Laboratory Test Report

For the

TBBH5A Base Station Transceiver

Tested In accordance with

FCC 47 CFR Parts 22 and 90

Report Revision: 2
Issue Date: 29-May-2007
FCC ID: CASTBBH5A

PREPARED BY: Marcus Ludwig _____
Test Technician

CHECKED & APPROVED BY: S A Crompton _____
Laboratory Manager

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
21-May-2007	1	Initial test report
29-May-2007	2	2400 bps FFSK was added to the report

INTRODUCTION

Type approval testing of the TBBH5A 25 Watt base station transceiver as addition to the Tait product range of the USA market in accordance with:

FCC CFR47 Part 22 and 90

The 25 W version of type TBBH5A equipment is to be assigned the FCC ID: CASTBBH5A

REPORT PREPARED FOR

Tait Electronics Ltd
PO Box 1645
558 Wairakei Rd
Christchurch
New Zealand

STATEMENT OF COMPLIANCE

The TBBH5A Base Station transceiver as tested in this report was found to conform to the following standards:

FCC CFR 47 Parts 22 & 90

DESCRIPTION OF SAMPLE

Equipment: Base Station Transceiver. 400MHz to 470MHz

Type: TBBH5A

Details:

Type Code	TBBH5A	
Product Code	TBBH5H5-A10-00	
Serial Number	18035298	
TX Module S/N	19242649	
RX Module S/N	19231049	
	TX Module	RX Module
Hardware ID	TMAB13-H5T1_0102	TMAB13-H5R1_0102
Radio Application	QMA1F_std_02.13.00.10	QMA1F_std_02.13.00.10
Boot Code	QMA1B_std_1.03.00.0005	QMA1B_std_1.03.00.0005
FPGA Image	QMA1G_std_1.07.02.0001	QMA1G_std_1.07.02.0001

TEST CONDITIONS

All testing was performed at the following conditions.

Ambient Temperature	15°C to 30°C
Relative Humidity	20% to 75%
Standard Test Voltage	120 V ac

MODULATION TYPES AND EMISSION DESIGNATORS

Modulation type:	F3E	Analogue FM
	F2D	FFSK Data (1200 bps, 2400 bps)
	F1D	THSD (12000 bps, 19200 bps)

Channel spacing: 12.5 kHz, 25 kHz

Emission designators:	Analogue FM	11K0F3E, 16K0F3E
	FFSK Data 1200bps	6k60F2D, 9k60F2D
	FFSK Data 2400bps	7k80F2D, 10k8F2D
	THSD	7K70F1D, 12K7F1D

TEST RESULTS

TRANSMITTER OUTPUT POWER (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1046

GUIDE: TIA/EIA-603C 2.2.1

MEASUREMENT PROCEDURE:
1. Refer Annex A for Equipment set up.
2. The coaxial attenuator has an impedance of 50 Ohms.
3. The unmodulated output power was measured with an RF Power sensor connected to the modulation analyser.

MEASUREMENT RESULTS:

Manufacturer's Rated Output Power: Continuously Variable: 1 W to 25 W

425.1 MHz	25 W nominal	1 W nominal
POWER (W)	25.9	1.04
Variation from Nominal (%)	3.6	4.0
Measurement Uncertainty (dB)	+/-0.6	

LIMIT CLAUSE: FCC 47 CFR 90.205 (r)

Radio Type: Base Station Transceiver
Frequency Band: 400 MHz ~ 470 MHz

The output power shall not exceed by more than 20% the manufacturer's rated output power for the particular transmitter.

TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC 47 CFR 2.1047 (a)

GUIDE: TIA/EIA-603C 2.2.6

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

MEASUREMENT RESULTS:
See the plots on the following pages for 12.5 kHz & 25 kHz channel spacings.
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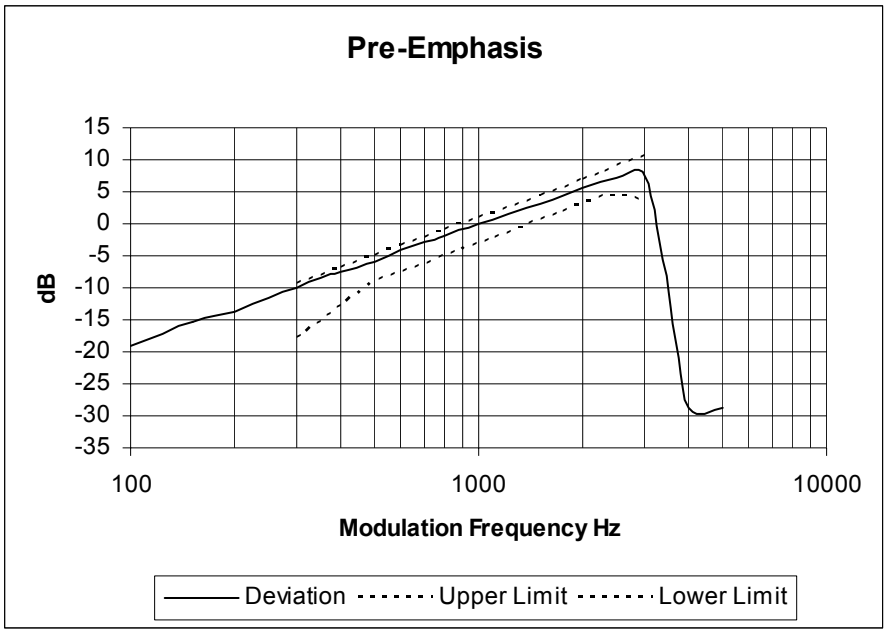
LIMIT CLAUSE: TIA/EIA-603C 3.2.6

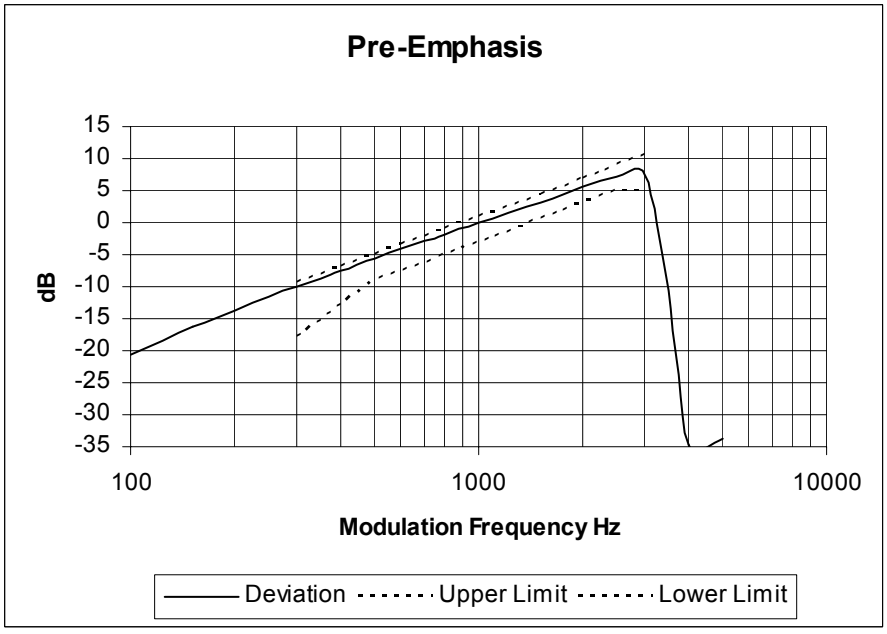
TRANSMITTER AUDIO FREQUENCY RESPONSE - PRE-EMPHASIS

SPECIFICATION: FCC CFR 2.1047 (a)

Tx FREQUENCY: 425.1 MHz 12.5 kHz Channel Spacing



Tx FREQUENCY: 425.1 MHz 25 kHz Channel Spacing



TRANSMITTER MODULATION LIMITING

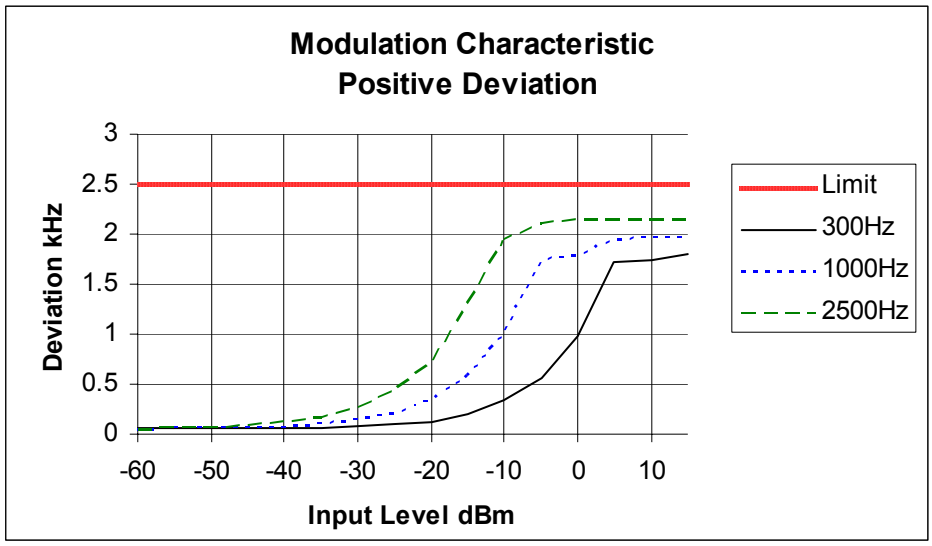
SPECIFICATION: FCC 47 CFR 2.1047 (b)

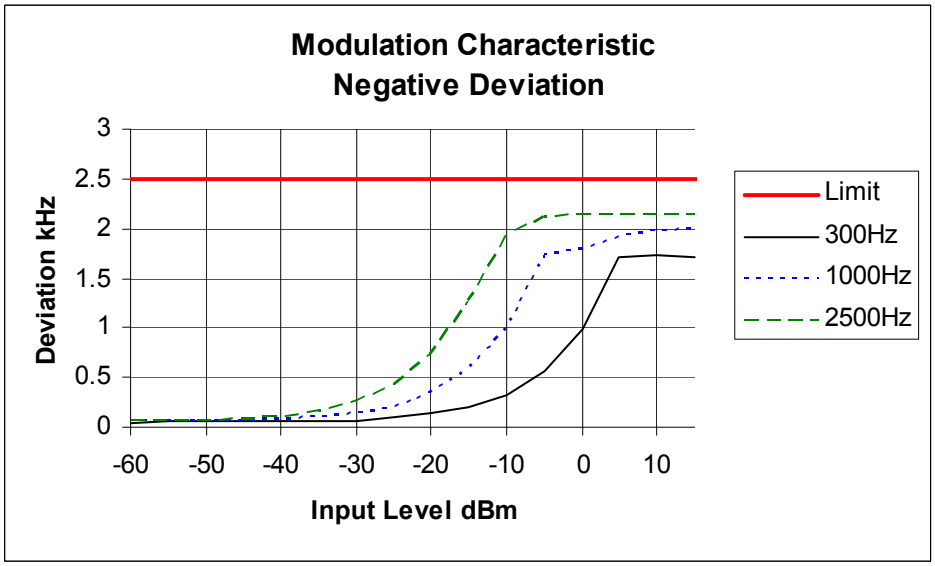
MEASUREMENT PROCEDURE:
1. Refer Annex A for Equipment set up.
2. The modulation response was measured at three audio frequencies while varying the input level.
3. Measurements were made for both Positive and Negative Deviation.

MEASUREMENT RESULTS:
See the plots on the following pages for 12.5 kHz & 25 kHz channel spacings.

LIMIT CLAUSE: TIA/EIA-603C 1.3.4.4

Tx FREQUENCY: 425.1 MHz 12.5 kHz Channel Spacing

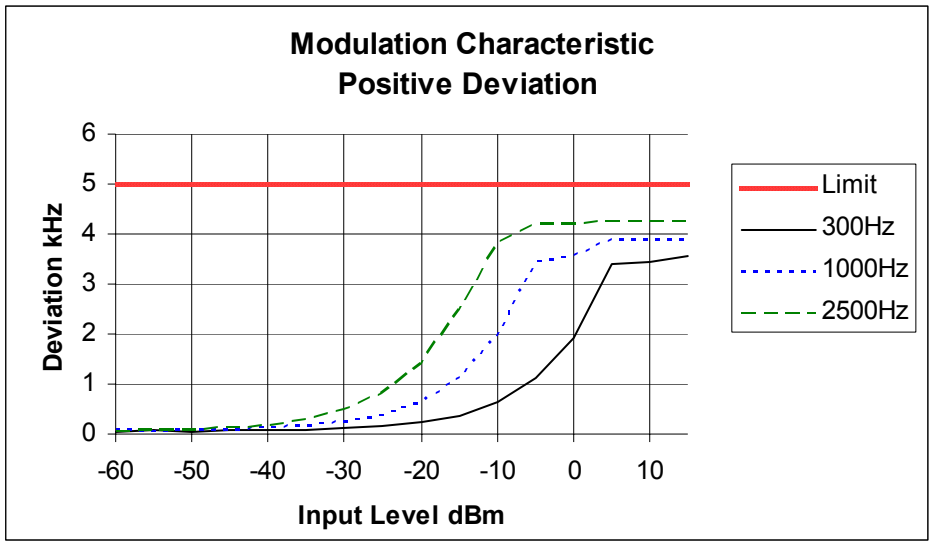


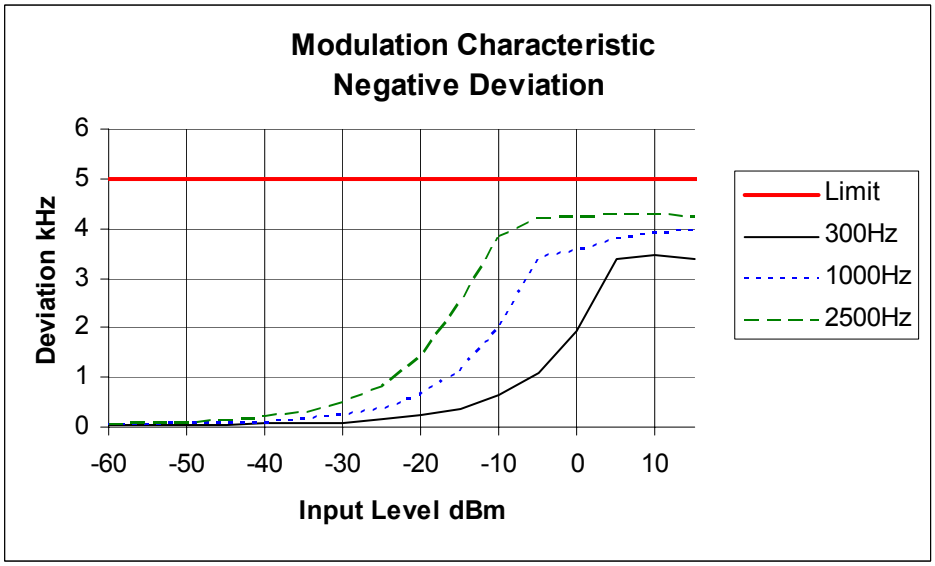


TRANSMITTER MODULATION LIMITING

SPECIFICATION: FCC CFR 2.1047 (b)

Tx FREQUENCY: 425.1 MHz 25 kHz Channel Spacing





SIDEBAND SPECTRUM

SPECIFICATION: FCC 47 CFR 2.1049 (c)

GUIDE: TIA/EIA-603C 2.2.11
TIA -102.CAAA - A

MEASUREMENT PROCEDURE:

1. Refer Annex A for Equipment Set up.

2. **For analogue measurements:** The EUT was modulated by a 2500Hz tone at an input level 16dB above a level that produced 50% deviation. The input level was established at the frequency of maximum response of the audio modulating circuit.

   For FFSK data measurements: The EUT was modulated with an internally generated pseudo random bit sequence at the appropriate Baud rate of 1200 bps and 2400 bps.

   For THSD data measurements: The EUT was modulated with an internally generated bit sequence using 12 kbps for 12.5 kHz channel spacing and 19.2 kbps on 25 kHz channel spacing.

3. The Sideband Spectrum was measured on the Spectrum Analyser, with bandwidth settings as follows.
   Emission Mask B, C – Resolution bandwidth = 300Hz, Video Bandwidth = 3 kHz
   Emission Mask D – Resolution bandwidth = 100Hz, Video Bandwidth = 1 kHz

MEASUREMENT RESULTS:

See the plots on the following pages tested at 425.1 MHz, 25 and 1 Watts, 12.5 kHz & 25 kHz channel spacings respectively.

LIMIT CLAUSE: FCC 47 CFR 90.210

EMISSION MASKS:

Emission Mask D	12.5 kHz Channel Spacing	Analogue; FFSK, THSD
Emission Mask B	25 kHz Channel Spacing	Analog;
Emission Mask C	25 kHz Channel Spacing	FFSK; THSD

DATA SPEED:

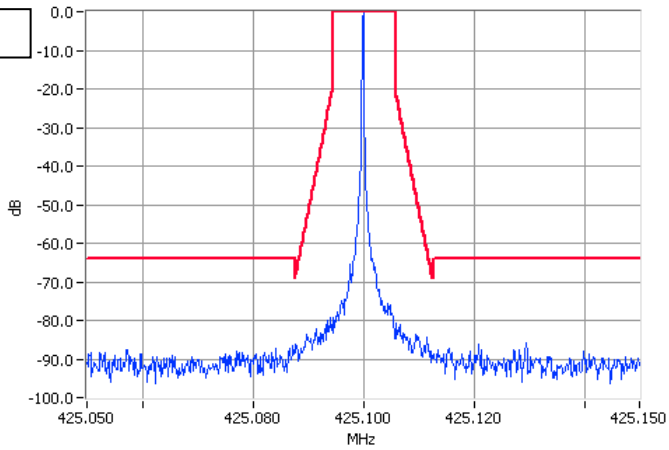
Tait High Speed Data	12000 bps	12.5 kHz Channel Spacing
Tait High Speed Data	19200 bps	25 kHz Channel Spacing
FFSK	1200 bps and 2400 bps	12.5 kHz Channel Spacing
FFSK	1200 bps and 2400 bps	25 kHz Channel Spacing

SIDEBAND SPECTRUM

SPECIFICATION: FCC CFR 2.1049 (c)

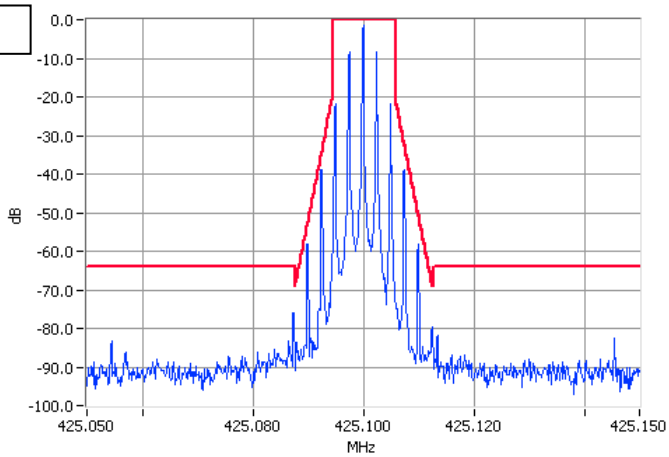
Tx Power: 25 W Channel Spacing: 12.5 kHz Mask: D

Unmodulated



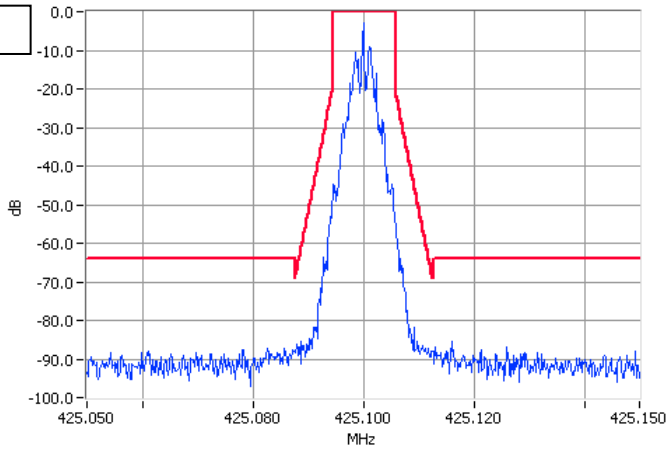
Unmodulated 425.1000MHz Mask D 25W Pass
RBW=100Hz VBW=1000Hz

Analogue



Analogue Modulation 425.1000MHz Mask D 25W Pass
RBW=100Hz VBW=1000Hz

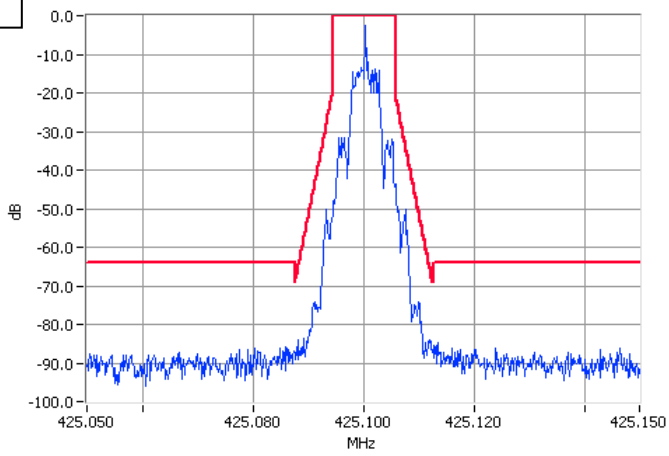
FFSK 1200 bps



Digital Modulation 425.1000MHz Mask D 25W Pass
RBW=100Hz VBW=1000Hz

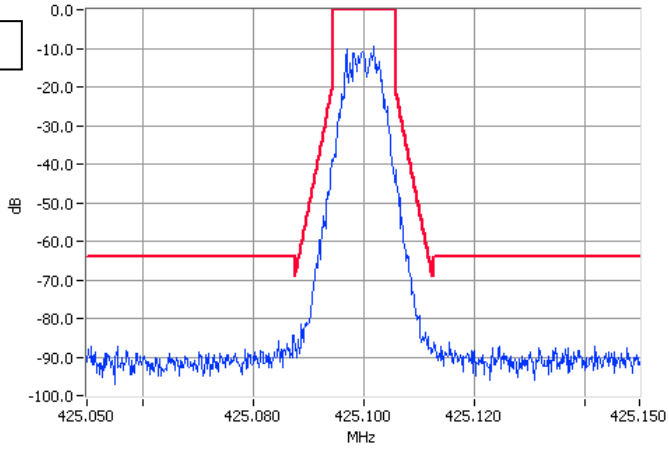
Tx Power: 25 W Channel Spacing: 12.5 kHz Mask: D

FFSK 2400 bps



Digital Modulation 425.1000MHz Mask D 25W Pass
RBW=100Hz VBW=1000Hz

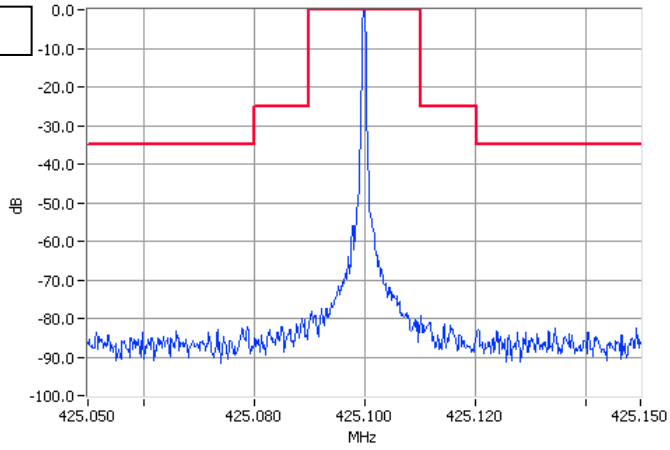
THSD



Digital Modulation 425.1000MHz Mask D 25W Pass
RBW=100Hz VBW=1000Hz

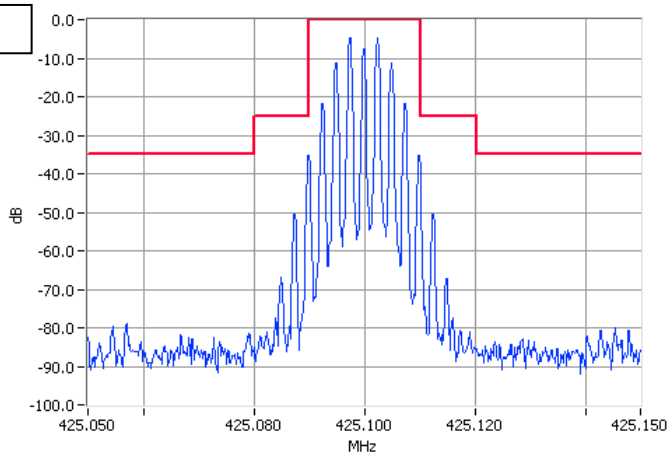
Tx Power: 25 W Channel Spacing: 25 kHz Mask: B

Unmodulated



Unmodulated 425.1000MHz Mask B 25W Pass
RBW=300Hz VBW=3000Hz

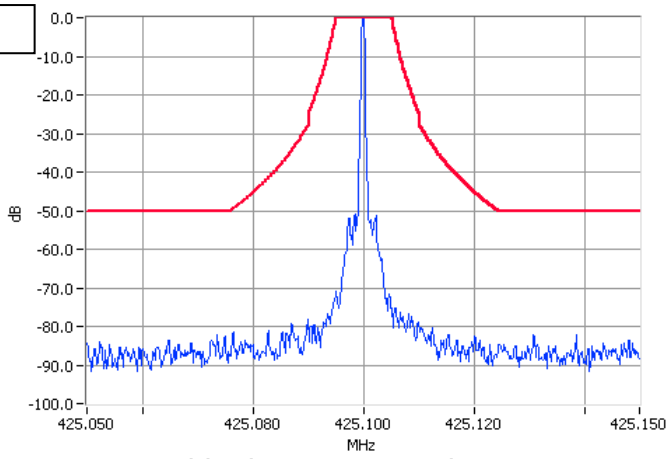
Analogue



Analogue Modulation 425.1000MHz Mask B 25W Pass
RBW=300Hz VBW=3000Hz

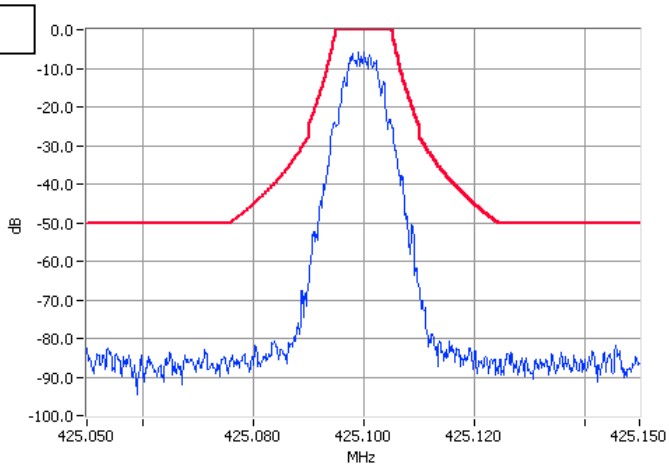
Tx Power: 25 W Channel Spacing: 25 kHz Mask: C

Unmodulated



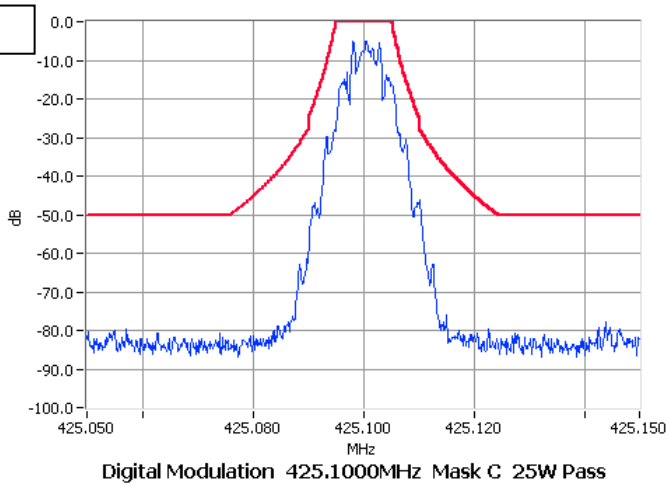
Unmodulated 425.1000MHz Mask C 25W Pass
RBW=300Hz VBW=3000Hz

FFSK 1200 bps



Digital Modulation 425.1000MHz Mask C 25W Pass
RBW=300Hz VBW=3000Hz

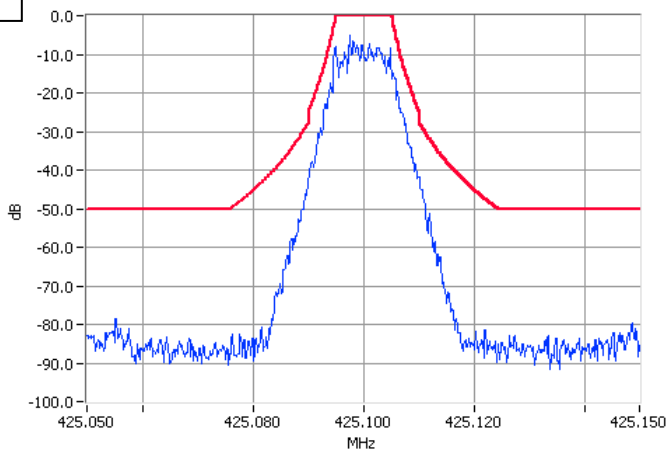
FFSK 2400 bps



Digital Modulation 425.1000MHz Mask C 25W Pass
RBW=300Hz VBW=3000Hz

Tx Power: 25 W Channel Spacing: 25 kHz Mask: C

THSD



Digital Modulation 425.1000MHz Mask C 25W Pass
RBW=300Hz VBW=3000Hz

SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: FCC 47 CFR 2.1051

GUIDE: TIA/EIA-603C 2.2.13

MEASUREMENT PROCEDURE:

1. Refer Annex A for equipment set up.
2. The frequency range examined was from the lowest frequency generated within the EUT, to a frequency higher than the 10th Harmonic: 100kHz to Fc-BW
   Fc+BW to 4.3 GHz
3. A Pre-scan is performed with a resolution bandwidth of 1 kHz, and a video bandwidth of 3 kHz. If any emissions are found to be within 20dB of the limit a second measurement is made with the carrier modulated, and a resolution bandwidth of 10 kHz, and a video bandwidth of 30kHz.
   Spurious emissions which were attenuated more than 20dB below the limit were not recorded.

MEASUREMENT RESULTS:
See the tables on the following pages for 12.5 kHz & 25 kHz channel spacings.

LIMIT CLAUSE: FCC 47 CFR 90.210

MEASUREMENT UNCERTAINTY: +/-3.0 dB

SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: FCC CFR 2.1051

Tx FREQUENCY: 425.1 MHz

12.5 kHz Channel Spacing	425.1 MHz @ 25 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
No emissions were detected at a level greater than 20 dB below the limit.		

LIMITS:

Carrier Output Power Watts	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
25 W	-20 dBm	-64 dBc
1 W	-20 dBm	-50 dBc

SPURIOUS EMISSIONS (CONDUCTED)

SPECIFICATION: FCC CFR 2.1051

Tx FREQUENCY: 425.1 MHz

12.5 kHz Channel Spacing	425.1 MHz @ 1 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
No emissions were detected at a level greater than 20 dB below the limit.		

LIMITS:

Carrier Output Power Watts	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
25 W	-20 dBm	-64 dBc
1 W	-20 dBm	-50 dBc

SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC 47 CFR 2.1053

GUIDE: TIA/EIA-603C 2.2.12

MEASUREMENT PROCEDURE:
Initial Scan:

1. The EUT is placed in the S-Line TEM cell and emissions are measured from 30MHz to 1000MHz. Any emission within 10dB of the limit is then re-tested on the OATS along with measurements from 1000MHz to the 10th harmonic of the fundamental frequency.
2. The EUT is then placed on a wooden turntable at a distance of 0.5 metres from the test antenna and emissions are measured from 1000MHz to the upper frequency required. Any emission within 10 dB of the limit is then re-tested on the OATS.

OATS Measurement:

1. The EUT is placed on a wooden turntable at a distance of three metres from the test antenna. The output terminal is connected to an RF dummy load.
2. The test antenna is raised from 1m to 4m to obtain a maximum reading, the turntable is then rotated through 360^{o} to obtain the maximum response of each spurious emission. Valid emissions are determined by switching the EUT on and off.
3. The EUT is then replaced by a signal generator and substitution antenna to make measurements by the substitution method.

MEASUREMENT RESULTS:
See the tables on the following pages

LIMIT CLAUSE: FCC 47 CFR 90.210

MEASUREMENT UNCERTAINTY: +/-4.6 dB

SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 425.1 MHz

12.5 kHz Channel Spacing	425.1 MHz @ 25 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
850.2	-33.7	-77.7
No other emissions were detected at a level greater than 10 dB below the limit.		

LIMITS:

Carrier Output Power Watts	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
25 W	-20 dBm	-64 dBc
1 W	-20 dBm	-50 dBc

SPURIOUS EMISSIONS (RADIATED)

SPECIFICATION: FCC CFR 2.1053

Tx FREQUENCY: 425.1 MHz

12.5 kHz Channel Spacing	425.1 MHz @ 1 W	Emission Mask D
Emission Frequency (MHz)	Level (dBm)	Level (dBc)
~	~	~
No emissions were detected at a level greater than 10 dB below the limit.		

LIMITS:

Carrier Output Power Watts	Emission Mask D 12.5 kHz Channel Spacing $50 + 10 \text{ Log}_{10} (P_{Watts})$	
25 W	-20 dBm	-64 dBc
1 W	-20 dBm	-50 dBc

TRANSMITTER FREQUENCY STABILITY (TEMPERATURE)

SPECIFICATION: FCC 47 CFR 2.1055 (a) (1)

GUIDE: TIA/EIA-603C 2.2.2

MEASUREMENT PROCEDURE:
1. Refer Annex A for equipment set up.
2. The EUT was tested for frequency error from –30 °C to +50°C in 10 °C increments
3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESULTS:
See the plots on the following pages for 12.5 kHz & 25 kHz channel spacings.

LIMIT CLAUSE: FCC 47 CFR 90.213

Frequency Range: 400 MHz to 470 MHz

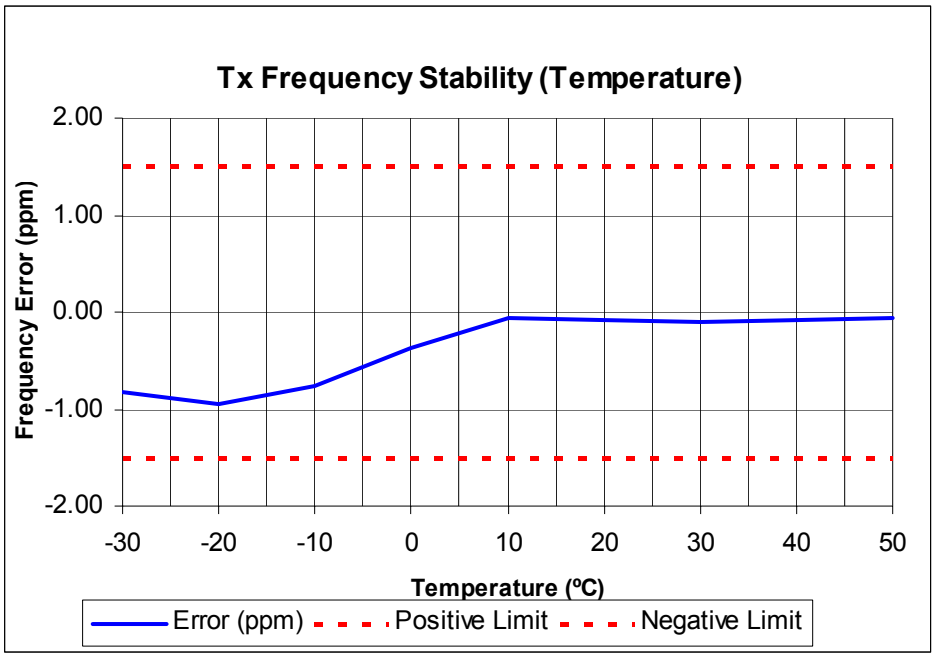
Channel Spacing (kHz)	Frequency Error (ppm)
12.5	1.5
25	2.5

Measurement Uncertainty	+/- 50 Hz

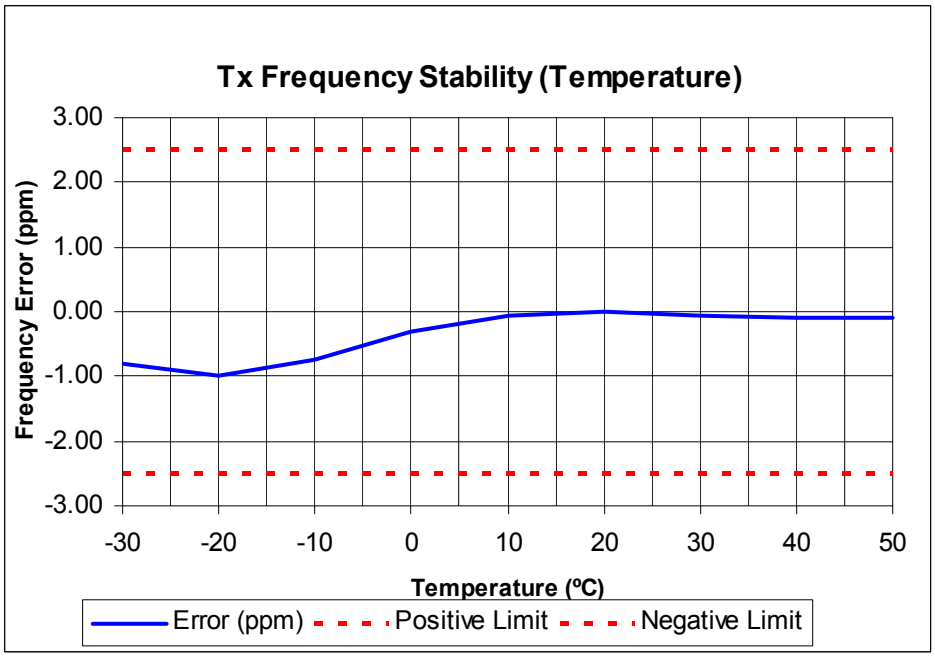
TRANSMITTER FREQUENCY STABILITY (TEMPERATURE)

SPECIFICATION: FCC 47 CFR 2.1055 (a) (1)

Tx FREQUENCY: 425.1 MHz 25 W 12.5 kHz channel Spacing



Tx FREQUENCY: 425.1 MHz 25 W 25 kHz channel Spacing



TRANSMITTER FREQUENCY STABILITY (VOLTAGE)

SPECIFICATION: FCC 47 CFR 2.1055 (d) (1)

GUIDE: TIA/EIA-603C 2.2.2

MEASUREMENT PROCEDURE:
1. Refer Annex A for equipment set up.
2. The EUT was tested for frequency error at an input voltage to the radio of 85% to 115%.
3. The frequency error was recorded in parts per million (ppm).

MEASUREMENT RESULTS: Frequency Range: 400 MHz ~ 470 MHz

Channel Spacing (kHz)	FREQUENCY ERROR (ppm) @ 425.1 MHz		
	102 V ac	120 V ac	138 V ac
12.5	-0.10	-0.11	-0.10
25	-0.12	-0.16	-0.09

LIMIT CLAUSE: FCC 47 CFR 90.213

Channel Spacing (kHz)	Frequency Error (ppm)
12.5	1.5
25	2.5

Measurement Uncertainty	+/- 50 Hz

TRANSIENT FREQUENCY BEHAVIOR

SPECIFICATION: FCC 47 CFR 90.214

GUIDE: TIA/EIA-603C 2.2.19

MEASUREMENT PROCEDURE:
1. Refer Annex A for equipment set up.
2. Measurements and plots were made following the TIA/EIA procedure.

MEASUREMENT RESULTS:
See the tables and plots on the following pages for 12.5 kHz & 25 kHz channel spacings.

LIMIT CLAUSE: FCC 47 CFR 90.214

TRANSIENT FREQUENCY BEHAVIOUR

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 425.1 MHz 25 W 12.5 kHz Channel Spacing

FREQUENCY	425.1 MHz @ 25 W Tx	
TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t_1	1.7	N/A
t_2	-0.3	N/A
t_3	N/A	-0.3
$t_2 \rightarrow t_3$ ppm	-1.1	
ERROR LIMIT ($t_2 \rightarrow t_3$) ppm	1.5	

Confirm that during periods t_1 and t_3 the frequency difference does not exceed the value of one channel separation.	YES	NO
	Y	
Confirm that during the period t_2 the frequency difference does not exceed half a channel separation.	YES	NO
	Y	
Confirm that during the period t_2 to t_3 the frequency difference does not exceed the frequency error limit.	YES	NO
	Y	

LIMIT:

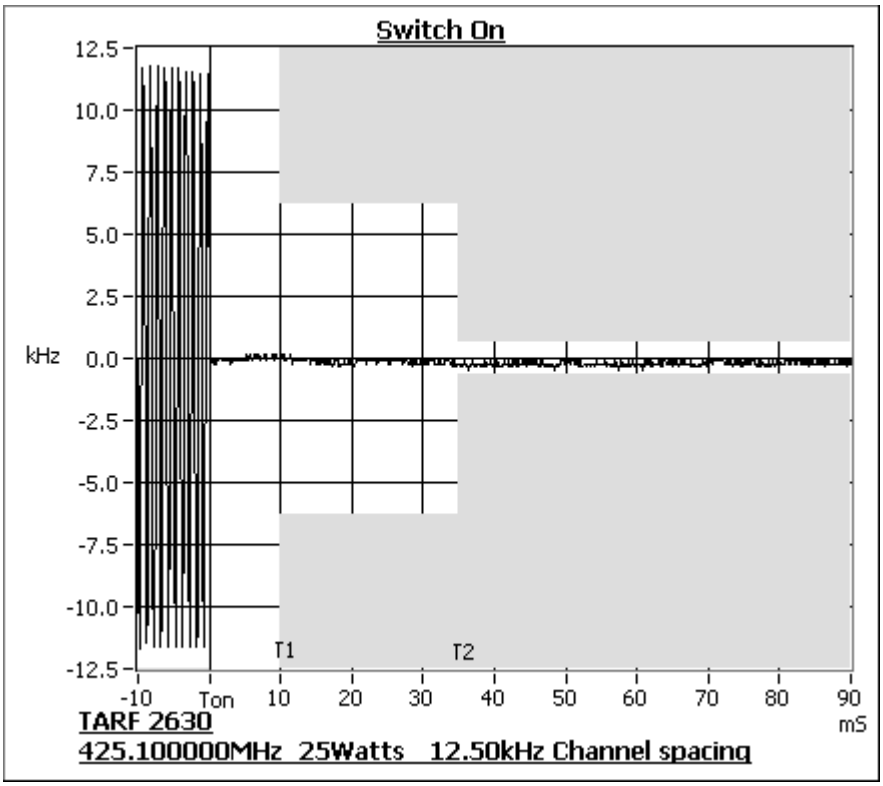
TRANSIENT PERIODS	FREQUENCY RANGE 150MHz – 174 MHz	FREQUENCY RANGE 421MHz – 512 MHz
t_1 (ms)	5 ms	10 ms
t_2 (ms)	20 ms	25 ms
t_3 (ms)	5 ms	10 ms

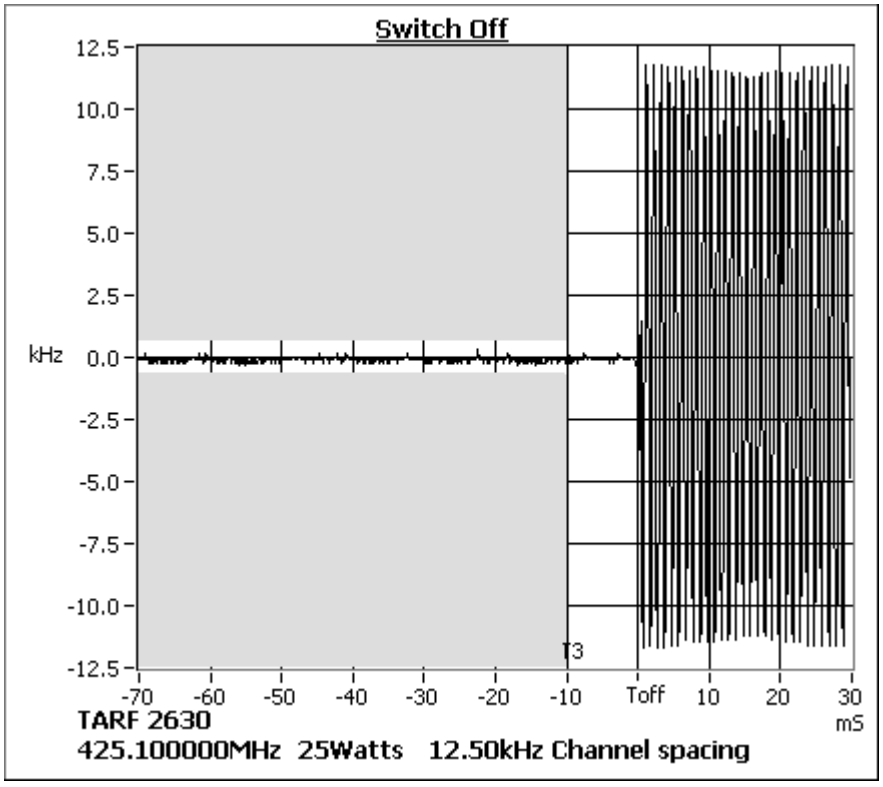
Measurement Uncertainty	+/- 130 Hz

TRANSIENT FREQUENCY BEHAVIOUR

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 425.1 MHz 25 W 12.5 kHz Channel Spacing





TRANSIENT FREQUENCY BEHAVIOUR

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 425.1 MHz 25 W 25 kHz Channel Spacing

FREQUENCY	425.1 MHz @ 25 W Tx	
TRANSIENT RESPONSE PERIOD	CARRIER PEAK VARIATION FROM NORMAL	
	Key ON (kHz)	Key OFF (kHz)
t_1	0.7	N/A
t_2	-0.5	N/A
t_3	N/A	-0.5
$t_2 \rightarrow t_3$ ppm	-2.4	
ERROR LIMIT ($t_2 \rightarrow t_3$) ppm	2.5	

Confirm that during periods t_1 and t_3 the frequency difference does not exceed the value of one channel separation.	YES	NO
	Y	
Confirm that during the period t_2 the frequency difference does not exceed half a channel separation.	YES	NO
	Y	
Confirm that during the period t_2 to t_3 the frequency difference does not exceed the frequency error limit.	YES	NO
	Y	

LIMIT:

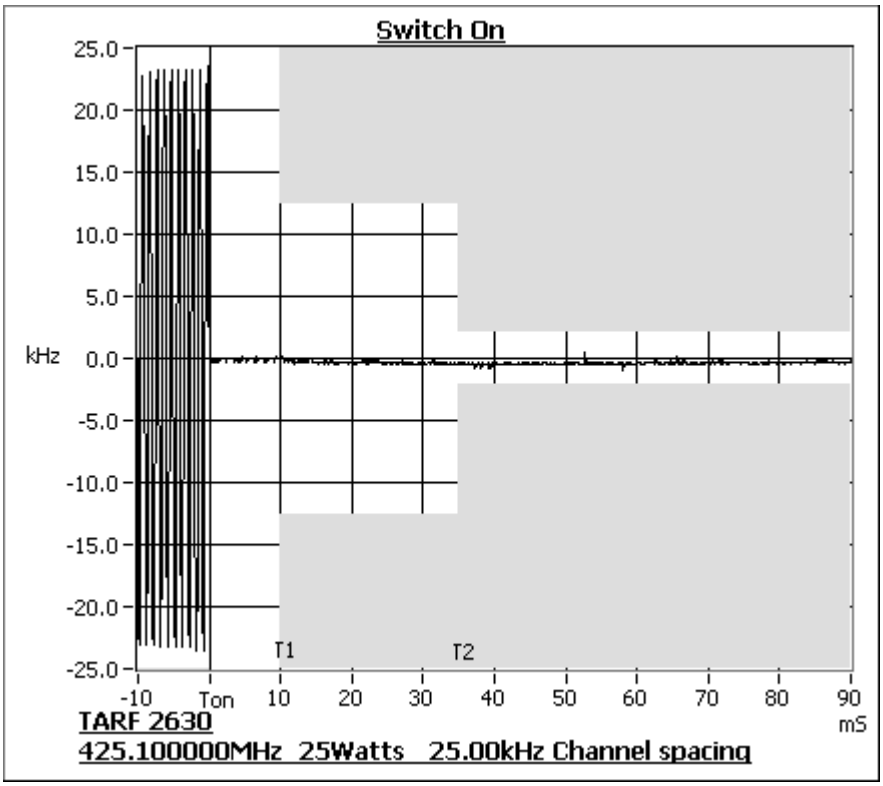
TRANSIENT PERIODS	FREQUENCY RANGE 150MHz – 174 MHz	FREQUENCY RANGE 421MHz – 512 MHz
t_1 (ms)	5 ms	10 ms
t_2 (ms)	20 ms	25 ms
t_3 (ms)	5 ms	10 ms

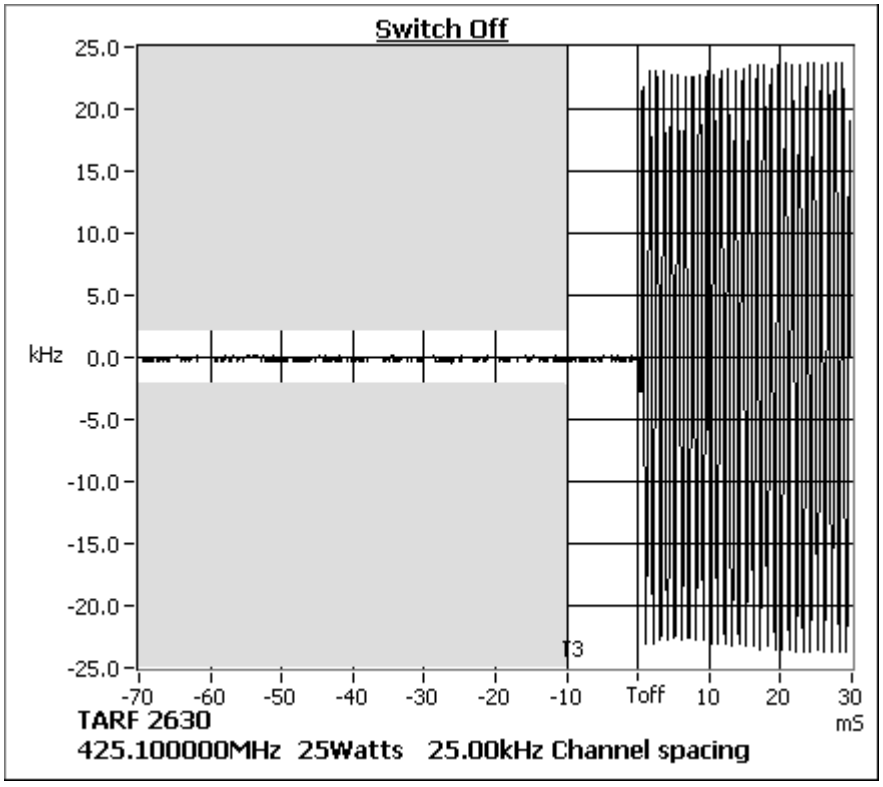
Measurement Uncertainty	+/- 130 Hz

TRANSIENT FREQUENCY BEHAVIOUR

SPECIFICATION: FCC 47 CFR 90.214

Tx FREQUENCY: 425.1 MHz 25 W 25 kHz Channel Spacing





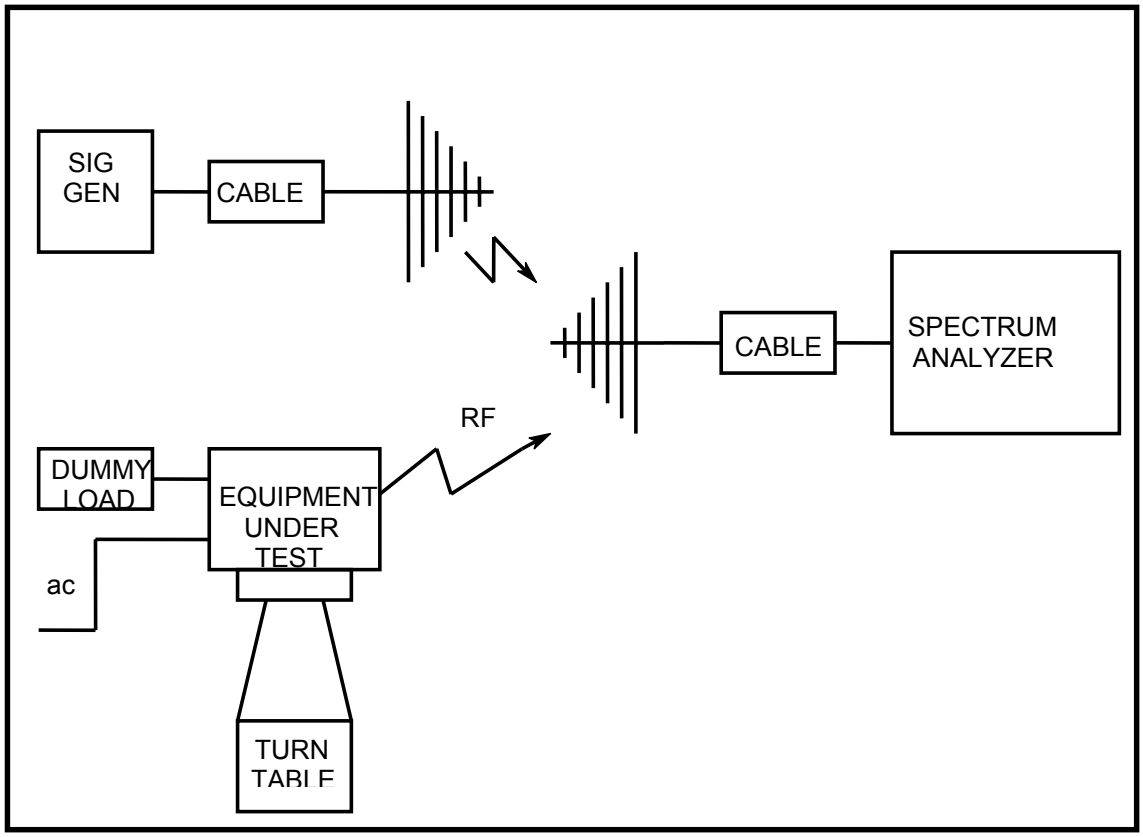
TEST EQUIPMENT USED

No#	Equipment	Manufacturer	Model No	Serial No#	Tait ID	Cal Due
1	Signal Generator	Hewlett Packard	HP8642B (Opt 001)	2512A00176	E3064	3-Nov-07
11	Modulation Analyser	Hewlett Packard	HP8901B (Opt 002)	2441A00393	E3073	2-Nov-07
13	Audio Analyser	Hewlett Packard	HP8903A	2308A02597	E3074	2-Nov-07
22	Oscilloscope	Tektronics	TDS340	B013611	E3585	2-Nov-07
37	Variac	Yamabishi	S-260-5	TX-533	E1737	
40	Reference Dipoles	Emco	3121C DB1	9510-1164	E3559	23-Nov-09
43	Horn Antenna	Emco	DRG3115	2084	E3076	25-Nov-09
46	S-LINE TEM CELL	Rohde & Schwarz	1089.9296.02	338232/003	E3636	20-Mar-09
64	RF Attenuator 50W	Weinschel	24-10-34	AZ0401	E3388	31-Oct-07
80	20m Coax Cable	Intelcom	RG214/U-50	CBL03	E3659	31-Oct-07
83	1m Coax Cable (BLUE)	Suhner	Sucoflex 104A	25006/4A	E3693	30-Oct-07
85	1m Coax Cable (BLUE)	Suhner	Sucoflex 104A	25004/4A	E3691	30-Oct-07
88	Spectrum Analyser	Hewlett Packard	HP8562E	3821A00779	E3715	31-Oct-07
91	20m Coax Cable		RG214/U-50 (Ext Cal)	CBL01	E3404	31-Oct-07
115	Environ. Chamber	Contherm	5400 RHSLT.M	1416	E4051	
123	Spectrum Analyser	Agilent	E4445A	MY42510072	E4139	4-Jul-07
129	Antenna Tower	Electrometrics	EM-4720-2	112	E4447	
130	Controller	Electrometrics	EM-4700	119	E4445	
131	Turntable	Electrometrics	EM-4704A	105	E4446	
135	Attenuator	Weinschel	67-30-33	BR0531	E4280	10-Jan-08
137	1m Multiflex Cable	Suhner	MF141	TT007	E4443	30-Oct-07
138	1m Multiflex Cable	Suhner	MF141	TT086	E4444	30-Oct-07
144	AC Voltmeter	Tait				24-Apr-08
146	2m Coax (Black)	Suhner	RG214HF/Nm/Nm/2000	CBL06		

ANNEX A

TEST SETUP DETAILS

Radiated Emissions Set up.



The Spectrum Analyser is connected to the EUT via a 30dB attenuator for Conducted Emissions testing.
For Transmitter Unwanted Emissions testing, the Spectrum Analyser is connected to the combiner in place of Signal Generator 3.