

FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part 2, Subpart J, sections 2.1031 - 2.1057.

2.1033(c)1 Applicant: Trimble Navigation Ltd.
645 N. Mary Avenue
Sunnyvale, CA 94086

2.1033(c)2 FCC ID: JUP-029A-SN450

2.1033(c)3 Installation and operating instructions are in separate documentation.

2.1033(c)4 Types of emission:

- | | | |
|--|--------------------|----------|
| 1. 4800 baud GMSK(.5), 3.5 kHz deviation | 20 kHz auth BW: | 20K0G1D |
| 2. 8000 baud GMSK(.5), 2.6 kHz deviation | 20 kHz auth BW: | 20K0G1D |
| 3. 9600 baud GMSK(.5), 2.4 kHz deviation | 20 kHz auth BW: | 20K0G1D |
| 4. 4800 baud GMSK(.5) 1.2 kHz deviation | 11.25 kHz auth BW: | 11K25G1D |
| 5. 8000 baud GMSK(.3) 1.5 kHz deviation | 11.25 kHz auth BW: | 11K25G1D |

2.1033(c)5 Frequency range: 430-470 MHz

2.1033(c)6 Range of operating power: 27 dBm (0.5 watt) design. Power set at factory.

2.1033(c)7 Maximum output power: 28.2 dBm (12.5 kHz)

2.1033(c)8 Applied DC voltages and currents to final amplifier:

Refer to schematic

2.1033(c)9 Tune-up procedure

Refer to user manual

2.1033(c)10 Schematic, Block Diagram, and Theory of Operation

Refer to separate exhibits. Confidentiality is requested for these items.

2.1033(c)11 Drawing or photograph of FCC ID label

Refer to separate exhibits

2.1033(c)12 Types of equipment: Refer to separate exhibits.

2.1033(c)13 Description of digital modulation: refer to Theory of Operation.

Power Requirements: 10.5 - 20.0 VDC unconditioned

2.1091 Radio frequency radiation exposure evaluation: mobile devices

The SiteNET 450 radio meets the requirements of a mobile device, as it is designed to be used as a GPS data receiver in other than fixed locations, and is generally used at a separation distance of at least 20 cm between the antenna and the body of the user or nearby persons.

The SiteNET 450 radio has a design nominal output of 27 dBm (0.5 watts). Test sample measurement yielded a maximum power output of 28.2 dBm (0.661 watt).

Antennas sold for this product are a 0 dBi integral and a 5 dBi whip antenna.

Worst case MPE is for 5 dBi antenna at 430 MHz (lowest frequency, lowest exposure level):

RF Hazard Distance Calculation

mW/cm² from Table1: 0.29

Max RF Power P, dBm	TX Antenna G, dBi	MPE Safe Distance, cm
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28.2	5.0	23.9
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Basis of Calculations:

$$E^2/3770 = S, \text{ mW/cm}^2$$

$$E, \text{ V/m} = (P_{\text{watts}} * G_{\text{gain}} * 30)^{.5} / d, \text{ meters}$$

$$d = ((P_{\text{watts}} * G * 30) / 3770 * S)^{.5} \quad P_{\text{watts}} * G_{\text{gain}} = 10^{(P_{\text{dBm}} - 30 + G_{\text{dBi}}) / 10}$$

NOTE: For mobile or fixed location transmitters, minimum separation distance is 20 cm, even if calculations indicate MPE distance is less

The user manual cautions users to maintain at least 2 ft. (60 cm) from the antenna during normal operation.

ERP for this radio is (5 dBi -2.15 dB) + 28.2 dBm = 31.05 dBm EIRP = 1.27 watts ERP.

The SiteNET 450 **meets** the requirements for exclusion from routine environmental investigation.

Spectral Efficiency per Section 90.203

CERTIFICATE:

Trimble Navigation Ltd. certifies that, per the requirements of 90.203(j)3, that the reference radio, FCC ID: JUP-029A-SN450, meets the spectrum efficiency channel of one voice channel bandwidth per 12.5 kHz of channel bandwidth. Channel bandwidth is calculated as the bandwidth containing 99% of the energy of the emission, or the 20 dB bandwidth.

Report of Measurements

All tests except for transmitter mask measurements were performed by Compliance Certification Services. Antenna conducted measurements were performed at Trimble Navigation's facility in Sunnyvale, CA. Radiated emissions tests were performed at a CCS open air test site in Sunnyvale, CA.

Emissions mask measurements were performed at Trimble in Sunnyvale.

Standard Test Conditions

The transmitter was tested under the following conditions:

Room Temperature: 20 - 23 °C

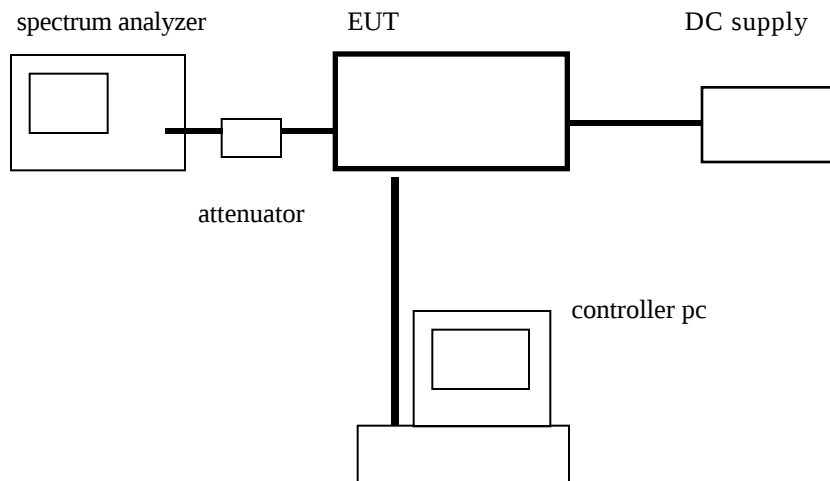
Relative Humidity: 35 - 50%

DC Supply Voltage: 12.6 VDC

The transmitter was aligned and tuned up according to manufacturer's alignment procedure, prior to testing. All data presented represents the worst case parameter being measured.

Section 2.1046 RF Power Output

Test Set-up



Measurement Equipment Used:

HP 8561 Spectrum Analyzer

Weinschel model 401034 attenuator, 50 watt

90.205 Power and Antenna Height Limits

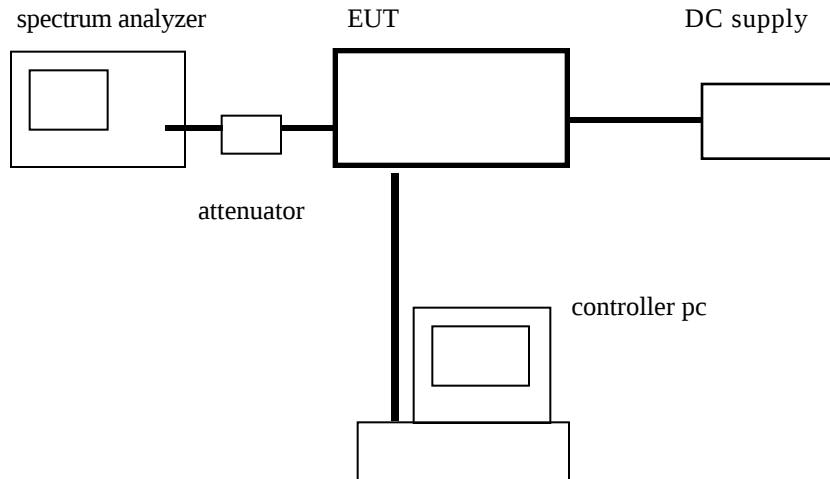
Test Results

Maximum Output Power: 28.2 dBm at 450 MHz (12.5 kHz channel)
27.9 dBm at 450 MHz (25 kHz channel)

Design Output Power: 27 dBm

Section 2.1049 Occupied Bandwidth

Test Set-up



Measurement Equipment Used:

HP 8561 Spectrum Analyzer
Weinschel model 401034 attenuator, 50 watt

Data on the bandwidth occupied by this transmitter is presented in graphical form using spectrum analyzer plots.

A separate spectrum plot is supplied for each modulation type.

90.209 Bandwidth limitations

90.210(b) Emission mask B: 25 kHz channel (20 kHz authorized BW)

Any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

1. On any frequency removed from the assigned frequency by more than 50 percent but less than 100 percent: at least 25 dB
2. On any frequency removed from the assigned frequency by more than 100 percent but less than 250 percent: at least 35 dB
3. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 250 percent: At least $43 + 10 \log(P)$ dB

90.210(d) Emission mask D: 12.5 kHz channel bandwidth (11.25 kHz authorized BW)

Any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

1. On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB
2. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB
3. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log(P)$ dB or 70 dB, whichever is the lesser attenuation.

Test Results:

Refer to spectrum analyzer charts labeled in Exhibit 8.

Section 2.1051 Spurious and Harmonic Emissions at Antenna Terminals**Measurement Equipment Used:**

HP 8561 Spectrum Analyzer
Weinschel model 401034 attenuator, 50 watt
HP Modulation analyzer/audio generator

Test Set-up

-see Occupied Bandwidth test above

90.210

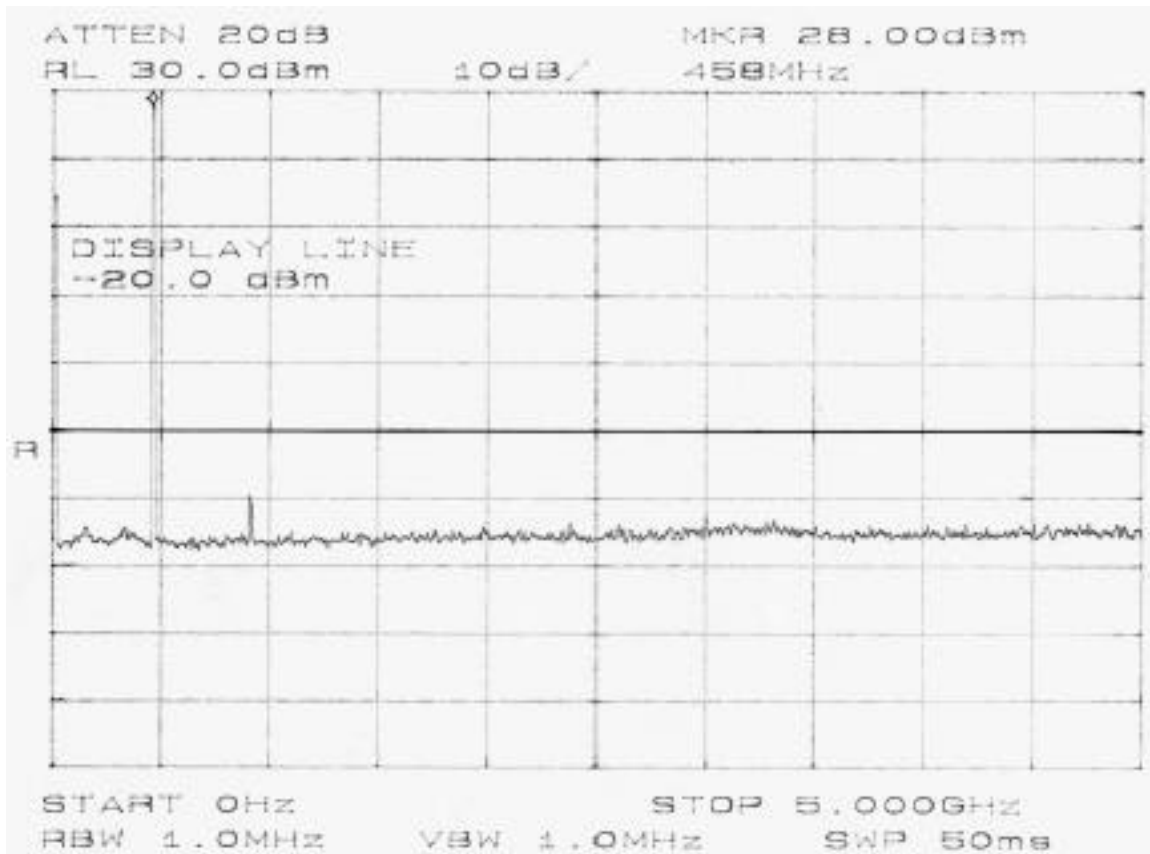
Minimum standard: The magnitude of each spurious and harmonic emission that can be detected when the equipment is operated under conditions specified in the instruction manual and/or alignment procedure, shall not be less than:

Mask B: $43 + 10 \log(\text{mean output power in watts})$ dBc, equivalent to -13 dBm

Mask D: $50 + 10 \log(\text{mean output power in watts})$ dBc , equivalent to - 20 dBm or 70 dB whichever is the lesser attenuation.

Test Results

Refer to spectrum analyzer charts. Output emissions data is presented for worst-case emission (12.5 kHz, Mask D), transmitter operating at 454.9 MHz, and for 25 kHz Mask B emission with transmitter operating at 445.1 MHz.



Mask D:

Highest emission is max output power = 28.2 dBm

Worst case (2nd harmonic) spurious or harmonic amplitude: = -33.3 dBm

Limit: -20 dBm

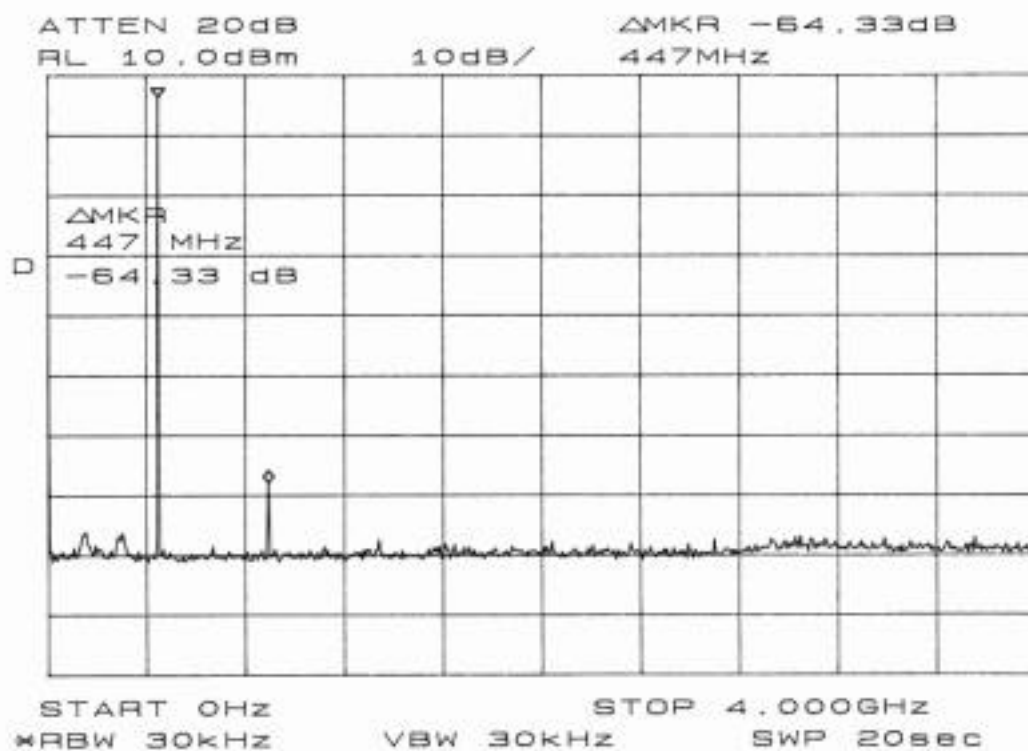
Mask B:

Highest emission is max output power = 27.9 dBm

Worst case (2nd harmonic) spurious or harmonic amplitude:

$$= 27.9 \text{ dBm} - 64.3 \text{ dBm} = -36.4 \text{ dBm}$$

Limit: -13 dBm

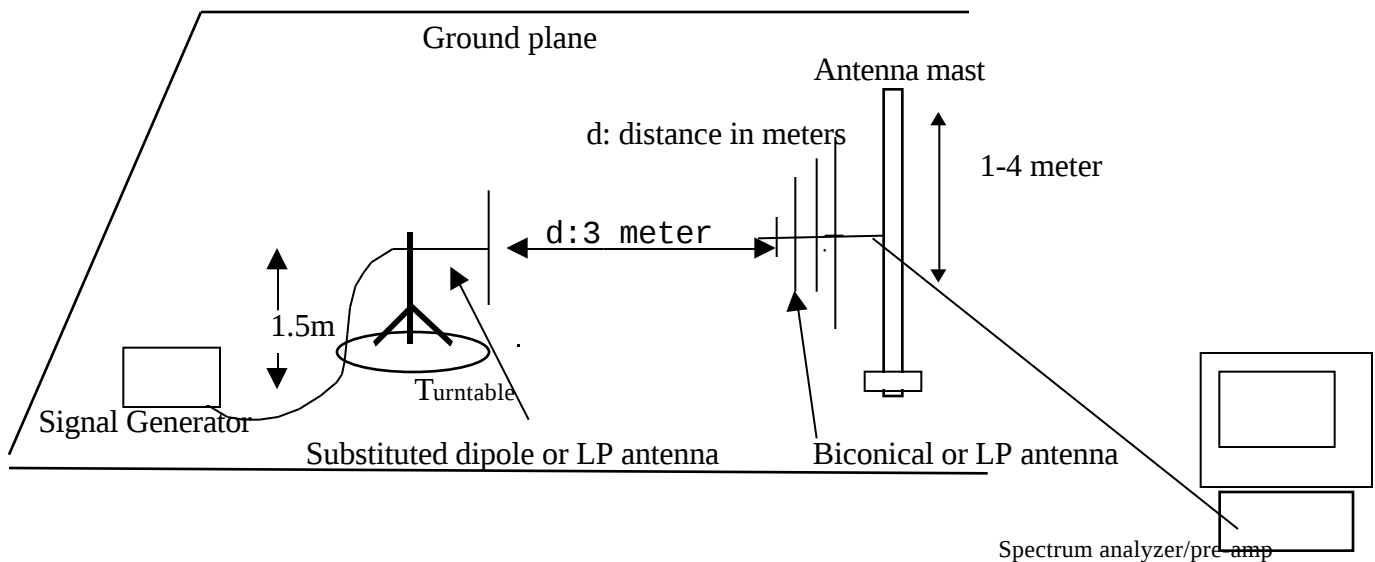
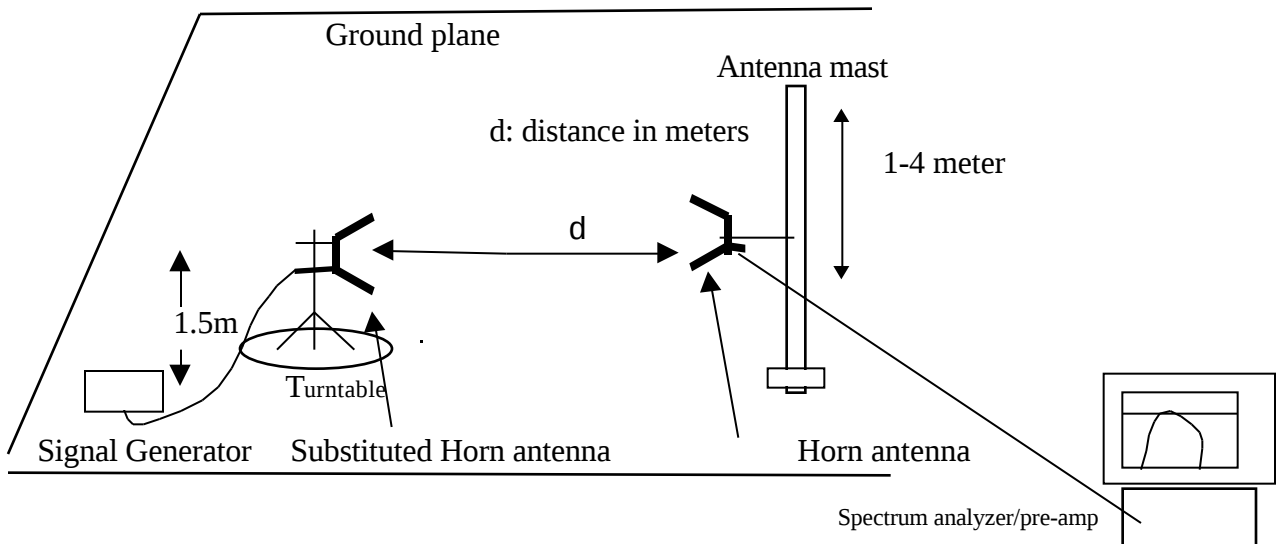


Section 2.1053 Field Strength of Spurious and Harmonic Radiation**Measurement Equipment Used:**

HP 8563E Spectrum Analyzer

EMCO 3146 Log Periodic Antenna, 200 - 1000 MHz

ARA DRG-118/A Double Ridged Horn antenna, 1 - 18 GHz

Test Set-up:**Radiated BELOW 1GHz****Radiated ABOVE 1 GHz**

Minimum Requirement

The magnitude of each spurious and harmonic emission detected as being radiated from the EUT must be at a level more than $50 + 10 \log(\text{mean output power, watts})$ dB below the mean power output (= -20 dBm).

Test Method

The antenna output port of the EUT was terminated with a 50 ohm shielded termination. With the transmitter operating at full power, the EUT was rotated 360° and the search antenna was raised and lowered in both polarities, all in an attempt to maximize the levels of the received emission for each harmonic and spurious emission up to 10 fo.

The actual signal generated by the measured equipment may be determined by means of a substitution measurement in which a known signal source replaces the device to be measured.

- A. The substitution antenna will replace the Eut antenna in the same position and in vertical polarization. The frequency of the signal generator shall be set to the frequencies that were measured on the Eut. The test antenna shall be raised and lowered, if necessary, to ensure that the maximum signal is still being received. The signal generator, output level, shall be adjusted until an equal or a known related level to what was measured from the Eut is obtained in the spectrum analyzer.

The radiated power is equal to the power supplied by the signal generator

The formula, to calculated the true reading, is: $\text{True reading} = \text{dBm} + \text{GdBd} - \text{CL}$

dBm = signal generator output level

GdBd = the gain in dBd of the substitution antenna

CL = the cable loss

The calculated True reading is then compared to the limit and should not exceed the limit. This method must be performed for every emission measured from the Eut. This shall also be repeated for horizontal polarization.

Test Results

Emissions are more than 30 dB below limit. Refer to data summary table below. Data is taken for transmitter operating in 25 kHz mode, operating at 445.1 MHz.

Compliance Certification Services

Trimble Navigation
Sitenet 450

Pete Krebill
5/29/01

Frequency MHz	SA reading dBuV	Sig Gen dBm	CL dB	Gain dBi	Gain dBd	ERP dBm	Limit dBm	Margin dB
890	46.1	-61.2	1	2.2	0	-62.2	-20	-42.2
1335	29.2	-68.9	1	8.3	6.1	-63.8	-20	-43.8
1780	29.8	-63.2	1	7.5	5.3	-58.9	-20	-38.9
2225	42.2	-90	1	8	5.8	-85.2	-20	-65.2
2670	51	-71	1	7.9	5.7	-66.3	-20	-19.3
3115	36	-78	1	7.7	5.5	-73.5	-20	-26.5
3560	52	-66	1	6.2	4	-63	-20	-16
4005	40	-98	1	10.09	7.89	-91.11	-20	-71.1

Emissions to 10fo were all below the noise floor. The highest noise floor readings were all in vertical polarity for channel frequency 445.1MHz.
The above measurements are for 445.1MHz Vertical

Section 2.1055 Frequency Stability

Test Set-up

- see Occupied Bandwidth above

Measurement Equipment Used

HP 8561 Spectrum Analyzer
Weinschel model 401034 attenuator, 50 watt

Section 90.213 Minimum Frequency Stability

Minimum Requirement

Mobile stations, under 2 watts: 5.0 ppm = 2.225 kHz for 445.1 MHz, 25 kHz channel
2.5 ppm = 1.112 kHz for 445.1 MHz, 12.5 kHz channel
5.0 ppm = 2.274 kHz for 454.9 MHz, 25 kHz channel
2.5 ppm = 1.137 kHz for 454.9 MHz, 12.5 kHz channel

Test Results, Frequency v Operating Temperature

Temp	Freq MHz	PPM
-30	445.100546	+1.2
-10	445.100275	+.6
10	445.100139	+.3
30	445.099861	-.3
50	445.099595	-.9

Test Results, Frequency v Supply Voltage

		13V	10.8V	31.2V	13V	10.8V	31.2V
CHANNEL	NORMAL	-20° C			+55° C		
FREQUENCY (MHz)	CONDITIONS	+0.159	+0.217	+0.166	-0.284	-0.282	-0.273
445.1	-0.036	+0.194	+0.173	+0.183	-0.288	-0.289	-0.289

12.5KHz Radio:

		13V	10.8V	31.2V	13V	10.8V	31.2V
CHANNEL	NORMAL	-20° C			+55° C		
FREQUENCY (MHz)	CONDITIONS	+0.141	+0.159	+0.147	-0.358	-0.356	-0.359
445.1	-0.069	+0.123	+0.185	+0.134	-0.337	-0.334	-0.340
454.9	-0.150						

25KHz Radio:

90.214 Transient frequency behavior

Transient frequencies must be within the tolerances and within the time frames described below:

12.5 kHz Channels

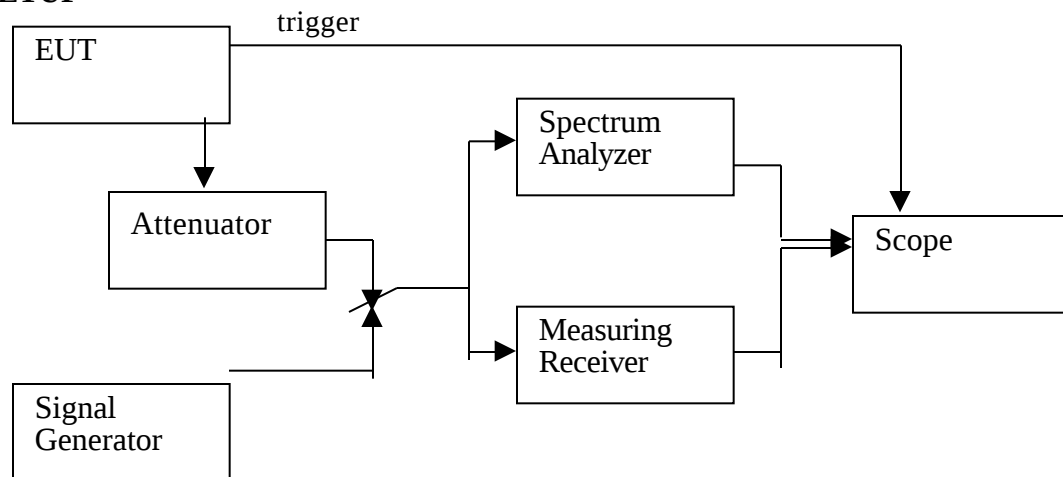
Time Intervals	Maximum freq. diff, kHz	Duration for 450-500 MHz
t1	12.5	10 msec
t2	6.25	25 msec
t3	12.5	10 msec

25 kHz Channels

Time Intervals	Maximum freq. diff, kHz	Duration for 450-500 MHz
t1	25	10 msec
t2	12.5	25 msec
t3	25	10 msec

TRANSIENT POWER AND FREQUENCY INSTRUMENT LIST

EQUIPMENT	MANUFACTURE	MODEL NO.	CAL. DUE DATE
Measuring Receiver	HP	8902a	4/10/02
Spectrum Analyzer	HP	8561B	Trimble in house calibration
Storage Scope	Agilent	54624A	Trimble in house calibration
Signal Generator	HP	8648C	Trimble in house calibration

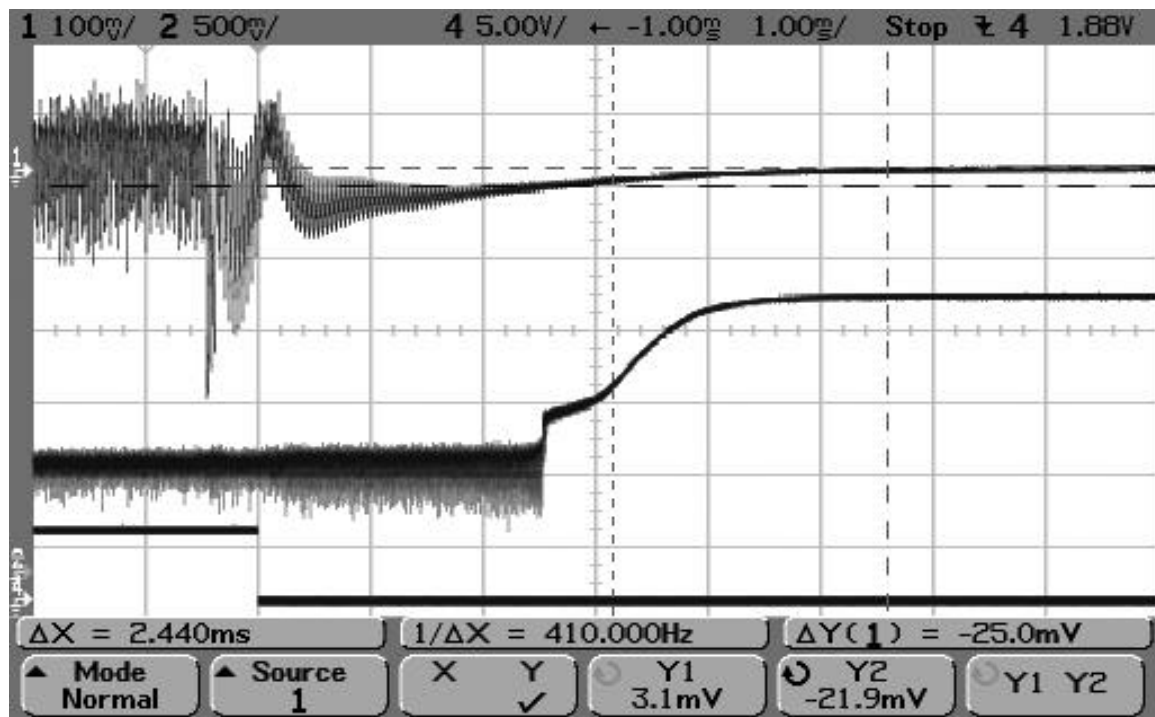
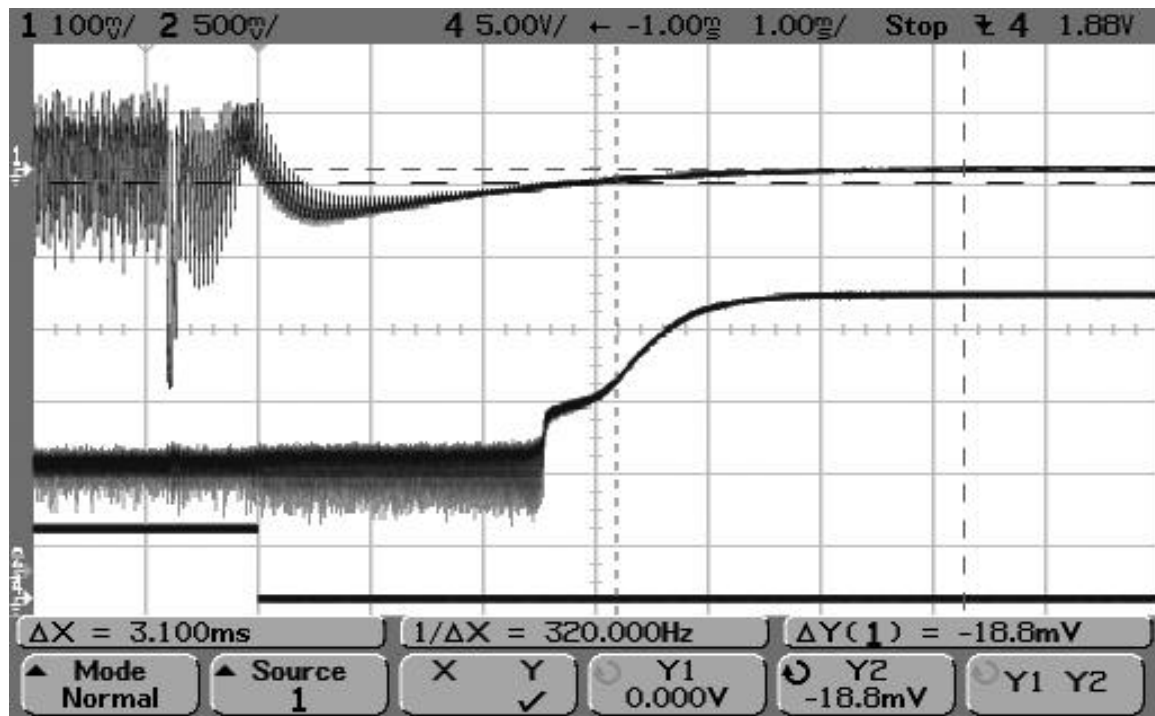
TEST SETUP

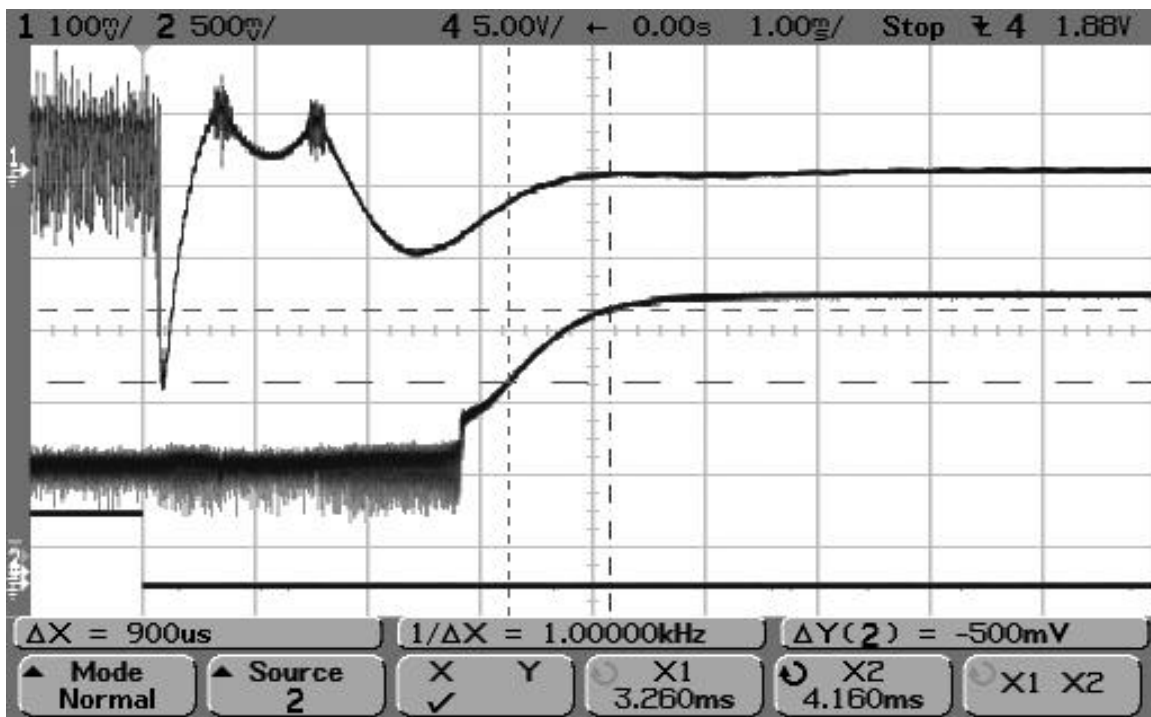
Test Procedures

The EUT is configured on a test bench, as shown above. The transmitter is connected to a spectrum analyzer a measuring receiver via power attenuators and a power splitter. The spectrum analyzer is set to display power as a function of time (zero span). The measuring receiver is calibrated with a signal generator using frequencies with defined differences from the nominal carrier frequency. The EUT generates a triggering pulse to the scope when Txon or Txoff are activated. The voltage occurring at the measuring receiver's output is recorded on the scope as a function of time. The voltage level is the frequency difference. "RF power on" and "RF power off" are then monitored and recorded with the scope for channels with frequencies of 445.1MHz and 455MHz.

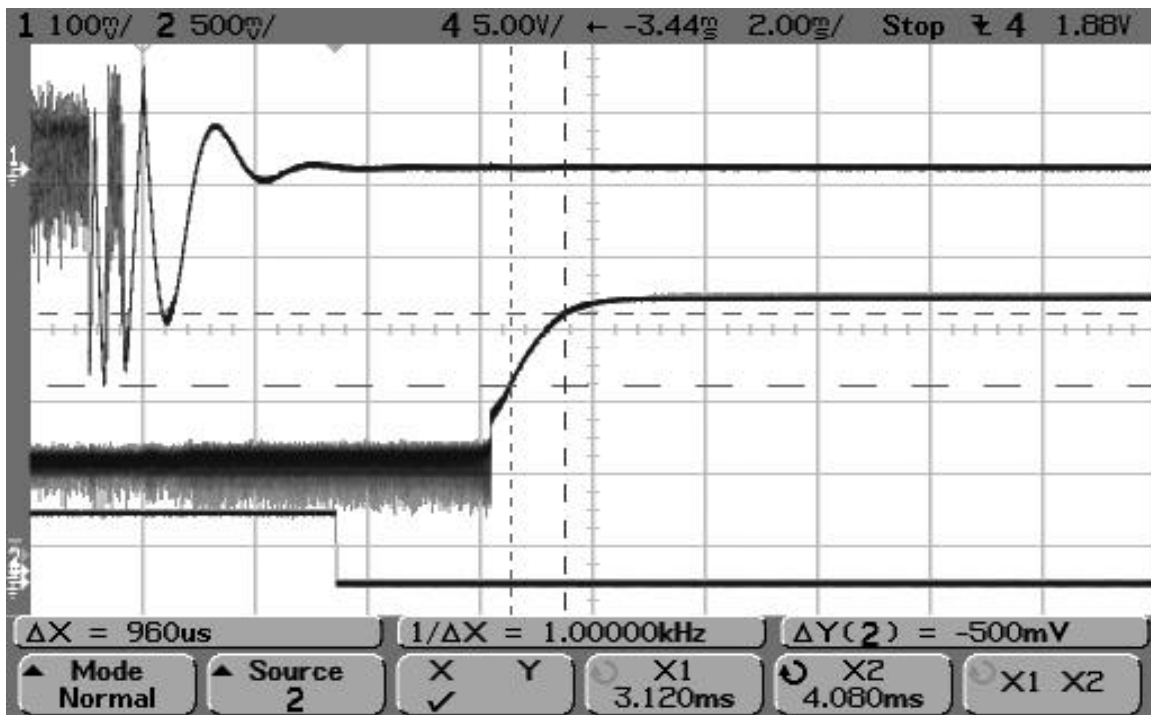
Test Results

Complies; see transmitter attack and release data.

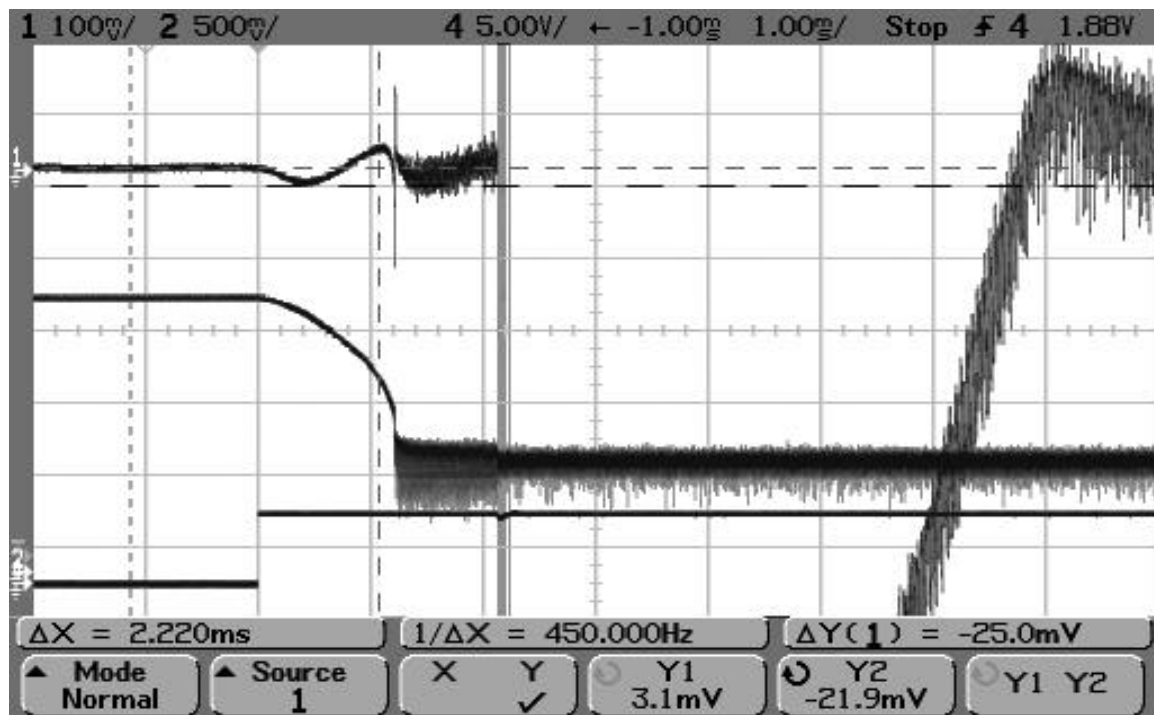
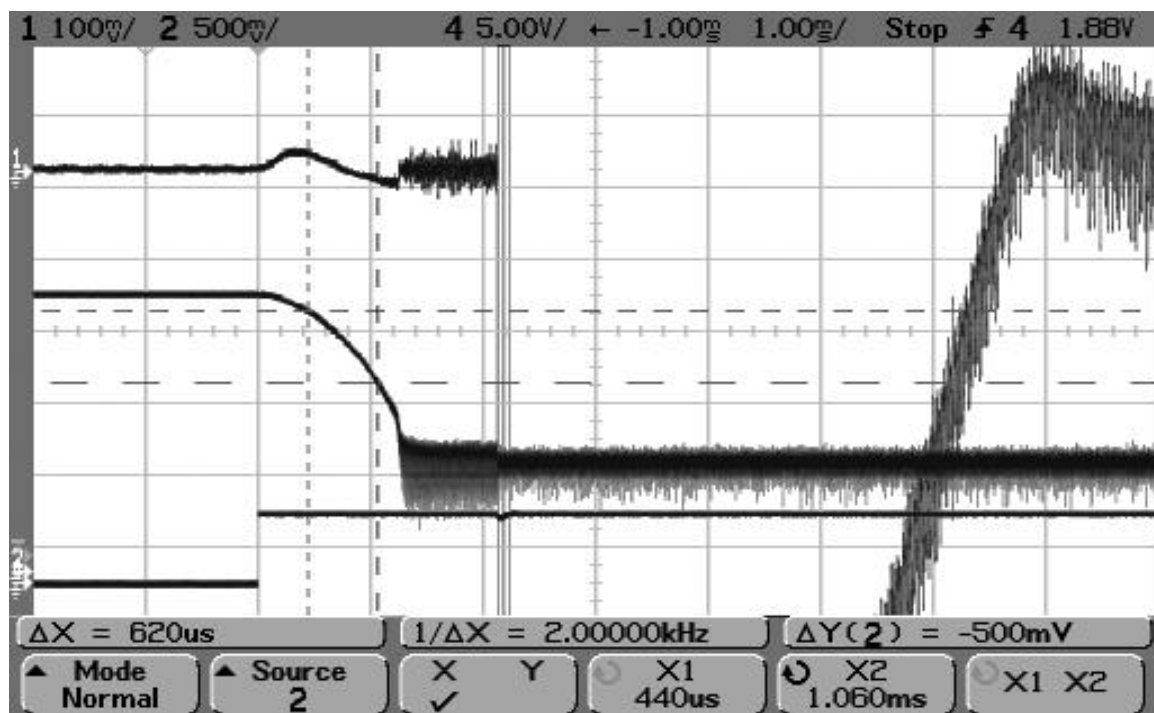
TRANSMITTER ATTACK TIME**12.5KHz Radio 445.1MHz****12.5KHz Radio 454.9MHz**

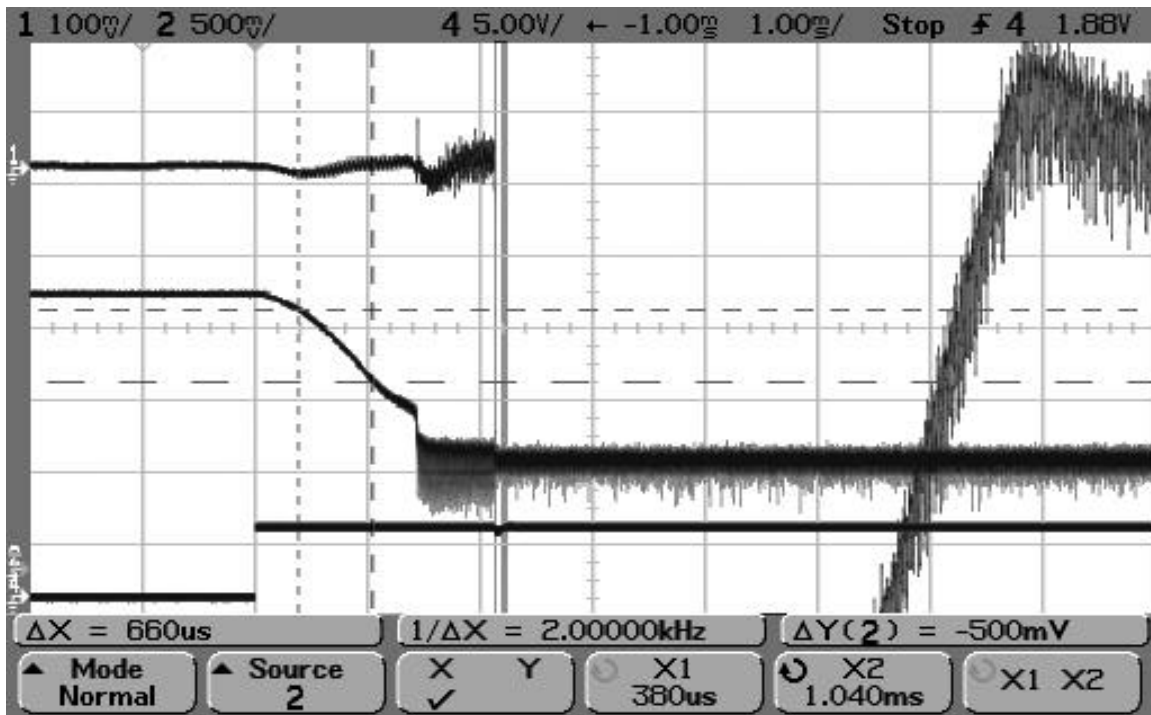


25KHz Radio 454.9MHz

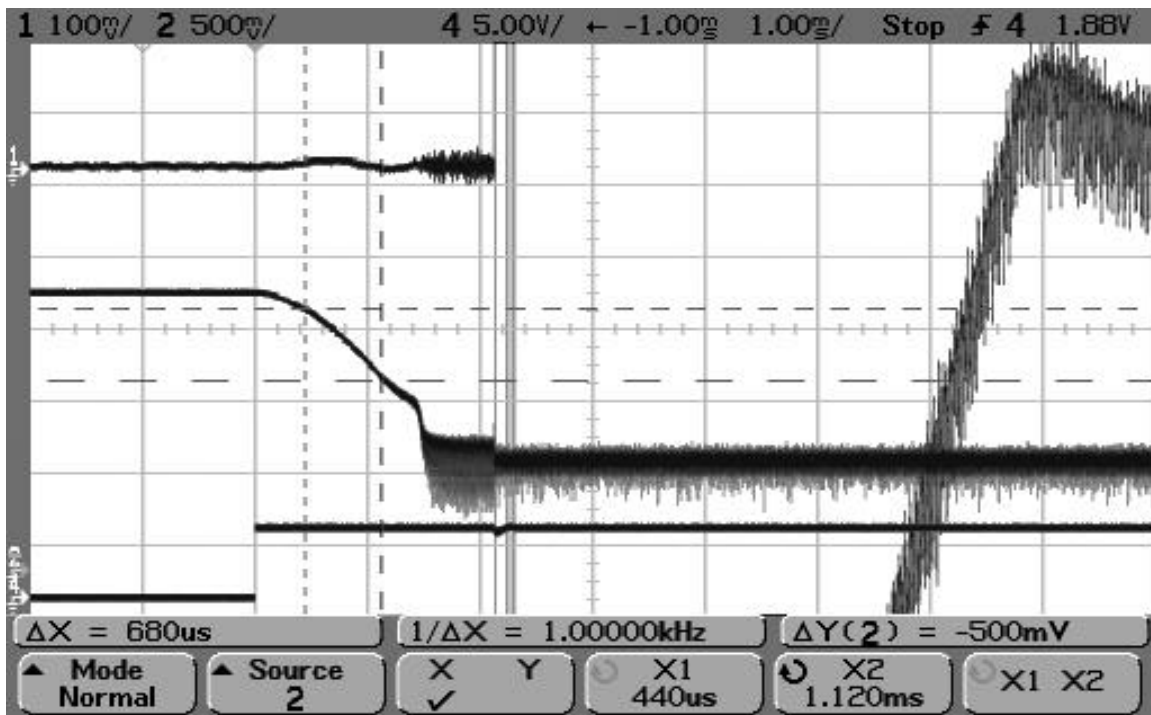


25KHz Radio 445.1MHz

TRANSMITTER RELEASE TIME**25KHz Radio 445.1MHz****25KHz Radio 454.9MHz**



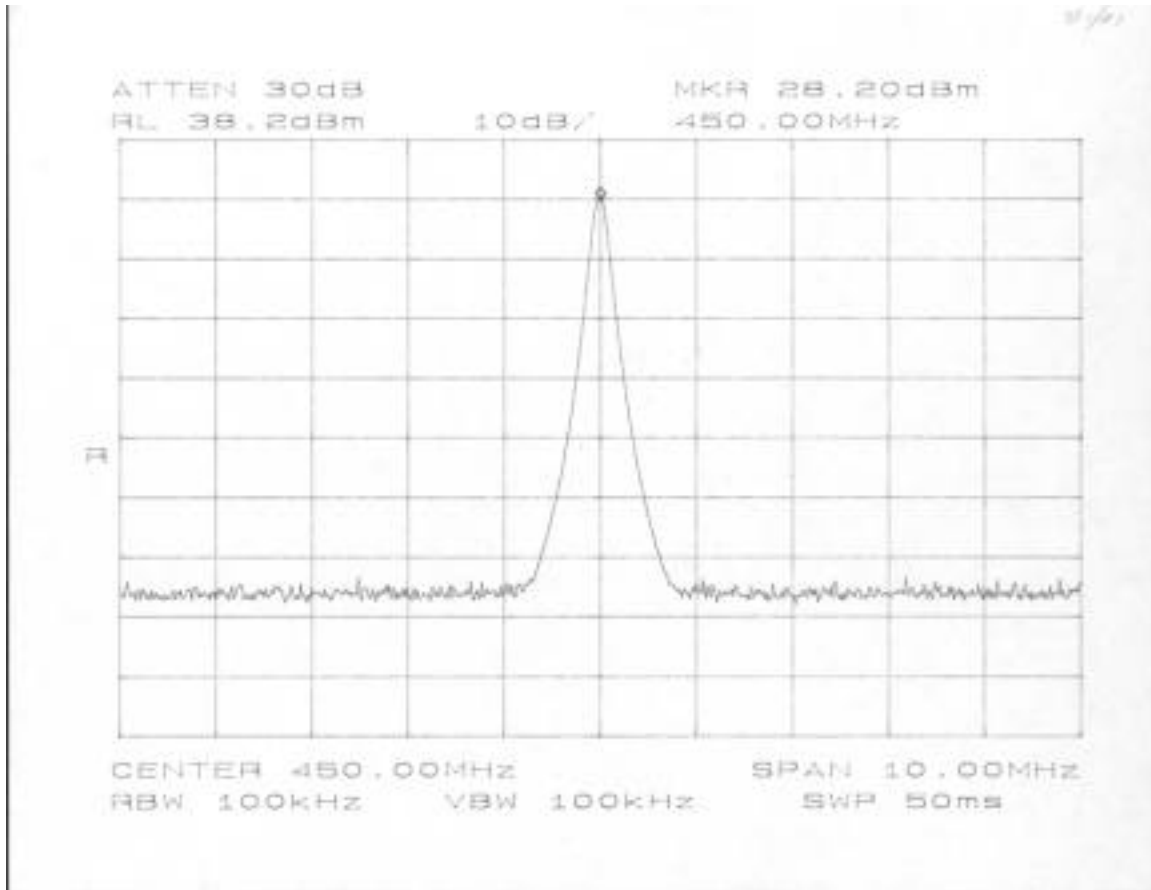
12.5KHz Radio 445.1MHz



12.5KHz Radio 454.9MHz

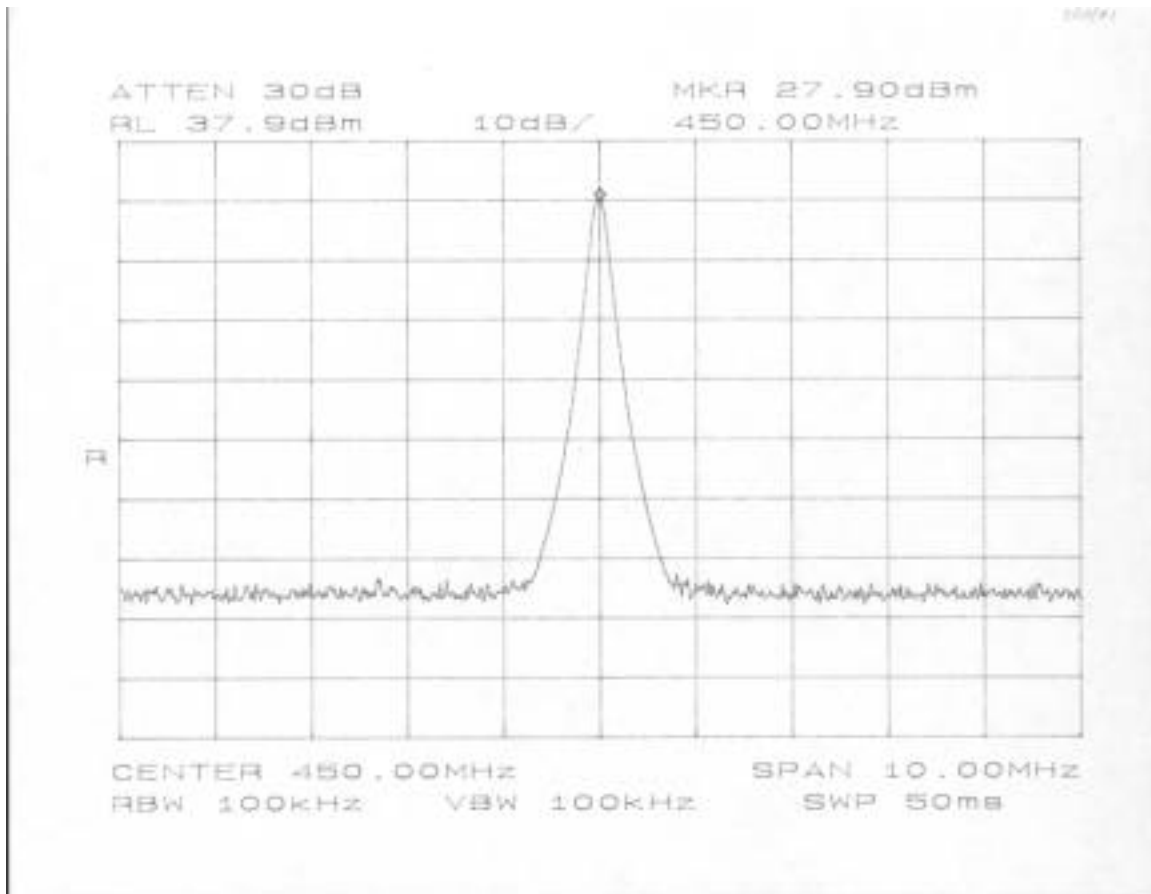
Data Graphs: Occupied Bandwidth

12.5 kHz Reference



Data Graphs: Occupied Bandwidth

25 kHz Reference



Data Graphs: Occupied Bandwidth

1. 4800 baud, GMSK(.5), $\pm 3.5\text{kHz}$ Deviation, BW= 20 kHz (25 kHz channel)

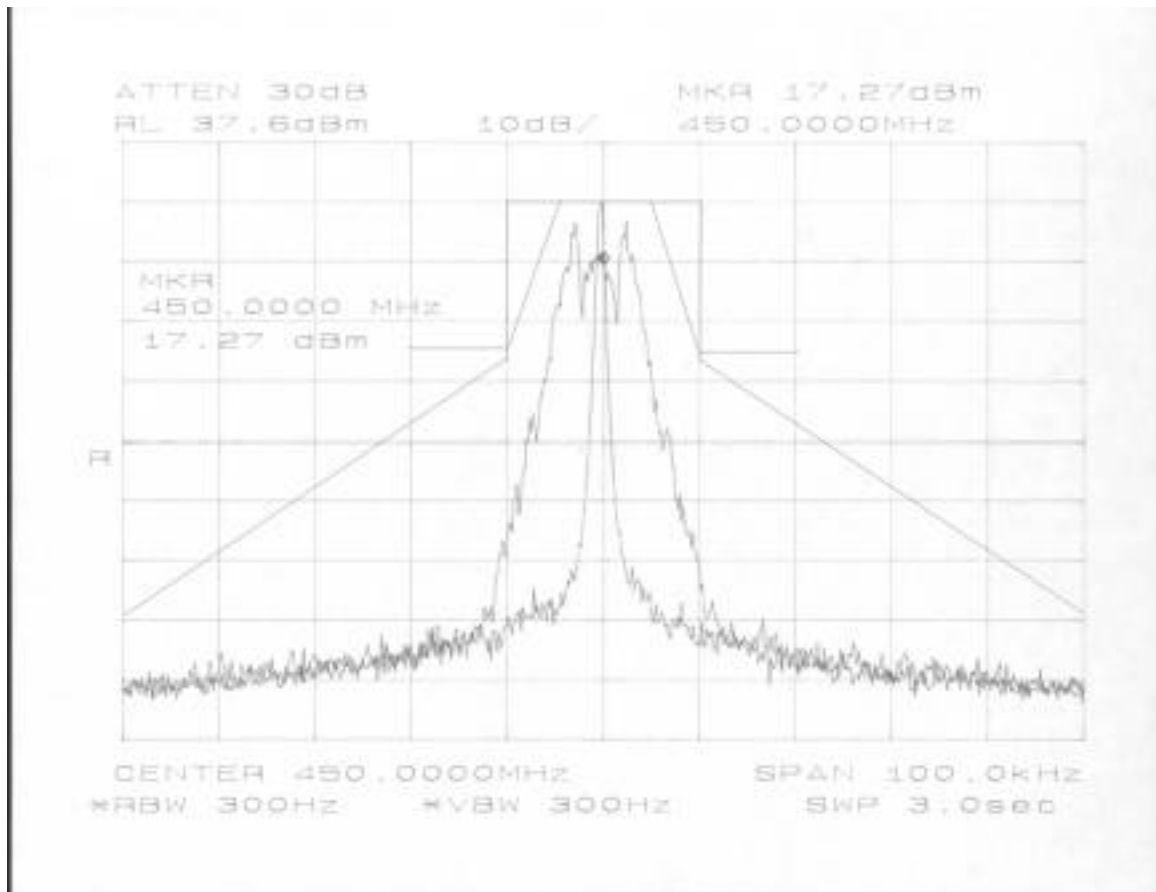


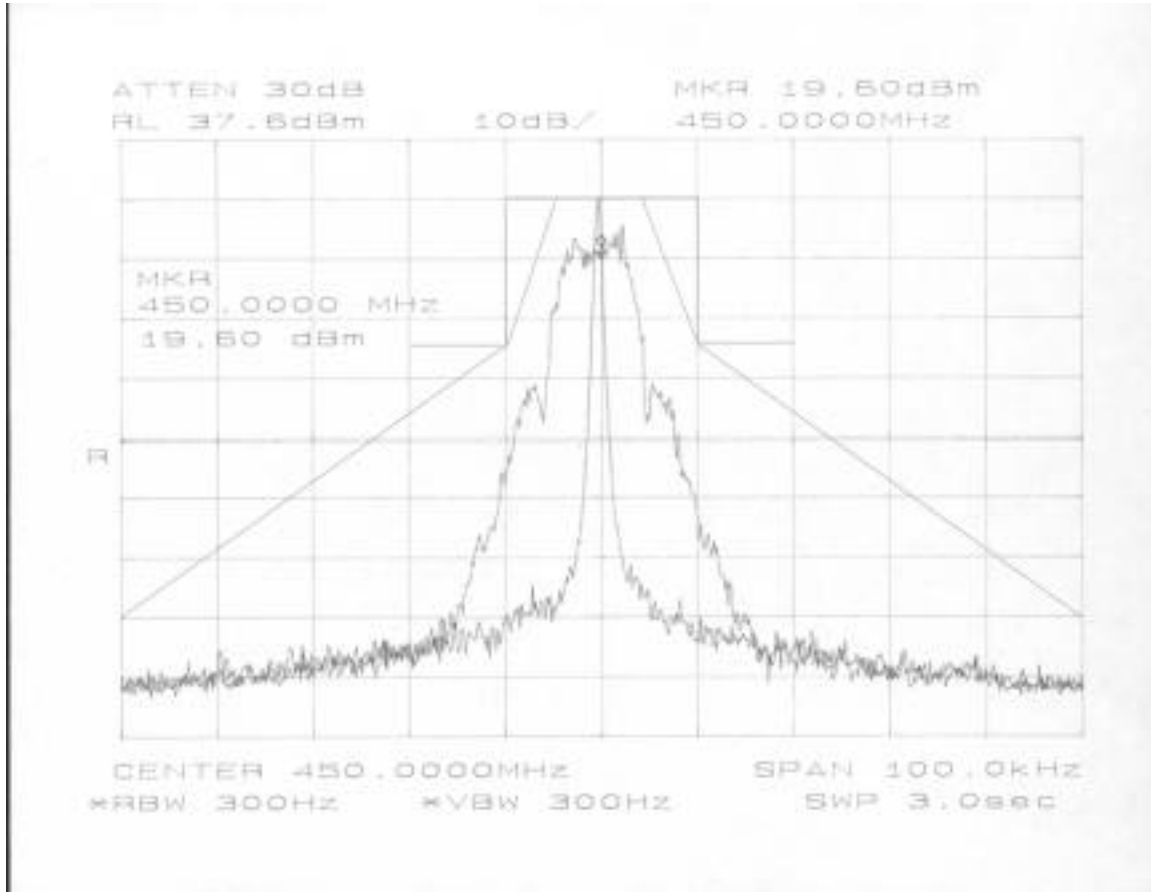
EXHIBIT 8: Data Graphs: Occupied Bandwidth**2. 8000 baud, GMSK(0.5), ± 2.6 kHz Deviation, BW= 20 kHz (25 kHz channel)**

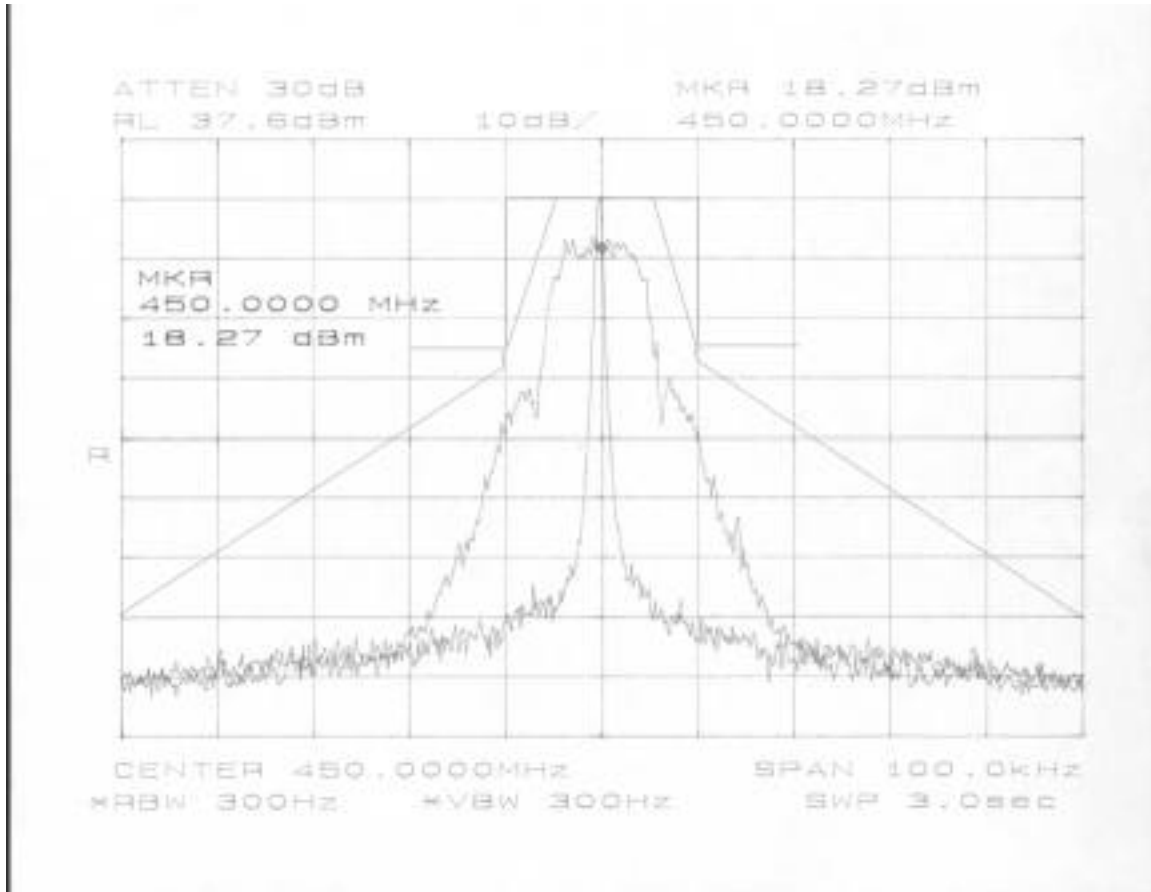
EXHIBIT 8: Data Graphs: Occupied Bandwidth**3. 9600 baud, GMSK(.5) $\pm$ 3.5 kHz deviation, BW=20 kHz (25 kHz channel)**

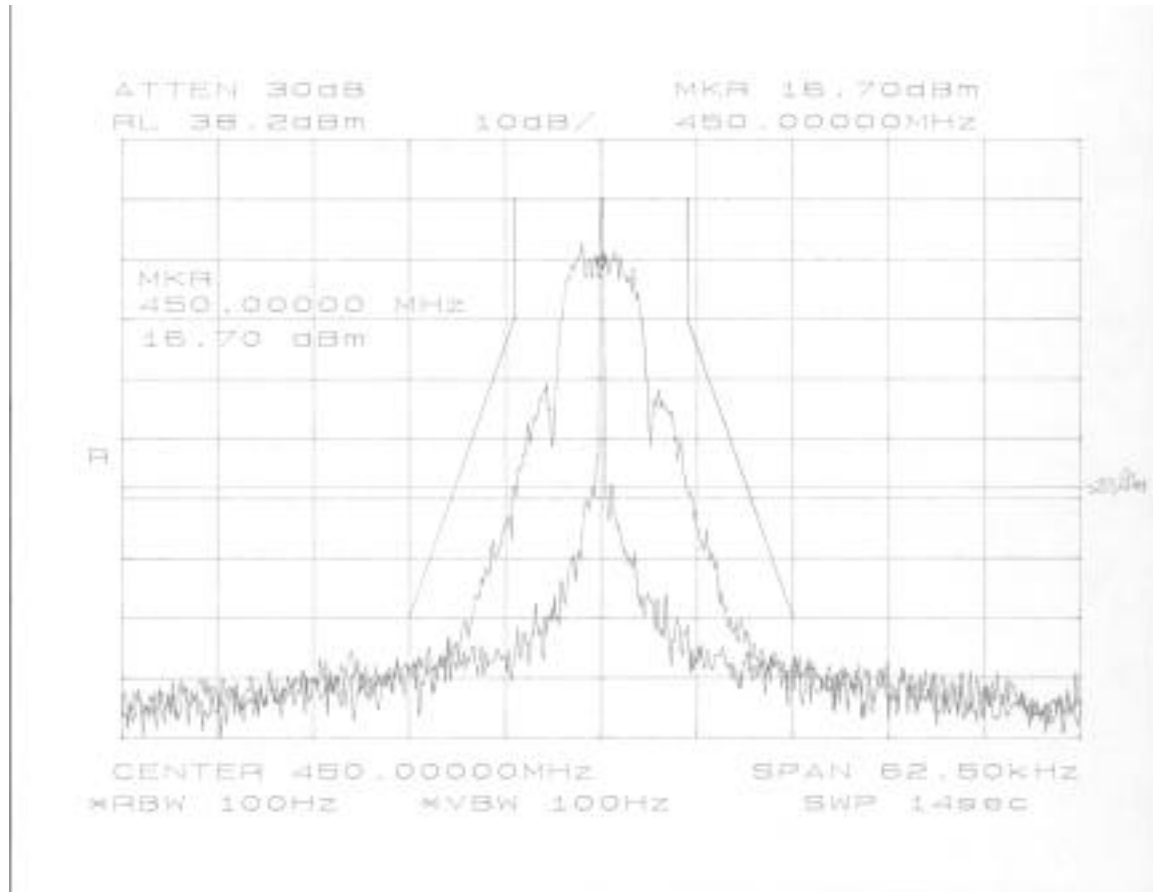
EXHIBIT 8: Data Graphs: Occupied Bandwidth**4. 4800 baud, GMSK(.5) $\pm$ 1.75 kHz deviation, BW=11.25 kHz (12.5 kHz channel)**

EXHIBIT 8: Data Graphs: Occupied Bandwidth**5. 8000 baud, GMSK(.3) ± 1.3 kHz deviation, BW=11.25 kHz (12.5 kHz channel)**