | State impedance | | Ohm |
| Temporary antenna connector ☐ | | | State impedance | | Ohm |
| Integral antenna ☒ | Type: | | Gain | | dBi |
| External antenna ☐ | Type: | | Gain | | dBi |
| For external antenna only:<br>Standard Antenna Jack ☐ If yes, describe how user is prohibited from changing antenna (if not professional installed):<br>Equipment is only ever professionally installed ☐<br>Non-standard Antenna Jack ☐ | | | | | |

## Ancillaries (if applicable)

| | | | |
|---|---|---|---|
| Manufacturer: | | Part Number: | |
| Model: | | Country of Origin: | |

I hereby declare that the information supplied is correct and complete.

Name: Frank Løke
Position held: Certification Manager Jotron AS
Date: 2021-07-07

## 1.6 Product Information

### 1.6.1 Technical Description

The Equipment under test (EUT) was a Jotron AS Tron 40VDR AIS EPIRB with Float Free capsule

The primary function of the EUT is an Emergency Position Indication Radio Beacon (EPIRB) within capsule.

Additionally, the EUT has functionality for Automatic Identification System (AIS), GNSS Rx (GPS/Galileo/Glonass), Transmitting 406 MHz, 121.5 MHz Home, RLS and VDR

## 1.7 Deviations from the Standard

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

## 1.8 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: Tron 40VDR AIS, Serial Number: 00039 and 00041 | | | |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |
| 1 | GNSS LED changed to blink before or after 406MHz to reduce noise on modulation | Manufacturer at TUV SUD site | 31-March 2021 |
| 2 | Addition of a LDO (Low Dropout Regulator) to the TCXO, to reduce the noise coming from the power supply. A resistor of 0 ohm (added to the design for current measurement) was replaced by the three-legged regulator. | Manufacturer | 27-April 2021 |
| 3 | SW update to reduce image AIS frequencies. Parameter in the synthesizer was adjusted to reduce the signal level from the clock. | Manufacturer | 21-May 2021 |

**Table 3**

Note: Tron 40VDR AIS, Serial Number: 00041 repair was carried out on 25-May-2021 to resolve an issue with low power output.

## 1.9 Test Location

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

| Test Name | Name of Engineer(s) | Accreditation |
|---|---|---|
| Configuration and Mode: 121.5 MHz Homer | | |
| Bandwidths | Neil Rousell | UKAS |
| Transmitter Frequency Tolerances | Neil Rousell | UKAS |
| Spurious Emissions at Antenna Terminals | Neil Rousell | UKAS |
| Radiated Spurious Emissions | Graeme Lawler | UKAS |
| Modulation Characteristics | Neil Rousell | UKAS |
| Transmitter Power | Neil Rousell | UKAS |
| Spectrum Characteristics | Neil Rousell | UKAS |

**Table 4**

Office Address:

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire
PO15 5RL
United Kingdom

# 2 Test Details

## 2.1 Bandwidths

### 2.1.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.205
FCC 47 CFR Part 2, Clause 2.1049,
ISED RSS-GEN, Clause 6.7

### 2.1.2 Equipment Under Test and Modification State

Tron 40VDR AIS, S/N: 00039 - Modification State 2

### 2.1.3 Date of Test

30-April-2021

### 2.1.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.4.3.

The EUT was transmitting at maximum power, with normal modulation as described in FCC CFR 47 Part 2, clause 2.1049. The EUT was connected to a spectrum analyser via a cable and attenuator, the RBW of the spectrum analyser was set to at least 1% of the emission bandwidth and a video bandwidth of 3 times RBW, the occupied bandwidth measurement function of the analyser was used and the 99% bandwidth recorded

The plots on the following pages show the resultant display from the Spectrum Analyser.

### 2.1.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.5 °C |
| Relative Humidity | 36.3 % |

### 2.1.6 Test Results

121.5 MHz Homer

| Occupied Bandwidth (kHz) |
|---|
| 16.6 |

**Table 5 - Occupied Bandwidth Result, 121.5 MHz**

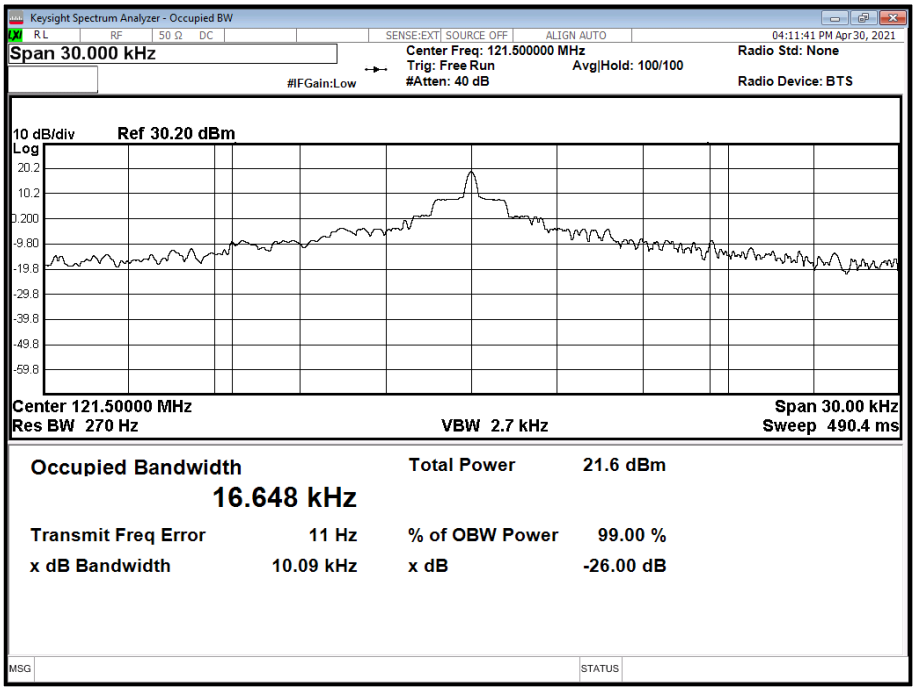


**Figure 1 - Occupied Bandwidth**

FCC 47 CFR Part 80, Limit Clause 80.205

< 25 kHz

ISED RSS-GEN, Limit Clause

None Specified.

### 2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 17-May-2021 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 29-Jan-2022 |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 30-Dec-2021 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 17-May-2021 |
| 1 metre K-Type Cable | Florida Labs | KMS-180SP-39.4-KMS | 4520 | 12 | 16-Nov-2021 |
| PXA Signal Analyser | Keysight Technologies | N9030A | 4654 | 12 | 06-Nov-2021 |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5475 | 12 | 06-Apr-2022 |
| Attenuator 5W 30dB DC-18GHz | Aaren | AT40A-4041-D18-30 | 5504 | 12 | 14-Apr-2022 |
| Attenuator 2W 10dB DC-10GHz | Telegartner | J01156A0031 | 5577 | - | O/P Mon |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB 40 | 5605 | 12 | 08-Sep-2021 |

**Table 6**

O/P Mon – Output Monitored using calibrated equipment

## 2.2 Transmitter Frequency Tolerances

### 2.2.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.209
FCC 47 CFR Part 2, Clause 2.1055
ISED RSS-287, Clause 7.4.2
ISED RSS-GEN, Clause 6.11

### 2.2.2 Equipment Under Test and Modification State

Tron 40VDR AIS, S/N: 00039 - Modification State 2

### 2.2.3 Date of Test

07-May-2021

### 2.2.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.6.

The EUT was connected to a spectrum analyser via a cable and attenuator. The external frequency reference of the spectrum analyser was locked to a 10 MHz rubidium frequency standard reference. The 99% OBW function of the spectrum analyser was used to record the carrier frequency error. The temperature was varied from -30°C to +55° in 10° steps. At 20°C the voltage was also reduced to the manufacturer declared battery endpoint voltage and the carrier frequency measured.

### 2.2.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 24.9 °C |
| Relative Humidity | 19.6 % |

### 2.2.6 Test Results

121.5 MHz Homer

| Voltage | Frequency Error (ppm) |
|---|---|
| 4.5 V DC | 0.46 |
| 7.2 V DC | 1.42 |

**Table 7 - Frequency Stability Under Voltage Variations**

| Temperature | Frequency Error (ppm) |
|---|---|
| +55.0 °C | 0.64 |
| +50.0 °C | 0.99 |
| +40.0 °C | -0.76 |
| +30.0 °C | -0.77 |
| +20.0 °C | 1.42 |
| +10.0 °C | -2.39 |
| 0 °C | 0.12 |
| -10.0 °C | -1.95 |
| -20.0 °C | 2.67 |
| -30.0 °C | 0.40 |

**Table 8 - Frequency Stability Under Temperature Variations**

FCC 47 CFR Part 80, Limit Clause 80.209

± 50 ppm.

ISED RSS-287, Limit Clause 7.4.2

The carrier frequency shall not depart by more than 0.005% (±50 ppm) from that measured at 20˚C and the rated supply voltage. If the 121.5 MHz and 243 MHz frequencies are derived from the same oscillator circuitry, it is not necessary to repeat the frequency stability test for the other frequency.

### 2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 17-May-2021 |
| Hygrometer | Rotronic | I-1000 | 2891 | 12 | 16-Oct-2021 |
| Multimeter | Fluke | 79 Series II | 3057 | 12 | 21-Aug-2021 |
| Thermocouple Data Logger | Pico Technology Ltd | TC-08 | 3783 | 12 | 22-Jun-2021 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 17-May-2021 |
| 1 metre K-Type Cable | Florida Labs | KMS-180SP-39.4-KMS | 4519 | 12 | 16-Nov-2021 |
| PXA Signal Analyser | Keysight Technologies | N9030A | 4654 | 12 | 06-Nov-2021 |
| Quad Power Supply | Rohde & Schwarz | HMP4040 | 4954 | - | O/P Mon |
| Thermo-Hygro-Barometer | PCE Instruments | OCE-THB-40 | 5470 | 12 | 31-Mar-2022 |
| Attenuator 5W 30dB DC-18GHz | Aaren | AT40A-4041-D18-30 | 5504 | 12 | 14-Apr-2022 |
| Attenuator 2W 10dB DC-10GHz | Telegartner | J01156A0031 | 5577 | - | O/P Mon |
| Environmental Chamber | ACS | DY110TC | 5589 | - | O/P Mon |

**Table 9**

O/P Mon – Output Monitored using calibrated equipment

## 2.3 Spurious Emissions at Antenna Terminals

### 2.3.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.211
FCC 47 CFR Part 2, Clause 2.1051
ISED RSS-287, Clause 7.9
ISED RSS-GEN, Clause 6.13

### 2.3.2 Equipment Under Test and Modification State

Tron 40VDR AIS, S/N: 00039 - Modification State 2

### 2.3.3 Date of Test

04-May-2021

### 2.3.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.7.

For emissions where the frequency is removed less than 250% of the authorized bandwidth measurements were performed as follows:

The EUT was connected to a spectrum analyser via a cable and attenuator. The path loss between the EUT and analyser was calibrated using a network analyser and entered in to the spectrum analyser as a reference level offset. The RBW was configured to 300 Hz using an average detector with max hold.

For emissions where the frequency is removed more than 250% of the authorized bandwidth measurements were performed as follows:

A network analyser was used to measure the path loss and the worst case was entered as a reference level offset into the spectrum analyser. The EUT was connected to a spectrum analyser via a cable and attenuator. The analyser was configured with an RBW of 100 kHz below 1 GHz and 1 MHz for frequencies greater than 1 GHz with the trace set to max hold using a peak detector.

### 2.3.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 24.6 °C |
| Relative Humidity | 35.3 % |

### 2.3.6 Test Results

121.5 MHz Homer

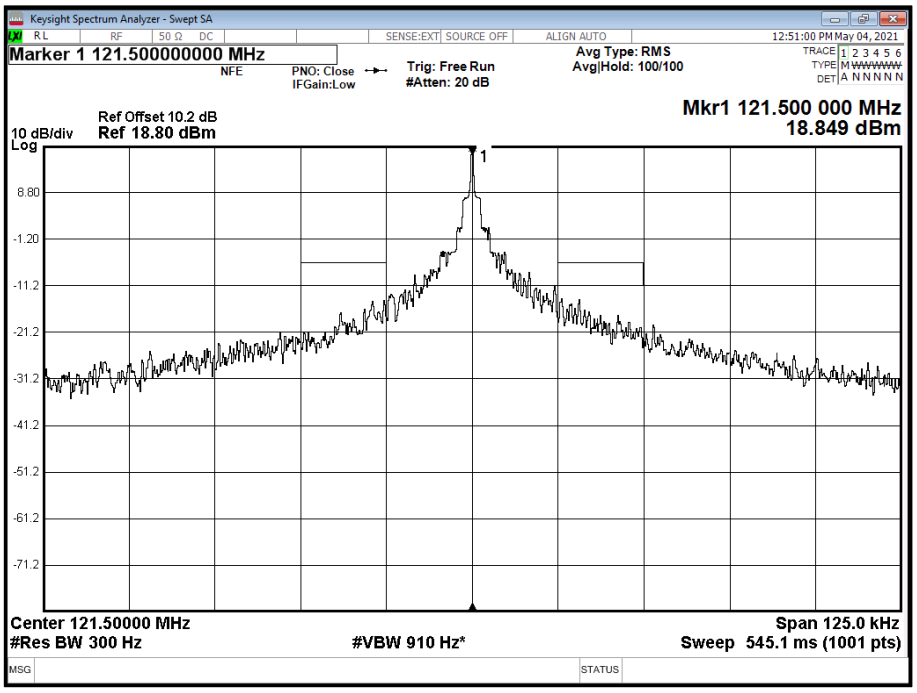


**Figure 2 - Transmitter Spectrum Mask**

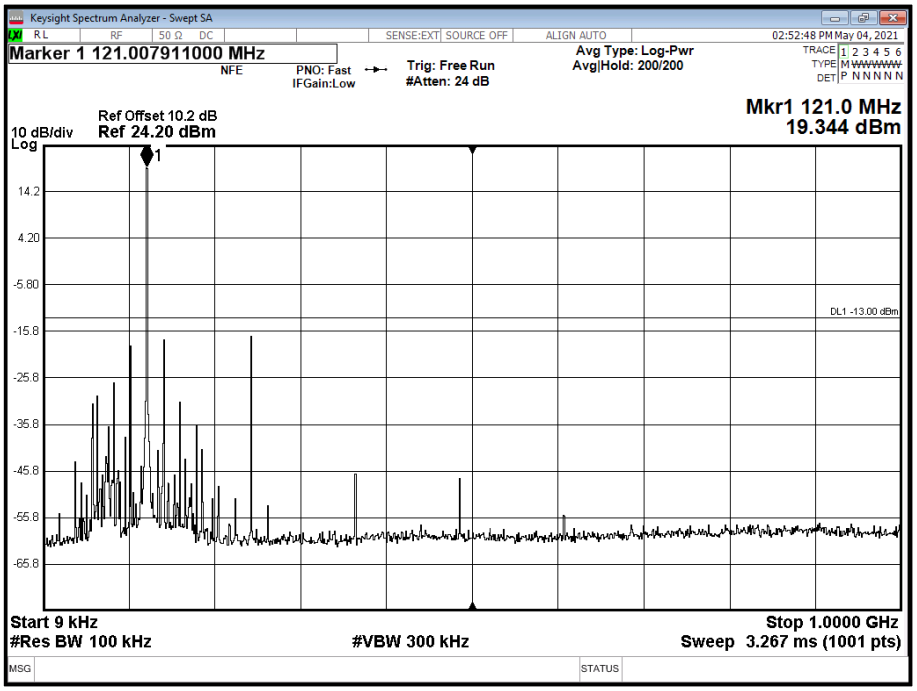


**Figure 3 - 9 kHz to 1 GHz**

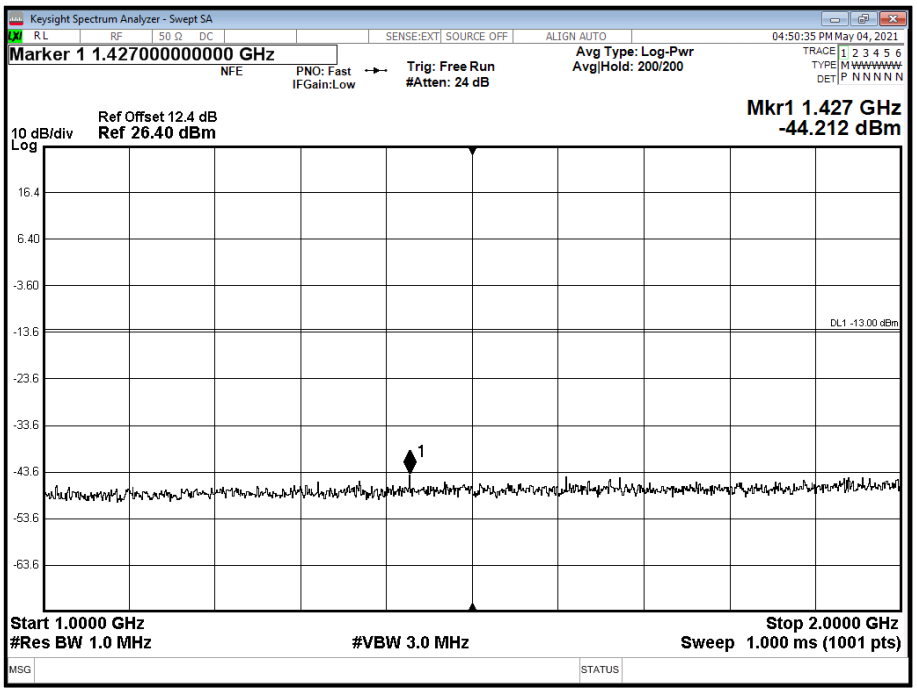


**Figure 4 - 1 GHz to 2 GHz**

FCC 47 CFR Part 80, Limit Clause 80.211(e)

On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

On any frequency removed from the assigned frequency by more than 100 percent: At least 30 dB

ISED RSS-287, Limit Clause 7.4.4

The average power of unwanted emissions in a 300 Hz resolution bandwidth shall be attenuated below the level of the average transmitter power P (dBW) by:

(a) at least 25 dB on any frequency removed from the centre of the authorized bandwidth by more than 50%, up to and including 100% of the authorized bandwidth; and

(b) at least 30 dB on any frequency removed from the centre of the authorized bandwidth by more than 100%

where the authorized bandwidth is set at 25 kHz with the transmit frequency at the centre of the bandwidth.

### 2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 17-May-2021 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 29-Jan-2022 |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 30-Dec-2021 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 17-May-2021 |
| 1 metre K-Type Cable | Florida Labs | KMS-180SP-39.4-KMS | 4520 | 12 | 16-Nov-2021 |
| PXA Signal Analyser | Keysight Technologies | N9030A | 4654 | 12 | 06-Nov-2021 |
| Cable (18 GHz) | Rosenberger | LU7-071-1000 | 5099 | 12 | 12-Oct-2021 |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5475 | 12 | 06-Apr-2022 |
| Attenuator 5W 30dB DC-18GHz | Aaren | AT40A-4041-D18-30 | 5504 | 12 | 14-Apr-2022 |
| 300 MHz High Pass Filter | Mini-Circuits | NHP-300 | 5532 | 12 | 25-Mar-2022 |
| Attenuator 2W 10dB DC-10GHz | Telegartner | J01156A0031 | 5577 | - | O/P Mon |

**Table 10**

O/P Mon – Output Monitored using calibrated equipment

## 2.4 Radiated Spurious Emissions

### 2.4.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.211
FCC 47 CFR Part 2, Clause 2.1053
ISED RSS-287, Clause 7.9
ISED RSS-GEN, Clause 6.13

### 2.4.2 Equipment Under Test and Modification State

Tron 40VDR AIS, S/N: 00041 - Modification State 3

### 2.4.3 Date of Test

09-June-2021

### 2.4.4 Test Method

Testing was performed in accordance with ANSI C63.26, clause 5.5.4.

A preliminary profile of the Spurious Radiated Emissions was obtained up to the 10th harmonic by operating the EUT on a remotely controlled turntable within a semi-anechoic chamber.

Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

Using the information from the preliminary profiling of the EUT, the list of emissions was then confirmed or updated under Alternative Open Site conditions. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth.

The EUT was set to transmit on maximum power with the 121.5 MHz homing channel operating.

### 2.4.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 21.0 °C |
| Relative Humidity | 59.3 % |

### 2.4.6 Test Results

<u>121.5 MHz Homer</u>

| Frequency (MHz) | Level (dBm) |
|---|---|
| * | |

**Table 11 - Emissions Results**

*No emissions were detected within 10 dB of the limit.

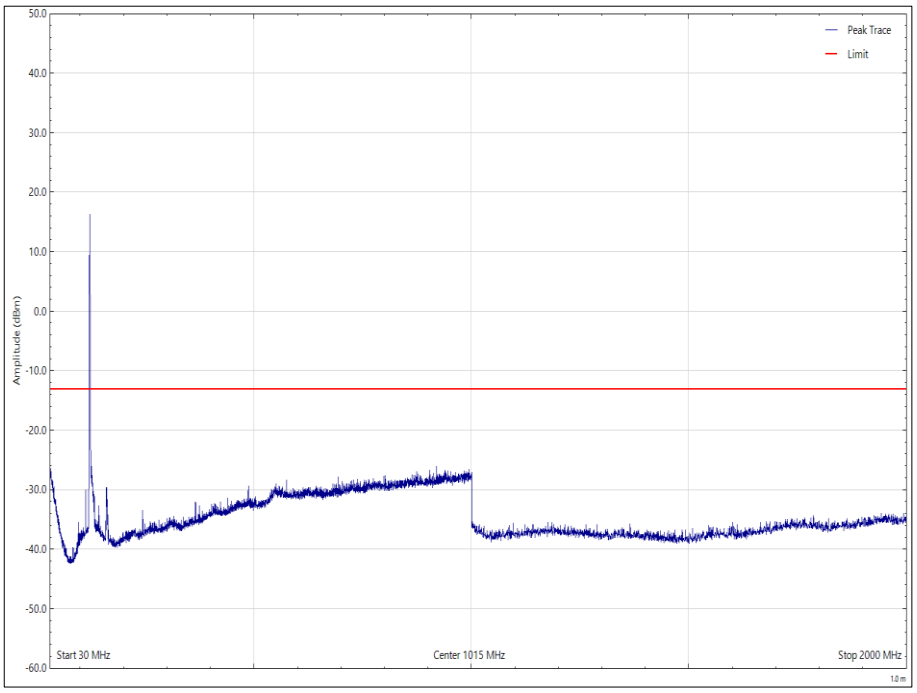


**Figure 5 - 30 MHz to 2 GHz - Vertical Polarisation**

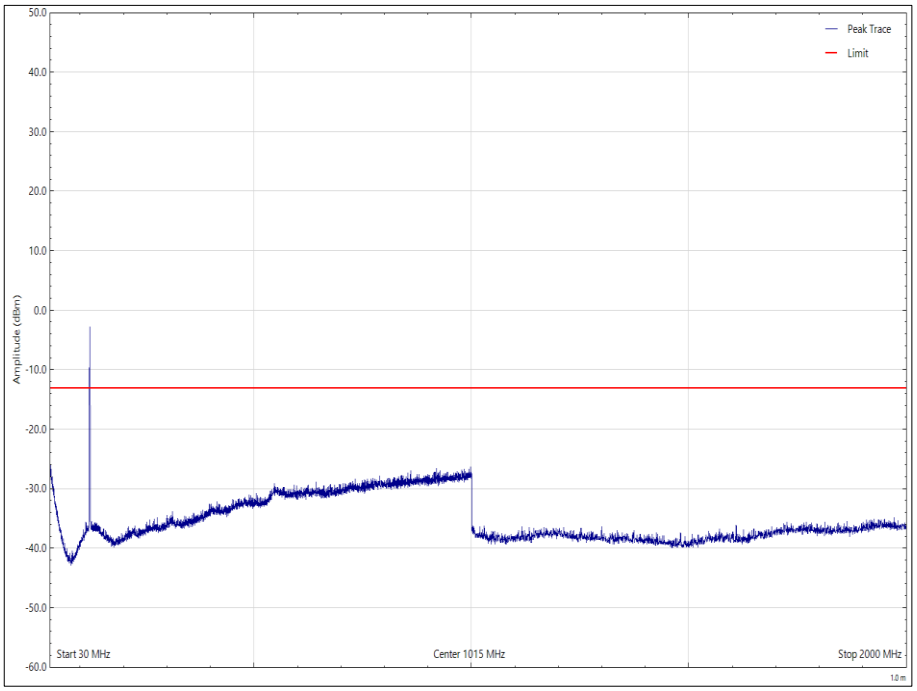


**Figure 6 - 30 MHz to 2 GHz - Horizontal Polarisation**

FCC 47 CFR Part 80, Limit Clause 80.211(e)

On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;

On any frequency removed from the assigned frequency by more than 100 percent: At least 30 dB

ISED RSS-287, Limit Clause 7.4.4

The average power of unwanted emissions in a 300 Hz resolution bandwidth shall be attenuated below the level of the average transmitter power P (dBW) by:

(a) at least 25 dB on any frequency removed from the centre of the authorized bandwidth by more than 50%, up to and including 100% of the authorized bandwidth; and

(b) at least 30 dB on any frequency removed from the centre of the authorized bandwidth by more than 100%

where the authorized bandwidth is set at 25 kHz with the transmit frequency at the centre of the bandwidth.

### 2.4.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| Antenna with permanent attenuator (Bilog) | Schaffner | CBL6143 | 287 | 24 | 14-Oct-2022 |
| Comb Generator | Schaffner | RSG1000 | 3034 | - | TU |
| EMI Test Receiver | Rohde & Schwarz | ESU40 | 3506 | 12 | 18-Mar-2022 |
| EmX Emissions Software | TUV SUD | V2.1.9 | 5125 | - | Software |
| Cable 2.92mm | Junkosha | MWX241/B | 5411 | 12 | 22-Jun-2021 |
| 3.5 mm 2m Cable | Junkosha | MWX221-02000DMS | 5428 | 12 | 15-Oct-2021 |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5481 | 12 | 31-Mar-2022 |
| Broadband Horn Antenna (1-10 GHz) | Schwarzbeck | BBHA 9120 B | 5611 | 12 | 22-Sep-2021 |
| Turntable & Mast Controller | Maturo Gmbh | NCD/498/2799.01 | 5612 | - | TU |
| Tilt Antenna Mast TAM 4.0-P | Maturo Gmbh | TAM 4.0-P | 5613 | - | TU |
| Turntable | Maturo Gmbh | Turntable 1.5 SI-2t | 5614 | - | TU |
| 3m Semi Anechoic Chamber | MVG | EMC-3 | 5621 | 36 | 11-Aug-2023 |
| Cable Assembly - 18GHz 8m | Junkosha | MWX221-08000NMSNMS/B | 5732 | 6 | 05-Aug-2021 |

**Table 12**

TU - Traceability Unscheduled

## 2.5 Modulation Characteristics

### 2.5.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.1061
FCC 47 CFR Part 2, Clause 2.1047
ISED RSS-287, Clause 7.4.1

### 2.5.2 Equipment Under Test and Modification State

Tron 40VDR AIS, S/N: 00039 - Modification State 2

### 2.5.3 Date of Test

11-May-2021

### 2.5.4 Test Method

This test EUT antenna was connected either directly to the oscilloscope via a cable and attenuator or was connected to the spectrum analyser and then the demodulated output of the spectrum analyser was connected to the oscilloscope.

The markers on the oscilloscope was used to measure the parameters specified in the table below.

### 2.5.5 Environmental Conditions

Ambient Temperature 23.2 °C
Relative Humidity 40.6 %

### 2.5.6 Test Results

121.5 MHz Homer

| Requirement | Result | Unit |
|---|---|---|
| | Ambient | |
| Audio sweep frequency (low) | 368 | Hz |
| Audio sweep frequency (high) | 1172 | Hz |
| Audio sweep frequency range | 804 | Hz |
| Audio sweep frequency direction | High to Low | - |
| Audio sweep repetition rate | 2.48 | Hz |
| Modulation factor | 0.91 | - |
| Modulation duty cycle (low) | 34.7 | % |
| Modulation duty cycle (mid) | 35.0 | % |
| Modulation duty cycle (high) | 35.7 | % |
| Continuous transmission (during burst) | Yes | - |
| Morse letter "V" dot length | 115.4 | ms |
| Morse letter "V" dash length | 344.3 | ms |
| Morse letter "V" gap length | 115.5 | ms |
| Morse letter "V" modulation frequency | 1008 | Hz |

**Table 13 - Modulation Characteristics**

FCC 47 CFR Part 80, Limit Clause 80.1061(b)

The 406.0-406.1 EPIRB must contain as an integral part a “homing” beacon operating only on 121.500 MHz that meets all the requirements described in the RTCM Recommended Standards document described in paragraph (a) of this section. The 121.500 MHz “homing” beacon must have a continuous duty cycle that may be interrupted during the transmission of the 406.0-406.1 MHz signal only.

ISED RSS-287, Limit Clause 7.4.1

| Requirement | Limit |
|---|---|
| The carrier is not interrupted (except for two seconds encompassing the transmission of the 406 MHz pulse plus the additional time required for the Morse “P” transmission). | True |
| Lower Audio Frequency | > 300 Hz |
| Upper Audio Frequency | < 1600 Hz |
| Audio Frequency Range | > 700 Hz |
| Sweep Repetition Rate | Between 2 Hz and 4 Hz |
| Modulation Duty Cycle | Between 33% and 55% |
| Modulation Factor | Between 85% and 100% |
| Morse Letter P:<br>Dot Length<br>Dash Length<br>Gap Length<br>Modulating Frequency | <br>115 ms ± 5%<br>345 ms ± 5%<br>115 ms ± 5%<br>1000 Hz ± 50 Hz |

**Table 14 - Modulation Characteristic Limits**

### 2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 17-May-2021 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 29-Jan-2022 |
| Oscilloscope | Agilent Technologies | DSO9104A | 4142 | 12 | 14-Sep-2021 |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 30-Dec-2021 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 17-May-2021 |
| 1 metre K-Type Cable | Florida Labs | KMS-180SP-39.4-KMS | 4520 | 12 | 16-Nov-2021 |
| PXA Signal Analyser | Keysight Technologies | N9030A | 4654 | 12 | 06-Nov-2021 |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5475 | 12 | 06-Apr-2022 |
| Attenuator 2W 10dB DC-10GHz | Telegartner | J01156A0031 | 5577 | - | O/P Mon |

**Table 15**

O/P Mon – Output Monitored using calibrated equipment

## 2.6 Transmitter Power

### 2.6.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.215
FCC 47 CFR Part 2, Clause 2.1046
ISED RSS-287, Clause 7.4.3
ISED RSS-GEN, Clause 6.12

### 2.6.2 Equipment Under Test and Modification State

Tron 40VDR AIS, S/N: 00039 - Modification State 2

### 2.6.3 Date of Test

30-April-2021

### 2.6.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.2.3.3.

### 2.6.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.4 °C |
| Relative Humidity | 36.4 % |

### 2.6.6 Test Results

121.5 MHz Homer

| 121.5 MHz | |
|---|---|
| Result (dBm) | Result (W) |
| 20.157 | 0.104 |

**Table 16 - Transmitter Power Results**

FCC 47 CFR Part 80, Limit Clause 80.215

>25 mW

ISED-RSS 287, Limit Clause 7.4.3

The average output power of EPIRBs and PLBs shall not be less than 50 mW when the transmitter is used as a primary beacon and not less than 25 mW when used as a homing transmitter. The output power of MSLDs shall be less than 25 mW.

### 2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 17-May-2021 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 29-Jan-2022 |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 30-Dec-2021 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 17-May-2021 |
| 1 metre K-Type Cable | Florida Labs | KMS-180SP-39.4-KMS | 4520 | 12 | 16-Nov-2021 |
| PXA Signal Analyser | Keysight Technologies | N9030A | 4654 | 12 | 06-Nov-2021 |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5475 | 12 | 06-Apr-2022 |
| Attenuator 5W 30dB DC-18GHz | Aaren | AT40A-4041-D18-30 | 5504 | 12 | 14-Apr-2022 |
| Attenuator 2W 10dB DC-10GHz | Telegartner | J01156A0031 | 5577 | - | O/P Mon |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB 40 | 5605 | 12 | 08-Sep-2021 |

**Table 17**

O/P Mon – Output Monitored using calibrated equipment

## 2.7 Spectrum Characteristics

### 2.7.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.1061
ISED RSS-287, Clause 7.4.5

### 2.7.2 Equipment Under Test and Modification State

Tron 40VDR AIS, S/N: 00039 - Modification State 2

### 2.7.3 Date of Test

29-April-2021

### 2.7.4 Test Method

This test was performed in accordance with RSS-287, clause 6.5

### 2.7.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.4 °C |
| Relative Humidity | 36.4 % |

### 2.7.6 Test Results

121.5 MHz Homer

| Parameter | Result |
|---|---|
| Total (Wideband) Power (dBm) | 20.157 |
| Power within the resolution bandwidth (dBm) | 17.315 |
| Difference (dB) | 2.842 |

**Table 18 - Spectrum Characteristics**

FCC 47 CFR Part 80, Limit Clause 80.1061

At least 30 percent of the total power emitted during any transmission cycle must be contained within plus or minus 30 Hz of the carrier frequency.

ISED RSS-287 Limit Clause 7.4.5

The total power in the resolution bandwidth shall not drop by more than 5 dB below the transmitter mean output power that is measured by a wideband meter, indicating that at least 30% of the power resides within the band fc ±30 Hz (at 121.5 MHz) and within the band fc ±60 Hz (at 243 MHz).

### 2.7.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

| Instrument | Manufacturer | Type No | TE No | Calibration Period (months) | Calibration Expires |
|---|---|---|---|---|---|
| Rubidium Standard | Rohde & Schwarz | XSRM | 1316 | 6 | 17-May-2021 |
| Network Analyser | Rohde & Schwarz | ZVA 40 | 3548 | 12 | 29-Jan-2022 |
| Calibration Unit | Rohde & Schwarz | ZV-Z54 | 4368 | 12 | 30-Dec-2021 |
| Frequency Standard | Spectracom | SecureSync 1200-0408-0601 | 4393 | 6 | 17-May-2021 |
| 1 metre K-Type Cable | Florida Labs | KMS-180SP-39.4-KMS | 4520 | 12 | 16-Nov-2021 |
| PXA Signal Analyser | Keysight Technologies | N9030A | 4654 | 12 | 06-Nov-2021 |
| Thermo-Hygro-Barometer | PCE Instruments | PCE-THB-40 | 5475 | 12 | 06-Apr-2022 |
| Attenuator 2W 10dB DC-10GHz | Telegartner | J01156A0031 | 5577 | - | O/P Mon |

**Table 19**

O/P Mon – Output Monitored using calibrated equipment

# 3 Photographs

## 3.1 Test Setup Photographs

**Figure 7 - Test Setup - 30 MHz to 1 GHz**

**Figure 8 - Test Setup - 1 GHz to 2 GHz**

# 4 Measurement Uncertainty

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

| Test Name | Measurement Uncertainty |
|---|---|
| Bandwidths | ± 58.05 Hz |
| Transmitter Frequency Tolerances | ± 11 Hz |
| Spurious Emissions at Antenna Terminals | ± 3.45 dB |
| Radiated Spurious Emissions | 30 MHz to 1 GHz: ± 5.2 dB<br>1 GHz to 18 GHz: ± 6.3 dB |
| Modulation Characteristics | Minimum Audio Frequency: ± 22.4 Hz<br>Maximum Audio Frequency: ± 121.56 Hz<br>Audio Frequency Range: ± 123.6 Hz<br>Sweep Repetition Rate: ± 5 %<br>Modulation Factor: ± 5%<br>Modulation Duty Cycle: ± 5%<br>30% Occupied Bandwidth: ± 5% |
| Transmitter Power | ± 3.2 dB |
| Spectrum Characteristics | ± 1.8 dB |

**Table 20**

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.