

# LABORATORY TEST REPORT

## RADIO PERFORMANCE MEASUREMENTS

for the

TBDH3G BASE STATION Transceiver  
Fitted with the H3 470-520 MHz Reciter

Tested in accordance with:

FCC 47 CFR Parts 22 and 90

Report Revision: 1

Issue Date: 28 September 2020

PREPARED BY: I.D. Russell

  
Test Technician

CHECKED & APPROVED BY: M. C. James

  
Laboratory Technical Manager



FCC Registration: 838288  
ISED Registration: 737A

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation.

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### REVISION HISTORY

| <b>Date</b>       | <b>Revision</b> | <b>Comments</b>     |
|-------------------|-----------------|---------------------|
| 28 September 2020 | 1               | Initial test report |
|                   |                 |                     |

## INTRODUCTION

Type approval testing of the TBDH3G, 40 Watt, BASE STATION transceiver in order to demonstrate continued compliance with FCC 47 Parts 22 & 90, due to the addition of Analogue Wideband (25kHz channel spacing) modulation.

This report contains results for Analogue Wide Band modulation.

This transceiver is also capable of Analogue NB (12.5kHz) , FFSK, DMR, and P25 phase1 C4FM modulations.

Results for other modulations can be found in TELTEST Reports 3880 and 4100.

### REPORT PREPARED FOR

Tait International Limited  
245 Wooldridge Road  
Harewood  
Christchurch 8051  
New Zealand

### DESCRIPTION OF SAMPLE

Manufacturer: Tait International Limited  
Equipment: BASE STATION Transceiver  
Type: TBDH3G  
Product Code: TB7310-H3B0-0000-00AE-10  
Serial Number(s): 18295485  
Frequency range: 470 → 520 MHz  
Transmit Power: 40 Watts

| Modulation  |           | Channel Spacing | Speech Channels | Symbol Rate (symbols/sec) | Data Rate (bps) |
|-------------|-----------|-----------------|-----------------|---------------------------|-----------------|
| Analogue FM | Wide Band | 25 kHz          | 1               | -                         | -               |

### HARDWARE & SOFTWARE

Quantity: 1

| Module          | Product Code   | Serial Number | Firmware Version | Hardware Version |
|-----------------|----------------|---------------|------------------|------------------|
| Reciter         | T01-01403-MAAA | 18295499      | p25-3.10.00.0006 | 01.01            |
| Power Amplifier | T01-01405-MAAA | 18295502      |                  | 00.01            |
| Front Panel     | T01-01410-AAAA | 04682948      | 1.10.01.0001     | 00.01            |

### TEST CONDITIONS

All testing was performed between 25 → 28 September 2020, and under the following conditions:

Ambient temperature: 15°C → 30°C  
Relative Humidity: 20% → 75%  
Standard Test Voltage: 13.8 V<sub>DC</sub>

TEST REQUIREMENTS AND RESULT SUMMARY

| FCC Specification         | Test Name   | Test Methods          | Result |
|---------------------------|---|-----------------------|--------|
| FCC 47 CFR 2.1046         | Transmitter Output Power (Conducted)                | ANSI C63.26 5.2.4.2   | N1     |
| FCC 47 CFR 2.1047 (a)     | Transmitter Audio Frequency Response – Pre-emphasis | ANSI C63.26 5.3.3.2   | P      |
| FCC 47 CFR 2.1047 (b)     | Transmitter Modulation Limiting                     | ANSI C63.26 5.3.2     | P      |
| FCC 47 CFR 2.1049 (c)     | Transmitter Occupied (99%) Bandwidth                | ANSI C63.26 5.4.4     | N1     |
| FCC 47 CFR 90.210         | Transmitter Spectrum Masks                          | TIA-603-E 2.2.11      | P      |
| FCC 47 CFR 90.543         | Adjacent Channel Power Ratio                        | ANSI C63.26 6.5.2.4   | N/A 2  |
| FCC 47 CFR 2.1051         | Transmitter Spurious Emissions (Conducted)          | ANSI C63.26 5.7       | N1     |
| FCC 47 CFR 2.1053         | Transmitter Spurious Emissions (Radiated)           | ANSI C63.26 5.5       | N1     |
| FCC CFR 90.543            | Transmitter Radiated Emissions in the GNSS Band     | ANSI C63.26 6.5.2.7.3 | N/A 2  |
| No specification          | Transmitter Conducted Emissions in the GNSS Band    | ANSI C63.26 6.5.2.7.4 | N/A 2  |
| FCC 47 CFR 90.214         | Transient Frequency Behaviour                       | ANSI C63.26 6.5.2.2   | P      |
| FCC 47 CFR 90.214         | Transmitter Frequency Stability - Temperature       | ANSI C63.26 5.6.4     | N1     |
| FCC 47 CFR 2.1055 (d) (1) | Transmitter Frequency Stability - Voltage           | ANSI C63.26 5.6.5     | N1     |
| FCC 47 CFR 15.111         | Receiver Spurious Emissions (Conducted)             | TIA-603-E 2.1.2       | N1     |

| Test Case Result Definitions           |                  |
|--|------------------|
| No test Performed                      | N                |
| Test does not apply to the test object | N/A              |
| Test object meets requirements         | P (Pass)         |
| Test object does not meet requirements | F (Fail)         |
| Test object is not conclusive          | I (Inconclusive) |

**Comments:**

N/A 2: Only required where the EUT transmits in the 769-775 or 799-805 MHz band (FCC).

N1: Not tested as this parameter is unlikely to be affected by the change in Modulation

## STATEMENT OF COMPLIANCE

We, TELTEST LABORATORIES of 558 Wairakei Road, Christchurch, New Zealand, declare under our sole responsibility that the product:

Equipment: BASE STATION Transceiver  
Type: TBDH3G

| Module          | Product Code   | Serial Number | Firmware Version | Hardware Version |
|-----------------|----------------|---------------|------------------|------------------|
| Reciter         | T01-01403-MAAA | 18295499      | p25-3.10.00.0006 | 01.01            |
| Power Amplifier | T01-01405-MAAA | 18295502      |                  | 00.01            |
| Front Panel     | T01-01410-AAAA | 04682948      | 1.10.01.0001     | 00.01            |

to which this declaration relates, is in conformity with the following standards:

FCC 47 CFR Parts 22 and 90

for the parameters tested in this report.

**Signature:** 

Mike James  
Technical Manager

**Date:** 2 October 2020

The results obtained in this test report pertain only to the item(s) tested. Teltest does not make any claims of compliance for samples or variants that were not tested.

CHANNEL TABLE

| <b>Label</b> | <b>Channel Number</b> | <b>Receive Frequency MHz</b> | <b>Transmit Frequency MHz</b> | <b>Power Watts</b> | <b>Bandwidth kHz</b> |
|--------------|-----------------------|------------------------------|-------------------------------|--------------------|----------------------|
| 470 40W      | 1                     | NA                           | 470.0125                      | 40                 | 25                   |
| 470 2W       | 2                     | NA                           | 470.0125                      | 2                  | 25                   |
| 491 40W      | 3                     | NA                           | 491.0                         | 40                 | 25                   |
| 491 2W       | 4                     | NA                           | 491.0                         | 2                  | 25                   |
| 511 40W      | 5                     | NA                           | 511.975                       | 40                 | 25                   |
| 511 2W       | 6                     | NA                           | 511.975                       | 2                  | 25                   |

## MODULATION TYPES, NECESSARY BANDWIDTH & EMISSION DESIGNATORS

### MODULATION TYPES:

F3E FM Analogue Voice - -

CHANNEL SPACING: 25 kHz

### EMISSION DESIGNATORS:

Analogue Voice 16K0F3E

Equation:  $B_n = 2M + 2Dk$

(M is highest modulating frequency; D is peak allowable deviation; k is a constant of 1 for FM)

### Analogue Voice 25 kHz Channel Spacing

Necessary bandwidth

M = 3.0 kHz

D = 5.0 kHz

$$B_n = (2 \times 3.0) + (2 \times 5) \times 1 \\ = 16.0 \text{ kHz}$$

Emission Designator

**16K0F3E**

F3E represents an FM voice transmission



## TEST RESULTS

### TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC 47 CFR 2.1047 (a)

GUIDE: ANSI C63.26 5.3.3.2

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. An audio input tone of 1000 Hz was applied with the level set to obtain 20% of maximum deviation. This was used as the 0 dB reference point.
3. The AF was varied while the audio level was held constant.
4. The response in dB relative to 1000 Hz was measured.

MEASUREMENT RESULTS:

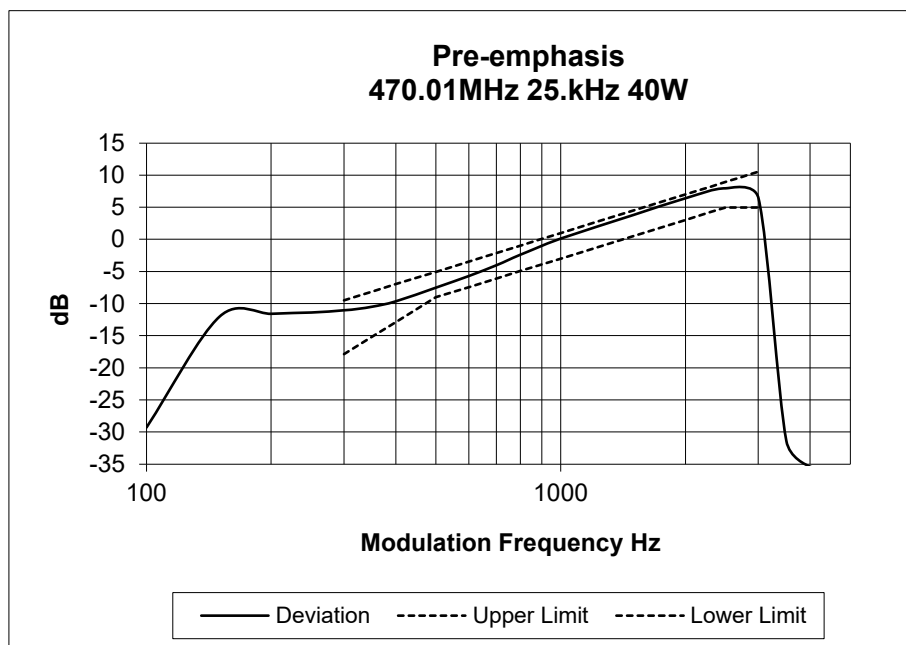
See the plots on the following pages for 25 kHz channel spacing tested at 40 W transmit power.

LIMIT CLAUSE: TIA/EIA-603E 3.2.6

MEASUREMENT UNCERTAINTY:  $\pm 1.5\%$

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 470.0125 MHz 25.0kHz Channel Spacing

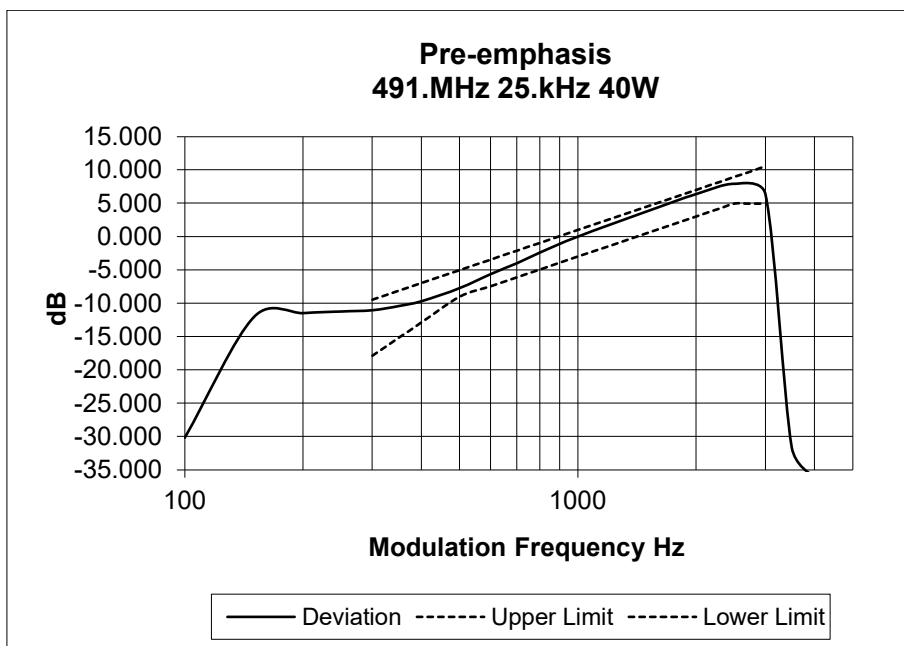


### Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 491.0 MHz

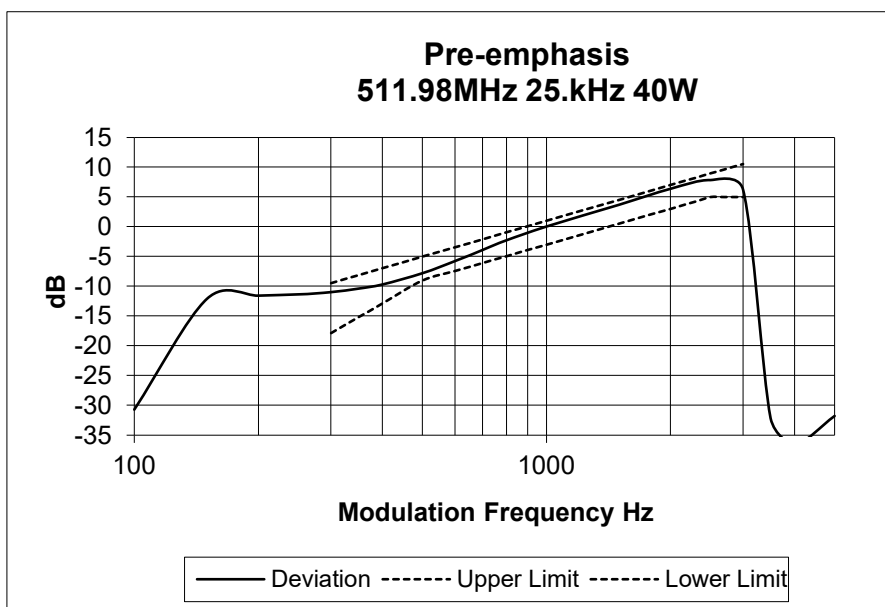
25.0kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 511.975 MHz

25.0kHz Channel Spacing



## TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC 47 CFR 2.1047 (b)

GUIDE: ANSI C63.26 5.3.2

### MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment set up.
2. An audio input tone of 1000 Hz was applied with the level set to obtain 60% of maximum deviation. This was used as the 0 dB reference point.
3. The modulation response was measured at four audio frequencies while increasing the input level in 5dB steps.
4. Additionally the level used to measure sideband spectrum (occupied bandwidth) was included in the level sweep.
5. Measurements were made for both Positive and Negative Deviation.

### MEASUREMENT RESULTS:

See the plots on the following pages for 25.0kHz channel spacing.

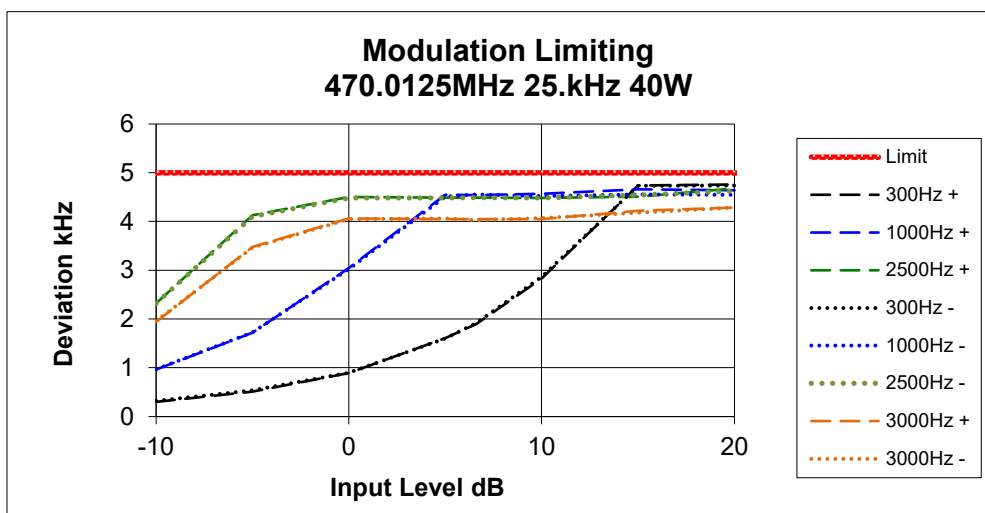
LIMIT CLAUSE: TIA/EIA-603E 1.3.4.4

MEASUREMENT UNCERTAINTY:  $\pm 1.5\%$

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 470.0125 MHz

25.0kHz Channel Spacing

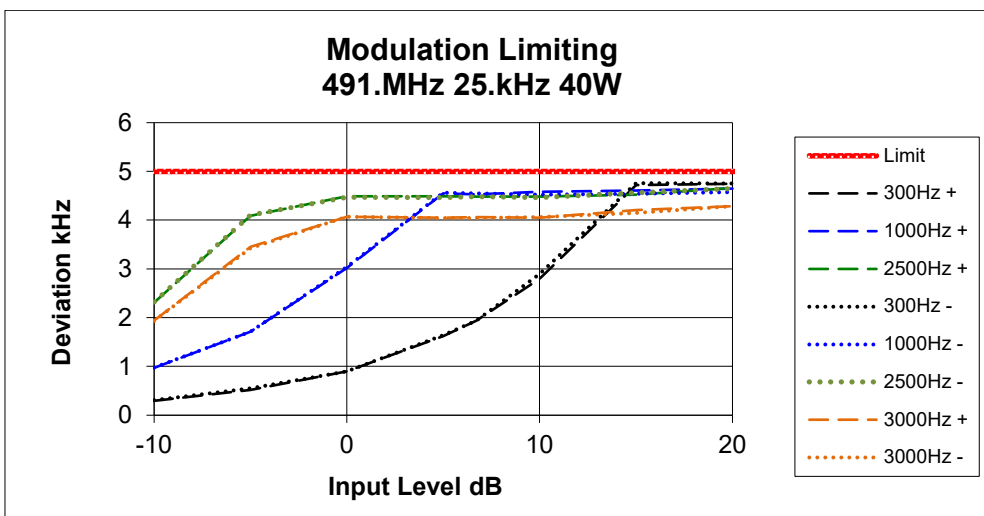


### Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 491.0 MHz

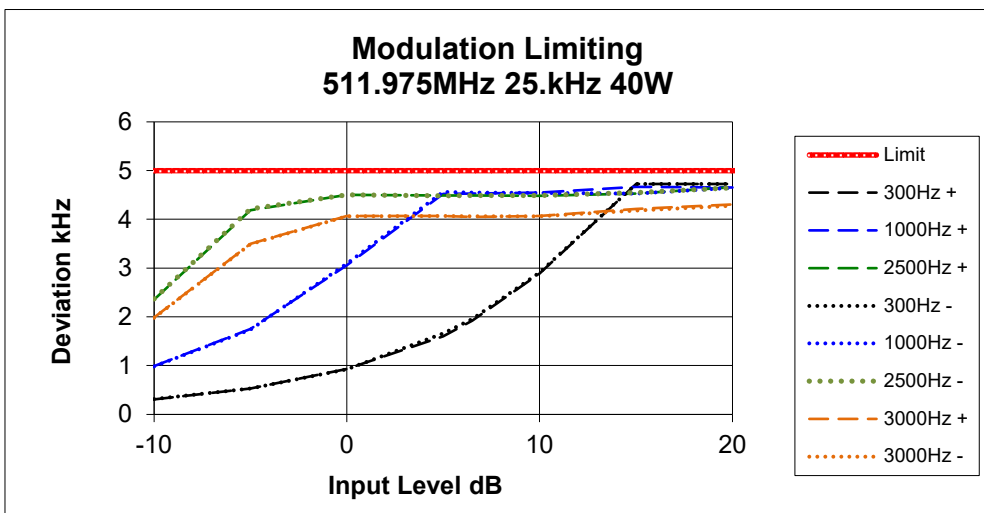
25.0kHz Channel Spacing



SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 511.975 MHz

25.0kHz Channel Spacing



## TRANSMITTER SPECTRUM MASKS

SPECIFICATION: FCC 47 CFR 2.1049 (c)

GUIDE: TIA/EIA-603E 2.2.11 (Analog)  
TIA-102.CAAA-C 2.2.5 (Digital)

### MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment Set up.
2. For Analogue measurements: The EUT was modulated by a 2500 Hz tone at an input level 16 dB above a level that produced 50% deviation. The input level was established at the frequency of maximum response of the audio modulating circuit.  
For Data measurements: The EUT was modulated with an internally generated pseudo random bit sequence at the appropriate Baud rates.
3. The Occupied Bandwidth was measured on the Spectrum Analyser, with bandwidth settings as noted on the recorded plots.

### MEASUREMENT RESULTS:

See the plots on the following pages for 25 kHz channel spacing.

MEASUREMENT UNCERTAINTY 95%  $\pm 0.65$ dB

LIMIT CLAUSE: FCC 47 CFR 90.210

### EMISSION MASKS

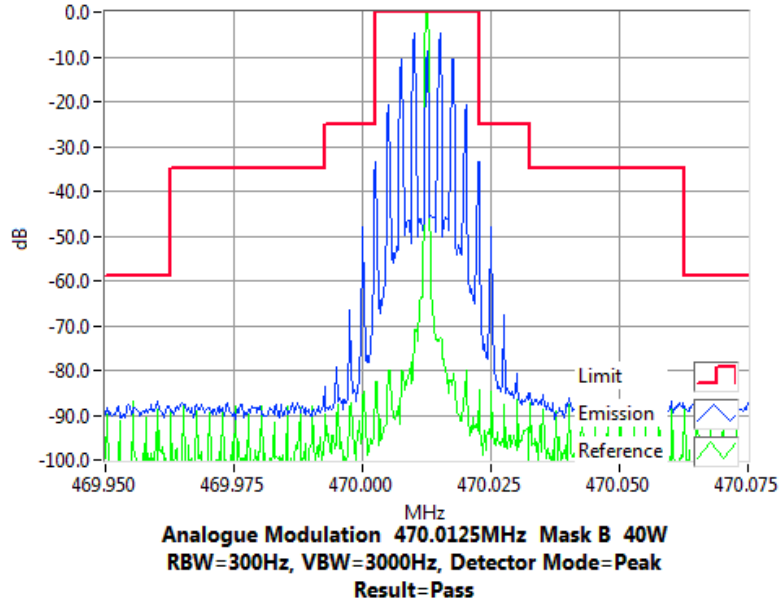
Emission Mask B      25 kHz Channel Spacing      Analogue

### Transmitter Spectrum Masks

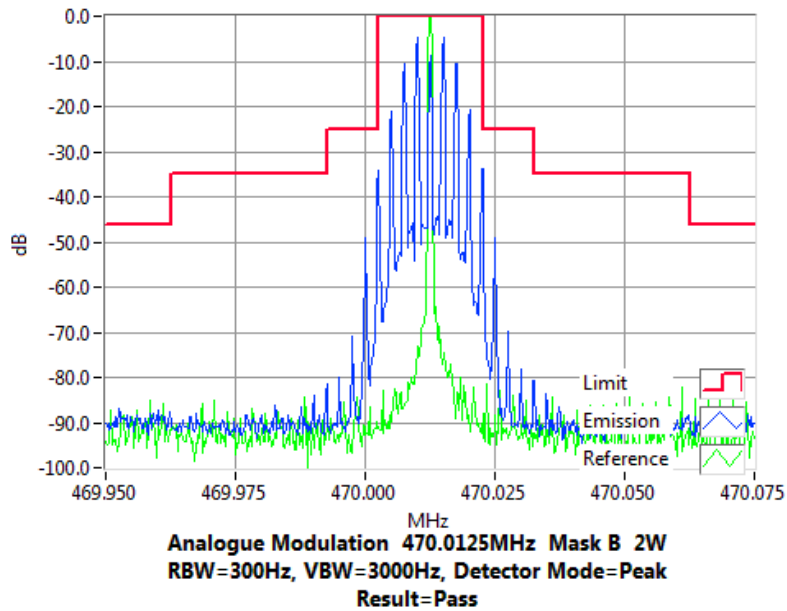
ANALOGUE VOICE

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 470.0125 MHz 40 W 25.0kHz Channel Spacing



Tx FREQUENCY: 470.0125 MHz 2 W 25.0kHz Channel Spacing

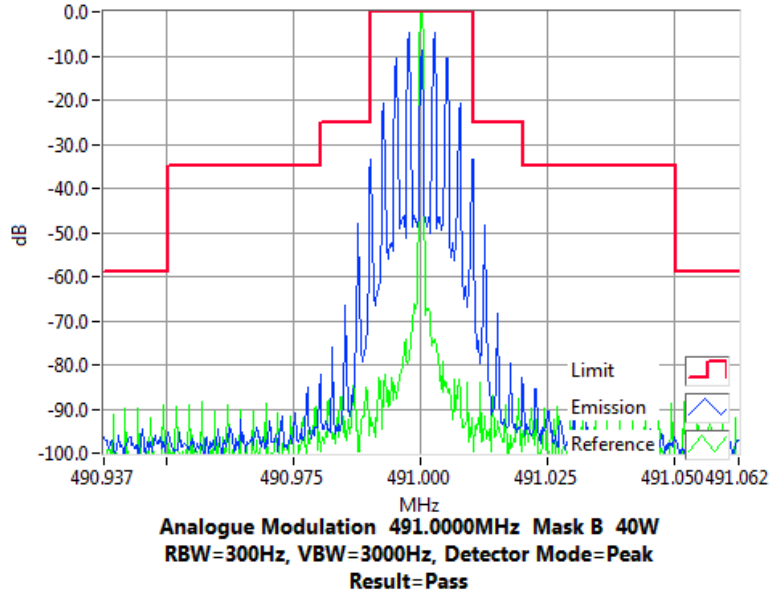


### Transmitter Spectrum Masks

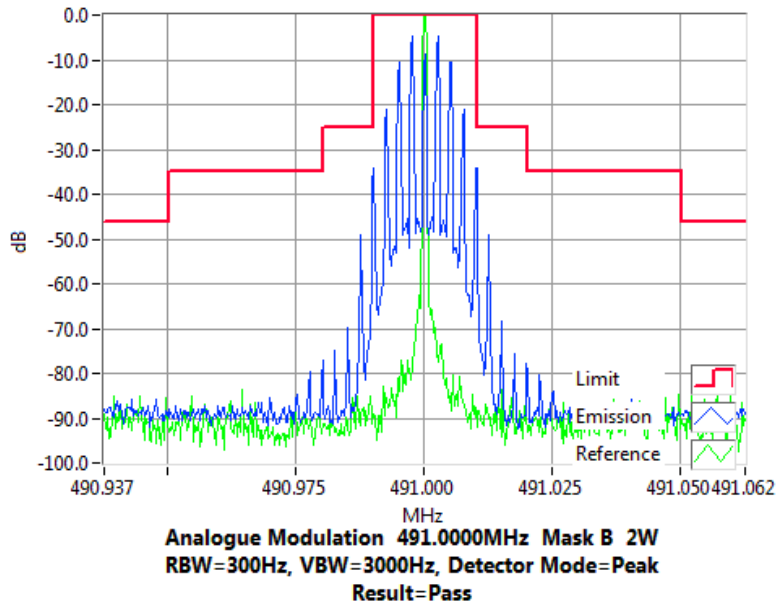
ANALOGUE VOICE

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 491.0 MHz 40 W 25.0kHz Channel Spacing



Tx FREQUENCY: 491.0 MHz 2 W 25.0kHz Channel Spacing

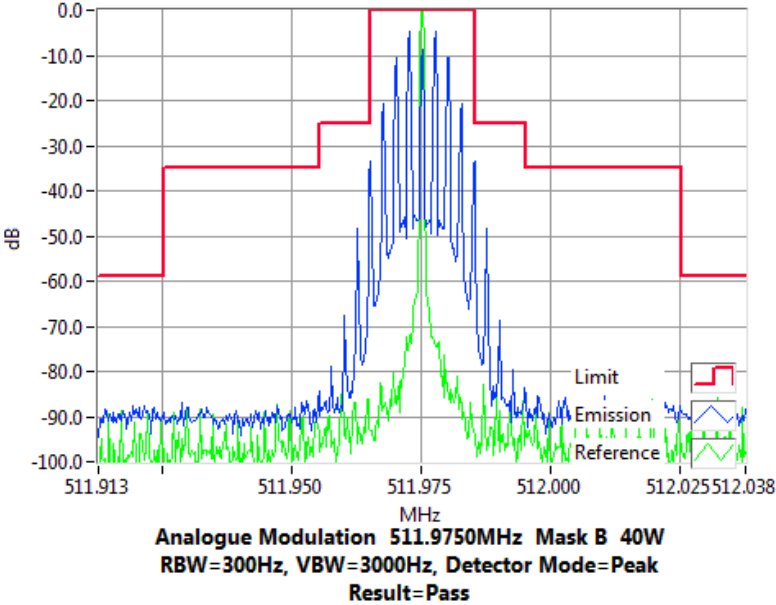


### Transmitter Spectrum Masks

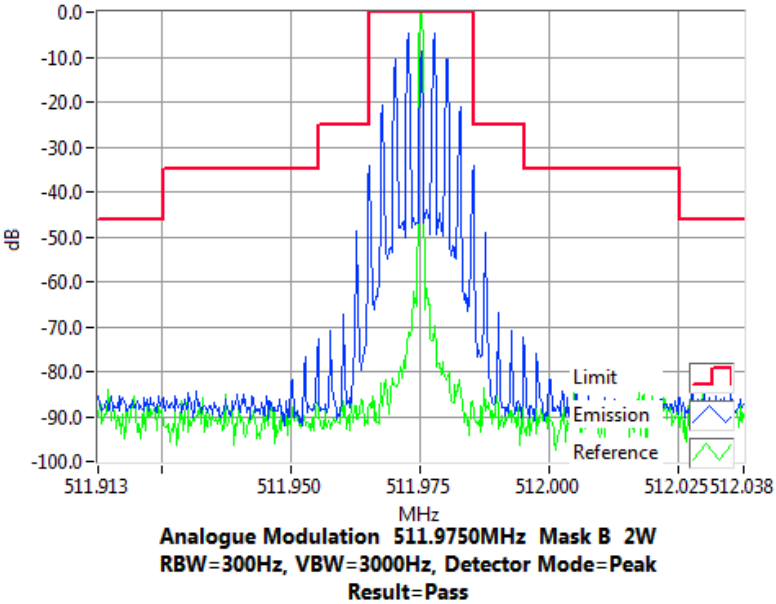
ANALOGUE VOICE

SPECIFICATION: FCC CFR 2.1049 (c)

Tx FREQUENCY: 511.975 MHz 40 W 25.0kHz Channel Spacing



Tx FREQUENCY: 511.975 MHz 2 W 25.0kHz Channel Spacing





## TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION: FCC 47 CFR 90.214

GUIDE: TIA/EIA-603E 2.2.19

MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.
2. Measurements and plots were made following the TIA procedure.

MEASUREMENT RESULTS:

See the tables and plots on the following pages for 25.0kHz channel spacing.

LIMIT CLAUSES: FCC 47 CFR 90.214

Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 470.0125 MHz      40 W      25.0kHz Channel Spacing

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | -0.3                               | N/A           |
| t2                        | -0.4                               | N/A           |
| t3                        | N/A                                | -2.3          |

|   |                          |                          |
|---|--------------------------|--------------------------|
| Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation. | YES                      | NO                       |
|   | <input type="checkbox"/> | <input type="checkbox"/> |
| Confirm that during the period t2 the frequency difference does not exceed half a channel separation.               | YES                      | NO                       |
|   | <input type="checkbox"/> | <input type="checkbox"/> |
| Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.         | YES                      | NO                       |
|   | <input type="checkbox"/> | <input type="checkbox"/> |

Measurement Uncertainty: Frequency ± 130 Hz; Time ± 0.2%

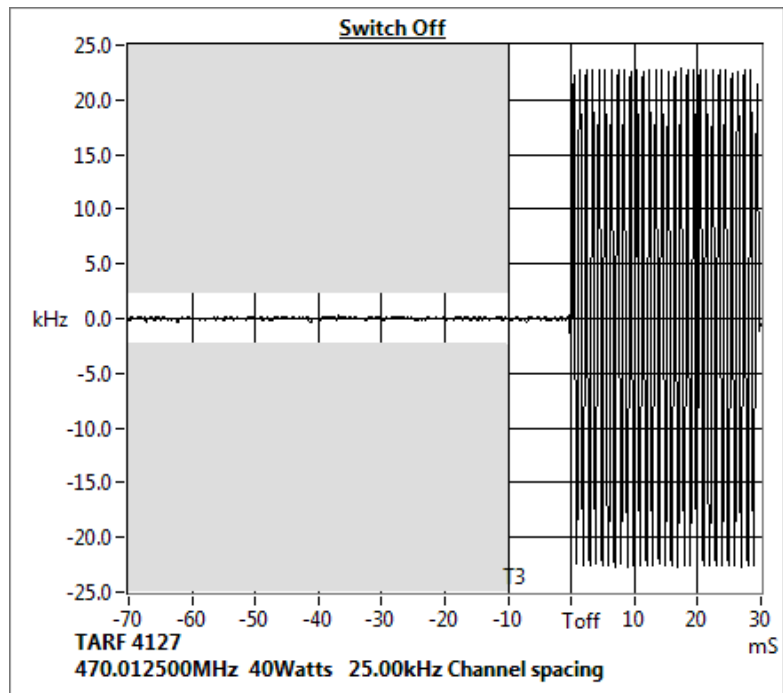
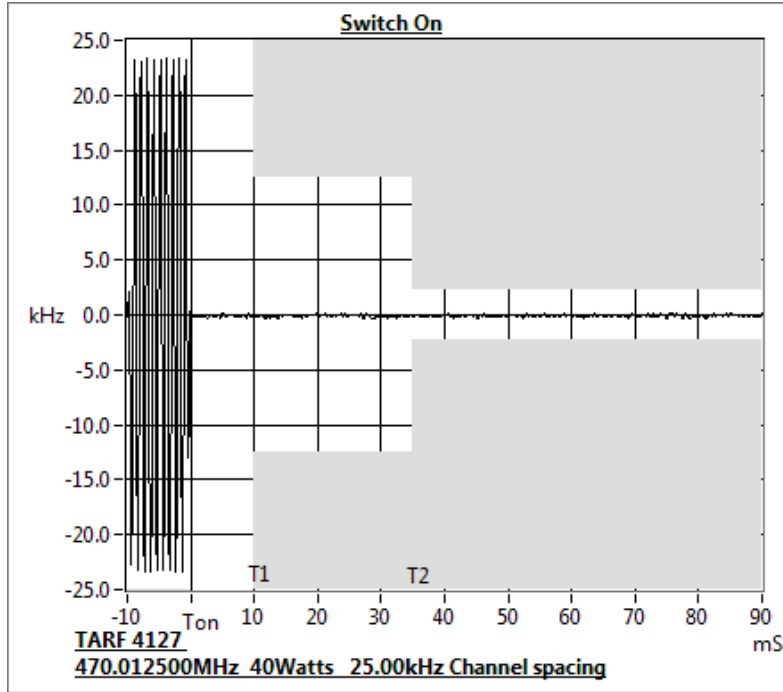
LIMIT: FCC 47 CFR 90.214

| TRANSIENT PERIODS | FREQUENCY RANGE   |                   |
|-------------------|-------------------|-------------------|
|                   | 150 MHz – 174 MHz | 421 MHz – 512 MHz |
| t1 (ms)           | 5 ms              | 10 ms             |
| t2 (ms)           | 20 ms             | 25 ms             |
| t3 (ms)           | 5 ms              | 10 ms             |

### Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 470.0125 MHz      40 W      25.0kHz Channel Spacing



Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 491.0 MHz                      40 W                      25.0kHz Channel Spacing

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | -0.4                               | N/A           |
| t2                        | -0.3                               | N/A           |
| t3                        | N/A                                | -1.4          |

|   |                          |                          |
|---|--------------------------|--------------------------|
| Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation. | YES                      | NO                       |
|   | <input type="checkbox"/> | <input type="checkbox"/> |
| Confirm that during the period t2 the frequency difference does not exceed half a channel separation.               | YES                      | NO                       |
|   | <input type="checkbox"/> | <input type="checkbox"/> |
| Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.         | YES                      | NO                       |
|   | <input type="checkbox"/> | <input type="checkbox"/> |

Measurement Uncertainty:      Frequency ± 130 Hz;      Time ± 0.2%

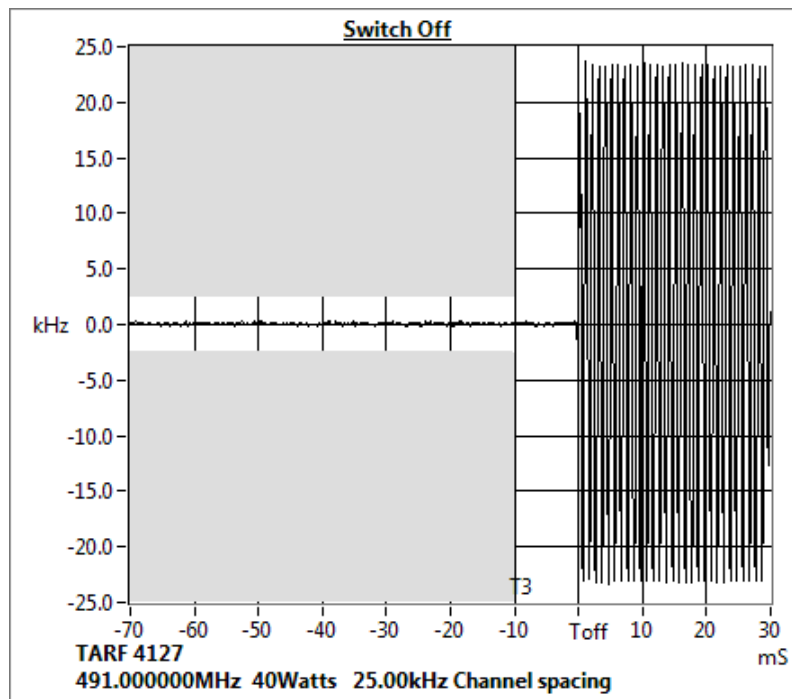
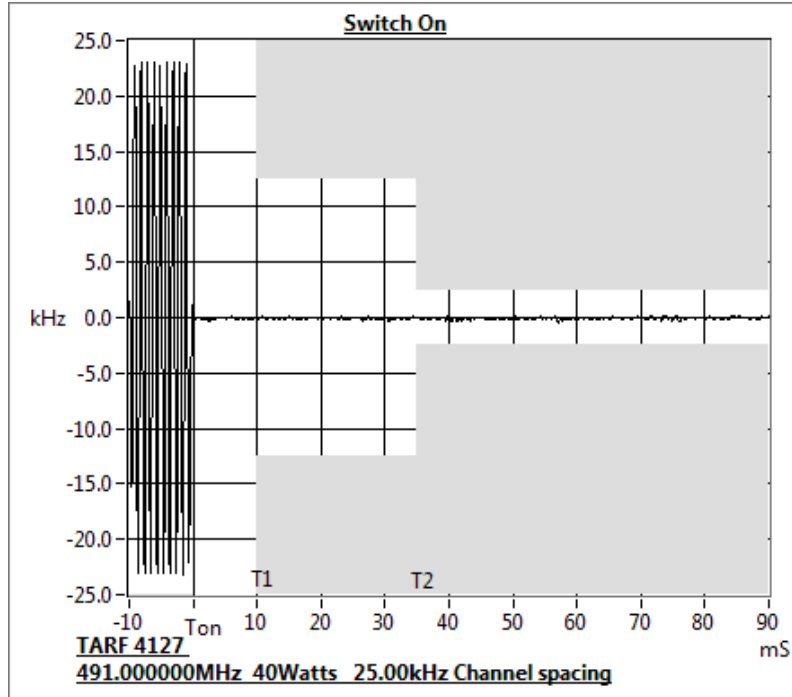
LIMIT:                      FCC 47 CFR 90.214

| TRANSIENT PERIODS | FREQUENCY RANGE   |                   |
|-------------------|-------------------|-------------------|
|                   | 150 MHz – 174 MHz | 421 MHz – 512 MHz |
| t1 (ms)           | 5 ms              | 10 ms             |
| t2 (ms)           | 20 ms             | 25 ms             |
| t3 (ms)           | 5 ms              | 10 ms             |

### Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 491.0 MHz                      40 W                      25.0kHz Channel Spacing



### Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 511.975 MHz                      40 W                      25.0kHz Channel Spacing

| TRANSIENT RESPONSE PERIOD | CARRIER PEAK VARIATION FROM NORMAL |               |
|---------------------------|------------------------------------|---------------|
|                           | Key ON (kHz)                       | Key OFF (kHz) |
| t1                        | -0.2                               | N/A           |
| t2                        | -0.4                               | N/A           |
| t3                        | N/A                                | 1.1           |

|   |                          |                          |
|---|--------------------------|--------------------------|
| Confirm that during periods t1 and t3 the frequency difference does not exceed the value of one channel separation. | YES                      | NO                       |
|   | <input type="checkbox"/> | <input type="checkbox"/> |
| Confirm that during the period t2 the frequency difference does not exceed half a channel separation.               | YES                      | NO                       |
|   | <input type="checkbox"/> | <input type="checkbox"/> |
| Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.         | YES                      | NO                       |
|   | <input type="checkbox"/> | <input type="checkbox"/> |

Measurement Uncertainty:      Frequency  $\pm$  130 Hz;      Time  $\pm$  0.2%

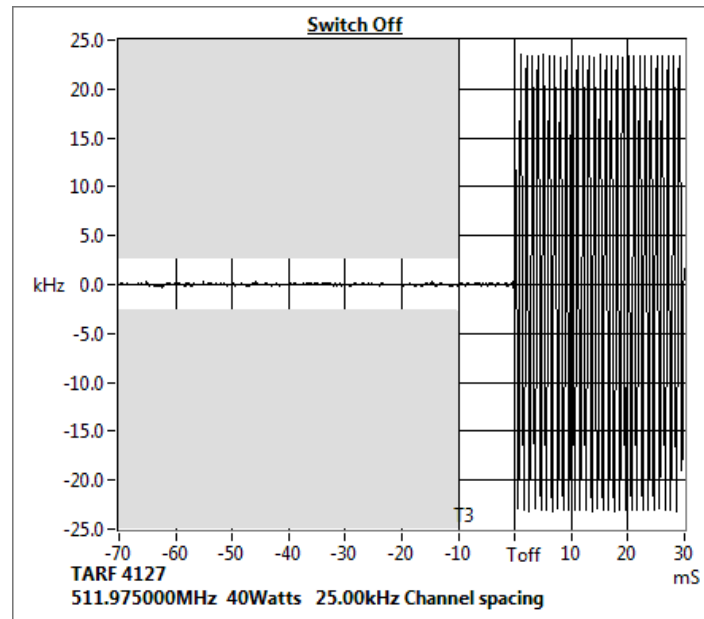
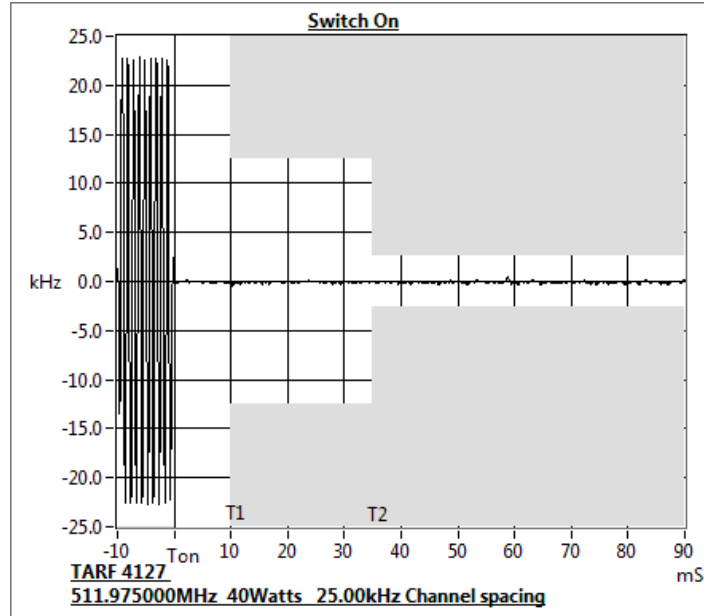
LIMIT:                      FCC 47 CFR 90.214

| TRANSIENT PERIODS | FREQUENCY RANGE   |                   |
|-------------------|-------------------|-------------------|
|                   | 150 MHz – 174 MHz | 421 MHz – 512 MHz |
| t1 (ms)           | 5 ms              | 10 ms             |
| t2 (ms)           | 20 ms             | 25 ms             |
| t3 (ms)           | 5 ms              | 10 ms             |

### Transient Frequency Behaviour

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 511.975 MHz      40 W      25.0kHz Channel Spacing



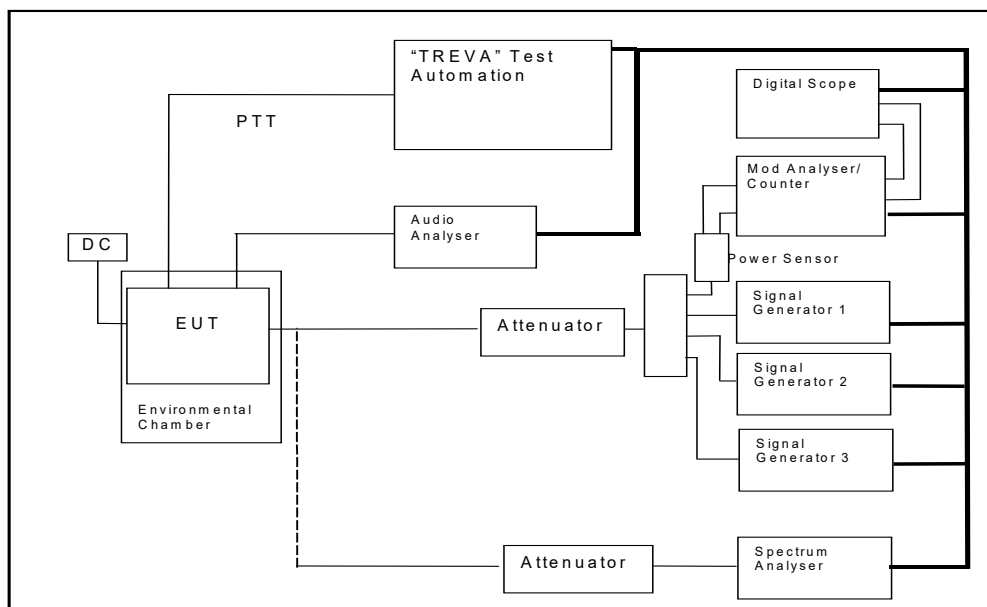
## TEST EQUIPMENT LIST

| Equipment Type             | Information         | Manufacturer    | Model No            | Serial No#    | Tait ID | Cal Due   |
|----------------------------|---------------------|-----------------|---------------------|---------------|---------|-----------|
| Audio Analyser             | TREVA2              | Hewlett Packard | HP8903B             | 2818A04275    | E3710   | 9-Oct-20  |
| Coax Cable                 | 2m Black            | Suhner          | RG214HF/Nm/Nm/2000  | TeltestBlack8 | E5005   | 28-Oct-20 |
| Coax Cable                 | 2.5m Blue           | Suhner          | Sucoflex 104A       | 33449/4PEA    | E4997   | 23-Oct-20 |
| Coax Cable                 | 3m Blue             | Suhner          | Sucoflex 126EA      | 503429/126EA  | E5015   | 23-Oct-20 |
| Modulation Analyser        | TREVA2              | Hewlett Packard | HP8901B (Opt 002)   | 3704A05837    | E3786   | 4-Oct-20  |
| Oscilloscope               | 100MHz Digital      | Tektronics      | TDS340              | B013611       | E3585   | 3-Oct-21  |
| Power Supply               | TREVA2 60V/25A      | Agilent         | N5767A              | US09F4901H    | E4656   | 3-Oct-21  |
| RF Attenuator              | TREVA2 20dB<br>150W | Weinschel       | 40-20-33            | CJ405         | E3733   | 23-Oct-20 |
| RF Attenuator              | 30+3dB 350W         | Weinschel       | 67-30-33 & BW-N3W5+ | CK9178        | E5023   | 23-Oct-20 |
| RF Attenuator              | TREVA2 3dB          | Weinschel       | Model 1             | BL9950        | E4080   | 23-Oct-20 |
| RF Combiner                | TREVA2              | Minicircuits    | ZFSC-4-1            | -             | E4084   |           |
| Spectrum Analyser          | 26.5GHz             | Agilent         | PXA N9030A          | MY49432161    | E4907   | 27-Oct-20 |
| Temp & Humidity datalogger |                     | Hobo            | U21-011             | 10134276      | E4981   | 7-Jul-21  |
| TREVA 2                    |                     | Teltest         | -                   | 2             | -       | 3-Dec-20  |
| Testware                   | Sideband Spectrum   |                 | February 2017       | -             | -       |           |
| Testware                   | TREVA               |                 | 29/01/2020          | -             | -       |           |

NOTE: Items without calibration dates are calibrated immediately before use, or set using calibrated instruments.

## ANNEX A – TEST SETUP DETAILS

All testing is performed using the Teltest Radio **EVA**luation system (TREVA), which is configured as shown below. The Spectrum Analyser is connected to the EUT via the attenuator network for Occupied Bandwidth.



END OF REPORT