

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

Date	Revision	Comments
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_{DC}

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

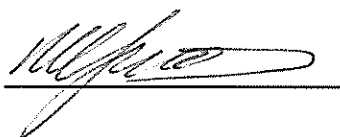
Module	Product Code	Serial Number	Firmware Version	Hardware Version
Reciter	T01-01403-MAAA	18295499	p25-3.10.00.0006	01.01
Power Amplifier	T01-01405-MAAA	18295502		00.01
Front Panel	T01-01410-AAAA	04682948	1.10.01.0001	00.01

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

Label	Channel Number	Receive Frequency MHz	Transmit Frequency MHz	Power Watts	Bandwidth kHz
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

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.

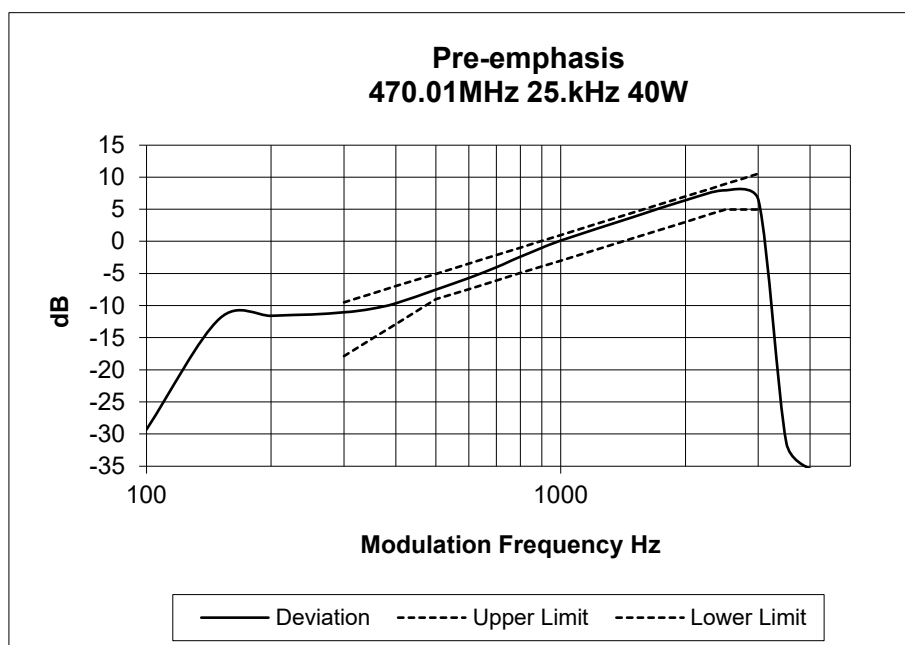
LIMIT CLAUSE: TIA/EIA-603E 3.2.6

MEASUREMENT UNCERTAINTY: $\pm 1.5\%$

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 470.0125 MHz

25.0kHz Channel Spacing

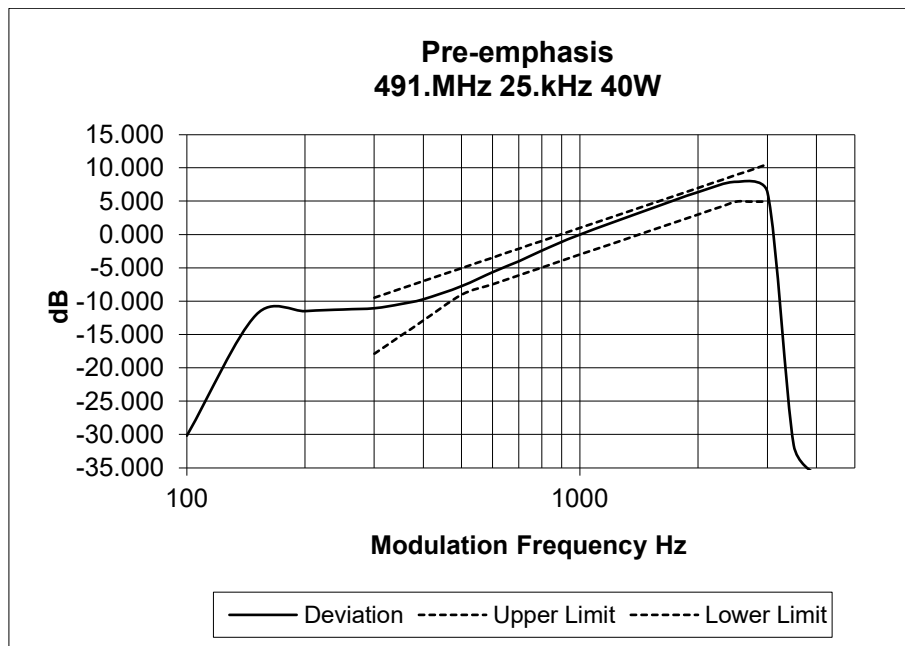


Transmitter Audio Frequency Response – Pre-emphasis

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 491.0 MHz

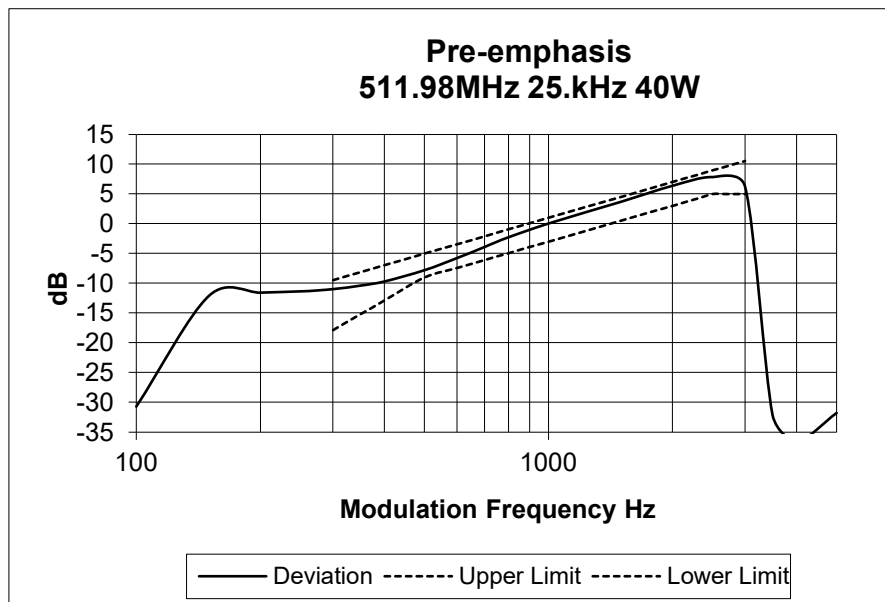
25.0kHz Channel Spacing



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.

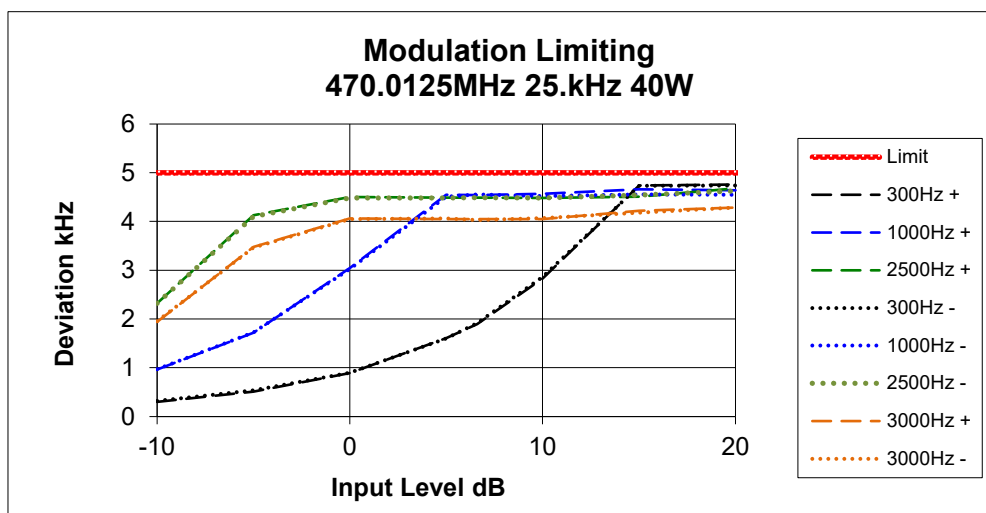
LIMIT CLAUSE: TIA/EIA-603E 1.3.4.4

MEASUREMENT UNCERTAINTY: $\pm 1.5 \%$

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 470.0125 MHz

25.0kHz Channel Spacing

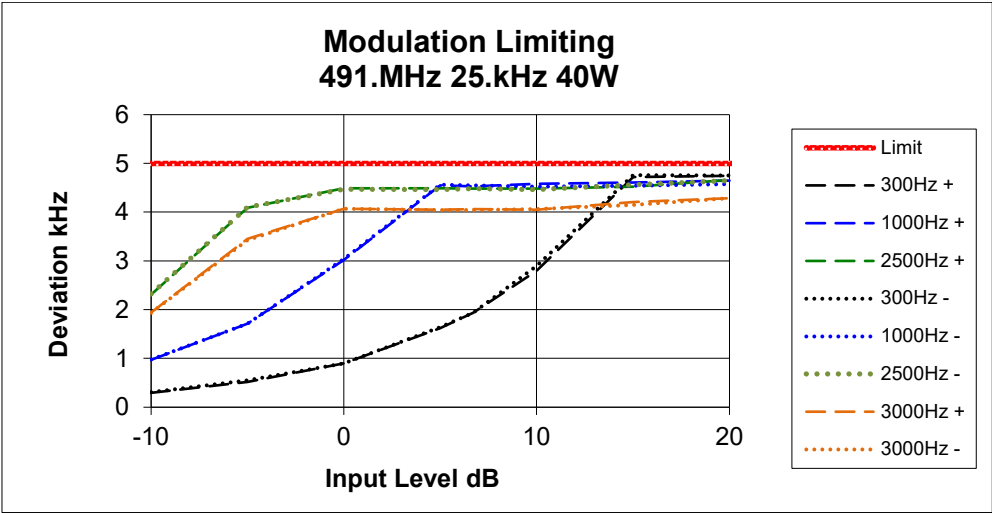


Transmitter Modulation Limiting

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 491.0 MHz

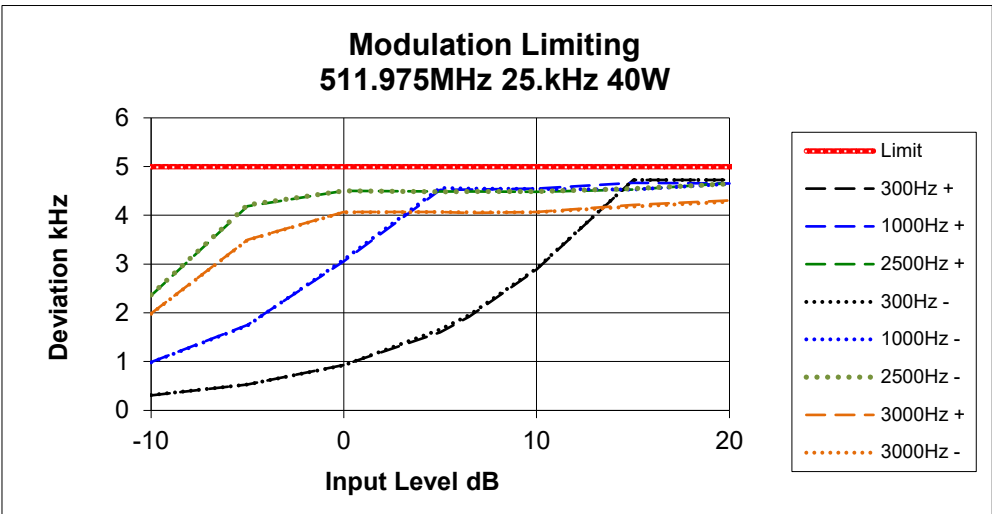
25.0kHz Channel Spacing



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% $\pm 0.65\text{dB}$

LIMIT CLAUSE: FCC 47 CFR 90.210

EMISSION MASKS

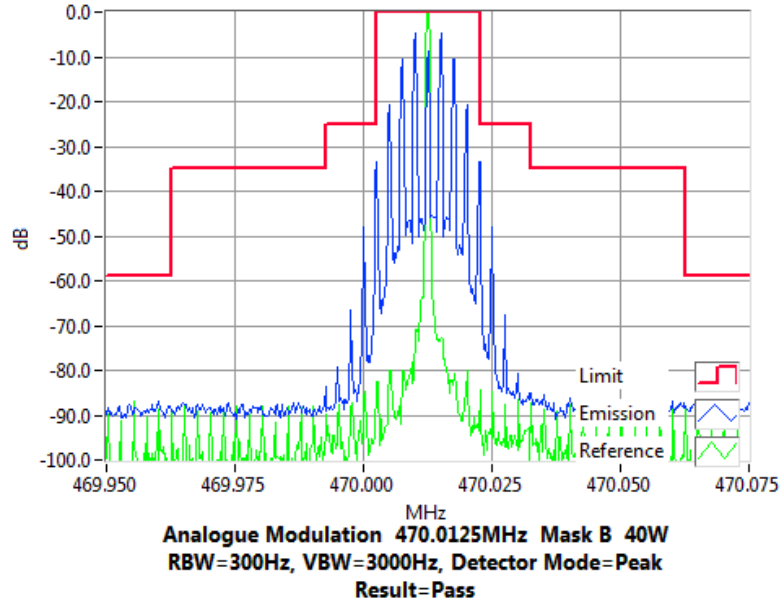
Emission Mask B	25 kHz Channel Spacing	Analogue
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Transmitter Spectrum Masks

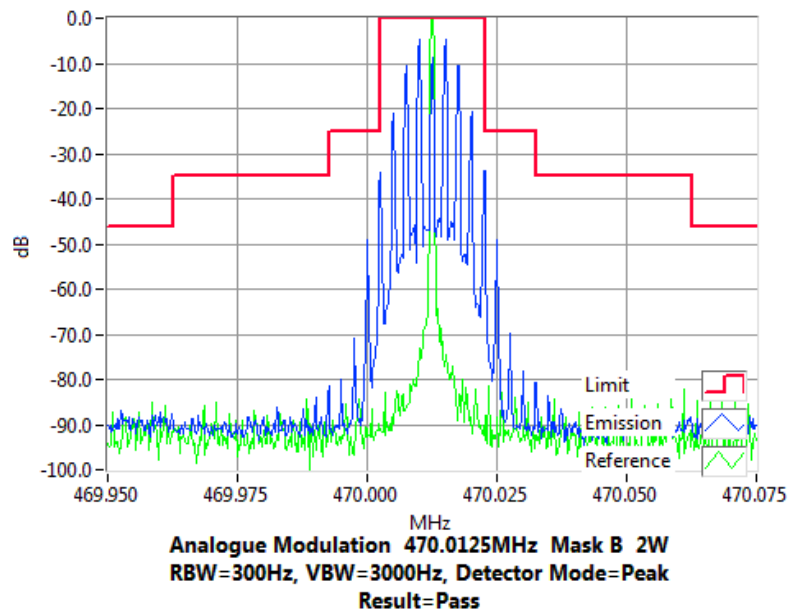
ANALOGUE VOICE

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

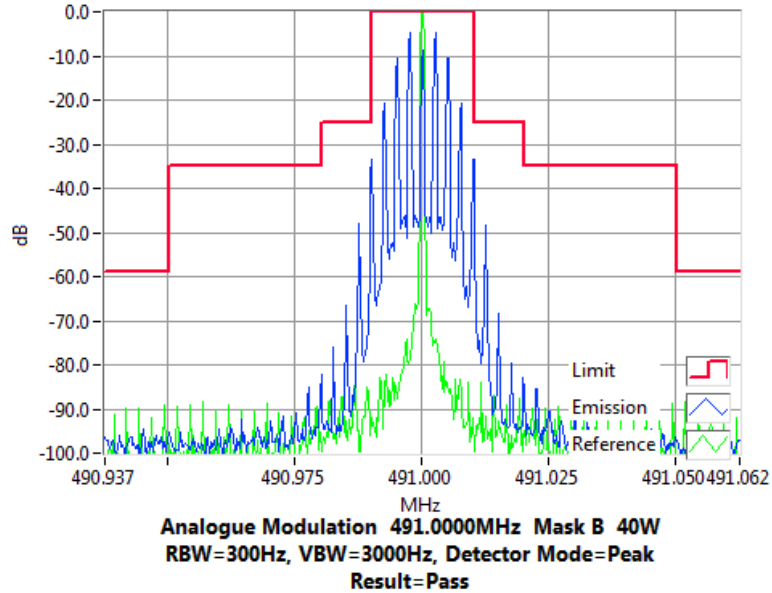


Transmitter Spectrum Masks

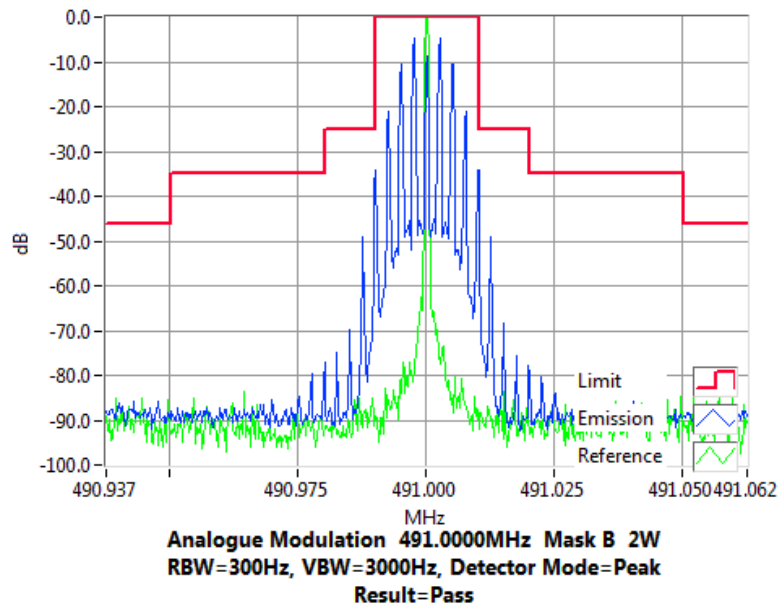
ANALOGUE VOICE

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

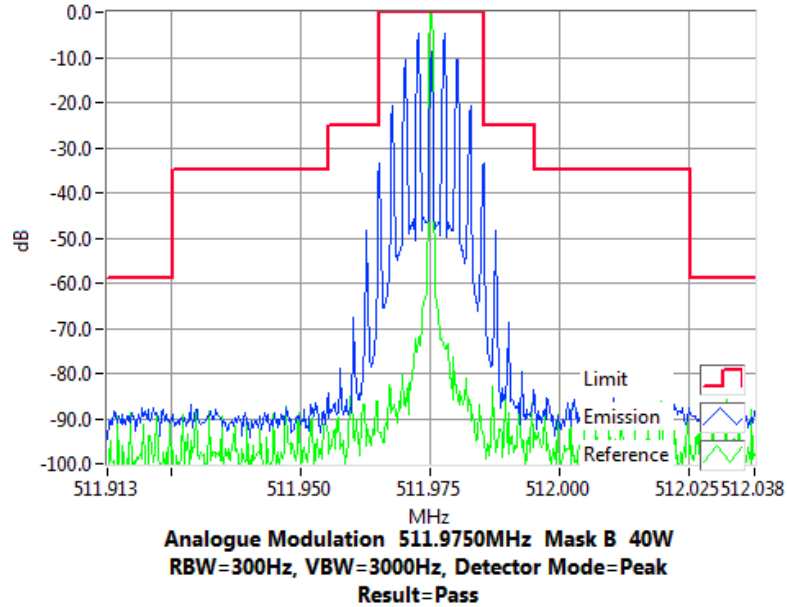


Transmitter Spectrum Masks

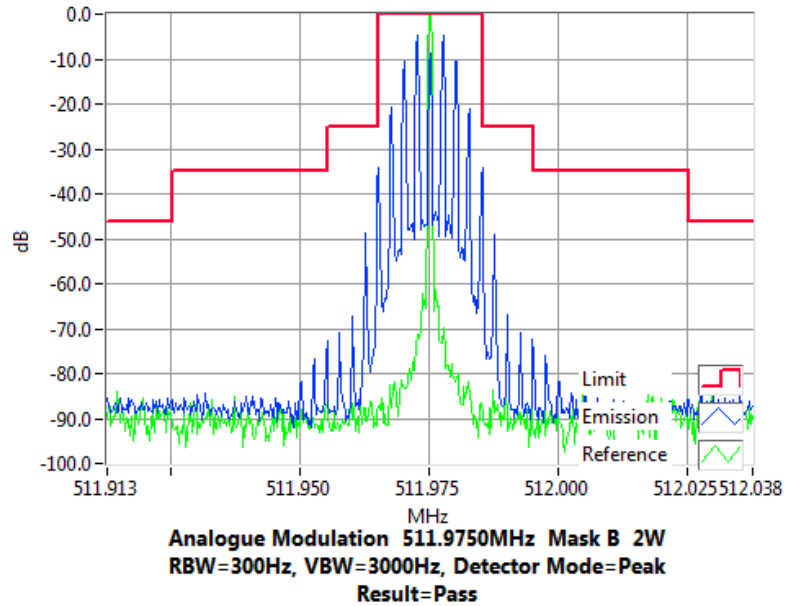
ANALOGUE VOICE

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
	☐	☐
Confirm that during the period t2 the frequency difference does not exceed half a channel separation.	YES	NO
	☐	☐
Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.	YES	NO
	☐	☐

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

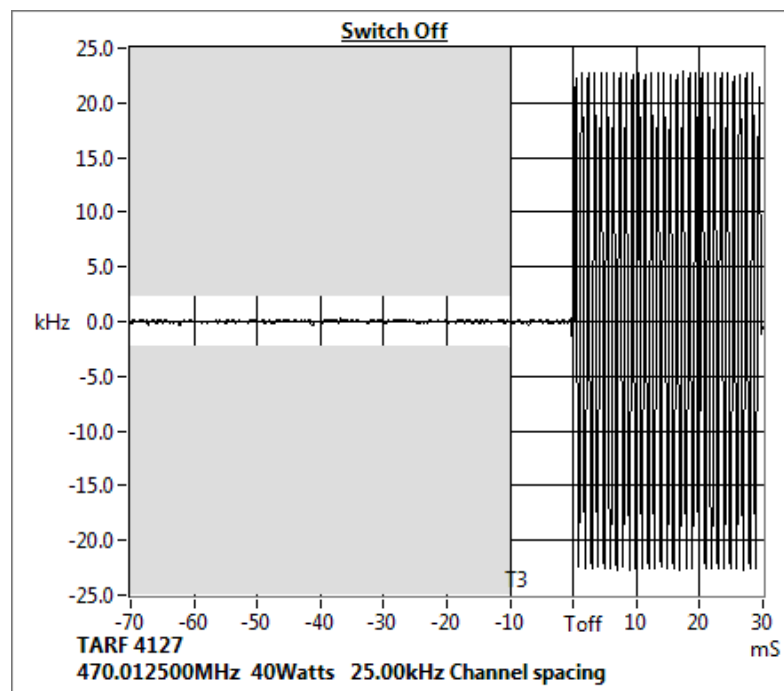
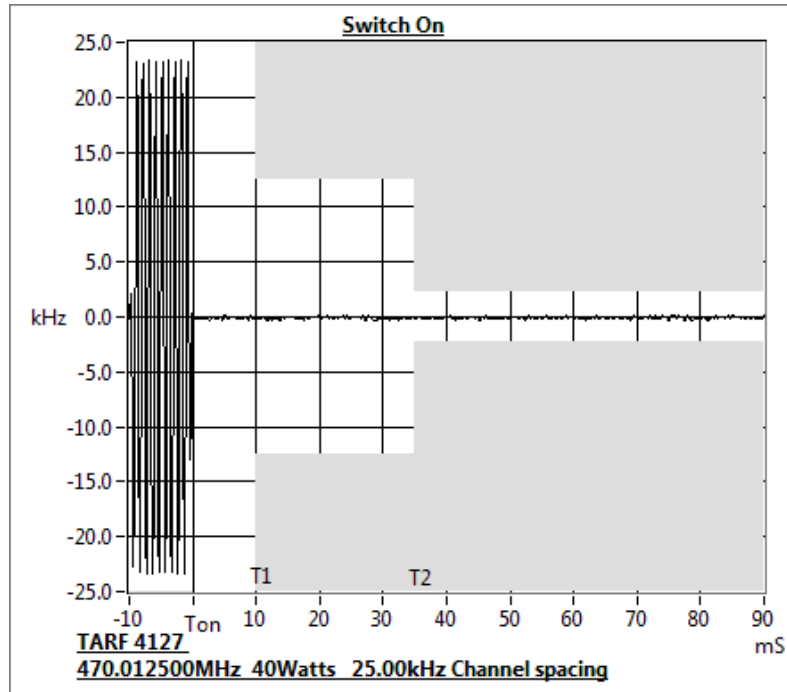
LIMIT: FCC 47 CFR 90.214

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: 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
	☐	☐
Confirm that during the period t2 the frequency difference does not exceed half a channel separation.	YES	NO
	☐	☐
Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.	YES	NO
	☐	☐

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

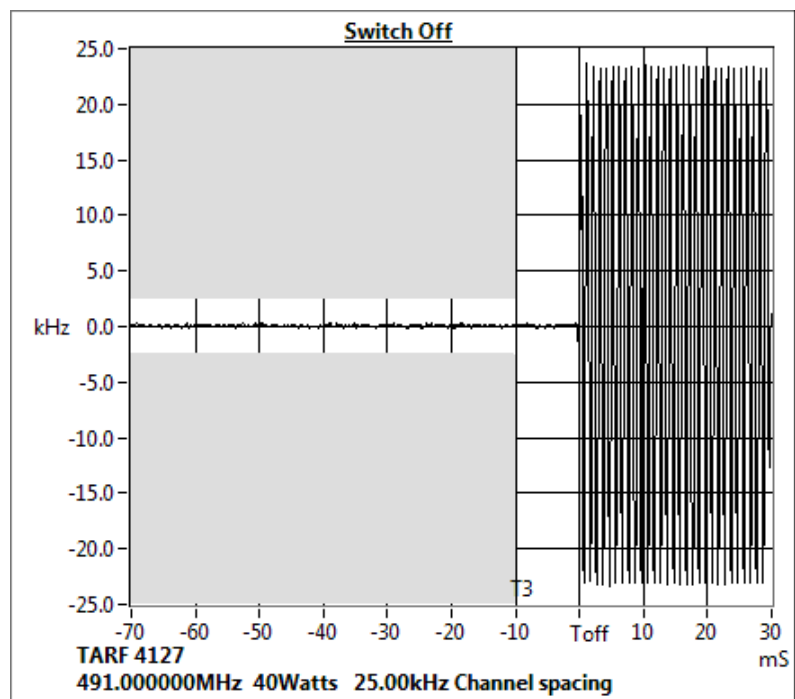
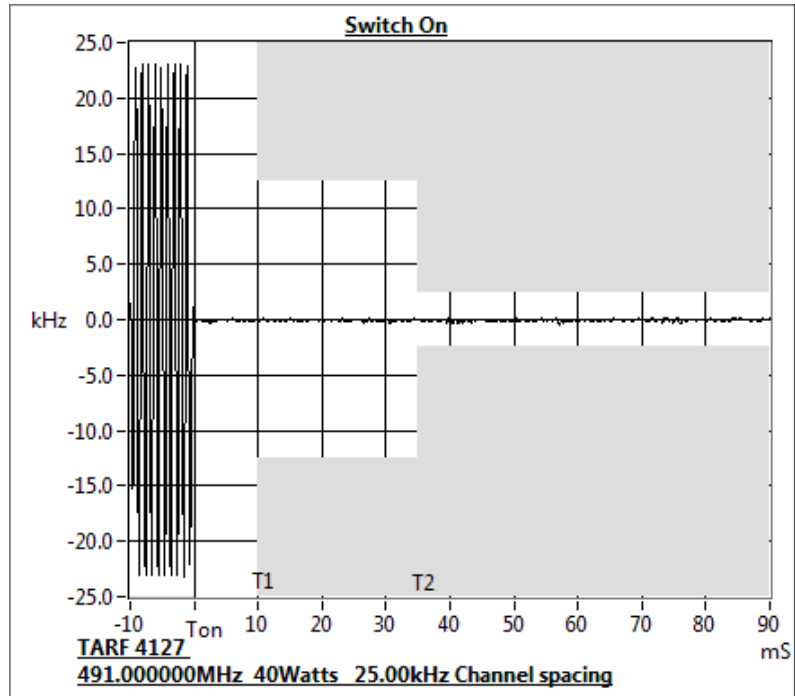
LIMIT: FCC 47 CFR 90.214

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: 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
	☐	☐
Confirm that during the period t2 the frequency difference does not exceed half a channel separation.	YES	NO
	☐	☐
Confirm that during the period t2 to t3 the frequency difference does not exceed the frequency error limit.	YES	NO
	☐	☐

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

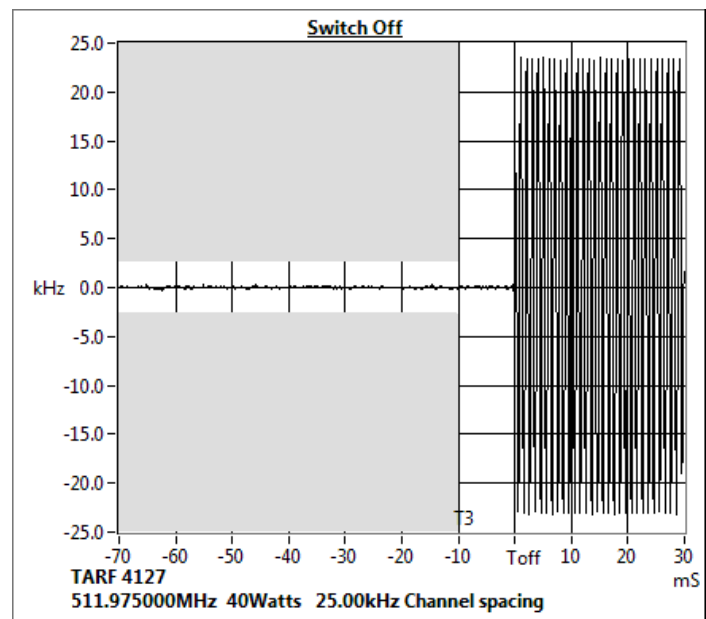
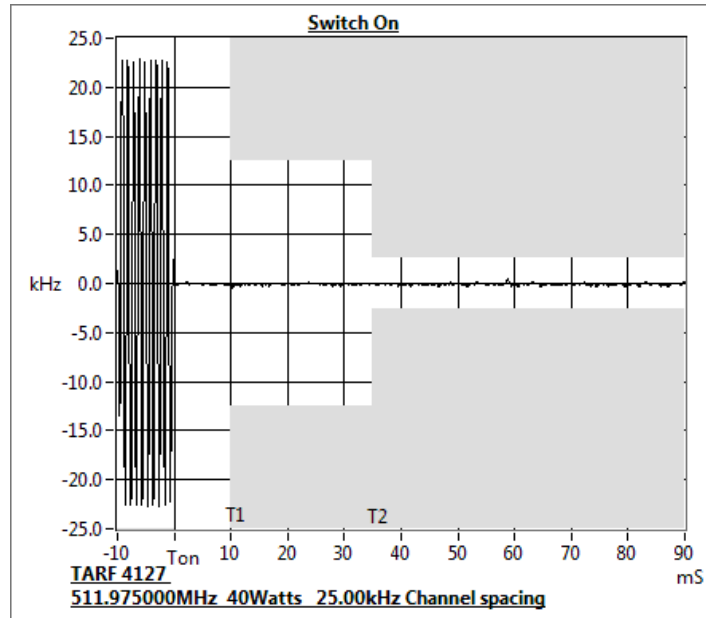
LIMIT: FCC 47 CFR 90.214

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



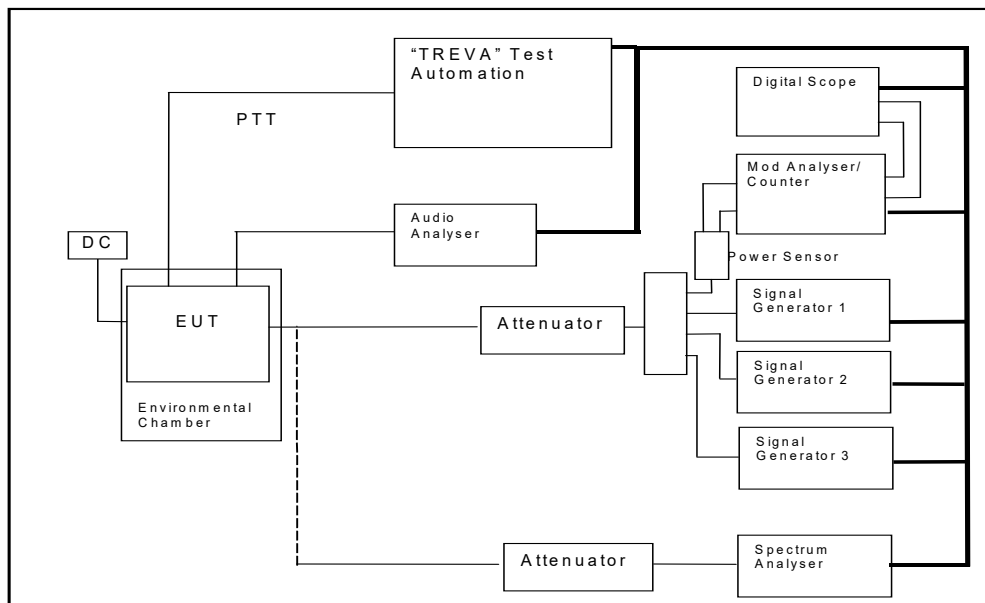
TEST EQUIPMENT LIST

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 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 **EVAL**uation 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