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TEST REPORT

WTE UHF TReX 460 Digital Transceiver

tested to the

Code of Federal Regulations (CFR) 47

Part 90 –Private Land Mobile Services

for

WTE Limited

This Test Report is issued with the authority of:

Andrew Cutler- General Manager

IANZ ACCREDITED LABORATORY

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

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1. COMPLIANCE STATEMENT

The **WTE UHF TReX 460** complies with the limits defined in 47 CFR Part 90 and 47 CFR Part 2 when tested in-accordance with the test methods described in 47 CFR Part 2 and ANSI / TIA-603-D-2010.

2. RESULT SUMMARY

The results of testing carried out between 9th January and the 20th February 2019 are summarised below.

Clause	Description	Result
90.203	Certification required	Noted
2.1046 90.205	RF power output Power and antenna height limits	Noted Complies
2.1049 2.202 90.207 90.209 90.210	Occupied bandwidth Bandwidths Types of emissions Bandwidth limitations Emission masks	Noted Noted Complies Complies Complies
2.1051	Spurious emissions at antenna terminals	Complies
2.1053	Field strength of spurious radiation	Not tested
2.1055 90.213	Frequency stability Frequency stability	Noted Complies
90.214	Transient frequency behaviour	Complies
1.1310	Radio frequency exposure limits	Complies

3. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

The client selected the test sample.

The report relates only to the sample tested.

This report does not contain corrections or erasures.

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

All compliance statements have been made with respect of the specification limit with no reference to the measurement uncertainty.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.

Andrew Cutler
General Manager
EMC Technologies NZ Ltd

4. CLIENT INFORMATION

Company Name WTE Limited

Postal Address 1 Pukeko Place, Southshore
Christchurch 8062

Physical Address 175 Lawford Road,
RD6 West Melton,
Christchurch 7676

Country New Zealand

Contact Mr Shannon Reardon

5. TEST SAMPLE DESCRIPTION

Brand Name WTE TReX UHF

Model Number TReX 460

Product Digital Transceiver

Manufacturer WTE Limited

Serial Number Not serialized

FCC ID 2ASGC-TREX460

Rated Transmitter Output Power

100 mW up to 4 watts (+36.0 dBm)

Transmitter Certification Range

Part 90: 421–512 MHz

Test frequencies

Frequency (MHz)	Power (Watts)	Emission
421.000	4.0	F1D
451.000	4.0	F1D
480.000	4.0	F1D

12.5 kHz and 25 kHz offsets from the above mentioned frequencies have been used during testing and have been clearly mentioned in the test description and results.

Standard Temperature and Humidity

Temperature: +15 °C to + 30 °C maintained.
Relative Humidity: 20% to 75% observed.

Standard Test Power Source

Standard Test Voltage: 13.8 Vdc

Extreme Temperature

High Temperature: + 50 °C maintained.
Low Temperature: - 30 °C maintained.

Extreme Test Voltages

High Voltage: 15.6 Vdc
Low Voltage: 10.8 Vdc

Product Overview:

The TReX is an Ethernet, Serial (RS232 plus RS485/RS422) and USB capable transceiver for data, paging and general telemetry use.

The TReX Transceiver can be configured through

- A simple integrated display and keypad

- Serial commands

- TCP

- USB

- Web browser.

The TReX Transceiver is suitable for commercial, industrial and remotely managed control/monitoring applications.

6. TEST RESULTS

Certification required

Part 90.203(j)

4) Applications for part 90 certification of transmitters designed to operate on frequencies in the 150.8–162.0125 MHz, 173.2–173.4 MHz, and/or 421–512 MHz bands, received on or after January 1, 2011;

The product tested operates in the frequency range 421- 480 MHz which falls within 421-512 MHz band and hence certification is required

(ii) 12.5 kHz for multi-bandwidth mode equipment with a maximum channel bandwidth of 12.5 kHz if it is capable of operating on channels of 6.25 kHz or less;

The multi bandwidth mode product tested is capable of operating using channel bandwidths of 25 kHz, 12.5 kHz and 6.25 kHz.

(5), Applications for part 90 certification of transmitters designed to operate on frequencies in the 150.8–162.0125 MHz, 173.2–173.4 MHz, and/or 421–512 MHz bands, after January 1, 2011, must include a certification that the equipment meets a spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth;

The product tested is a digital modulated transceiver that has been shown to meet the spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth.

Additionally, if the equipment is capable of transmitting data, has transmitter output power greater than 500 mW, and has a channel bandwidth of more than 6.25 kHz, the equipment must be capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of channel bandwidth:

The product tested supports 4800 bits per second per 6.25 kHz of channel bandwidth.

Result: Complies.

-

RF power output

Measurements were carried out at the RF output terminals of the transmitter using a 30 dB power attenuator and a 50 Ω dummy load.

Measurements were carried out when the transmitter was not being modulated.

Testing was carried out at maximum power output.

Maximum transmitter power (CW) - Rated 4 W (+36.0 dBm)

Frequency (MHz)	Voltage (Vdc)	Carrier Power (dBm) +22˚ C	+55˚ C	-30˚ C
421.0125	15.6	35.4	35.5	35.4
	13.8	35.4	35.4	35.4
	10.8	35.3	35.3	35.3
451.0000	15.6	35.6	35.7	35.7
	13.8	35.5	35.5	35.5
	10.8	34.8	34.9	34.9
479.9875	15.6	35.5	35.5	35.6
	13.8	35.4	35.4	35.6
	10.8	35.3	35.3	35.3

Limits:

Part 90 does not specify the transmitter output power

Result: Complies.
Measurement Uncertainty: ± 0.5 dB

Emission types and bandwidth limitations:

The following emission types are used:

F1D: Digital CPM Continuous Phase Modulation using channel bandwidths of 6.25 kHz, 12.5 kHz and 25.0 kHz.

Following emission designators been declared by the client:

6k00F1D for 6.25 kHz channel spacing

11k2F1D for 12.5 kHz channel spacing

20k0F1D for 25.0 kHz channel spacing

.

The authorised bandwidth is taken to be the necessary bandwidth.

Measurements have been made to verify this declared bandwidth using the various modulation types and data rates that this radio can support at each test frequency.

Measurements were made using a spectrum analyser that was operating in occupied bandwidth mode with the 99% power points being determined automatically.

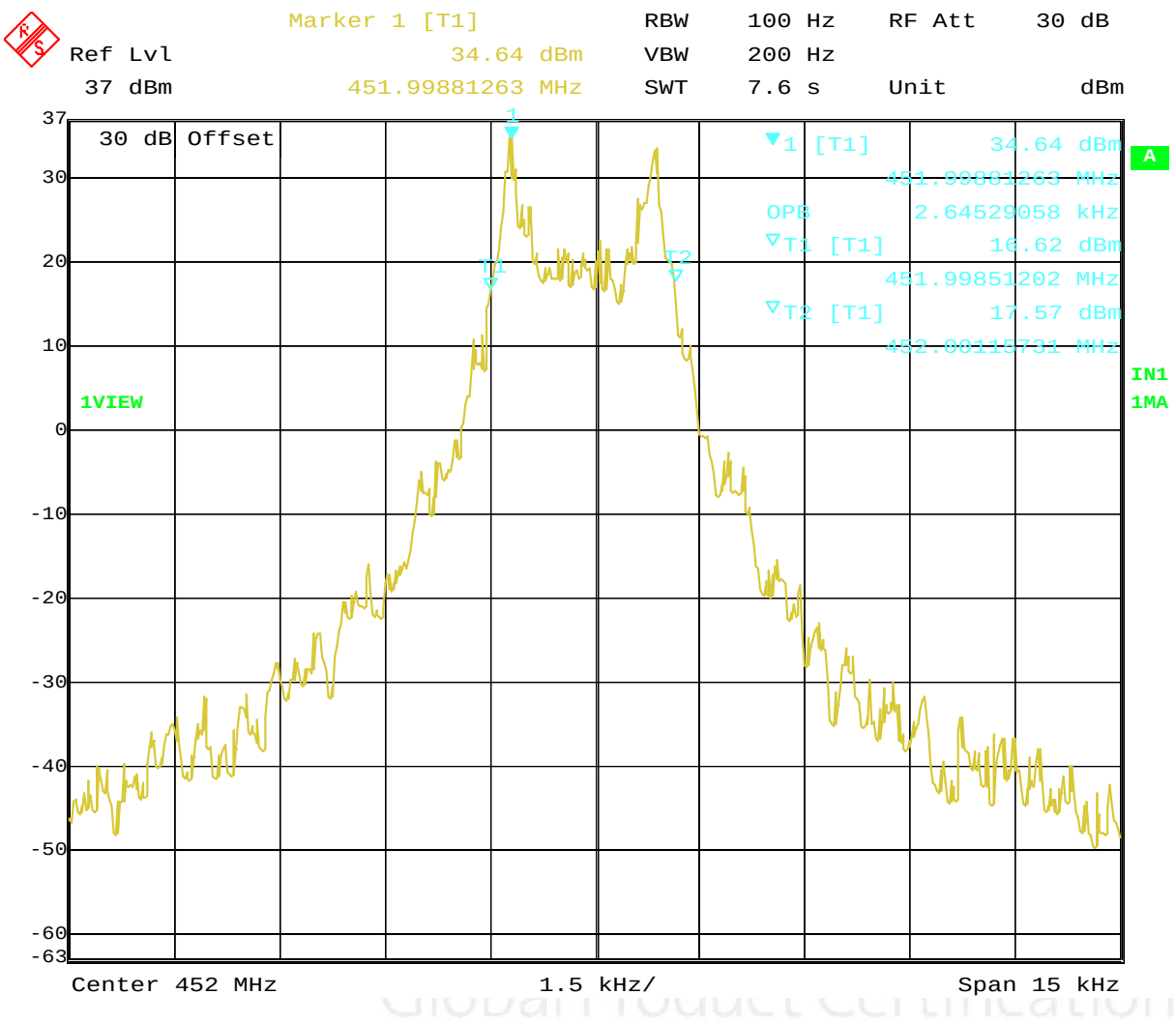
The analyser was set up with a resolution bandwidth of 100 Hz and a video bandwidth of 200 Hz while operating in peak hold mode.

Attached to the input of the spectrum analyser was an external 30 dB attenuator.

Result: Complies

F1D – 6.25 kHz spacing

2FSK / 512

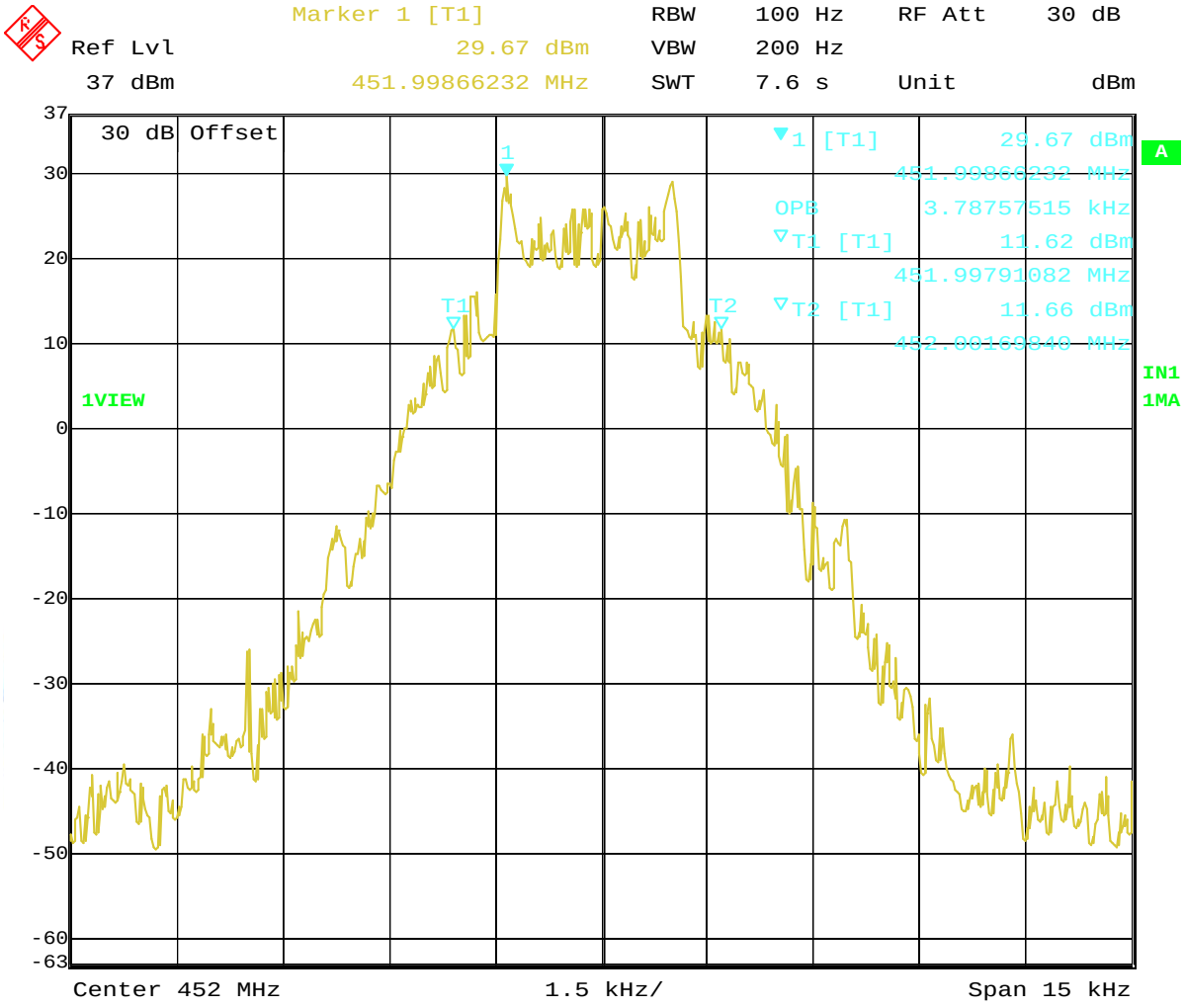


2FSK/512

Emission	Frequency (MHz)	Measured (kHz)	Designated
2FSK/512	421.0125	2.640	6.0 kHz
	451.0000	2.645	
	479.9875	2.652	

F1D – 6.25 kHz spacing continued

GFSK / 2400



GFSK/2400

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
GFSK/2400	451.0000	3.787	6.0 kHz

F1D – 6.25 kHz spacing continued

The following measurements were made but the plots have not been included in the test report in order to simplify the test report.

GFSK/4800

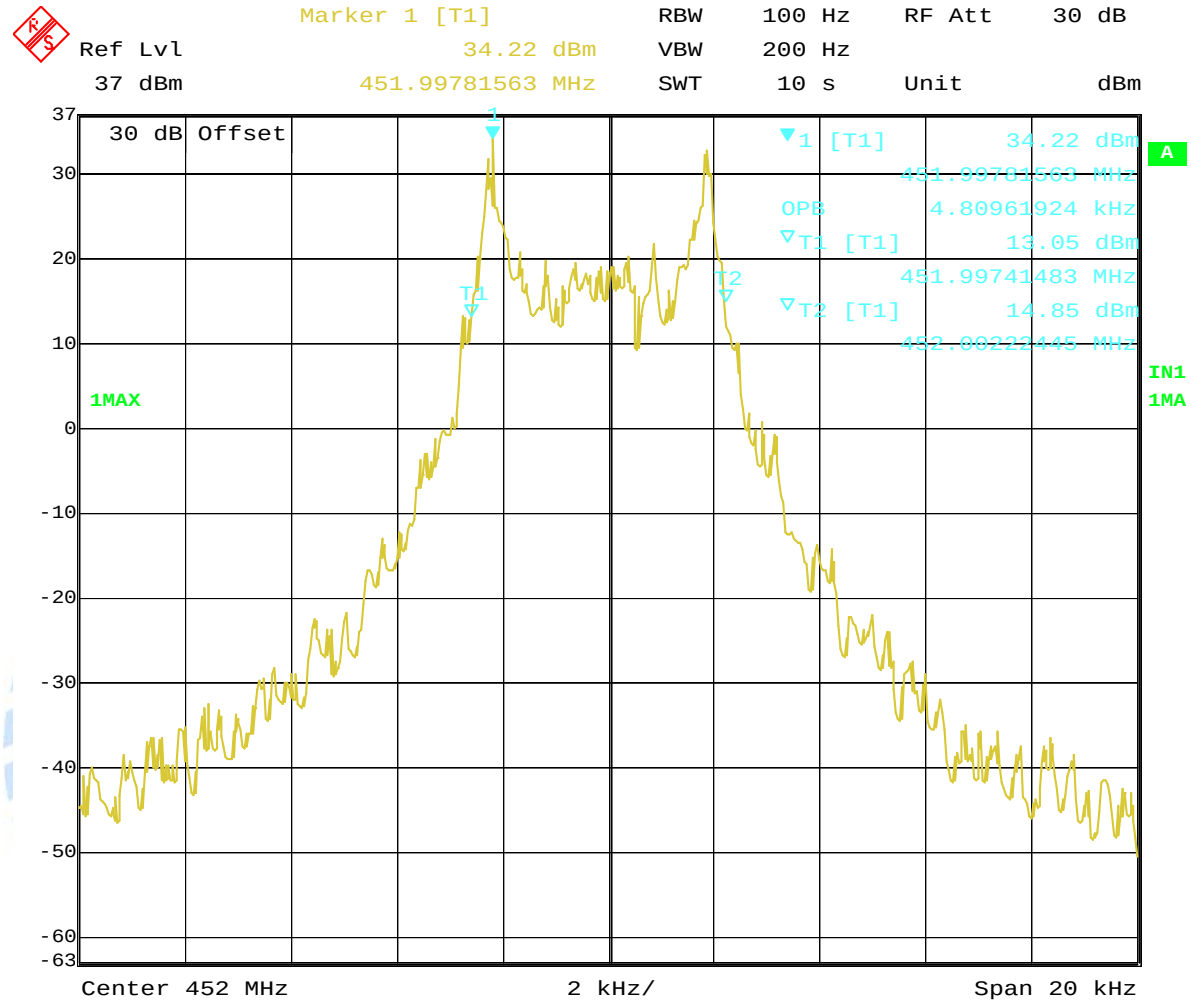
Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
GFSK/4800	451.0000	3.096	6.0 kHz

GFSK/1200

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
GFSK/1200	451.0000	3.006	6.0 kHz

F1D – 12.5 kHz spacing,

2FSK / 512

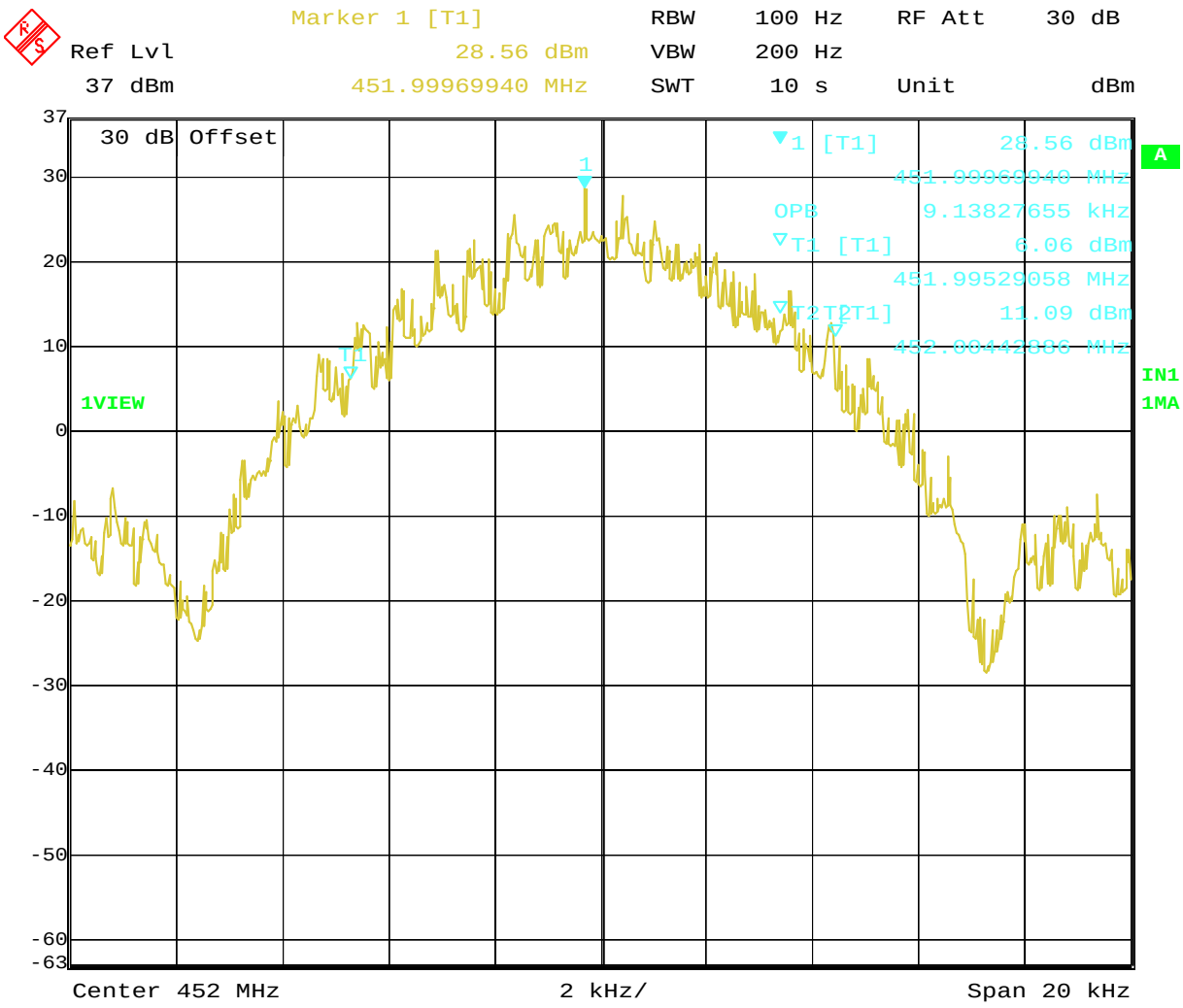


2FSK/512

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
2FSK/512	421.0125	4.769	11.250 kHz
	451.0000	4.801	
	479.9875	4.759	

F1D – 12.5 kHz spacing continued

4GFSK / 9600



4GFSK/9600

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
4GFSK/9600	451.0000	6.316	11.250 kHz

F1D – 12.5 kHz spacing continued

The following measurements were made but the plots have not been included in the test report in order to simplify the test report.

2FSK/1200

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
2FSK/1200	451.0000	5.561	11.250 kHz

2FSK/2400

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
2FSK/2400	421.0125	6.153	11.250 kHz
	451.0000	6.162	
	479.9875	6.161	

2GFSK/4800

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
2GFSK/4800	421.0125	7.563	11.250 kHz
	451.0000	7.565	
	479.9875	7.564	

GFSK/9600

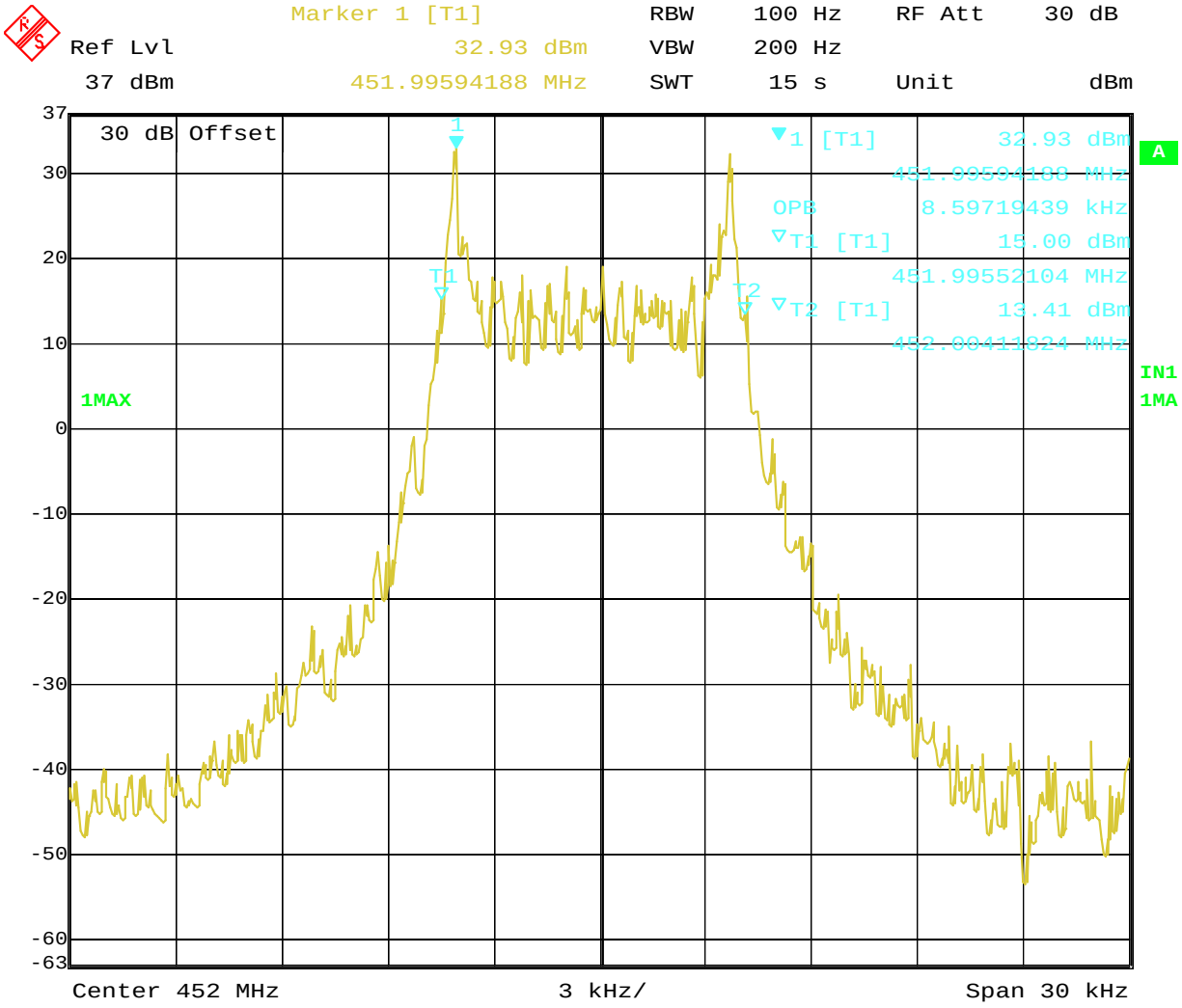
Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
GFSK/9600	421.0125	9.195	11.250 kHz
	451.0000	9.138	
	479.9875	9.168	

4GFSK/16000

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
4GFSK/16000	451.0000	8.116	11.250 kHz

F1D – 25.0 kHz spacing

2FSK / 512

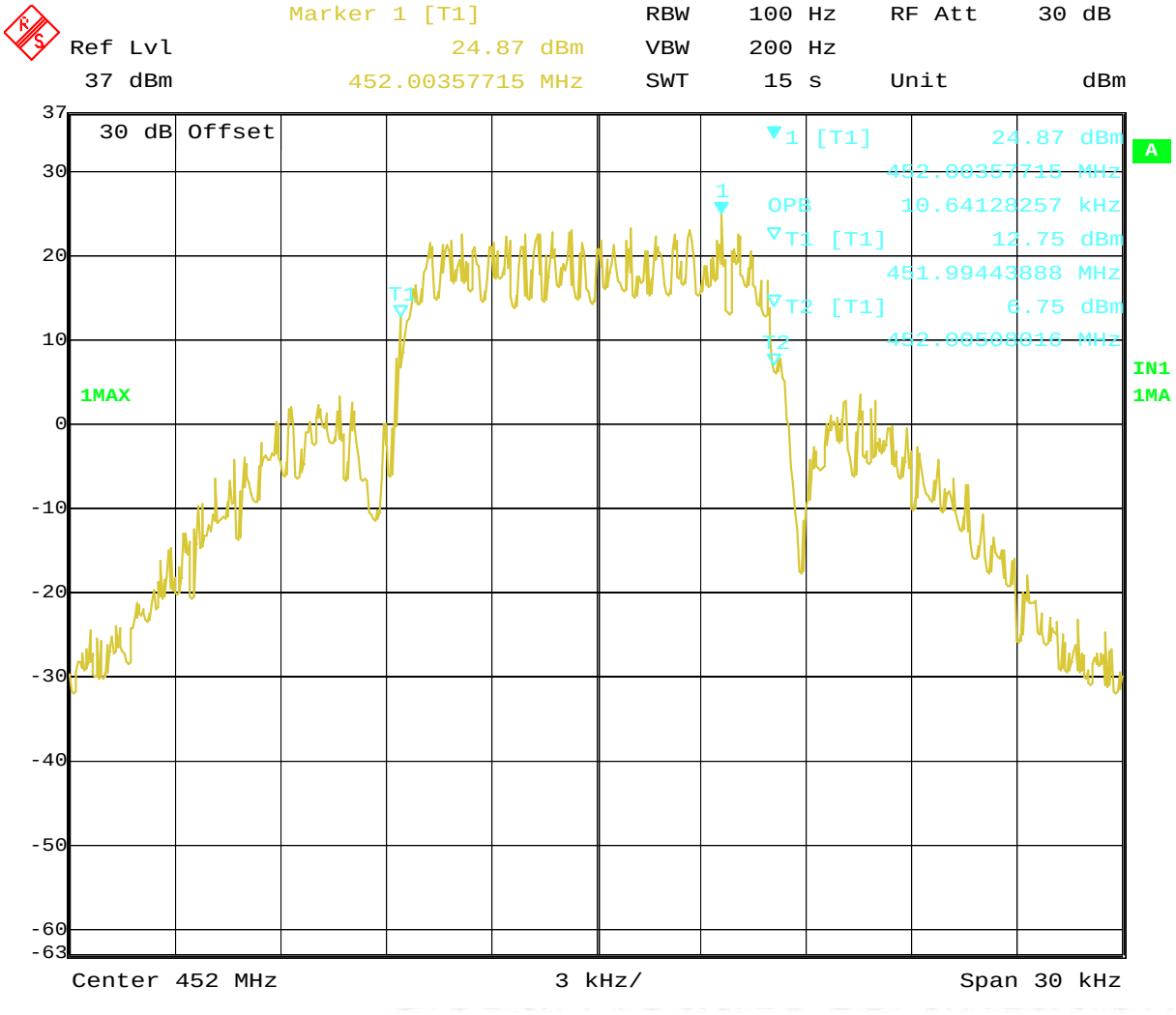


2FSK/512

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
2FSK/512	421.0250	8.466	20.0 kHz
	451.0000	8.667	
	479.9750	8.568	

F1D – 25.0 kHz spacing continued

GFSK / 9600

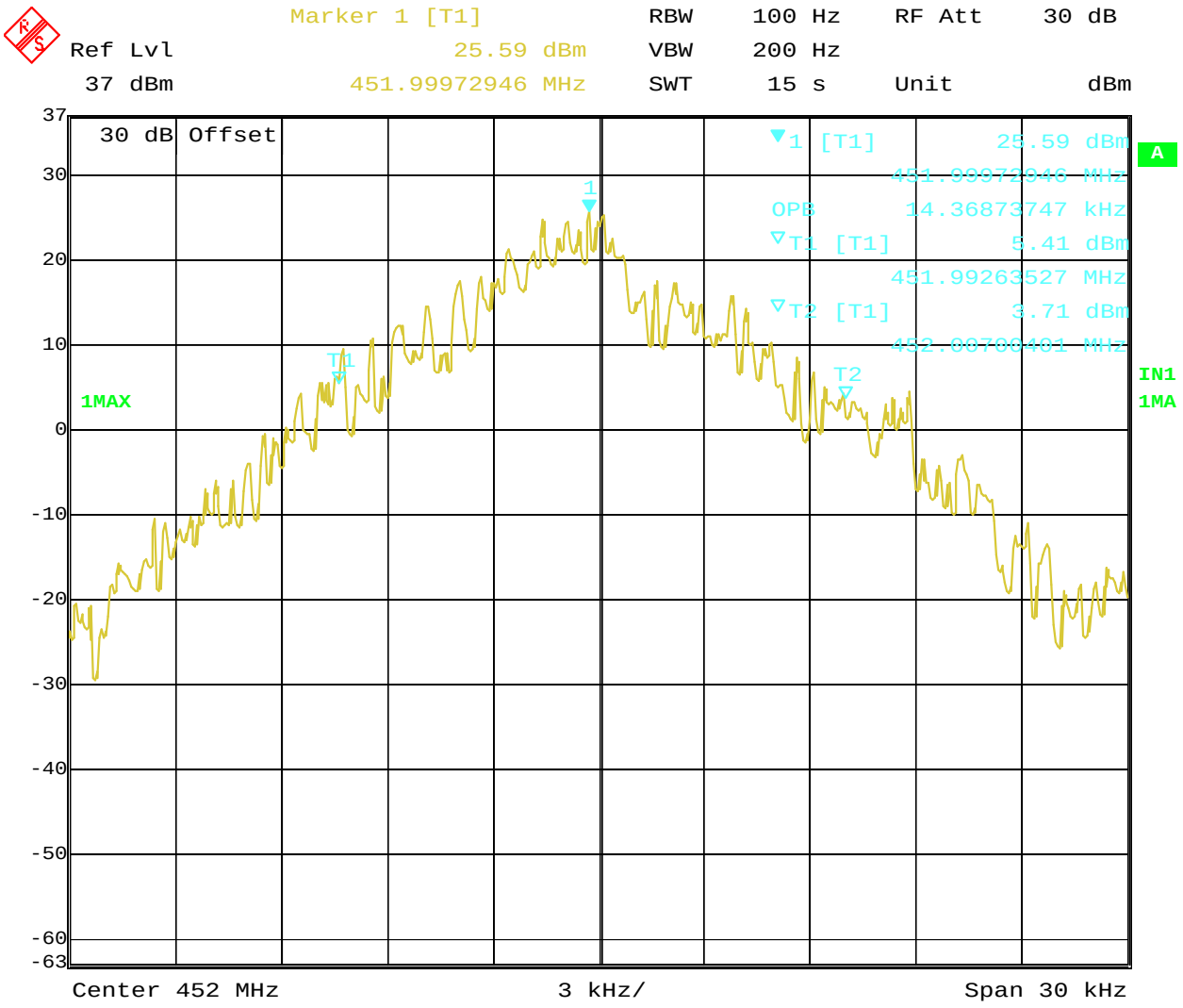


GFSK/9600

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
GFSK/9600 25.0 kHz	451.0000	10.672	20.0 kHz

F1D – 25.0 kHz spacing continued

4GFSK / 32000



4GFSK/32000

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
4GFSK/32000	451.0000	14.368	20.0 kHz

F1D – 25.0 kHz spacing continued

The following measurements were made but the plots have not been included in the test report in order to simplify the test report.

2FSK/1200

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
2FSK/1200	451.0000	9.669	20.0 kHz

FSK/1600

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
2FSK/1600	451.0000	10.070	20.0 kHz

FSK/2400

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
FSK/2400	451.0000	10.070	20.0 kHz

4GFSK/3200

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
GFSK/3200	421.0250	10.500	20.0 kHz
	451.0000	10.521	
	479.9750	10.543	

GFSK/4800

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
GFSK/4800	421.0250	10.168	20.0 kHz
	451.0000	10.173	
	479.9750	10.172	

F1D – 25.0 kHz spacing continued

The following measurements were made but the plots have not been included in the test report in order to simplify the test report.

4GFSK/9600

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
4GFSK/9600	421.0250	6.300	20.0 kHz
	451.0000	6.212	
	479.9750	6.215	

4GFSK/16000

Emission	Frequency (MHz)	Measured (kHz)	Designated (kHz)
4GFSK/16000	451.0000	10.220	20.0 kHz

Spectrum Masks

The spectrum masks are defined in:

Section 90.210(d) – Mask C, D and E have been applied as the transmitter can operate in the band 421.000–512.000 MHz using an authorised bandwidth of 25.0 kHz, 12.5 kHz and 6.25 kHz respectively as per Section 90.209(b)(5).

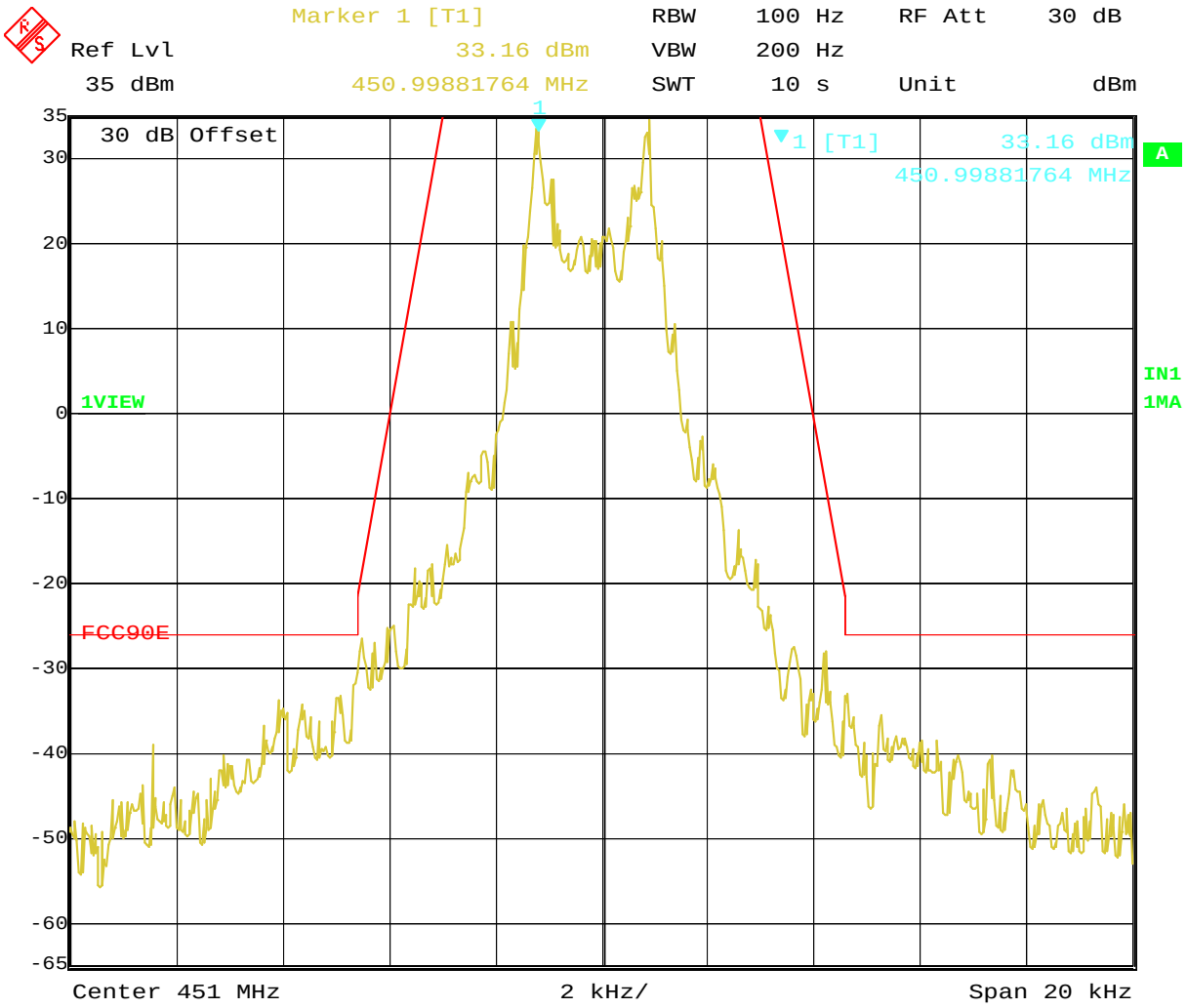
The reference level for the following emission mask measurements has been determined using a resolution bandwidth of 120 kHz with the transmitter modulated.

For all measurements a 30 dB attenuator is placed between the transmitter and the spectrum analyser. Measurements were made in peak hold

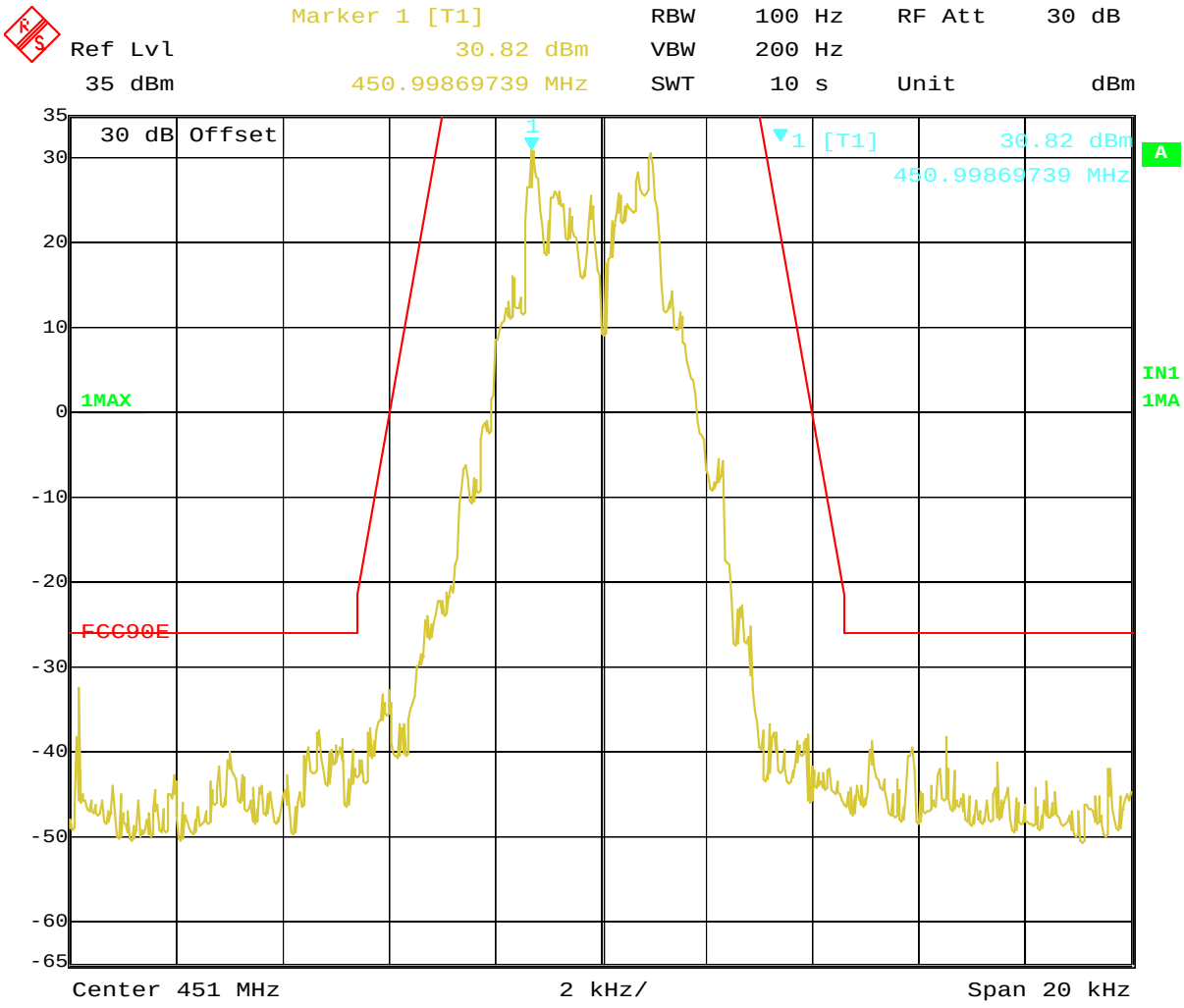
For the F1D mode the transmitter was modulated using the modulation sources internal to the transmitter as supplied by the client.

Result: Complies.

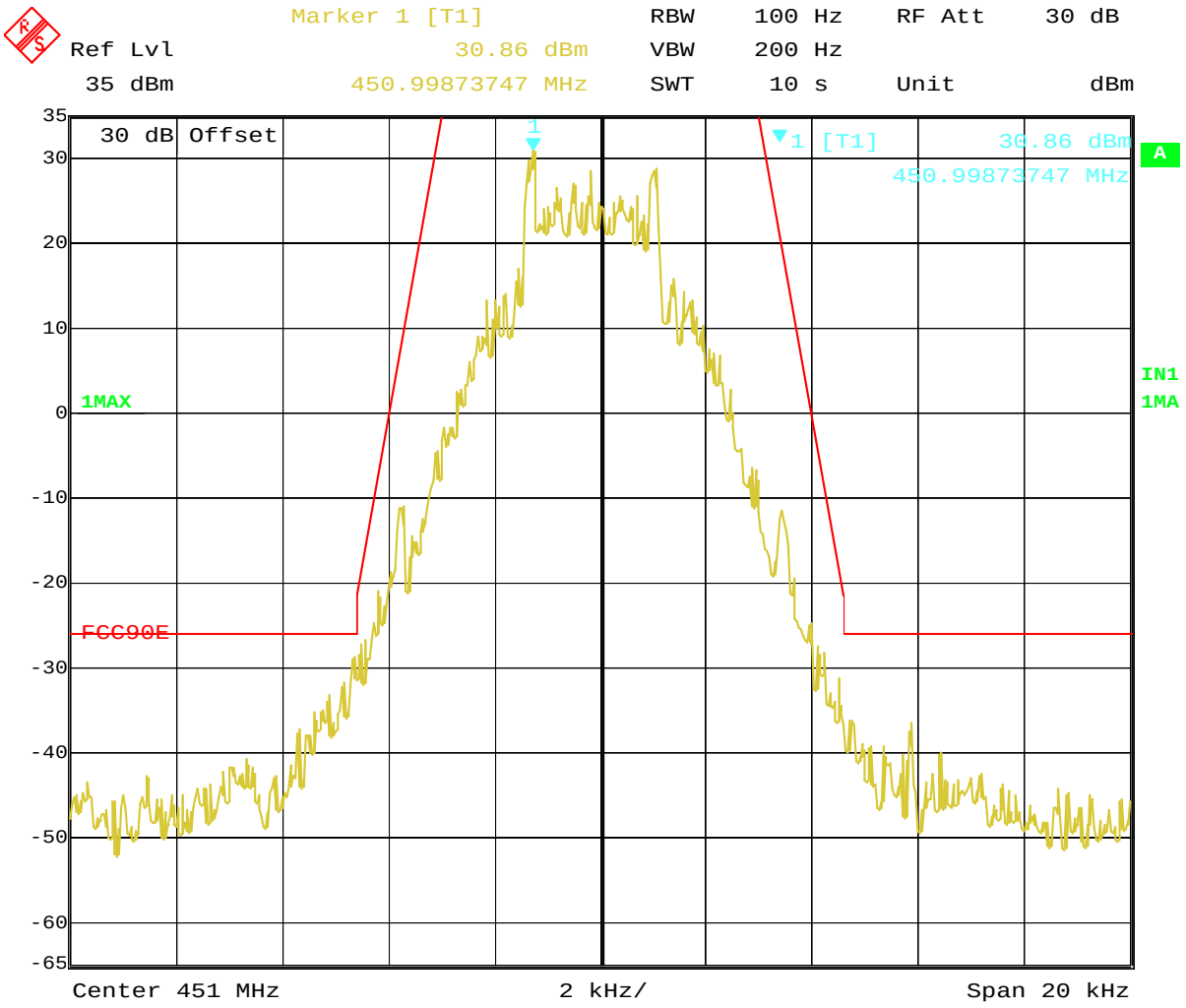
451.000 MHz, 6.25 kHz spacing, 2FSK/512



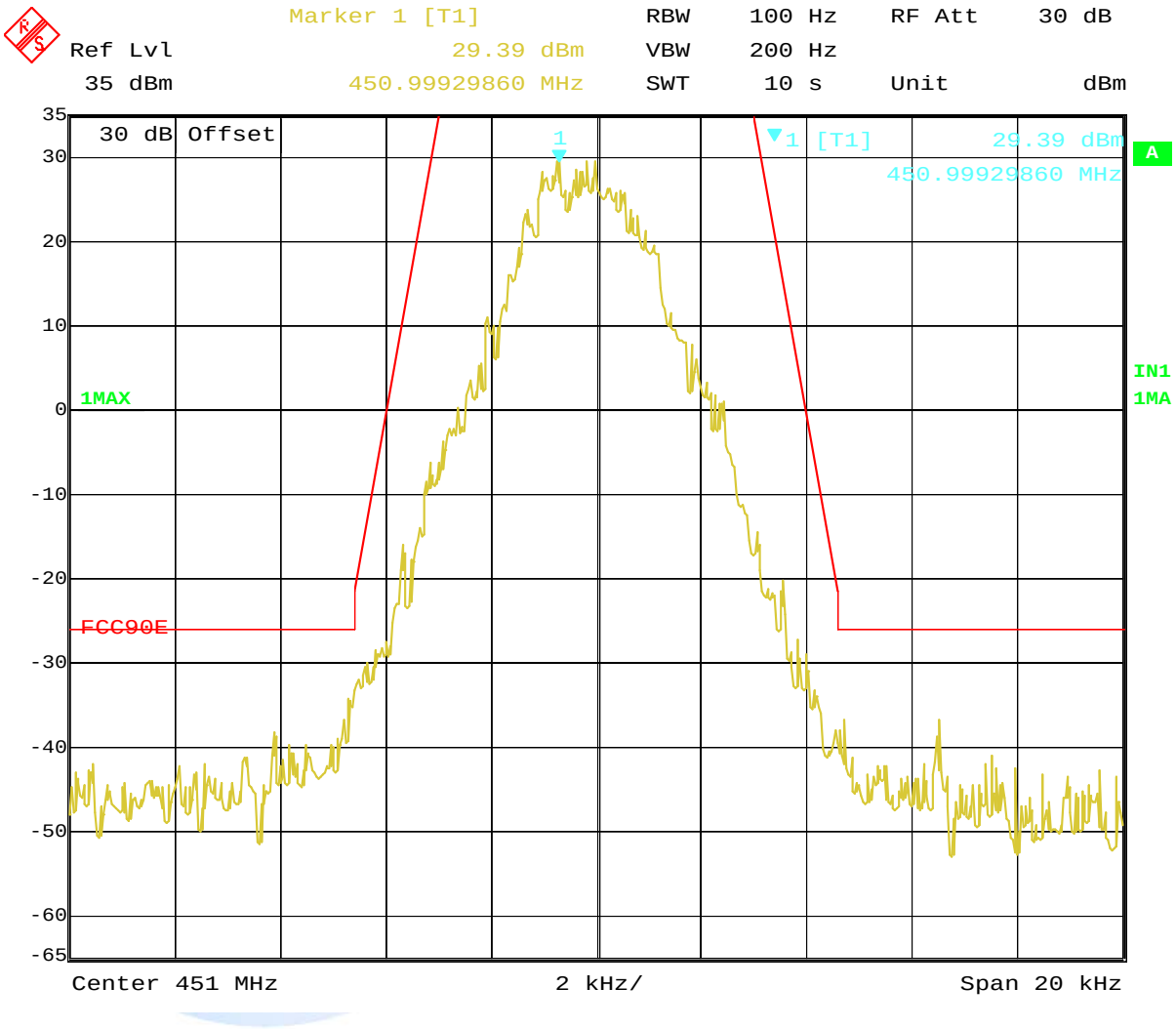
451.000 MHz, 6.25 kHz spacing, GFSK/1200



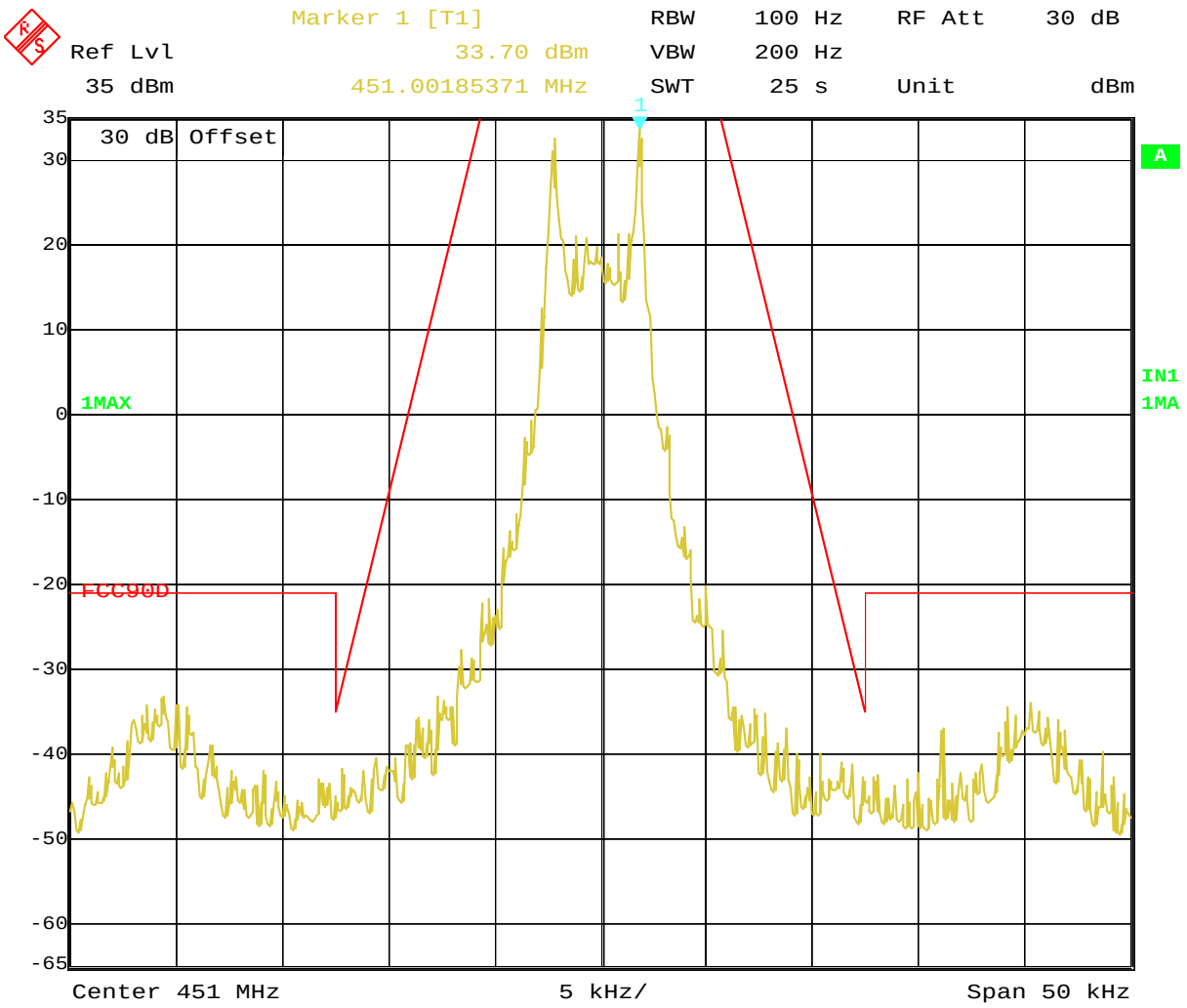
451.000 MHz, 6.25 kHz spacing, GFSK/2400



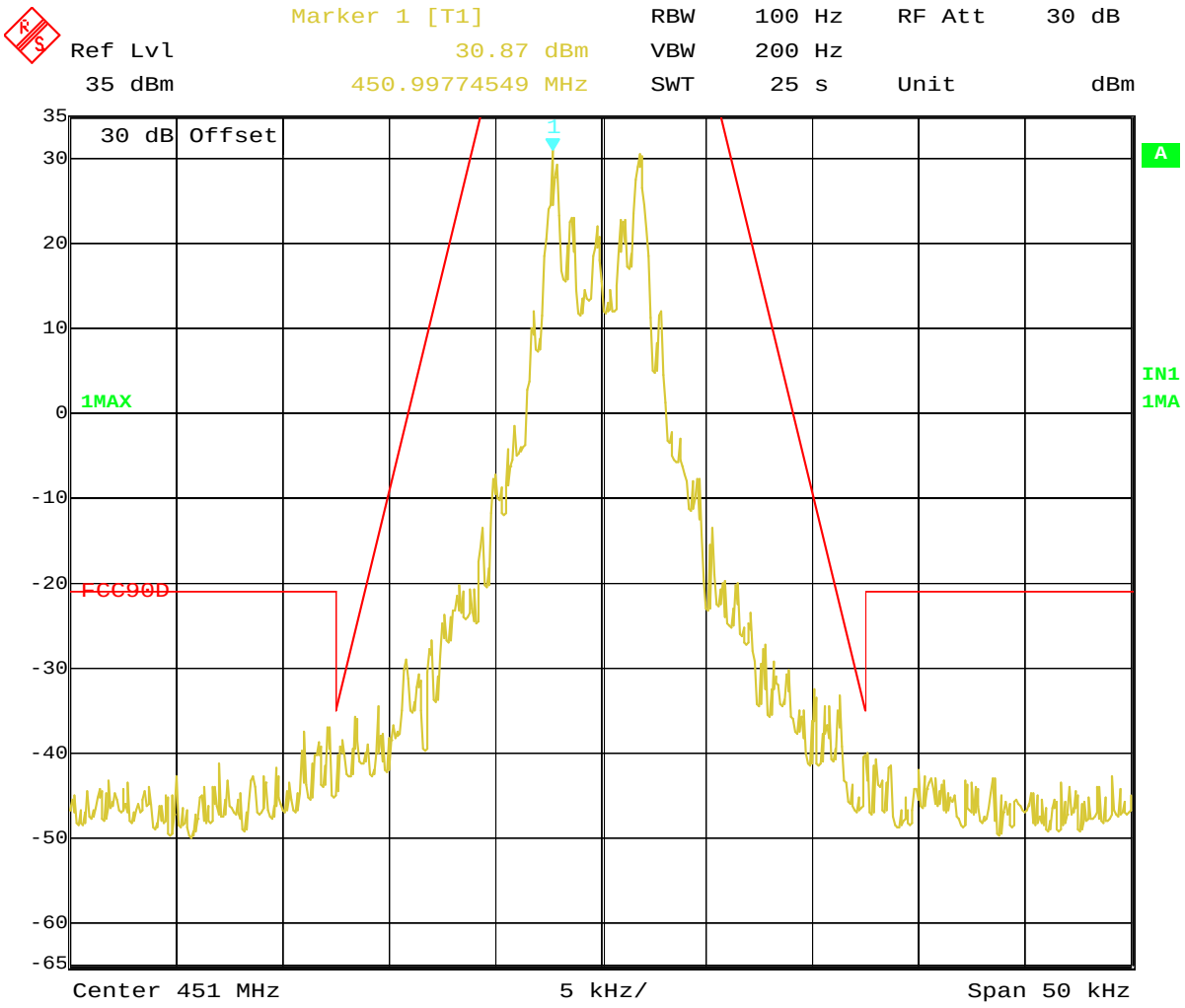
451.000 MHz, 6.25 kHz spacing, GFSK/4800



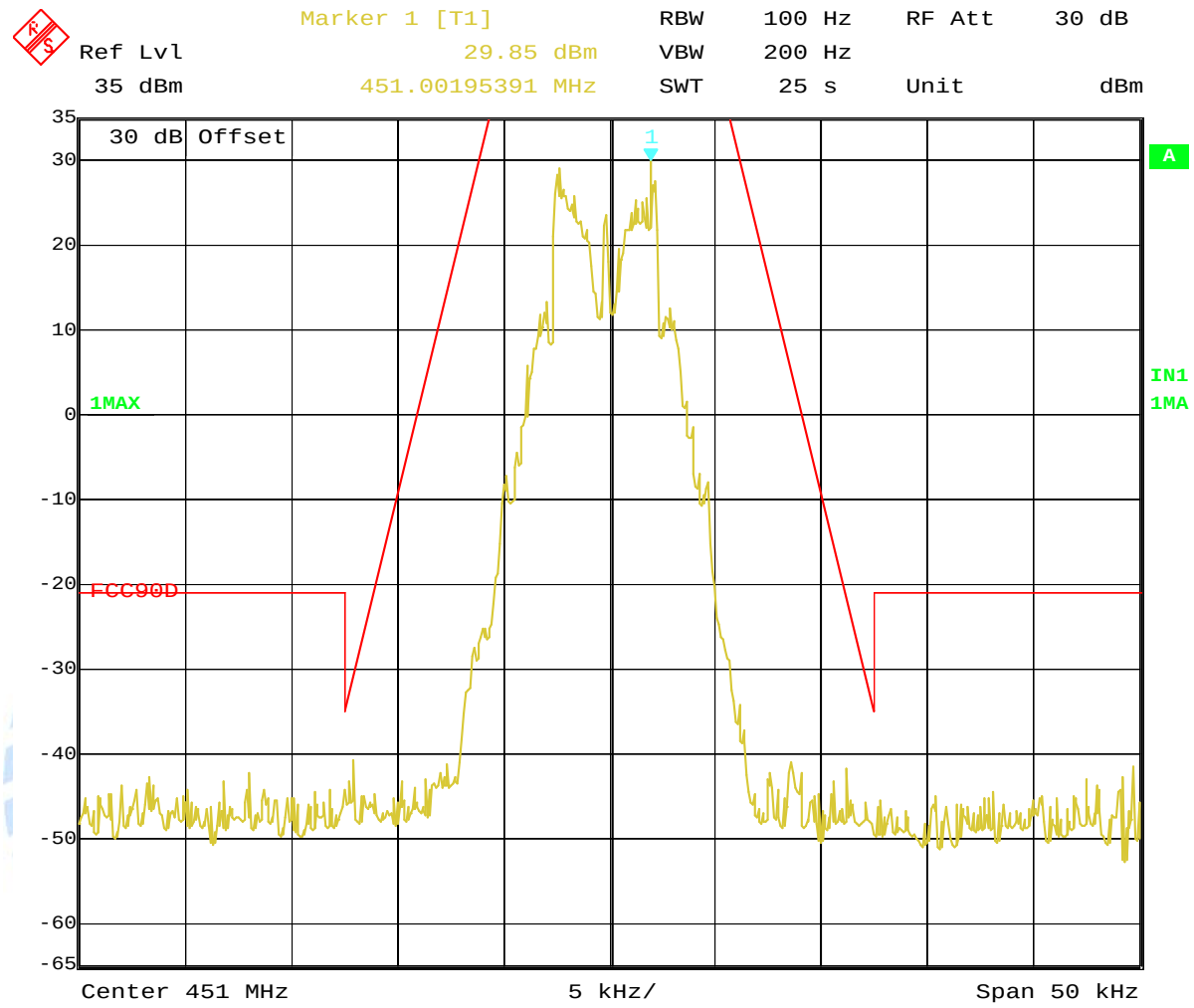
451.000 MHz, 12.5 kHz spacing, 2FSK/512



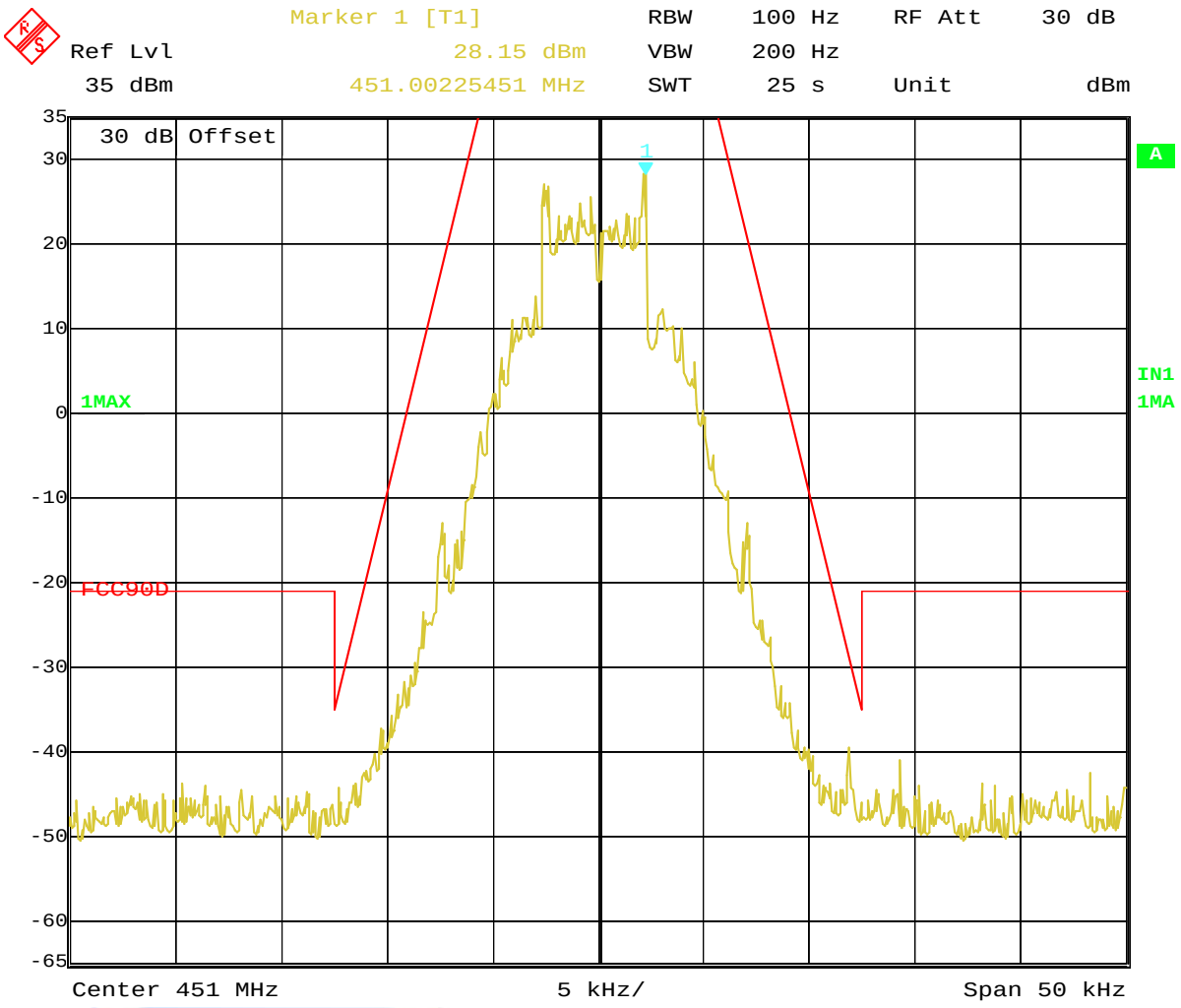
451.000 MHz, 12.5 kHz spacing, 2FSK/1200



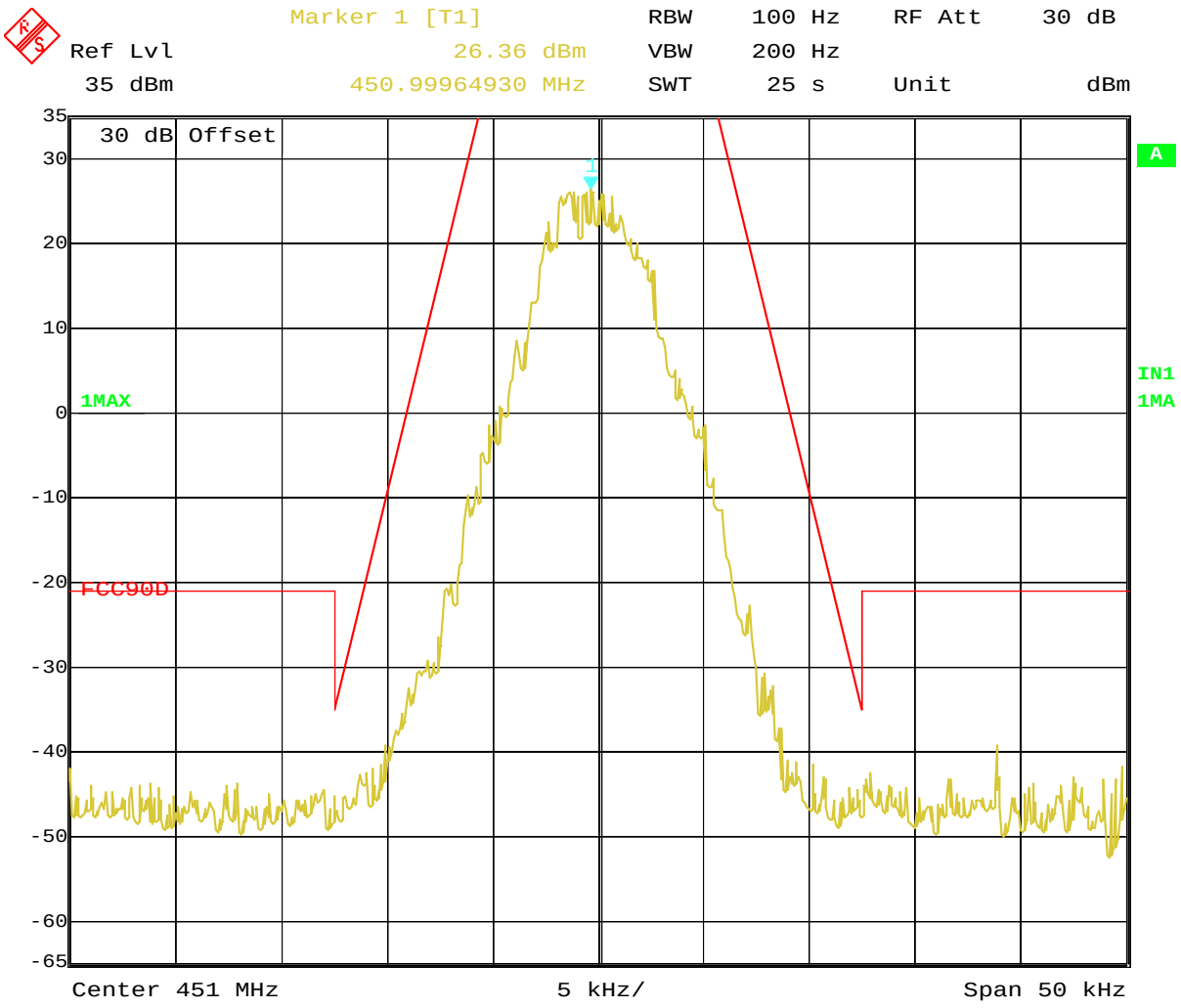
451.000 MHz, 12.5 kHz spacing, 2FSK/2400



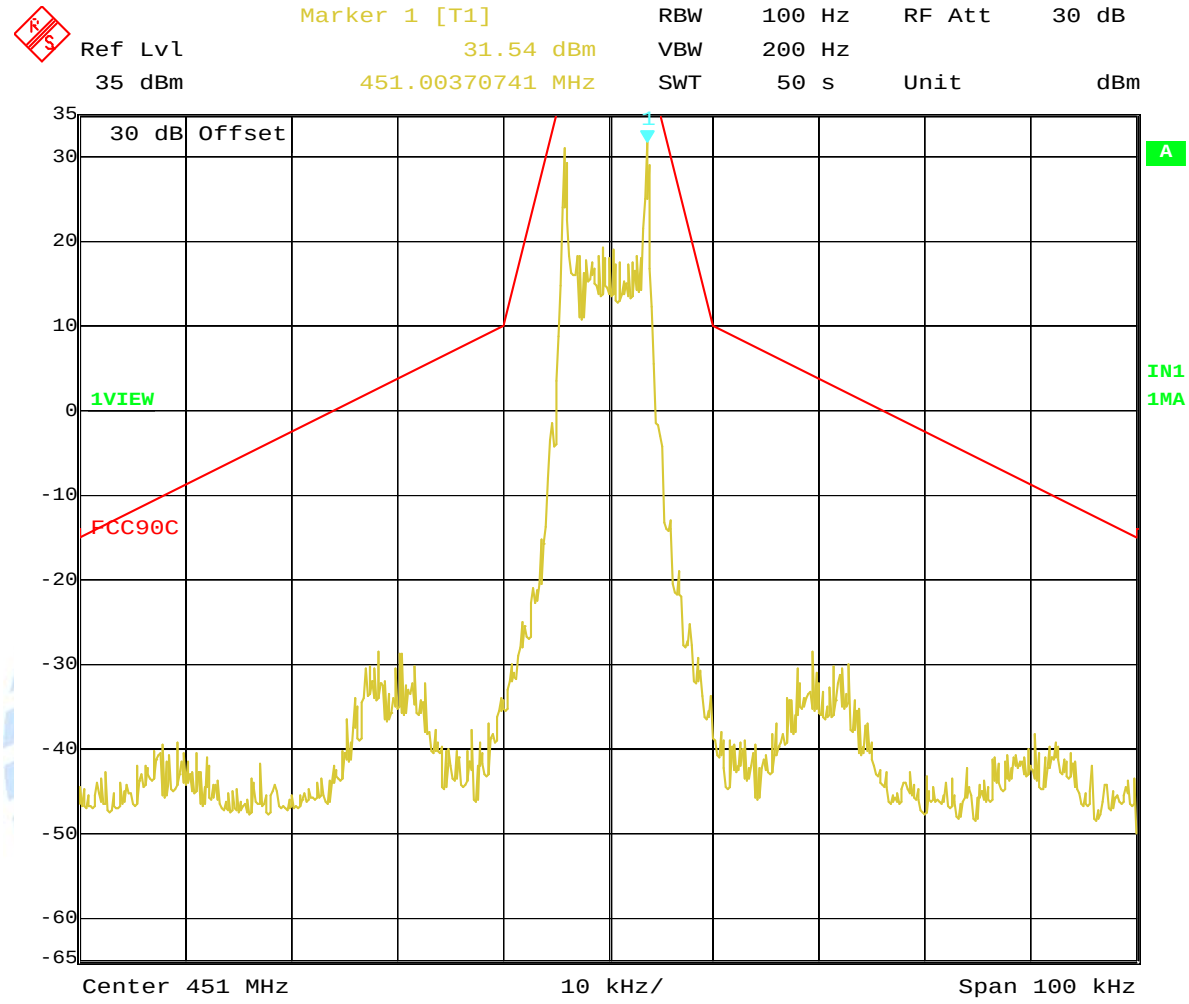
451.000 MHz, 12.5 kHz spacing, 2GFSK/4800



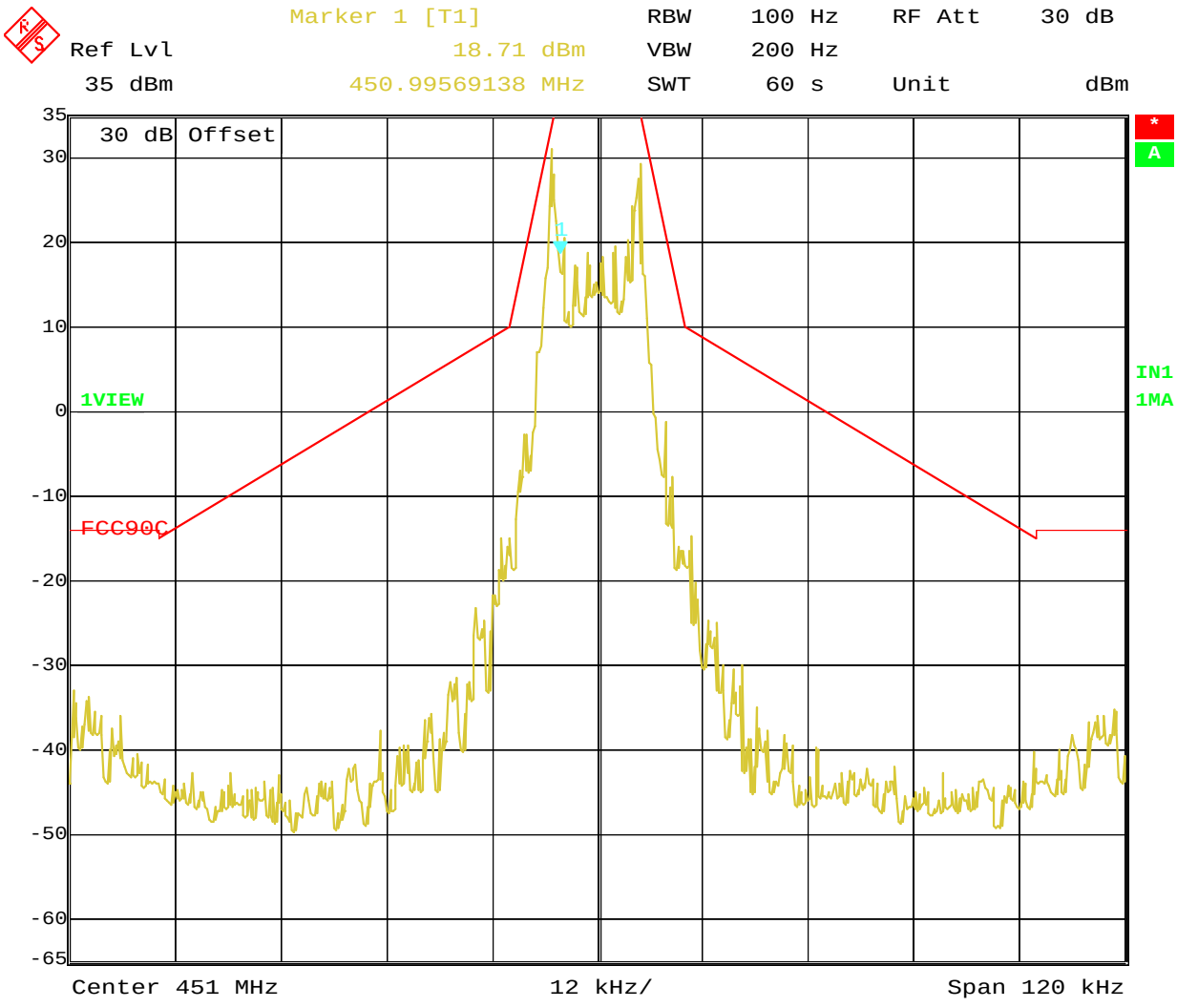
451.000 MHz, 12.5 kHz spacing, 4GFSK/9600



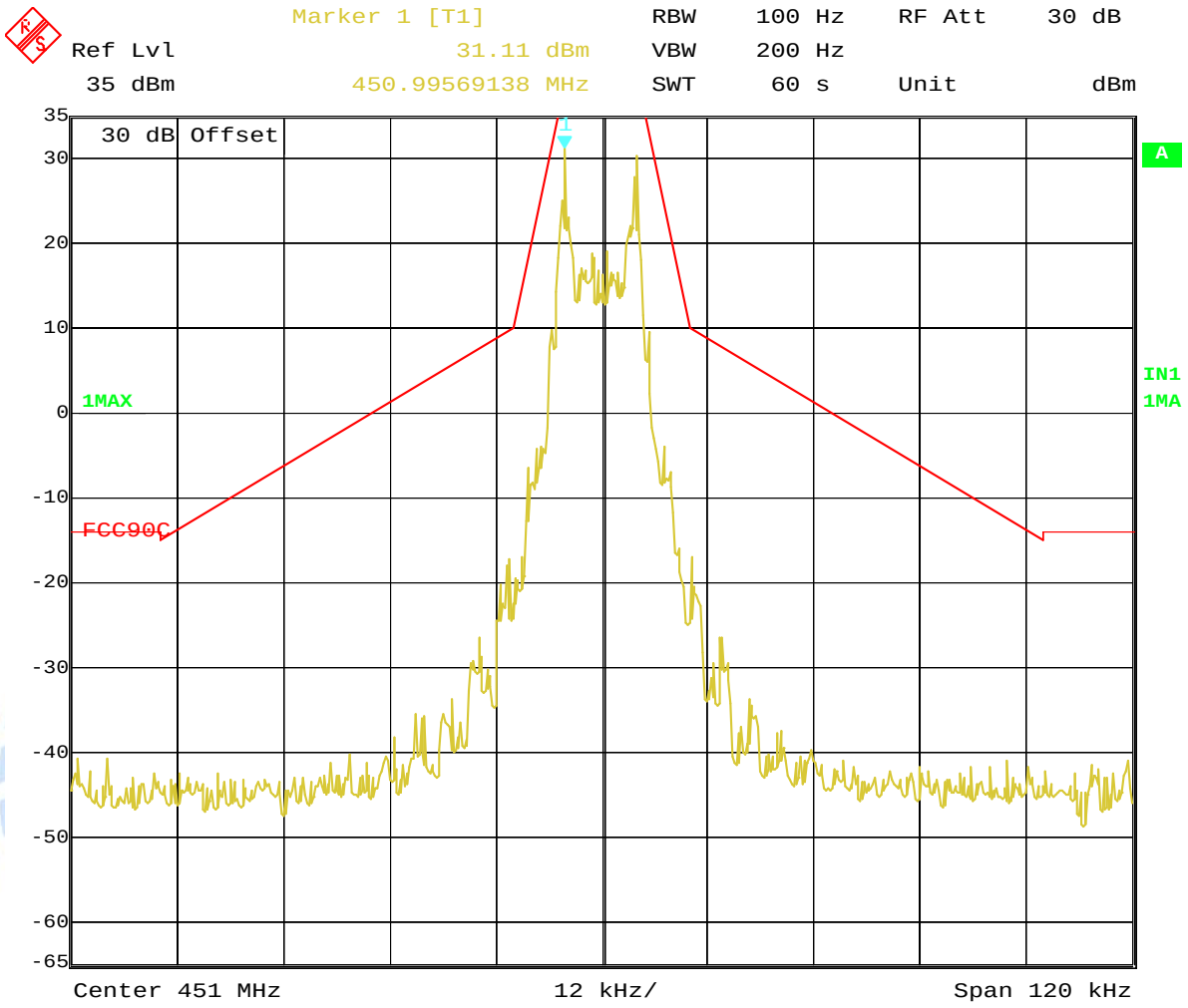
451.000 MHz, 25.0 kHz spacing, 2FSK/512



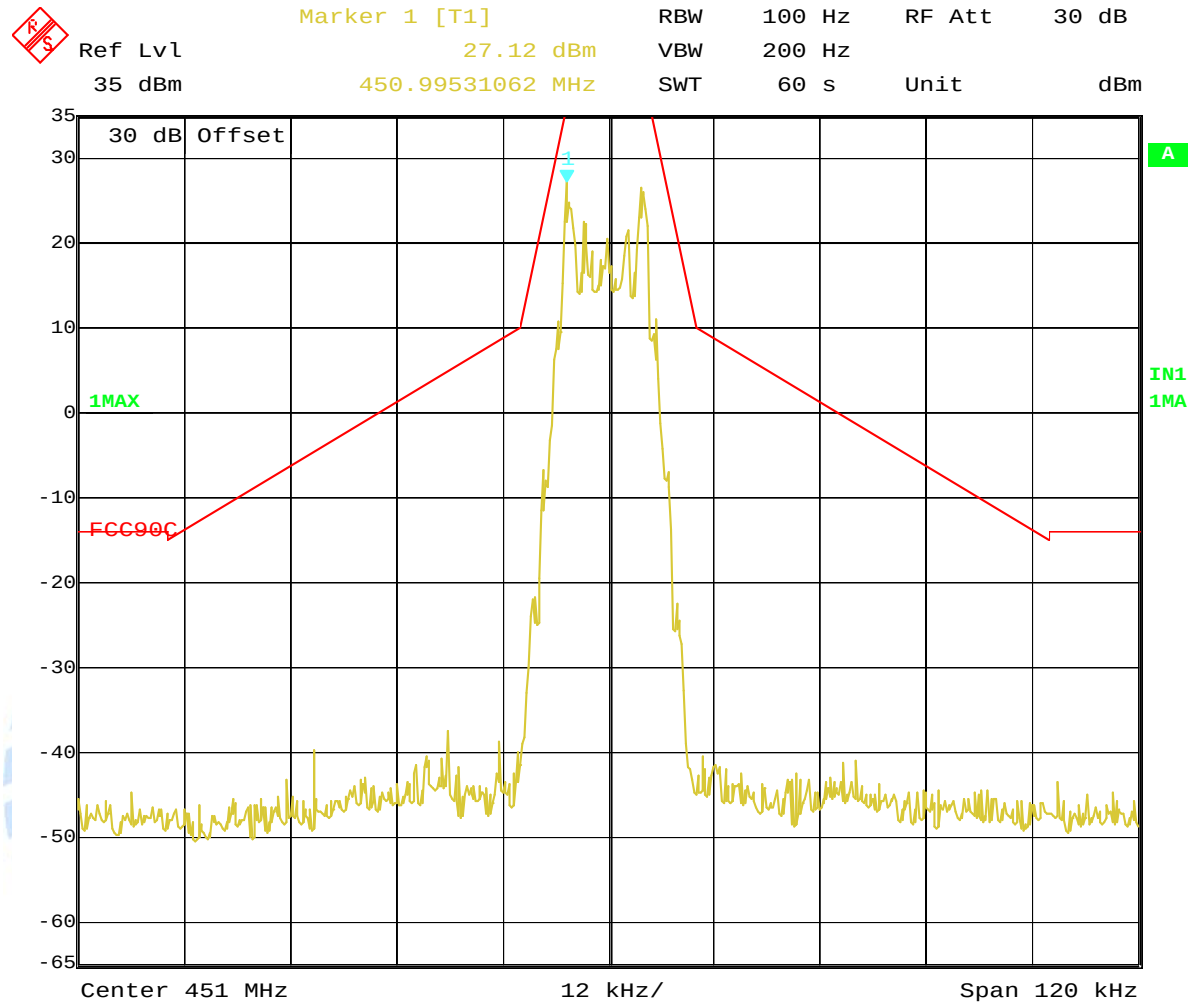
451.000 MHz, 25.0 kHz spacing, 2FSK/1200



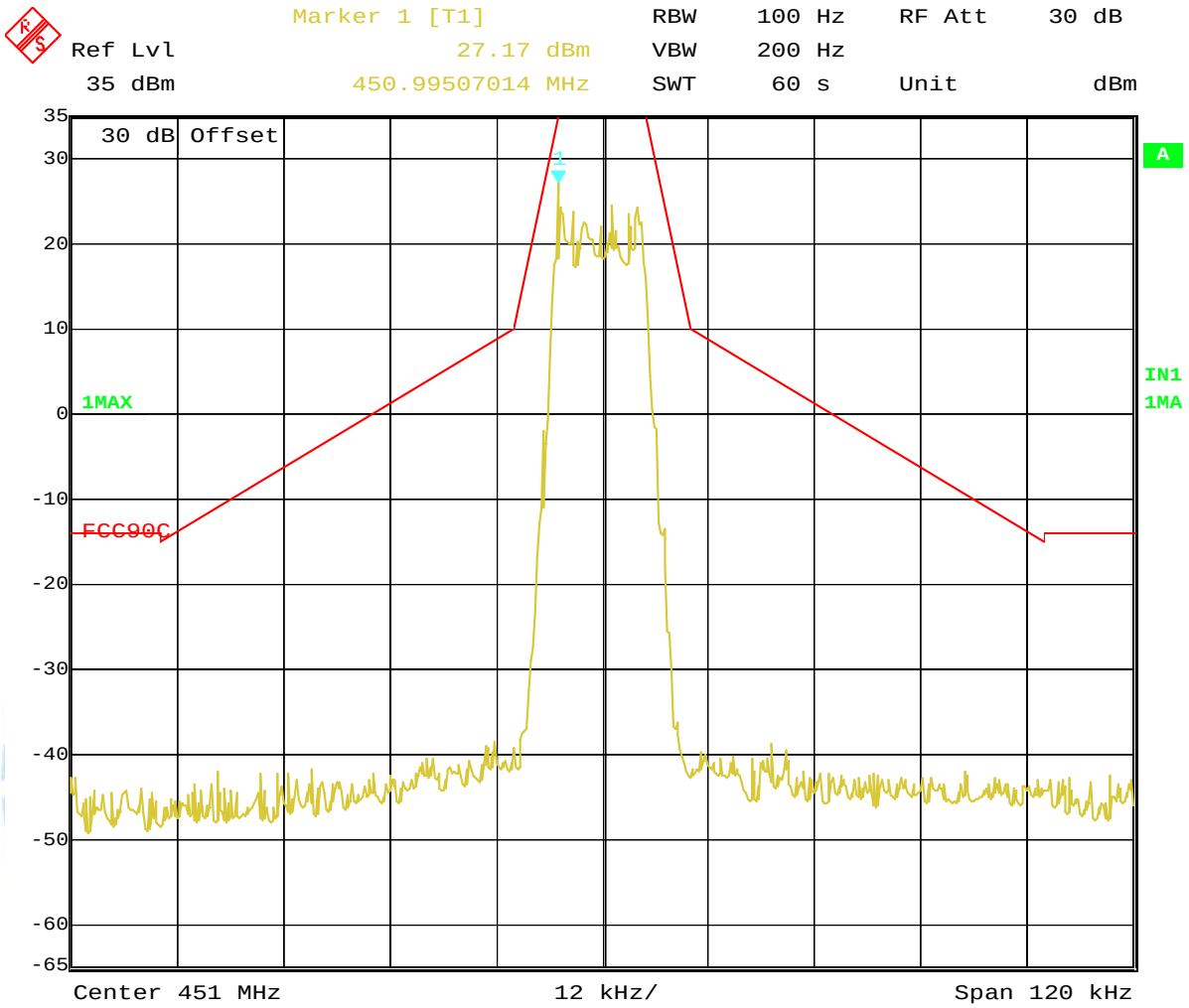
451.000 MHz, 25.0 kHz spacing, FSK/1600



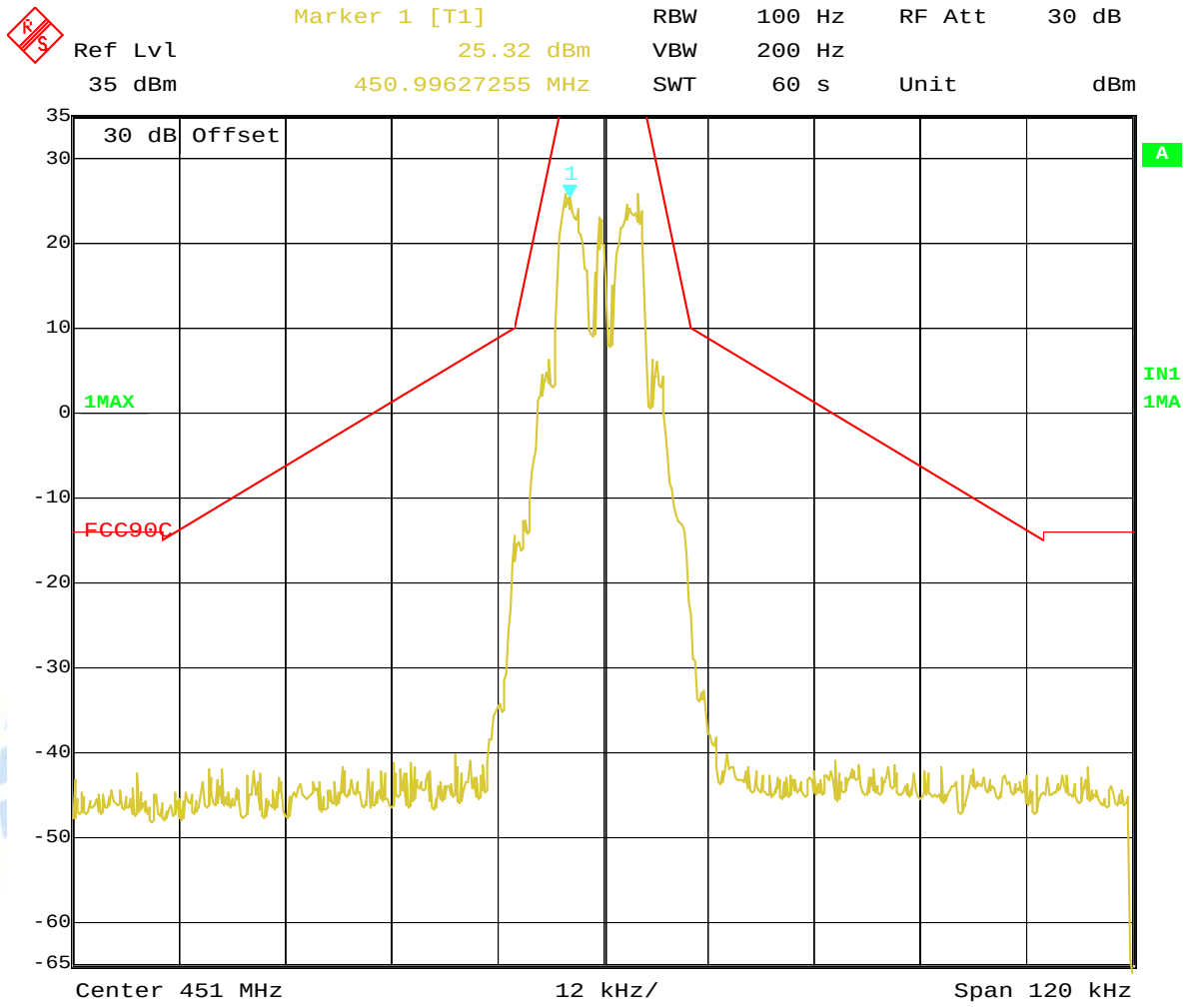
451.000 MHz, 25.0 kHz spacing, FSK/2400



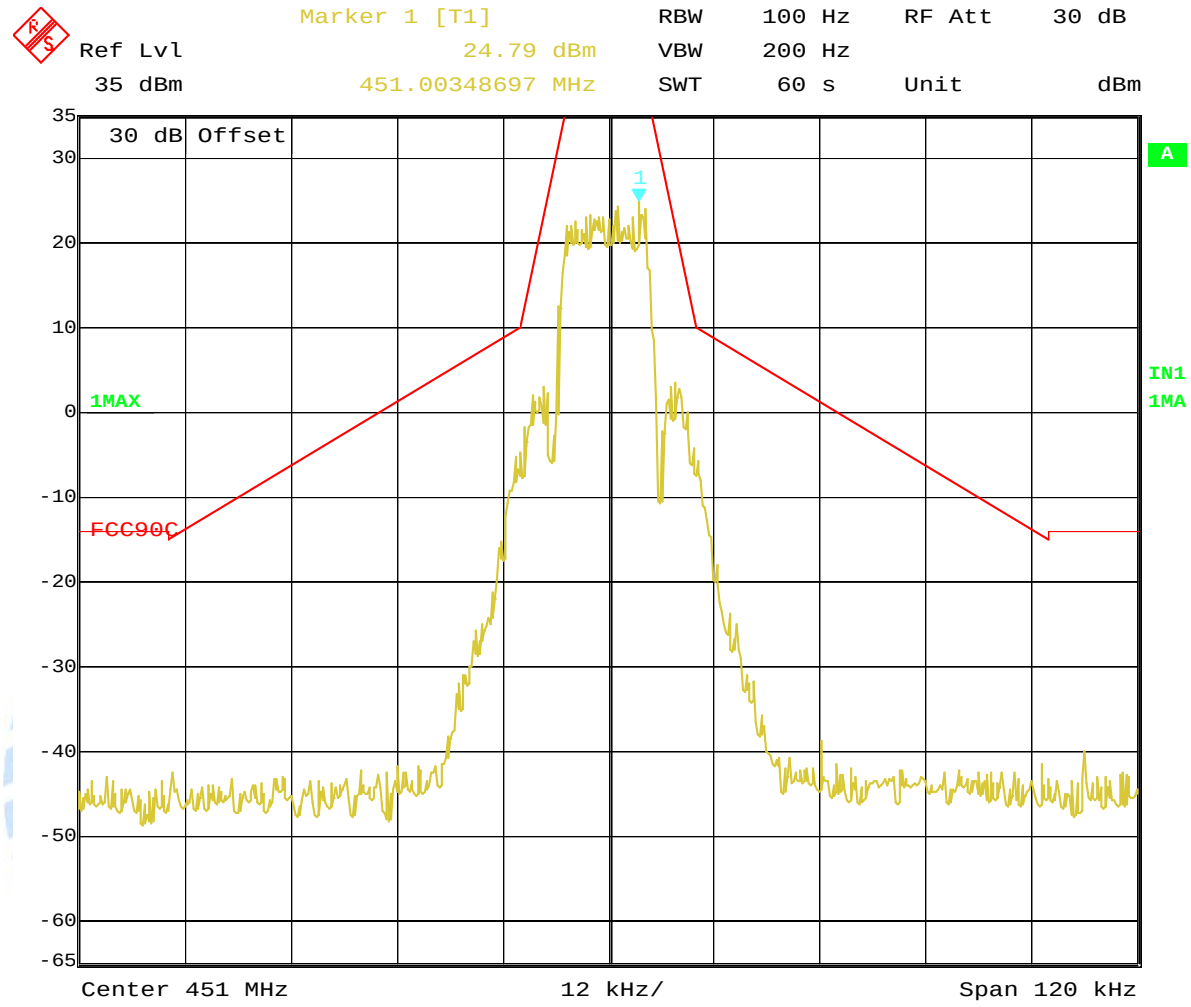
451.000 MHz, 25.0 kHz spacing, 4GFSK/3200



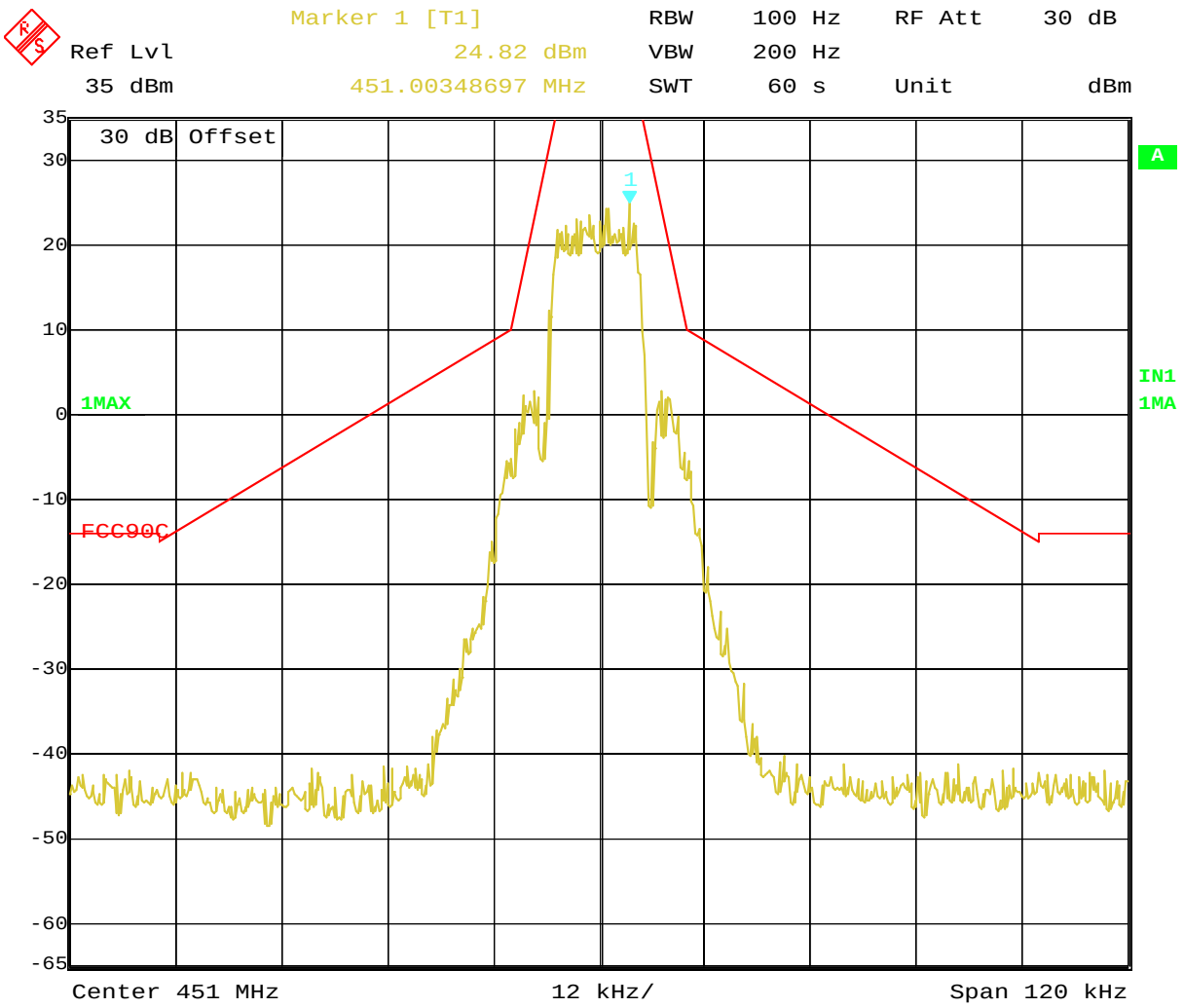
451.000 MHz, 25.0 kHz spacing, GFSK/4800



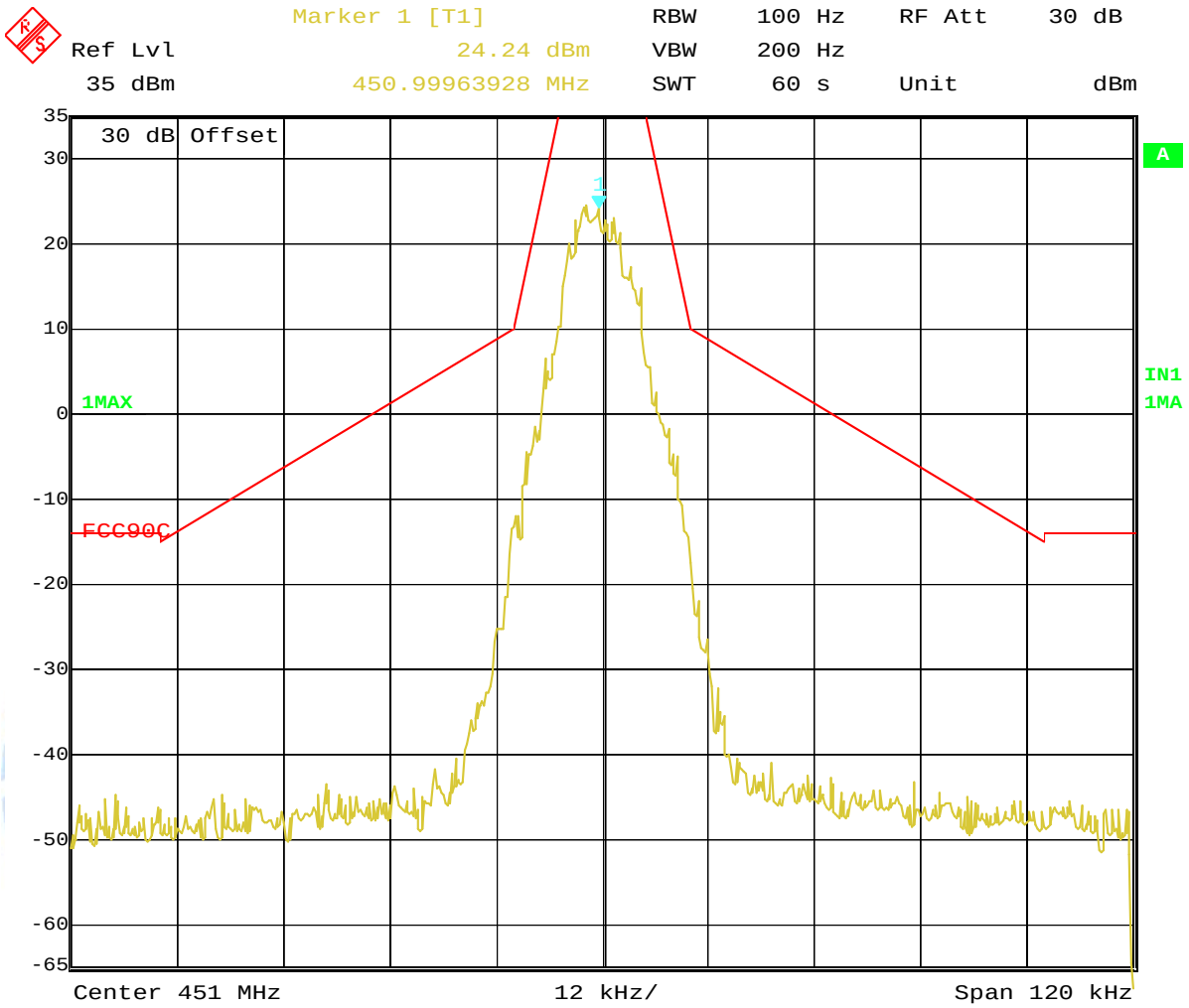
451.000 MHz, 25.0 kHz spacing, GFSK/9600



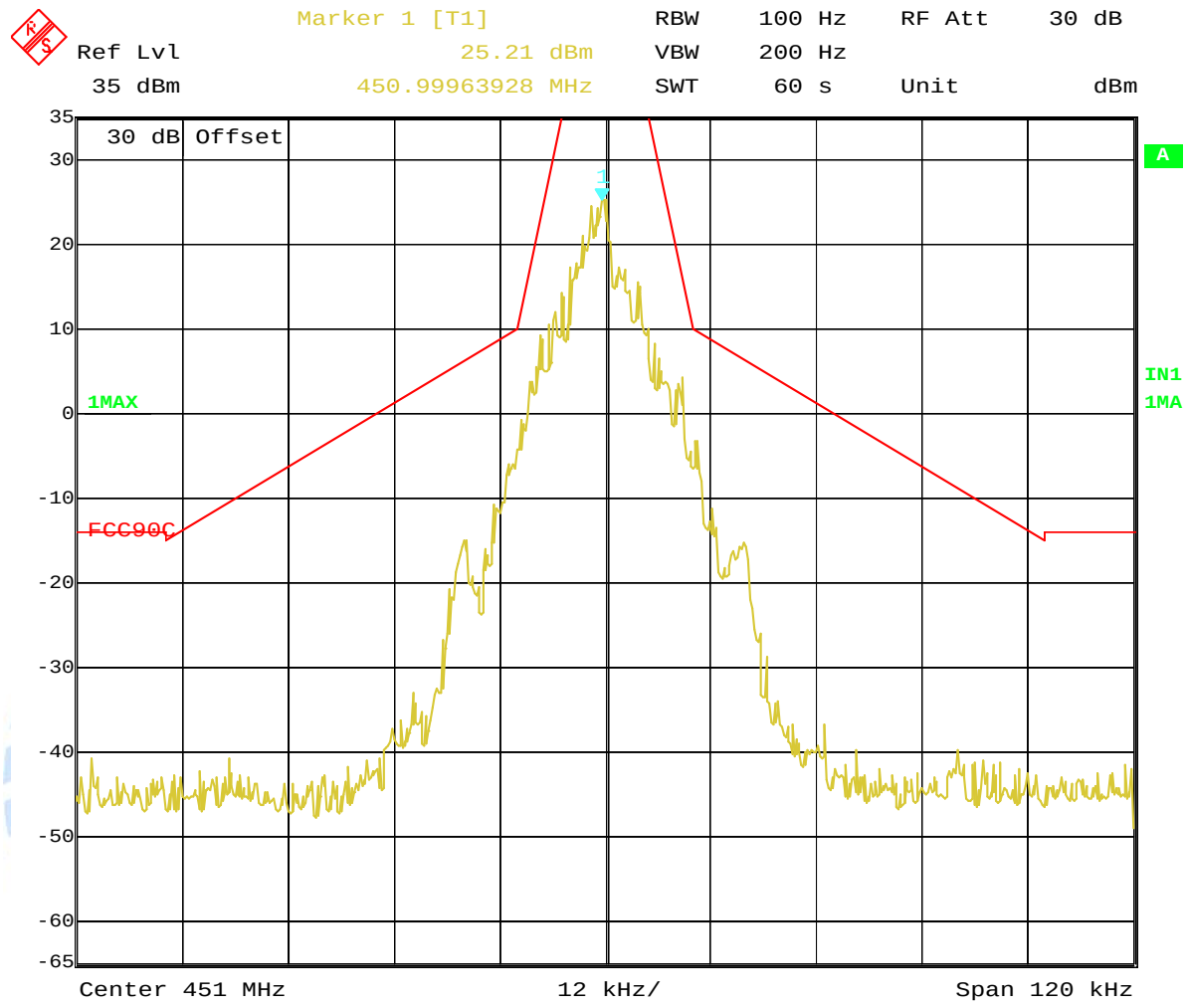
451.000 MHz, 25.0 kHz spacing, 4GFSK/9600



451.000 MHz, 25.0 kHz spacing, 4GFSK/16000



451.000 MHz, 25.0 kHz spacing, 4GFSK/32000



Transmitter spurious emissions at the antenna terminals

Frequency: 421.0125 MHz

Spurious emission (MHz)	Emission level (dBm)	Limit (dBm)
324.6554	-49.6	-20.0
368.7431	-48.6	-20.0
394.7950	-44.8	-20.0
446.8987	-46.4	-20.0
842.0250	-44.3	-20.0
1263.0375	-45.3	-20.0
1684.0500	-45.0	-20.0
2105.0625	-44.6	-20.0

Frequency: 479.9870 MHz

Spurious emission (MHz)	Emission level (dBm)	Limit (dBm)
402.8109	-46.0	-20.0
428.8629	-45.4	-20.0
454.9147	-43.2	-20.0
507.0185	-40.7	-20.0
959.9750	-46.9	-20.0
1439.9625	-41.5	-20.0
1919.9500	-45.5	-20.0
2399.9375	-45.3	-20.0

Limit:

Part 90.210(d) Mask D, (3) on any frequency removed from the centre of the authorised bandwidth by a displacement frequency of more than 12.5 kHz shall be attenuated by at least 50 + 10 log (P) or 70 dB whichever is the lesser attenuation.

The spurious emission limit defined by Mask D has been applied as this transmitter can operate using channel spacing of 12.5 kHz.

Part 2.1051 states that emissions greater than 20 dB below the limit need not be specified.

Part 2.1057 states that the spectrum should be investigated up to the 10th harmonic if the transmitter operates below 10 GHz.

A rated power of 4.0 watts gives a limit of –20.0 dBm.

No measurements were made above the 10th harmonic.

Result: Complies.
Measurement Uncertainty: ± 3.3 dB

Field strength of the transmitter spurious emissions

Nominal Frequency: 451.100 MHz

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Polarity	Margin (dB)	Result
902.2000	58.8	-38.6	-24.0	Vertical	14.6	Pass
	55.1	-42.3	-24.0	Horizontal	18.3	Pass
1353.3000	67.1	-30.3	-24.0	Vertical	6.3	Pass
	61.7	-35.7	-24.0	Horizontal	11.7	Pass
1804.4000	45.2	-52.2	-24.0	Vertical	28.2	Pass
	45.3	-52.1	-24.0	Horizontal	28.1	Pass
2255.5000	59.9	-37.5	-24.0	Vertical	13.5	Pass
	57.1	-40.3	-24.0	Horizontal	16.3	Pass
2706.6000	63.1	-34.3	-24.0	Vertical	10.3	Pass
	59.6	-37.8	-24.0	Horizontal	13.8	Pass
3157.7000	61.7	-35.7	-24.0	Vertical	11.7	Pass
	59.5	-37.9	-24.0	Horizontal	13.9	Pass
3608.8000	62.6	-34.8	-24.0	Vertical	10.8	Pass
	61.2	-36.2	-24.0	Horizontal	12.2	Pass
4059.9000	50.4	-47.0	-24.0	Vertical	23.0	Pass
	47.8	-49.6	-24.0	Horizontal	25.6	Pass
4511.0000	55.2	-42.2	-24.0	Vertical	18.2	Pass
	50.3	-47.1	-24.0	Horizontal	23.1	Pass
4962.1000	60.9	-36.5	-24.0	Vertical	12.5	Pass
	57.9	-39.5	-24.0	Horizontal	15.5	Pass

The transmitter was tested while transmitting continuously while attached to a dummy load.

When operating in transmit mode no significant emissions were detected between the harmonic emissions that were detected.

Device was tested on an open area test site at a distance of 3 metres.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland.

The level recorded is the signal generator output level in dBm less any gains / losses due to the coax cable and the dipole antenna.

Limit:
All spurious emissions are to be attenuated by at least 60 dB from below the mean power of the transmitter. The rated power of 4.0 watts gives a limit of –24 dBm.

No measurements were made above the 10th harmonic.

Result: Complies.

Measurement Uncertainty: ± 4.1 dB

Frequency Stability

Frequency stability measurements were between - 30 °C and + 50°C in 10°C increments.

At each temperature the transmitter was given a period of 30 minutes to stabilise.

The transmitter was then turned on and the frequency error measured after a period of 1 minute.

Frequency: 421.0125 MHz

Temperature (°C)	10.8 Vdc (Hz)	13.8 Vdc (Hz)	15.6 Vdc (Hz)
+50	230	231	230
+40	160	160	160
+30	135	136	136
+20	124	125	125
+10	33	31	32
0	28	28	28
-10	20	20	20
-20	68	67	69
-30	27	27	27

Frequency: 451.0125 MHz

Temperature (°C)	10.8 Vdc (Hz)	13.8 Vdc (Hz)	15.6 Vdc (Hz)
+50	252	252	252
+40	168	170	170
+30	142	142	141
+20	110	110	110
+10	45	46	46
0	50	51	50
-10	50	50	51
-20	67	68	68
-30	35	35	36

Frequency: 479.0125 MHz

Temperature (°C)	10.8 Vdc (Hz)	13.8 Vdc (Hz)	15.6 Vdc (Hz)
+50	265	267	267
+40	175	175	176
+30	152	153	153
+20	120	120	121
+10	98	98	97
0	50	49	51
-10	41	42	42
-20	97	96	96
-30	31	32	32

Limits:

Part 90.213 states that fixed station transmitters operating between 421.000-512.000 MHz with 12.5 kHz channelling are required to have a frequency tolerance of 1.5 ppm.

A worst case error of 0.559 ppm (252 Hz / 451.0125 MHz) was observed.

Result: Complies.
Measurement Uncertainty: ± 30 Hz

Transient frequency behaviour

Measurements were carried out using the method described in TIA-603 and EN 300-086.

The modulation analyser produces an amplitude difference signal and a frequency difference signal, which are applied to the input of a storage oscilloscope.

The unmodulated transmitter is then keyed which produces a trigger pulse that is AC coupled to the oscilloscope that produces a display on the screen.

The result of the change in the ratio of power between the test signal from the signal generator and the transmitter output will produce 2 separate sides on the oscilloscope picture. One will show the 1000 Hz test modulation and the other will be the frequency difference of the transmitter versus time.

Channel Spacing (kHz)	Transient Period t_1	Frequency Period t_2	Deviation (kHz) Period t_3
6.25	Nil	Nil	Nil
12.5	Nil	Nil	Nil
25.0	Nil	Nil	Nil

Limits:

Time Interval	Period (ms)	6.25 kHz Deviation (kHz)	12.5 kHz Deviation (kHz)	25 kHz Deviation (kHz)
t_1	10	± 6.25	± 12.5	± 25.0
t_2	25	± 3.125	± 6.25	± 12.5
t_3	10	± 6.25	± 12.5	± 25.0

Result: Complies.
Measurement Uncertainty: Frequency difference ± 1.6 kHz, Time period ±1 ms.

6.25 kHz Transmitter

Transmitter turn on

Green Trace = 1 kHz tone with FM deviation of 6.25 kHz.

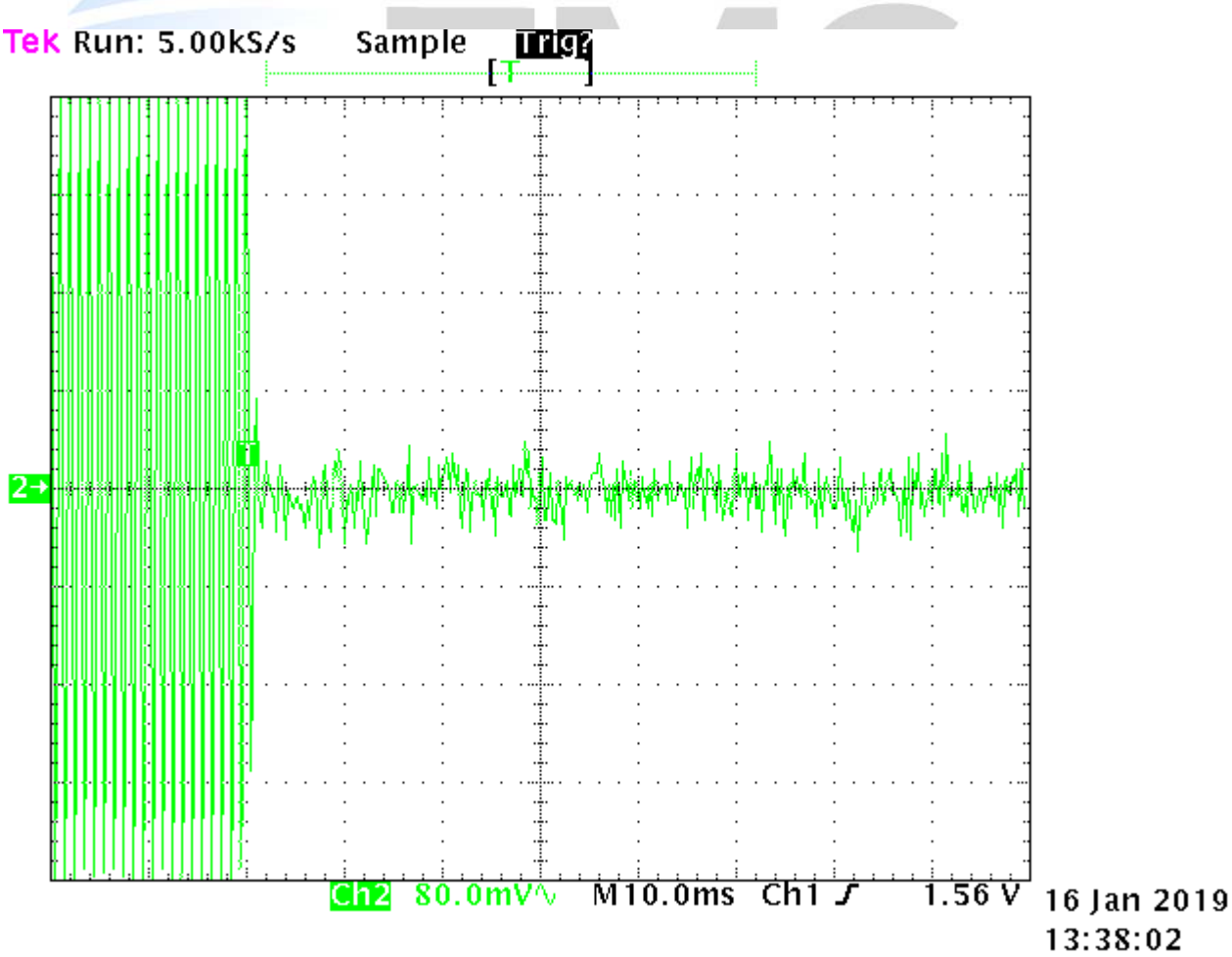
Green trace has been maximised to give full screen indication of +/- 6.25 kHz.
Therefore each Y axis division = 1.5 kHz per division.
The X axis has been set to a sweep rate of 10 ms/division.

Triggering has been set to occur 2 divisions from the left hand edge (20 ms).

*t*on occurs at 20 ms.

*t*1 occurs between 2.0 and 3.0 divisions from the left hand edge.
t2 occurs between 3.0 and 5.5 divisions from the left hand edge.

No transient was observed during *t*1 and t2.



Transmitter turn off

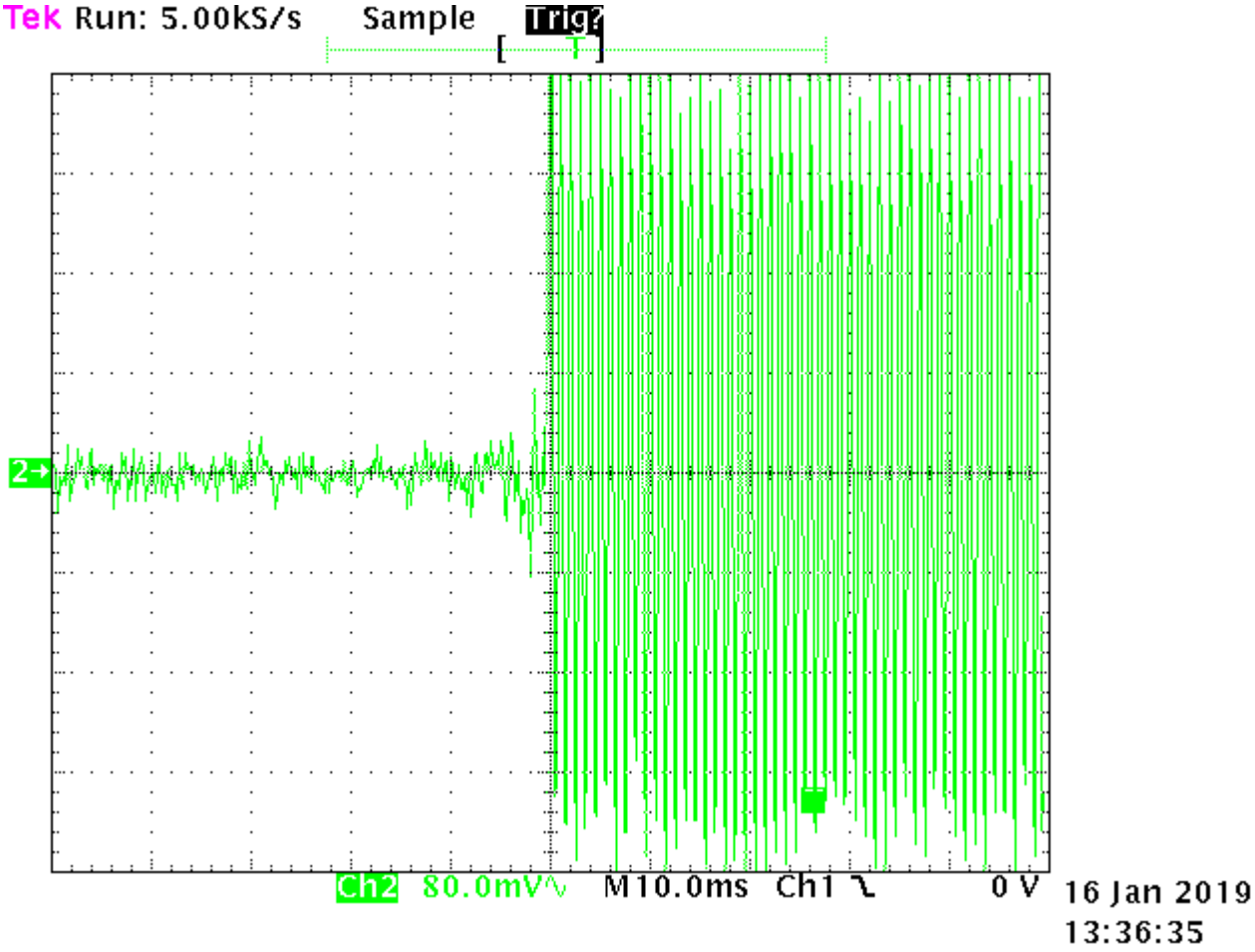
Green Trace = 1 kHz tone with FM deviation of 6.25 kHz.

Green trace has been maximised to give full screen indication of +/- 6.25 kHz.
Therefore each Y axis division = 1.5 kHz per division.
The X axis has been set to a sweep rate of 10 ms/division

The display of the 1 kHz signal rising has been positioned 5 divisions from the left hand edge (50 ms). This is position *t*off.

*t*3 occurs between 4.0 and 5.0 divisions from the left hand edge.

No transient response was observed before *t*off.



12.5 kHz Transmitter

Transmitter turn on

Green Trace = 1 kHz tone with FM deviation of 12.5 kHz.

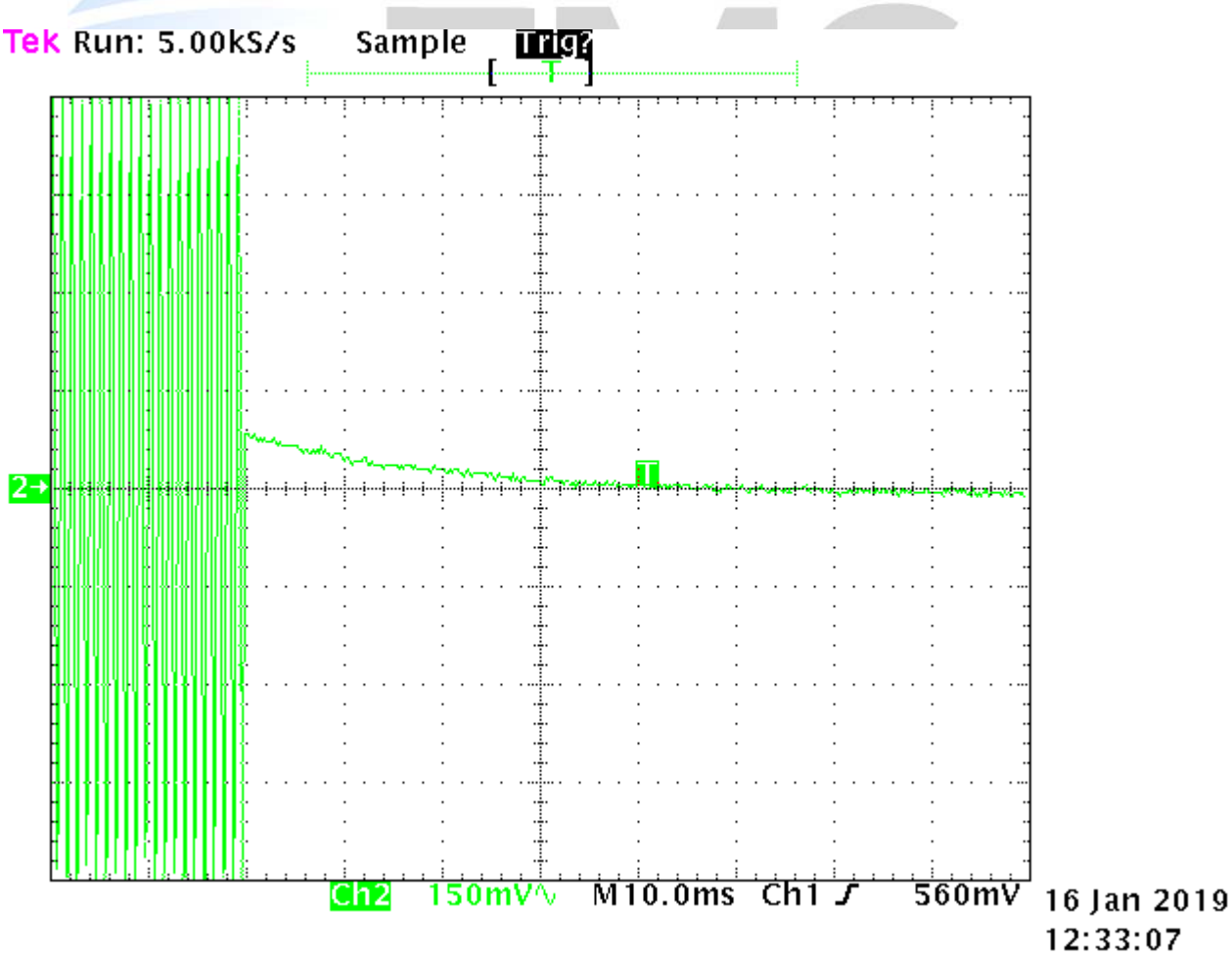
Green trace has been maximised to give full screen indication of +/- 12.5 kHz.
Therefore each Y axis division = 3.125 kHz per division.
The X axis has been set to a sweep rate of 10 ms/division.

Triggering has been set to occur 2 divisions from the left hand edge (20 ms).

*t*on occurs at 20 ms.

*t*1 occurs between 2.0 and 3.0 divisions from the left hand edge.
t2 occurs between 3.0 and 5.5 divisions from the left hand edge.

No transient was observed during *t*1 and t2.



Transmitter turn off

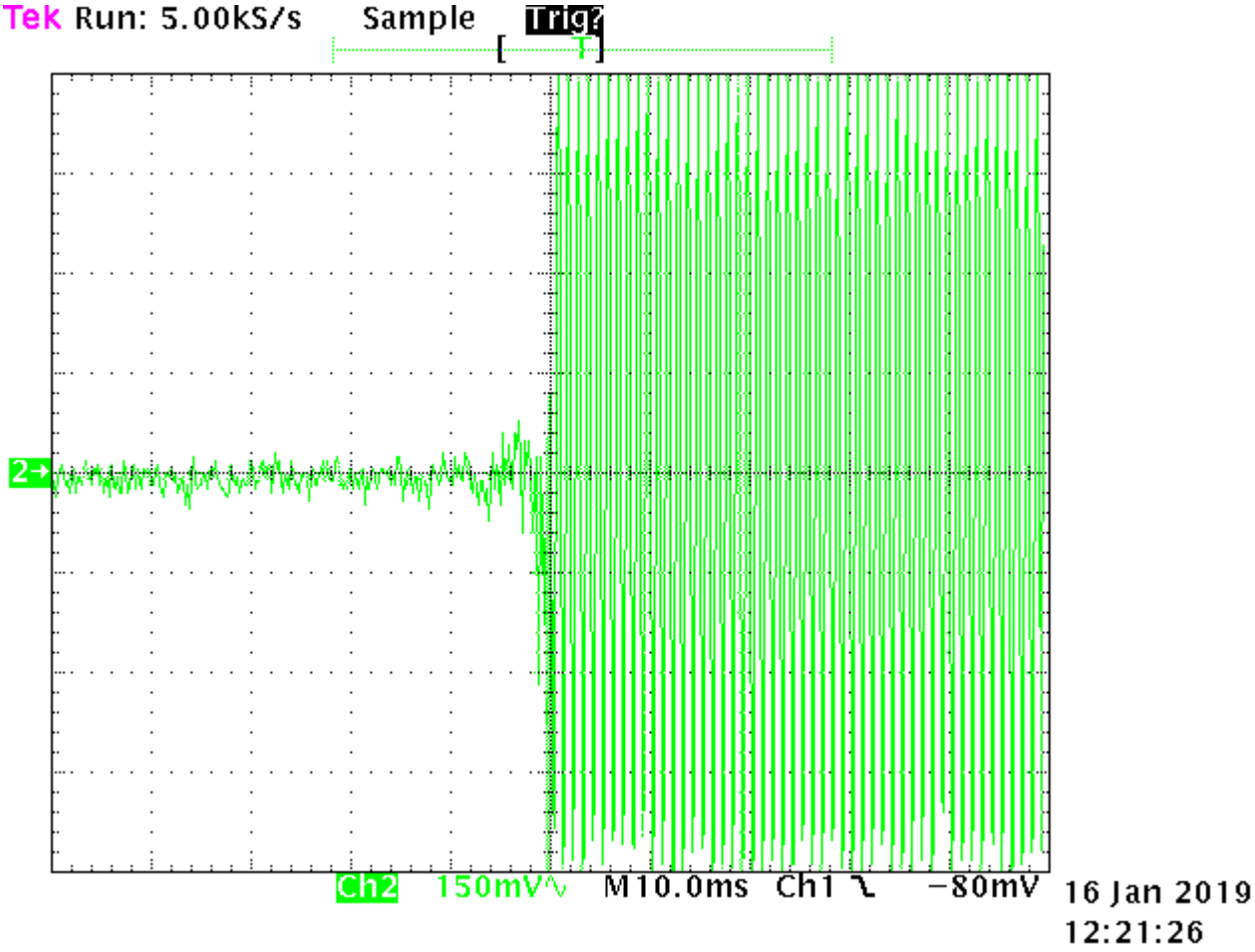
Green Trace = 1 kHz tone with FM deviation of 12.5 kHz.

Green trace has been maximised to give full screen indication of +/- 12.5 kHz.
Therefore each Y axis division = 3.125 kHz per division.
The X axis has been set to a sweep rate of 10 ms/division

The display of the 1 kHz signal rising has been positioned 5 divisions from the left hand edge (50 ms). This is position *t*off.

*t*3 occurs between 4.0 and 5.0 divisions from the left hand edge.

No transient response was observed before *t*off.



25.0 kHz Transmitter

Transmitter turn on

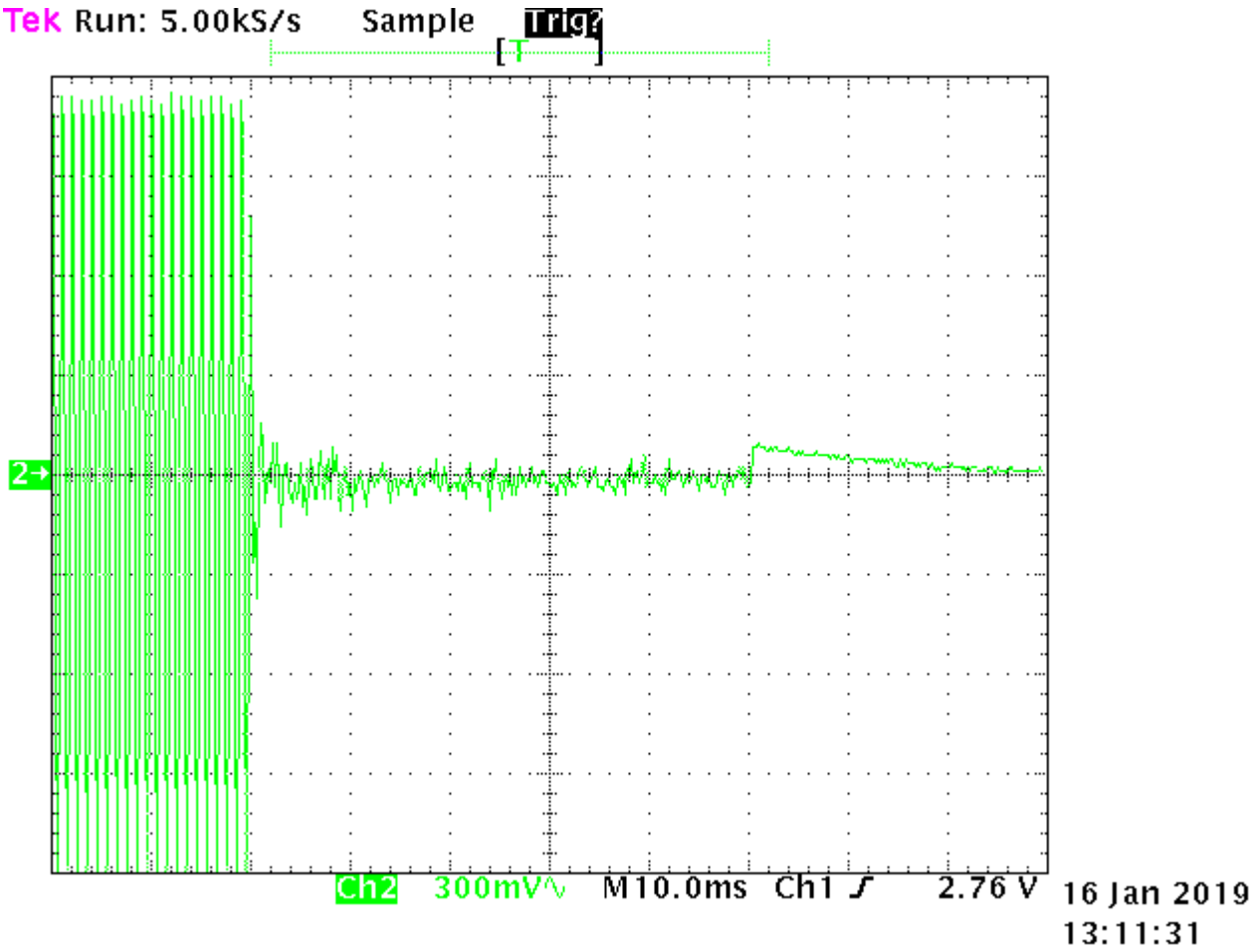
Green Trace = 1 kHz tone with FM deviation of 25 kHz.

Green trace has been maximised to give full screen indication of +/- 25 kHz.
Therefore each Y axis division = 6.25 kHz per division.
The X axis has been set to a sweep rate of 10 mS/division.

Triggering has been set to occur 3 divisions from the left hand edge (30 mS).

*t*on occurs 2 divisions from the left of the display (20 mS).

A small transient was observed after ton.



Transmitter turn off

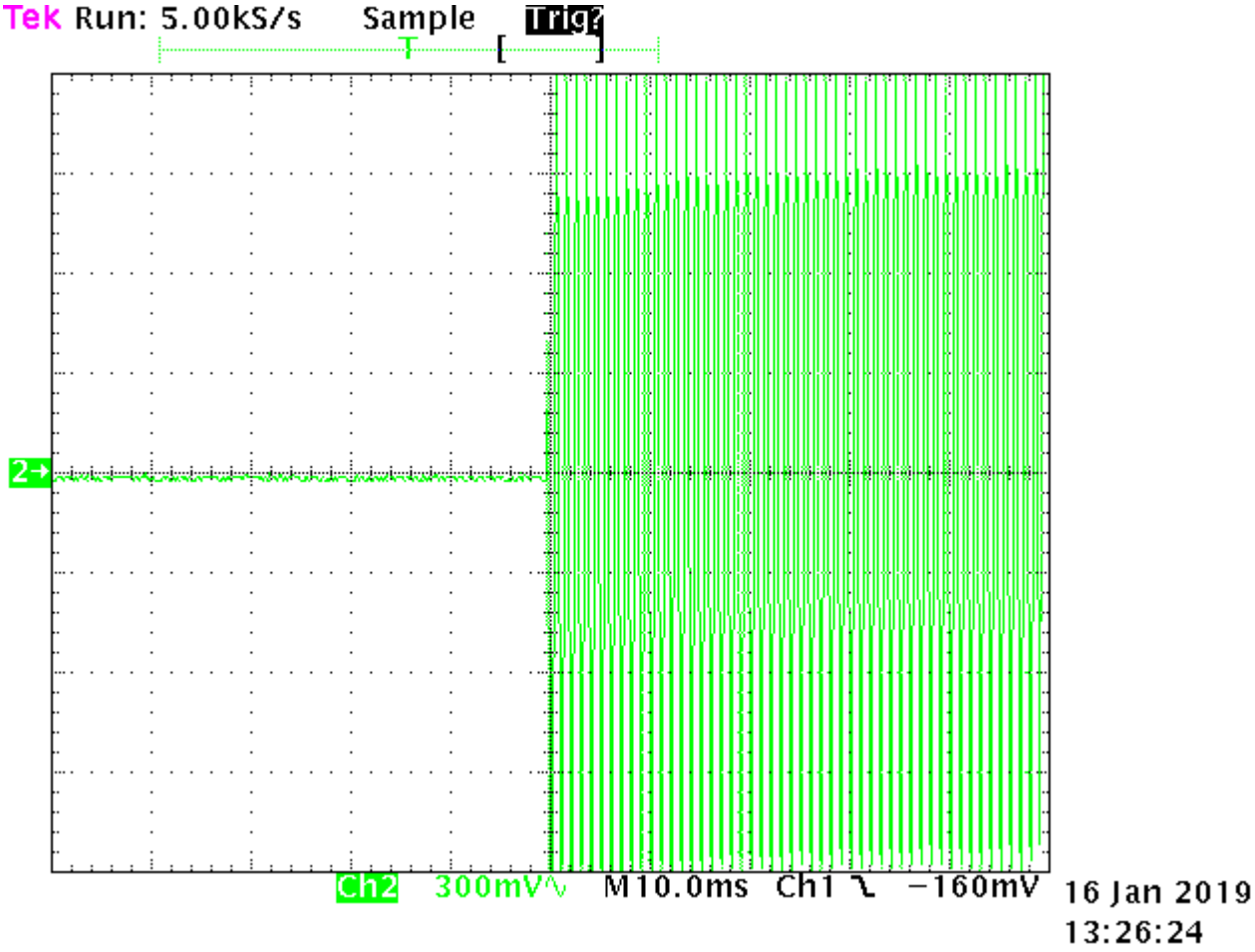
Green Trace = 1 kHz tone with FM deviation of 25 kHz.

Green trace has been maximised to give full screen indication of +/- 25 kHz.
Therefore each Y axis division = 6.25 kHz per division.
The X axis has been set to a sweep rate of 10 mS/division

The display of the 1 kHz signal rising has been positioned 5 divisions from the left hand edge (50 mS).

This is position *t*off.

No transient response can be observed during *t*off.



Exposure of humans to RF fields

As per FCC KDB 447498 D01 and Section 2.1091 radio frequency transmitters are required to be operated in a manner that ensures the public is not exposed to RF energy levels.

Calculations have been made using the General Public/Uncontrolled Exposure limits that are defined in Section 1.1310.

Minimum safe distances have been calculated below.

Power density, $mW/cm^2 = E^2/3770$

Limits for General Population / Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/ cm²)**	**Averaging Time |E|²,|H|² or S (minutes)**
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30
Note 1: f = frequency in MHz ; *Plane-wave equivalent power density Note 2: For the applicable limit, see FCC 1.1310				

- General Population / Uncontrolled exposure is (f/1500) mW/cm^2

As this radio can operate over the range of 421.0 to 480.0 MHz the lowest frequency of operation in the USA, which will give the worst case result, would be 421.0 MHz.

The power density at 421.0 MHz comes out to be 0.281 mW/cm^2.

For Uncontrolled Environment

Power Density = 0.281 $mW/cm^2 = E^2/3770$

$E = \sqrt{0.281*3770}$

E = 32.5 V/m

The rated maximum transmitter power = 4 watts (+36 dBm).

The client has stated that the unit is rated for 100% duty cycle for first 2 minutes, then 80% continuously.

A worst case scenario duty cycle of 100% has been used for the calculations.

The client has declared that this transmitter can be operated using quarter wave whip or dipole antennas which typically have a gain of 2.15 dBi or a numeric gain of 1.64.

The minimum distance from the antenna at which the MPE is met is calculated from the following

Field strength in V/m (FS),
Transmit power in watts (P)
Transmit antenna gain (G)
Transmitter duty cycle (DC)
Separation distance in metres (D)

The calculation is as follows:

FS = (√ (30 * P * G * DC)) / D

Therefore

D = (√ (30 * P * G * DC)) / FS

D = (√ (30 * 4 * 1.64 * 1)) / 32.5

d=0.43 m or 43 cm

Result: Complies if the safe distances defined for this environment is applied.

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Last Cal	Cal Due	Interval
Aerial Controller	EMCO	1090	9112-1062	N/a	N/a	N/a
Aerial Mast	EMCO	1070-1	9203-1661	N/a	N/a	N/a
Biconical Antenna	Schwarzbeck	BBA 9106	-	28/09/2017	28/09/2020	3 years
Horn Antenna	EMCO	3115	9511-4629	08/08/2017	08/08/2020	3 years
Log Periodic Antenna	Schwarzbeck	VUSLP 91111	9111-112	24/09/2017	24/09/2020	3 years
Modulation Analyzer	Rohde & Schwarz	FMA	837807/020	08/05/2018	08/05/2021	3 years
Modulation Analyzer	Hewlett Packard	8901B	-	13/10/2016	13/10/2019	3 years
Power Attenuator	JFW	50FH-030-100	-	N/a	N/a	N/a
Power Supply	Hewlett Packard	6032A	2743A-02859	N/a	N/a	N/a
Receiver	Rohde & Schwarz	ESIB-40	100295	26/08/2018	26/08/2019	1 years
Selective Level Meter	Anritsu	ML422C	M35386	22/05/2018	22/05/2020	2 years
Signal Generator	Rohde & Schwarz	SMHU	838923/028	22/05/2017	22/05/2019	2 years
Spectrum Analyzer	Hewlett Packard	E7405A	US39150142	21/05/2018	21/05/2019	1 year
Thermal chamber	Contherm	M180F	86025	N/a	N/a	N/a
Thermometer	DSIR	RT200	35	10/10/2016	10/10/2021	5 years
Turntable	EMCO	1080-1-2.1	9109-1578	N/a	N/a	N/a
VHF Balun	Schwarzbeck	VHA9103	-	N/a	N/a	N/a

At the time of testing all test equipment was within calibration.

8. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd designation as a FCC Accredited Laboratory by International Accreditation New Zealand, designation number: NZ0002 under the APEC TEL MRA, which expires on the 15th August 2019.

All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.