Trimble Navigation Ltd.
35 MHz 300 watt transceiver

FCC ID: JUP-ELIZABETH35
FCC Rule Part: 22

General Overview

A description of the theory of operation and product configuration is found in an attachment to this application and report.

SPECIFICATIONS

Transmitter

TX operating frequency:	35.2 – 35.66 MHz
TX output power:	400 watts
Digital Modulation:	9600 GMSK
	20000 8PSK
	Modulation is internally generated and limited
Power requirements:	120 VAC
Antenna connector:	N- type
Frequency Tolerance	20 ppm
	-30 to +50 C
	85%-115% supply voltage at 20C

Block diagram and theory of operation is provided in a separate attachment.

FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part 2.

1.1307(b) RF exposure information is provided in a separate attachment in the form of maximum permissible exposure (MPE) data.

2.1033(c)1 Applicant: Trimble Navigation Ltd.
749 North Mary Avenue,
P.O. Box 3642
Sunnyvale, CA 94088-3642

2.1033(c)2 FCC ID: JUP-ELIZABETH35

2.1033(c)3 Installation instructions are found in separate document.

2.1033(c)4 Emission type: GMSK
Para. 22.531 Channel Bandwidth: 20 kHz

Emission designator: 14K0F1D (9600 GMSK)
19K0G1D (20000 8PSK)

2.1033(c)5 Frequency range: 35.2 – 35.66 MHz

2.1033(c)6 Range of Operating Power

400 watt maximum (56 dBm)

2.1033(c)7 Maximum Power Rating

56 dBm (400 watts) measured

Maximum allowed per Section 22.535: 600 watts EIRP

2.1033(c)8 Applied voltages and currents into the final transistor elements

Refer to schematics, separate submission accompanying this application

2.1033(c)9 Tune-up procedure

Refer to installation instructions..

2.1033(c)10 Circuit and Functional Block Diagram, Description of Circuitry

Product schematics are provided in separate attachments.
Circuit description and theory of operation are found in separate attachment.

2.1033(c)11 FCC ID Label

Refer to separate attachment.

2.1033(c)12 Product Photographs

Refer to separate attachment.

2.1033(c)13 Description of Modulation System

9600 bps GMSK or 20000 bps 8PSK

2.1033(c)14 Test Data per 2.1046 – 2.1057

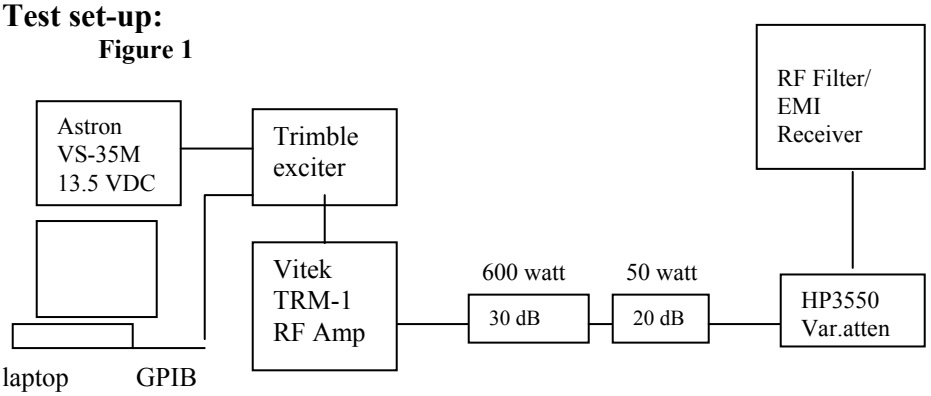
2.1046 RF Output Power Measurements

Measurement equipment used:

HP 8542E EMI Receiver
HP 85420E RF Filter Section
30 dB attenuator, 600 watts
20 dB attenuator, 50 watts
20 dB attenuator, 2 watts
4 short lengths coaxial cable

Test set-up:

Figure 1



Total cable loss (measured):	0.8 dB
600 watt atten:	30 dB
50 watt atten:	20 dB
Variable atten:	20 dB

Total offset: 70.8 dB

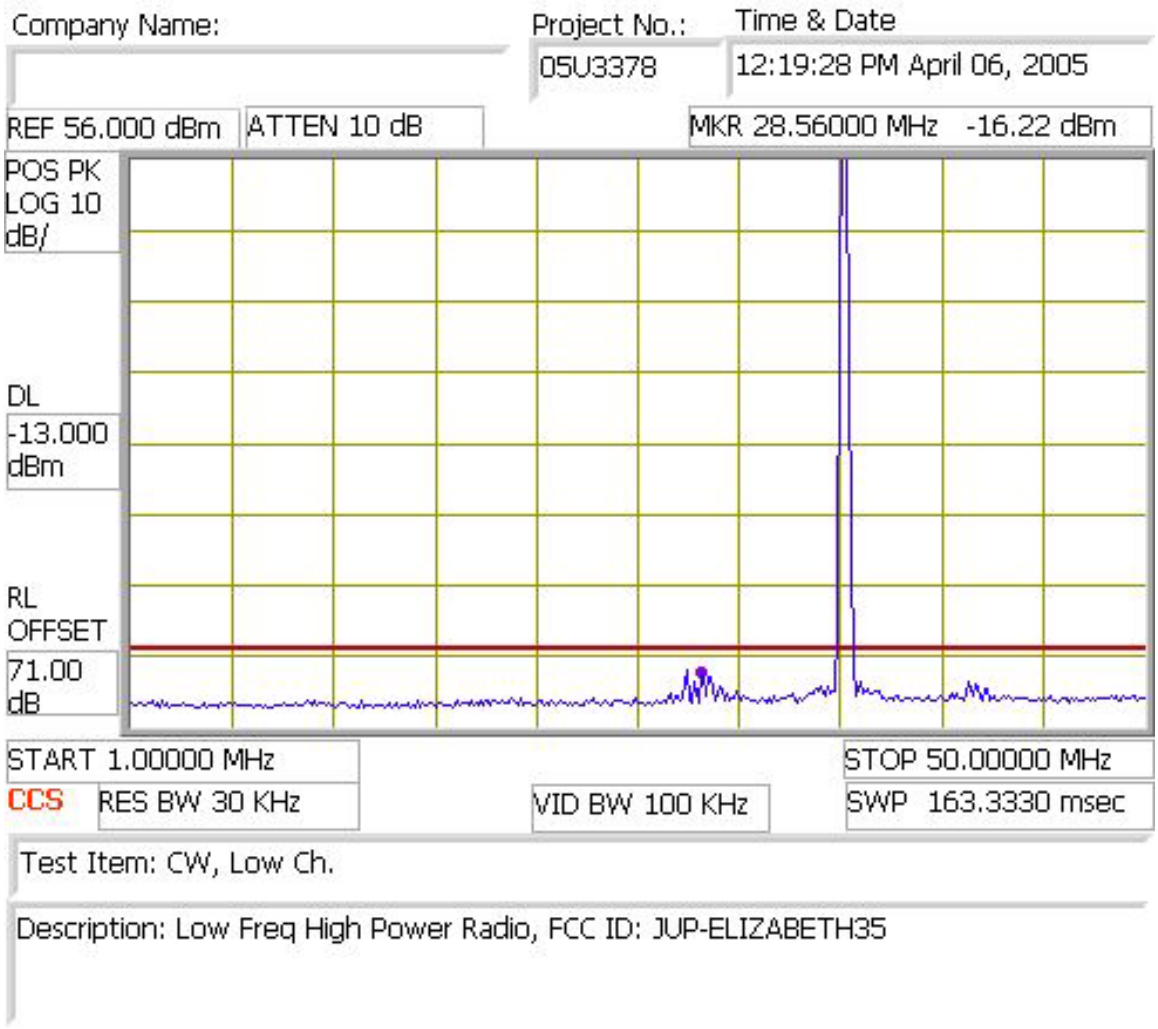
Test Procedures

1. Set the transmitter to produce maximum un modulated power at the desired frequency
2. Input total reference level offset
3. Read value directly from spectrum analyzer

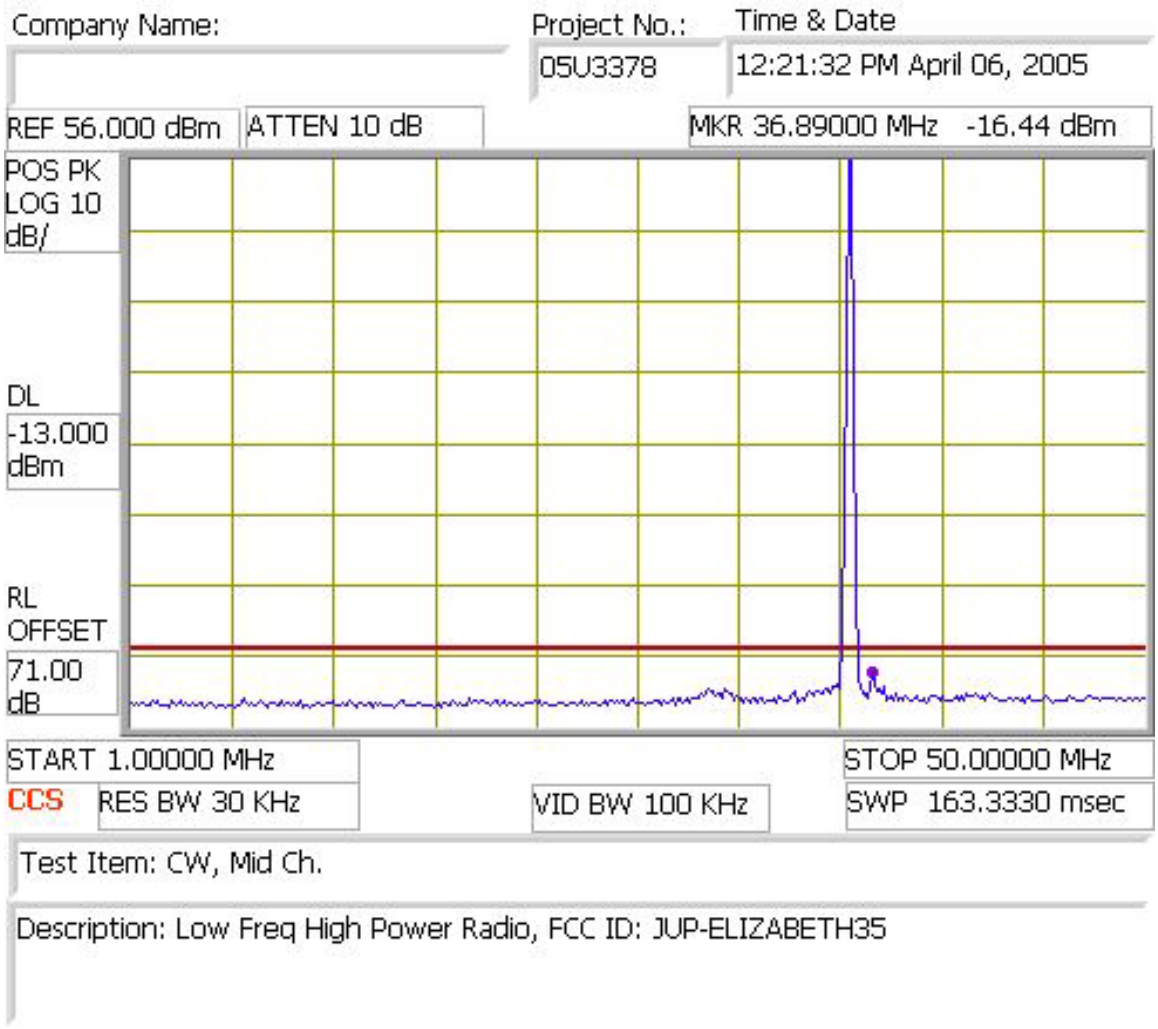
Test Results

400 watts maximum (56 dBm). Refer to attached spectrum analyzer plots.

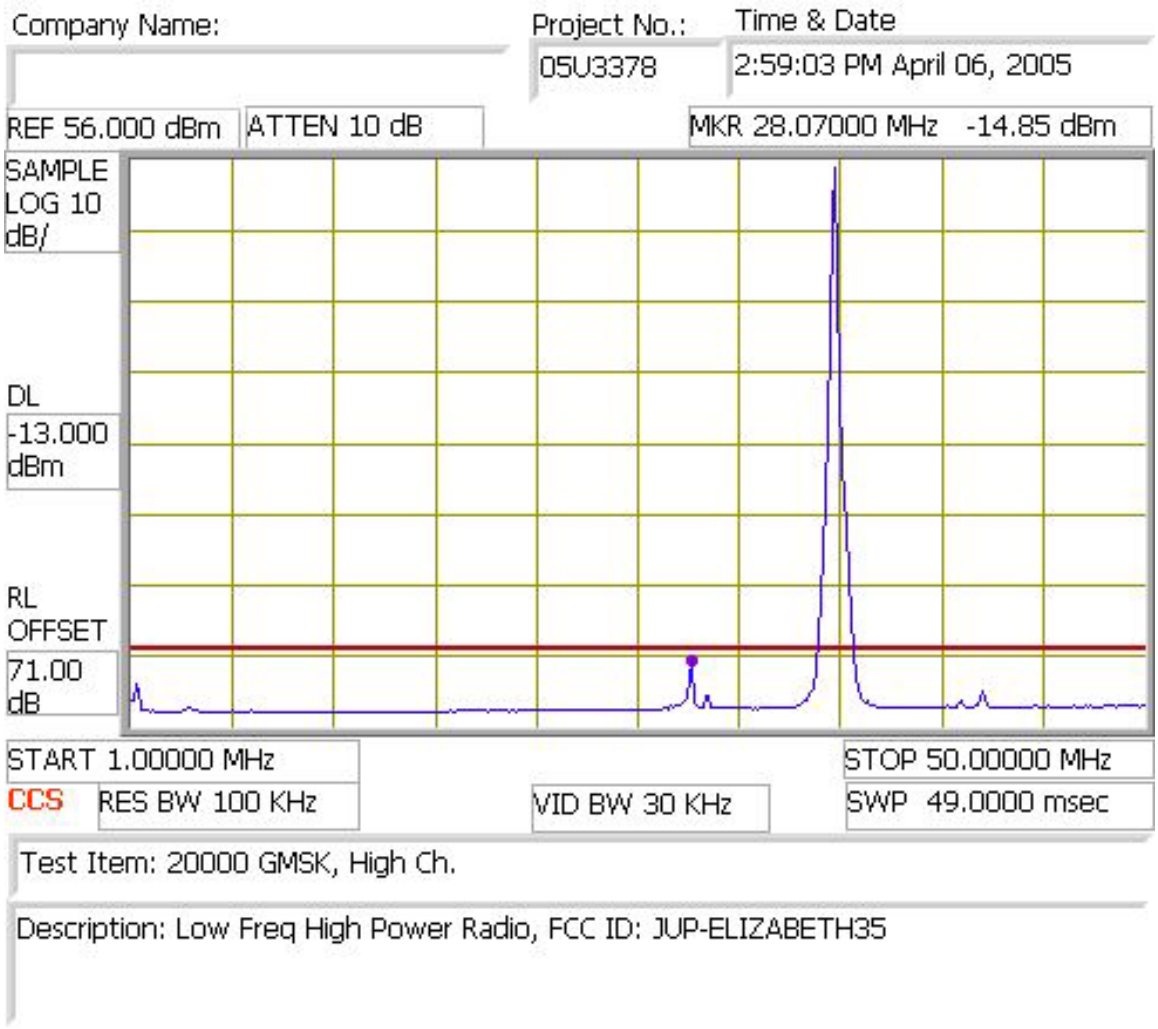
Low Channel Output Power



Mid Channel Output Power



High Channel Output Power



Section 2.1047 Modulation Characteristics
Requirement/Limit: 22.359 (b)1

(b) *Digital modulation.* For transmitters not equipped with an audio low pass filter and for transmitters employing digital modulation techniques, the mean or peak envelope power of sideband emissions must be attenuated below the mean or peak envelope power of the total emission (P, in Watts) in accordance with the following schedule:

(1) For transmitters that operate in the frequency ranges 35 to 44 MHz, 72 to 73 MHz, 75.4 to 76.0 MHz and 152 to 159 MHz,
(i) On any frequency removed from the center frequency of the assigned channel by a displacement frequency fd (in kHz) of more than 5 kHz but not more than 10 kHz:

at least 83 log (fd÷5) dB;

(ii) On any frequency removed from the center frequency of the assigned channel by a displacement frequency fd (in kHz) of more than 10 kHz but not more than 250 percent of the authorized bandwidth:

at least 29 log fd2÷11) dB or 50 dB, whichever is the lesser attenuation;

(iii) On any frequency removed from the center frequency of the assigned channel by more than 250 percent of the authorized bandwidth:

at least 43 + 10 log P dB, or 80 dB, whichever is the lesser attenuation.

Measurement equipment used:

HP 8542E EMI Receiver
HP 85420E RF Filter Section
30 dB attenuator, 600 watts
20 dB attenuator, 50 watts
20 dB attenuator, 2 watts
4 short lengths coaxial cable

Test set-up: Refer to Figure 1, above

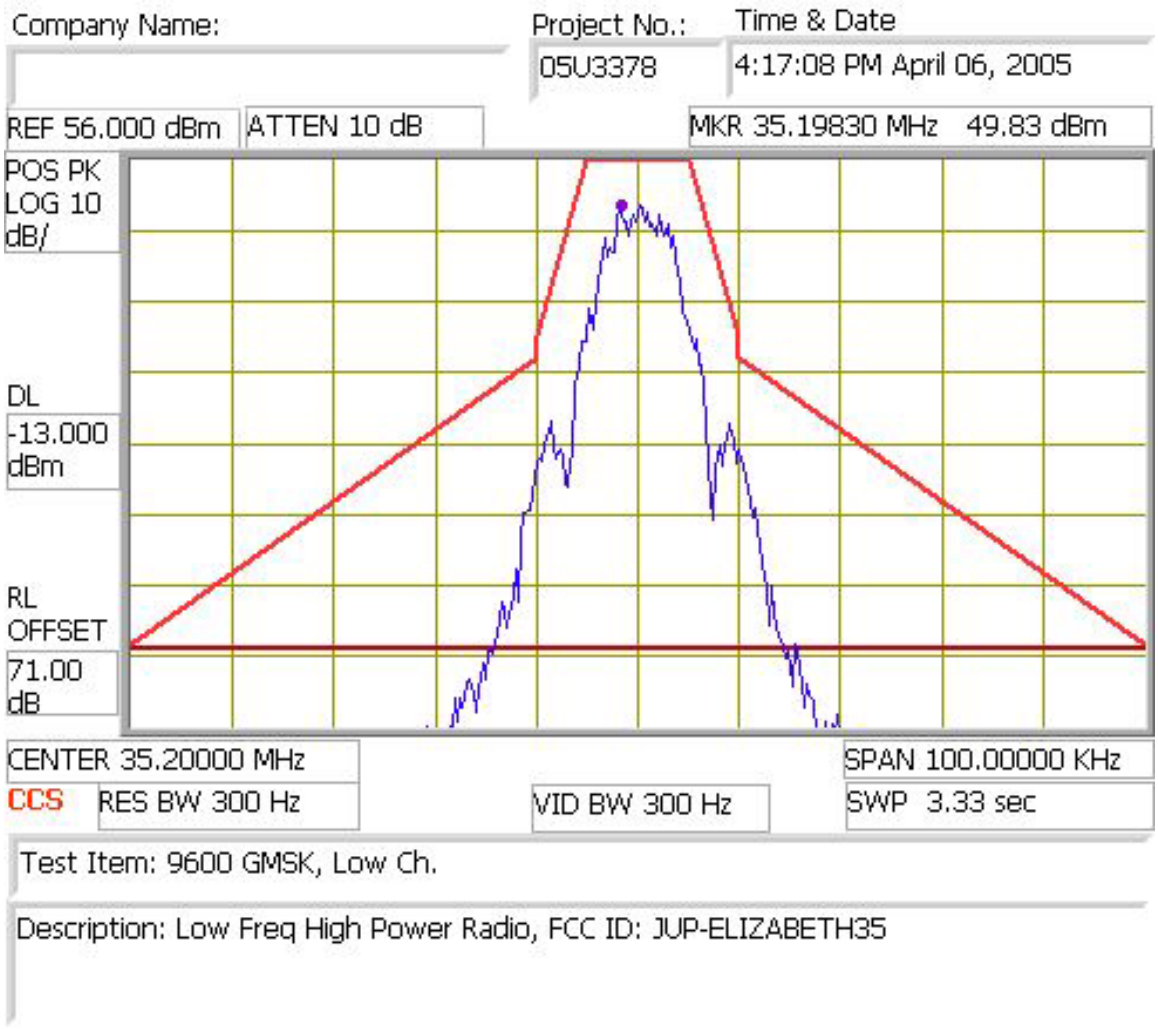
Test Procedures

Software was run to produce two different modulations; 9600 bps GMSK
20000 bps 8PSK

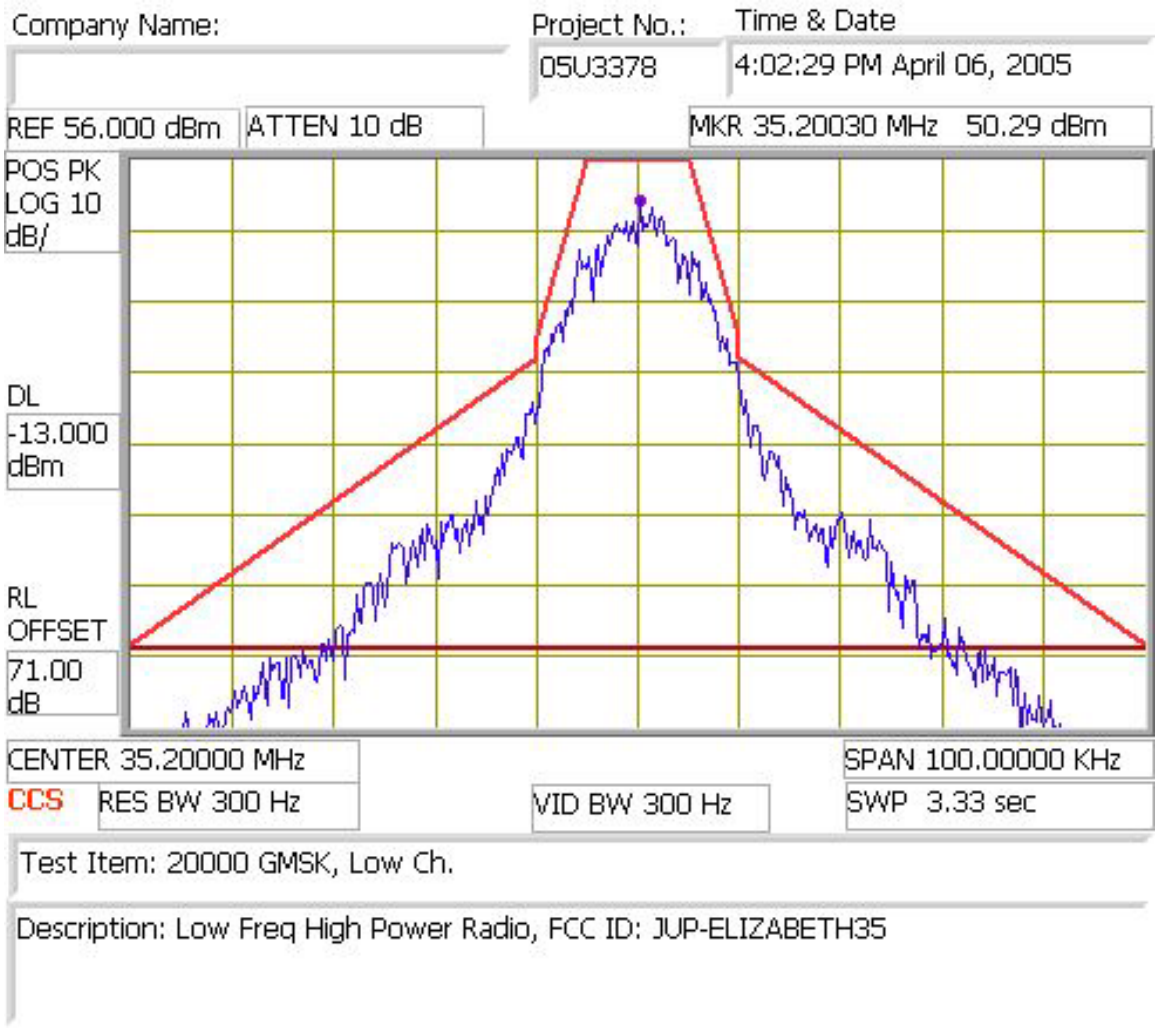
Test Results

PASS. Refer to attached spectrum analyzer charts for two modulations.
Emissions are shown with mask lines superimposed on spectrum analyzer charts.

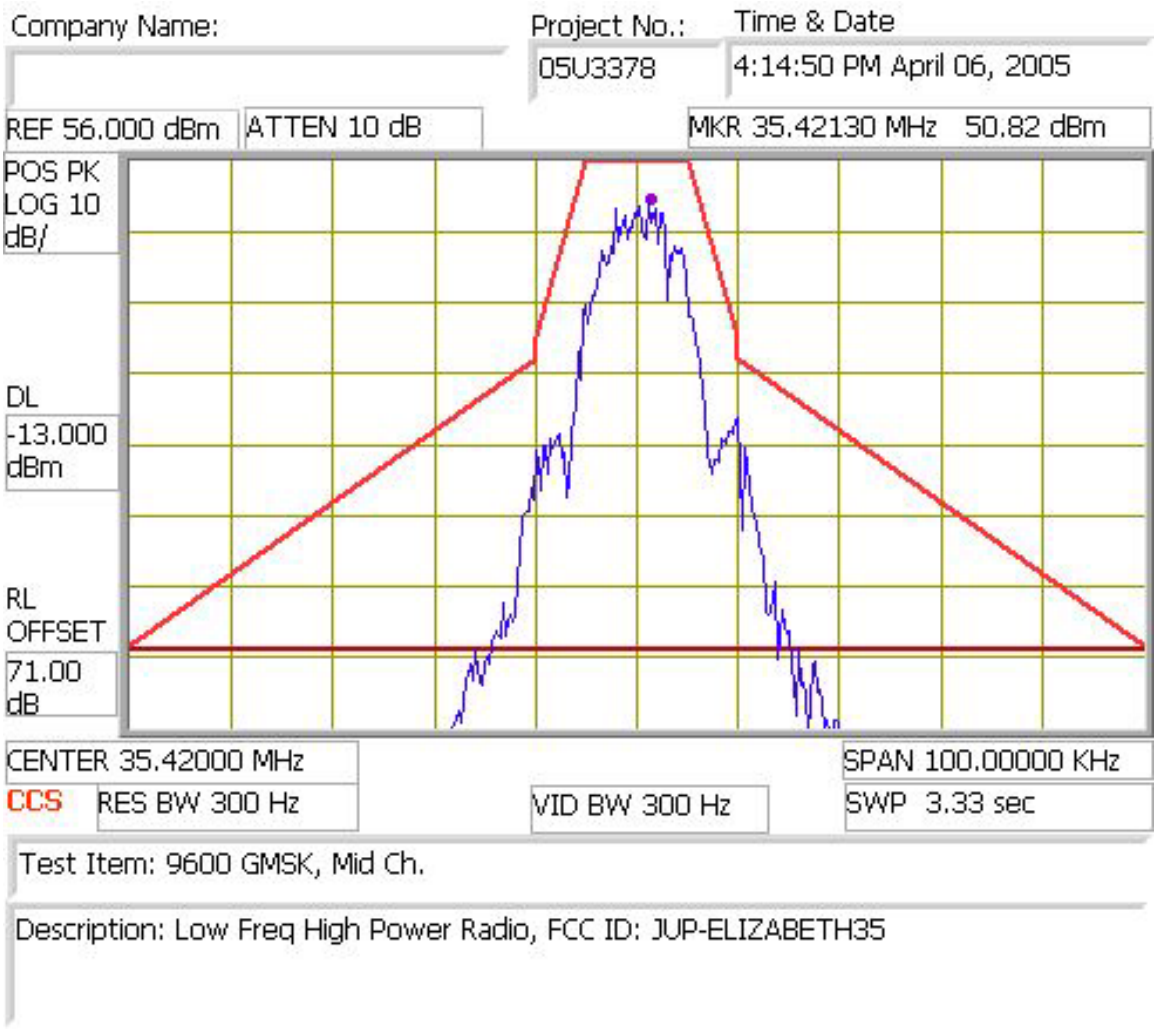
Low Channel 9600 bps GMSK



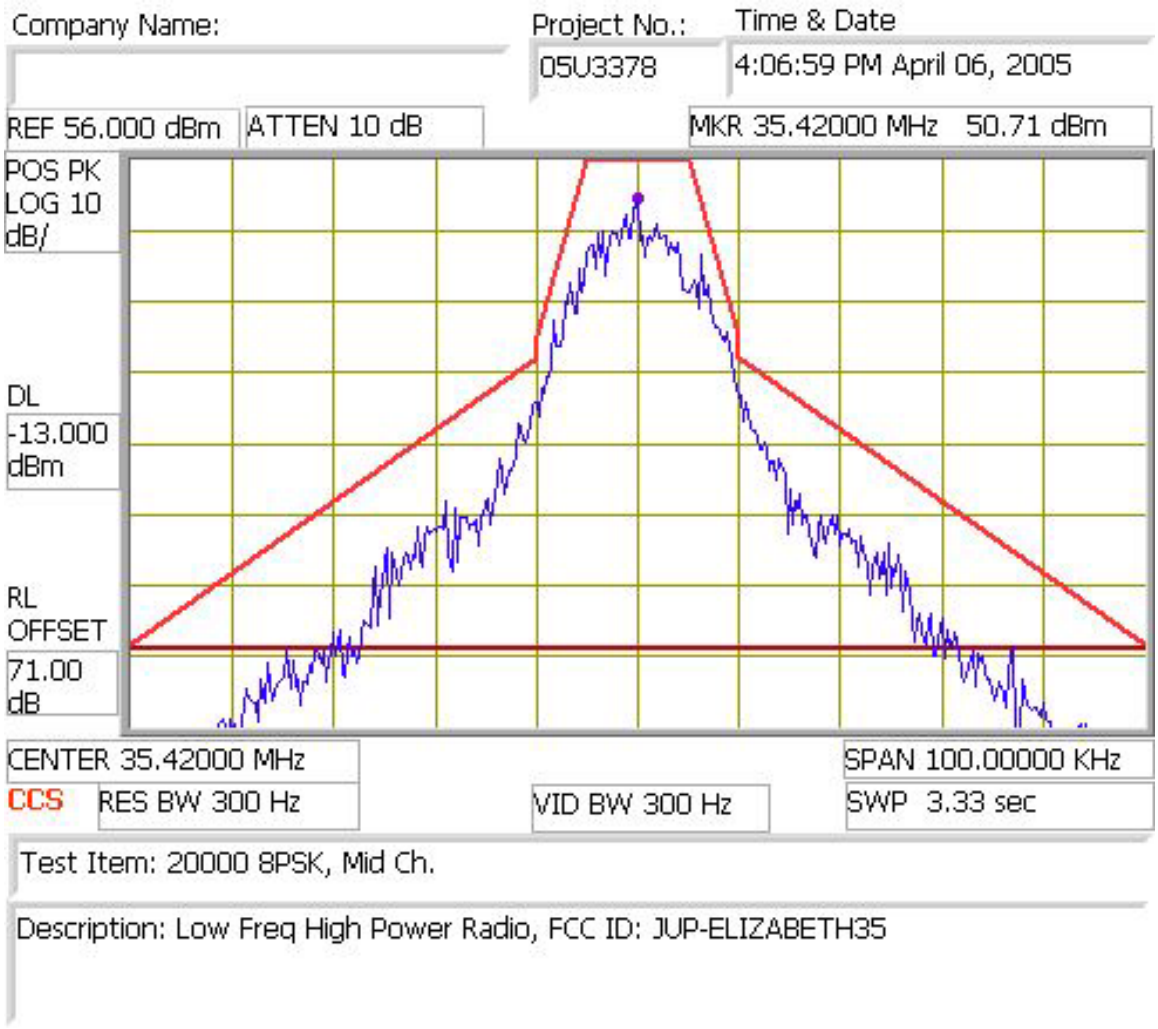
Low Channel 20000 bps 8PSK



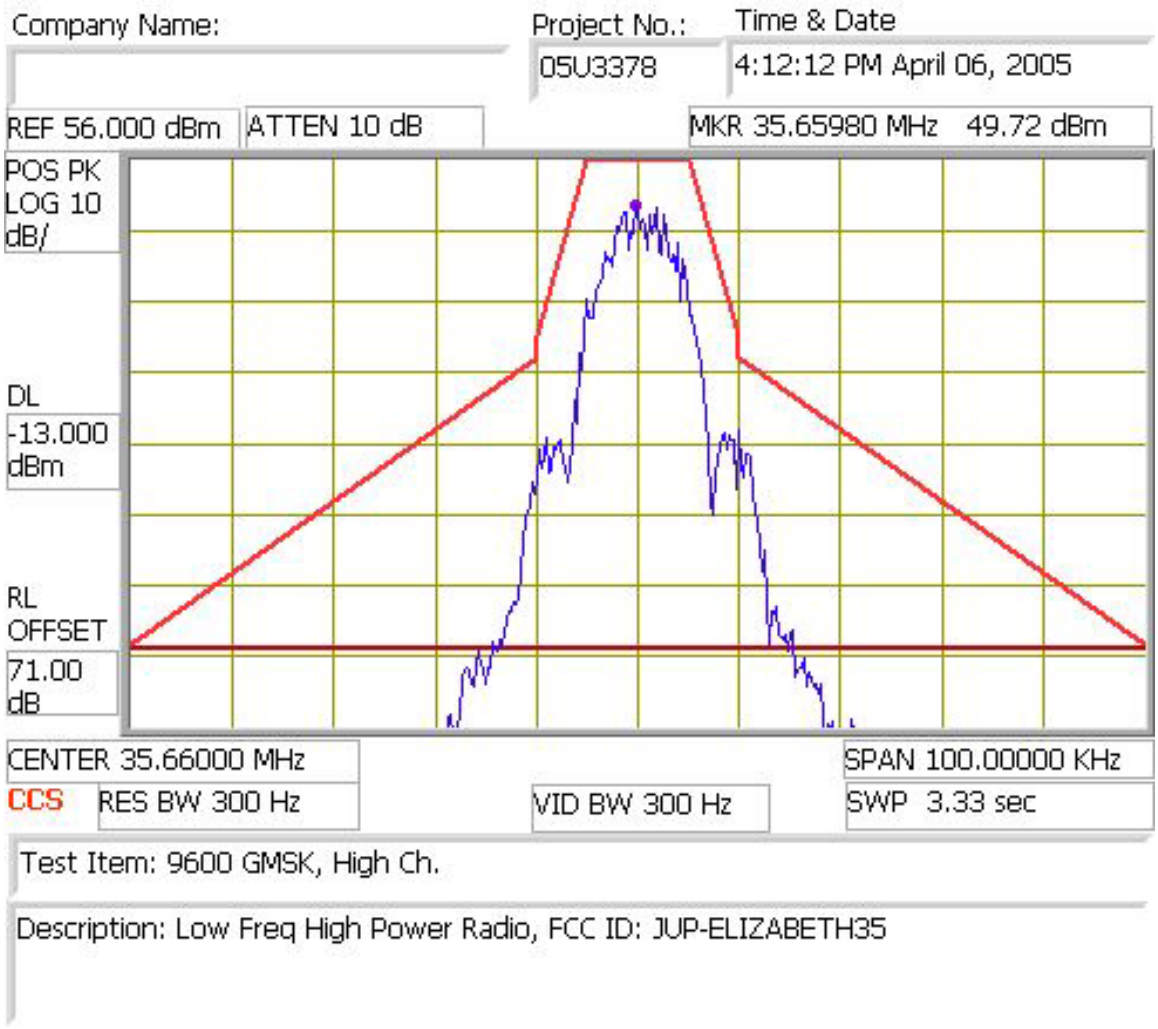
MID Channel 9600 bps GMSK



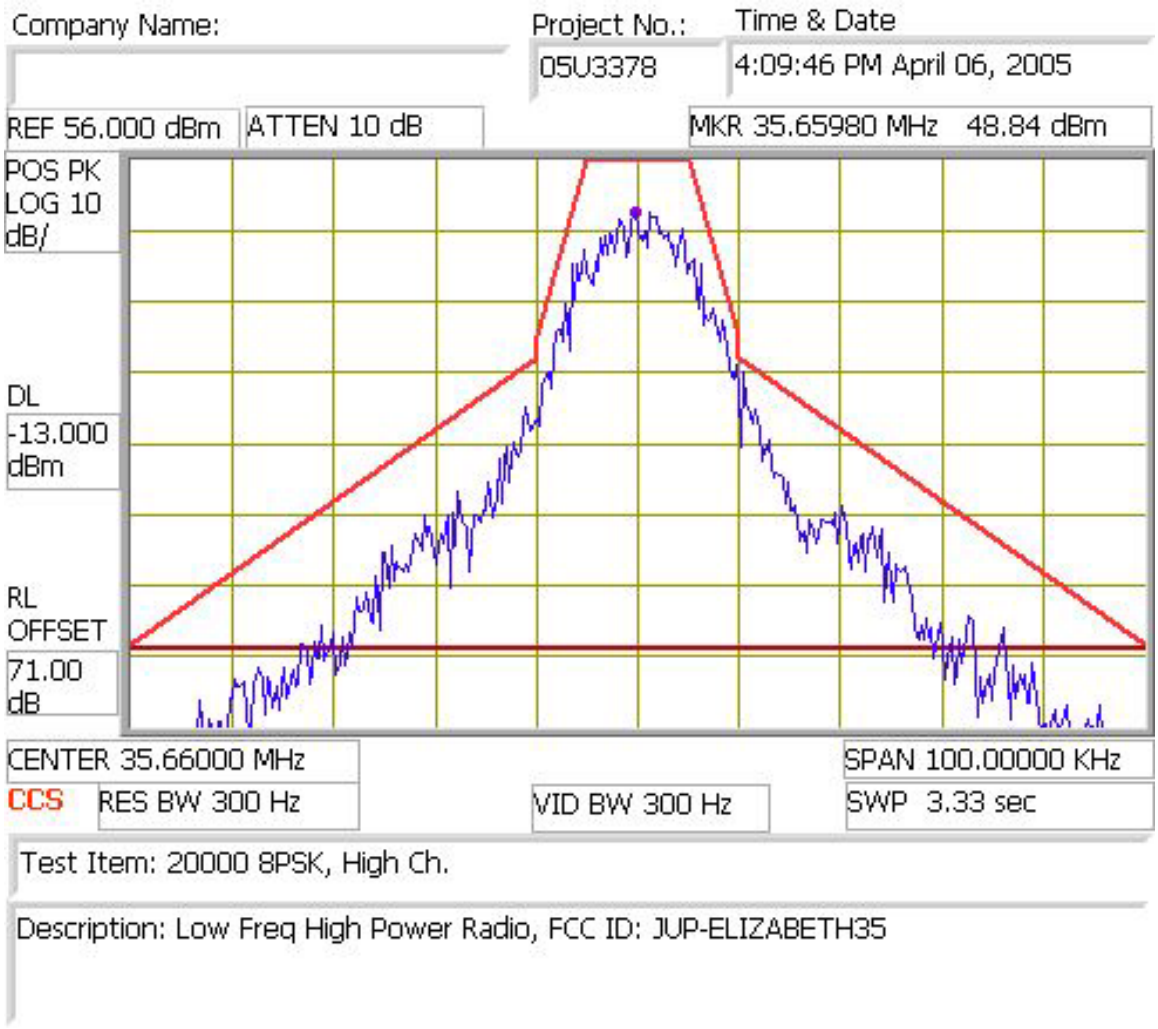
MID Channel 20000 bps 8PSK



HIGH Channel 9600 bps GMSK



HIGH Channel 20000 bps 8PSK



Section 2.1049 Occupied Bandwidth
Requirement/Limit: 22.531

20 kHz maximum

Measurement equipment used:

HP 8542E EMI Receiver
HP 85420E RF Filter Section
30 dB attenuator, 600 watts
20 dB attenuator, 50 watts
20 dB attenuator, 2 watts
4 short lengths coaxial cable

Test set-up: Refer to Figure 1, above

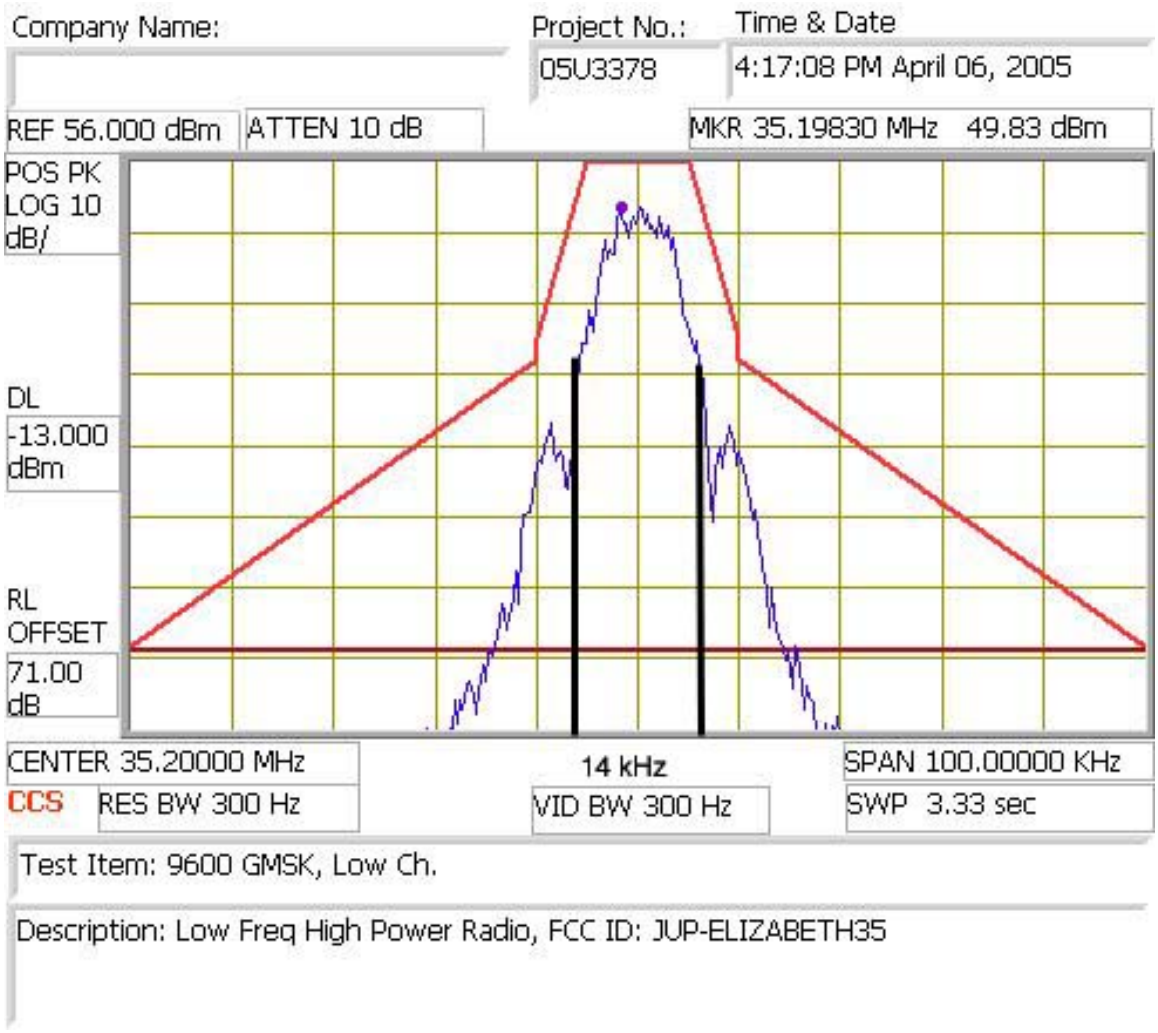
Test Procedures and Results:

Occupied bandwidth was measured manually using graphical means .

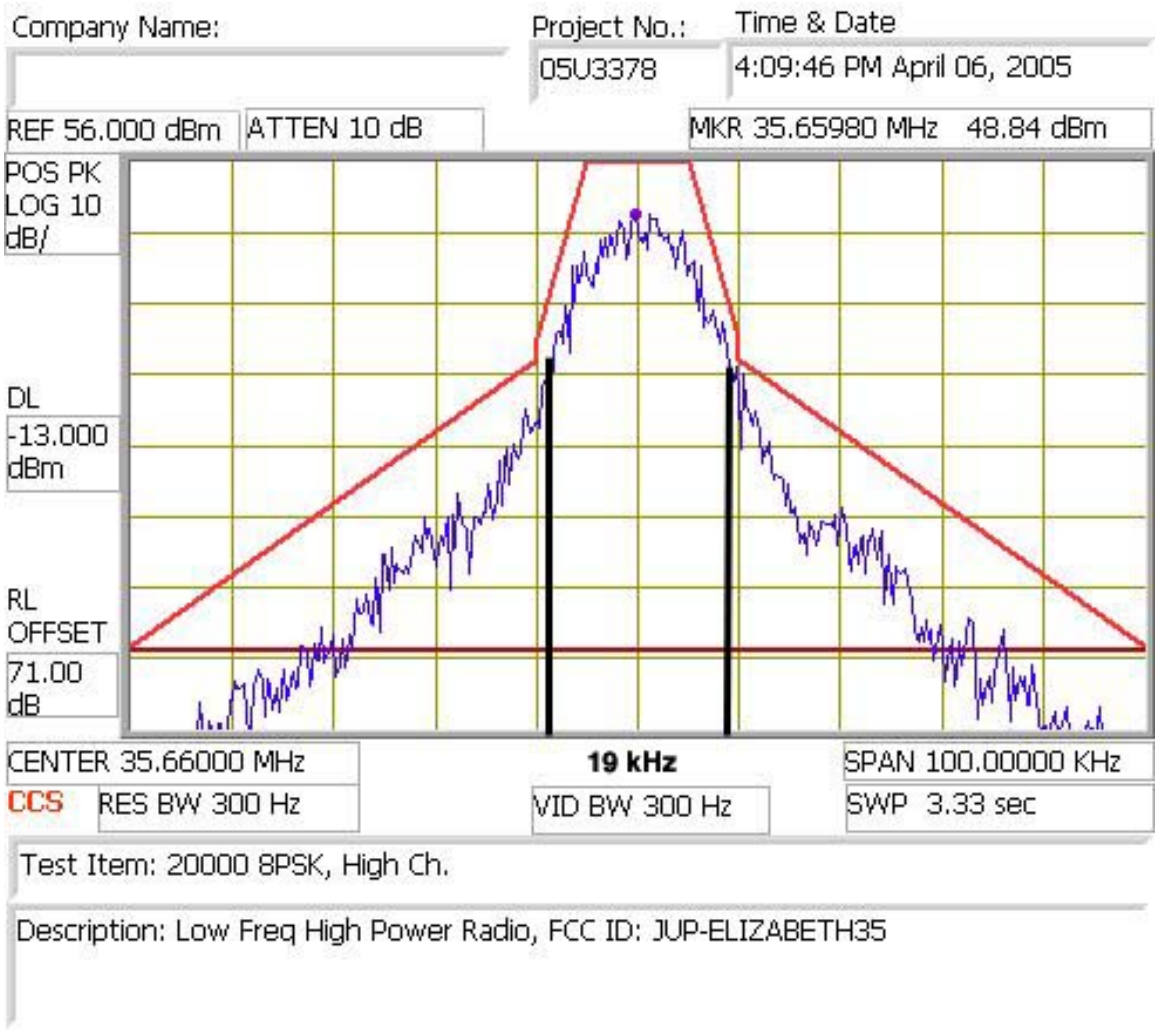
For 9600 bps GMSK worst case (LOW channel) occupied BW = 14 kHz
For 20000 bps 8PSK worst case (HIGH channel) occupied BW = 19 kHz

Occupied bandwidth is per definition in Rule para. 2.1 (99%, or 20 dB BW)

Occupied Bandwidth, 9600 bps GMSK



Occupied Bandwidth, 20000 bps 8PSK



Section 2.1051 Spurious and Harmonic Emissions at Antenna Terminals
Requirement/Limit: 22.531

Measurement equipment used:

HP 8542E EMI Receiver
HP 85420E RF Filter Section
30 dB attenuator, 600 watts
20 dB attenuator, 50 watts
20 dB attenuator, 2 watts
4 short lengths coaxial cable

Test set-up: Refer to Figure 1, above

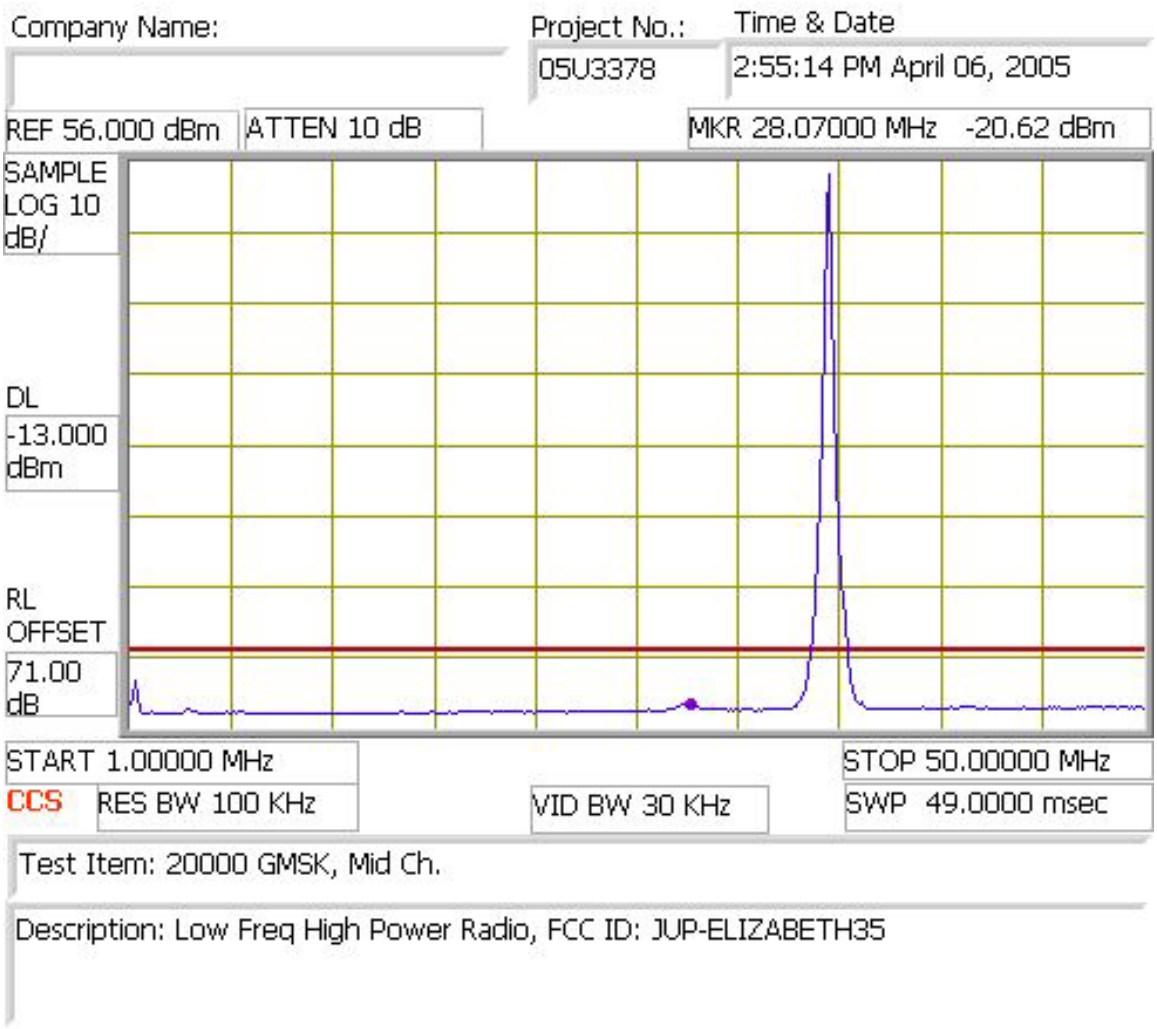
Test Procedures

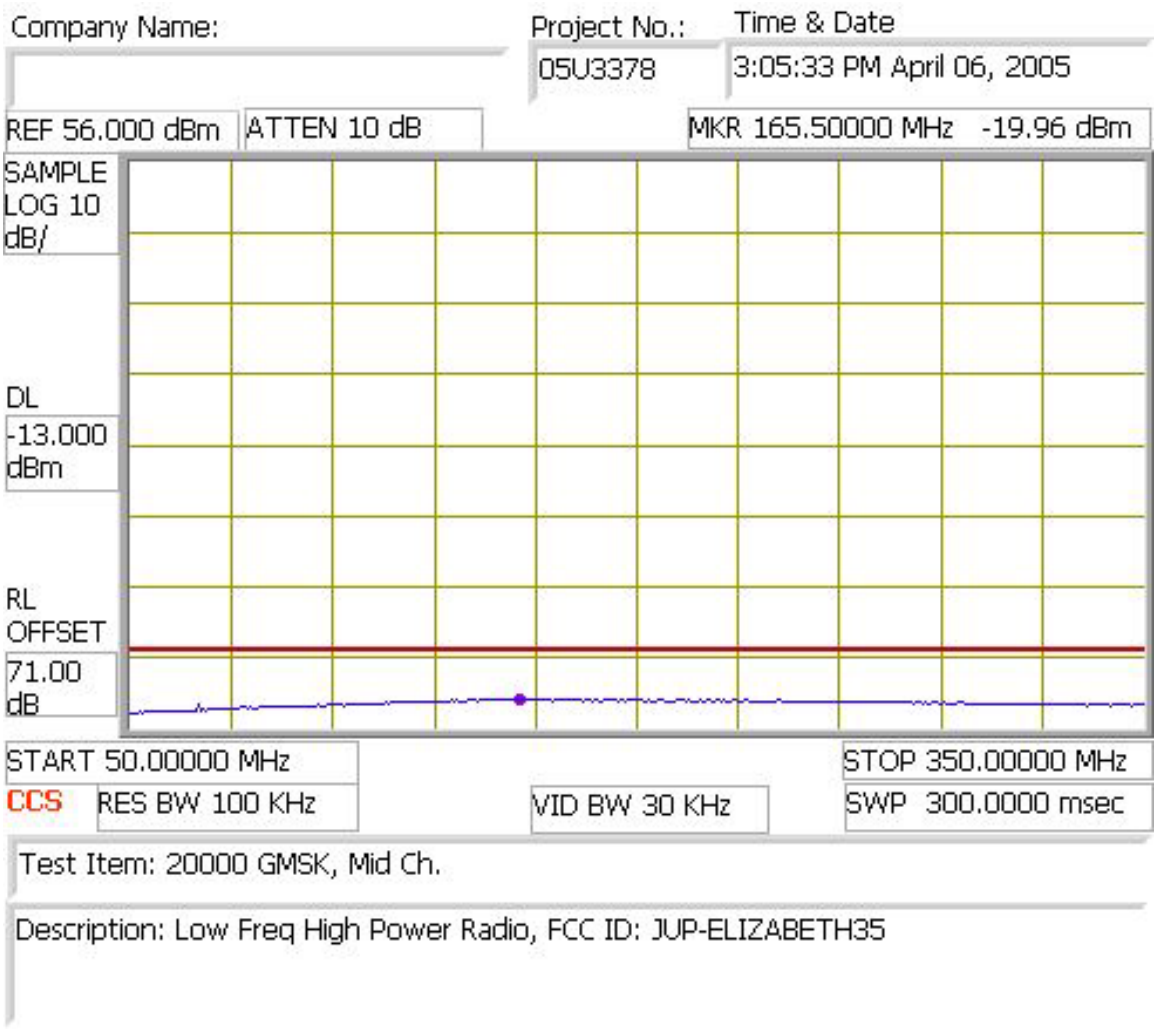
1. Set spectrum analyzer to TX output center frequency, RES BW = 100 kHz, VID BW = 100 kHz Hz.
2. Set spectrum analyzer to record Average reading.
3. Set DISPLAY LINE to a level 60 dB below flat top peak
4. Record transmitter output spectrum from 1 MHz to 10^{th} harmonic of TX output frequency
5. Plot spectrum analyzer output traces.

Test Results

PASS. Refer to data plots below.

Spurious Emissions, Antenna Conducted Output Spectrum Analyzer Graph

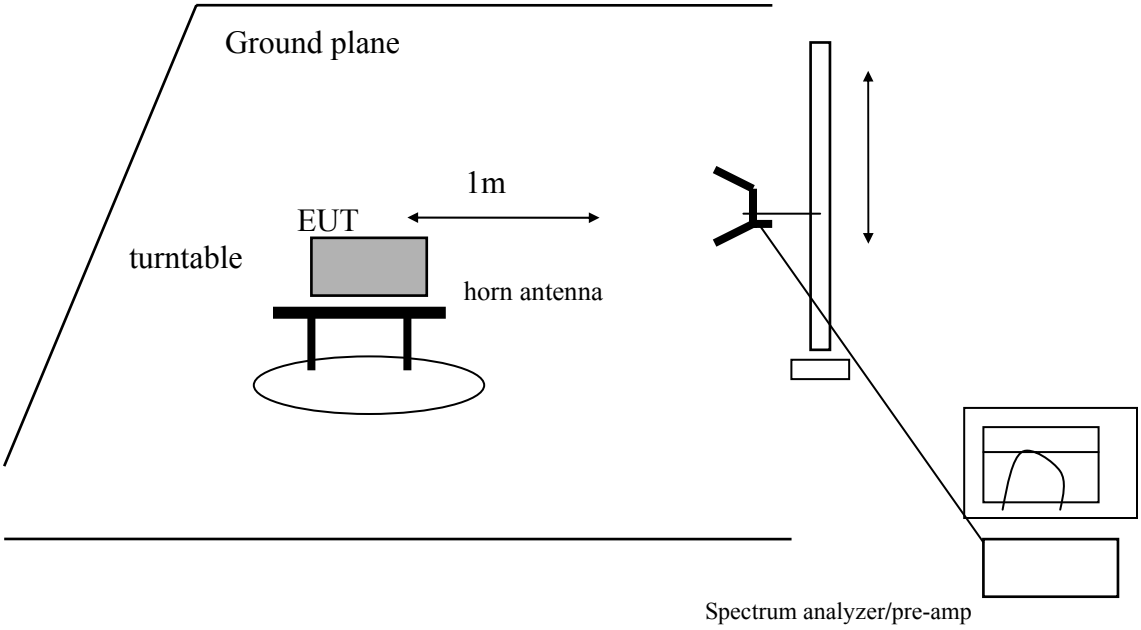

Company Name:
Project No.:
05U3378
Time & Date
2:55:14 PM April 06, 2005
REF 56.000 dBm
ATTEN 10 dB
MKR 28.07000 MHz -20.62 dBm
SAMPLE
LOG 10
dB/
DL
-13.000
dBm
RL
OFFSET
71.00
dB
START 1.00000 MHz
STOP 50.00000 MHz
CCS
RES BW 100 KHz
VID BW 30 KHz
SWP 49.0000 msec
Test Item: 20000 GMSK, Mid Ch.
Description: Low Freq High Power Radio, FCC ID: JUP-ELIZABETH35

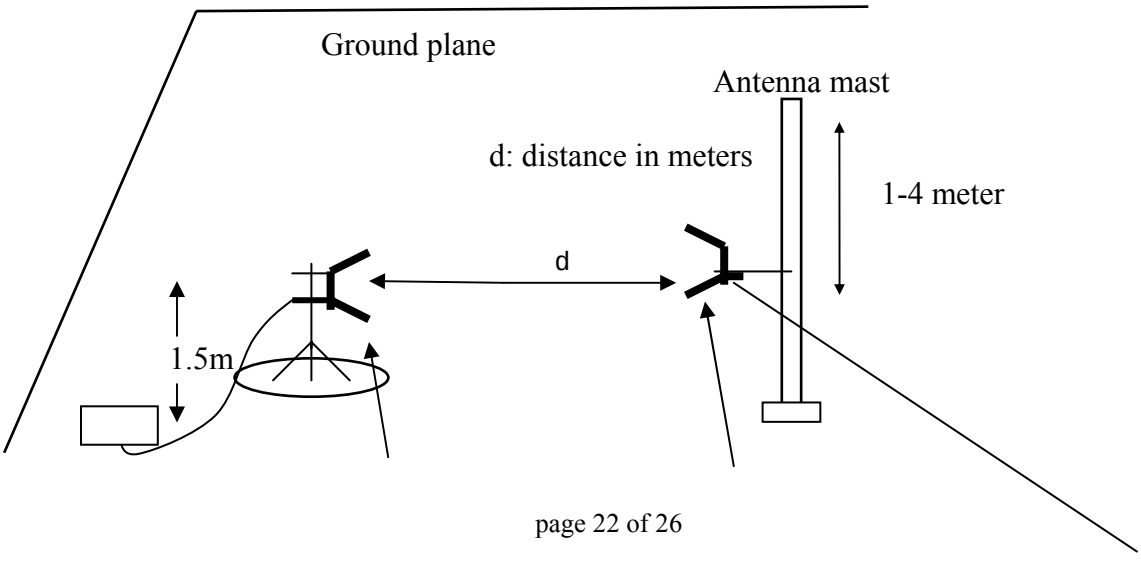

Company Name:
Project No.:
05U3378
Time & Date
3:05:33 PM April 06, 2005
REF 56.000 dBm
ATTEN 10 dB
MKR 165.50000 MHz -19.96 dBm
SAMPLE
LOG 10
dB/
DL
-13.000
dBm
RL
OFFSET
71.00
dB
START 50.00000 MHz
STOP 350.00000 MHz
CCS
RES BW 100 KHz
VID BW 30 KHz
SWP 300.0000 msec
Test Item: 20000 GMSK, Mid Ch.
Description: Low Freq High Power Radio, FCC ID: JUP-ELIZABETH35

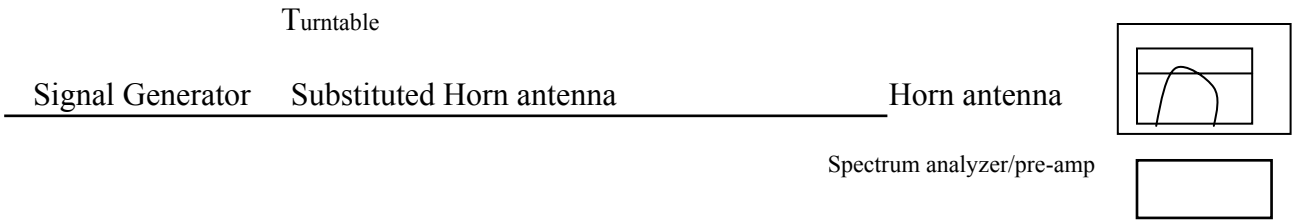
Section 2.1053 Field Strength of Spurious and Harmonic Radiation
Requirement/Limit: 22.531

Measurement equipment used
HP 8542E EMI Receiver
HP 85420E RF Filter Section
30 dB attenuator, 600 watts
20 dB attenuator, 50 watts
20 dB attenuator, 2 watts
4 short lengths coaxial cable

Test Set-Up







Minimum Requirement

-13 dBm EIRP beyond 250% of authorized bandwidth

Test Method

The antenna output port of the EUT was terminated with a 50 ohm load. 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 EUT was removed and was replaced by a substitution antenna connected via coax to a signal generator. The generator output was set to each emission frequency detected, the search antenna was raised and lowered, the turntable was rotated, until the maximum emission level was obtained. The signal generator output level was adjusted to match the radiated emission level from the EUT. After correcting for substitution antenna factor and generator cable loss, output power level is compared to the limit.

Test Results

Pass. All emissions detected were at least 18.5 dB below limits. Refer to test data below.

04/06/05 **30 - 1000MHz Substitution Measurement**

Compliance Certification Services, Morgan Hill 5m Chamber Site

Test Engr:William Zhuang
Project #:05U3378
Company:Tom Cokenias
EUT Descrip.:Low Freq High Power Radio
EUT M/N:Low Band
Test Target:FCC Part22
Mode Oper:CW

Test Equipment:

Bilog Antenna	Cable	Pre-amplifer 8447D	Limit
5m Chamber Sunol Bilog	5m Chamber Cable		EIRP

f MHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	Gain (dBd)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Notes
CW High Ch										
71.28	35.8	H	-51.6	1.2	-1.6	-3.8	-56.5	-13.0	-43.5	
107.44	41.1	H	-40.3	1.4	-1.6	-3.7	-45.4	-13.0	-32.4	
142.64	53.2	H	-27.2	1.5	-0.6	-2.7	-31.5	-13.0	-18.5	
178.48	39.0	H	-42.8	1.7	2.9	0.8	-43.7	-13.0	-30.7	
214.64	44.8	H	-38.3	1.9	5.8	3.6	-36.6	-13.0	-23.6	
250.48	32.9	H	-48.9	1.9	6.1	3.9	-46.9	-13.0	-33.9	
321.84	33.7	H	-45.1	2.2	6.0	3.9	-43.4	-13.0	-30.4	
61.04	40.1	V	-47.9	1.1	-2.2	-4.3	-53.4	-13.0	-40.4	
107.44	44.3	V	-37.1	1.4	-1.6	-3.7	-42.2	-13.0	-29.2	
142.64	50.7	V	-30.4	1.5	-0.6	-2.7	-34.6	-13.0	-21.6	
178.48	35.6	V	-46.4	1.7	2.9	0.8	-47.3	-13.0	-34.3	
214.64	40.4	V	-42.6	1.9	5.8	3.6	-40.8	-13.0	-27.8	
321.84	30.9	V	-48.9	2.2	6.0	3.9	-47.1	-13.0	-34.1	
CW Mid Ch										
70.64	36.5	H	-50.9	1.2	-1.7	-3.8	-55.9	-13.0	-42.9	
106.42	41.5	H	-40.0	1.4	-1.5	-3.6	-45.0	-13.0	-32.0	
141.68	53.0	H	-27.4	1.5	-0.7	-2.9	-31.7	-13.0	-18.7	
177.84	42.1	H	-39.6	1.7	2.9	0.7	-40.6	-13.0	-27.6	
213.04	45.8	H	-37.3	1.9	5.8	3.6	-35.6	-13.0	-22.6	
320.24	37.0	H	-41.9	2.1	6.0	3.9	-40.2	-13.0	-27.2	
70.64	31.0	V	-53.7	1.2	-1.7	-3.8	-58.7	-13.0	-45.7	
106.48	43.4	V	-38.1	1.4	-1.5	-3.7	-43.1	-13.0	-30.1	
141.68	49.1	V	-31.9	1.5	-0.7	-2.9	-36.2	-13.0	-23.2	
177.52	36.4	V	-45.6	1.7	2.8	0.7	-46.5	-13.0	-33.5	
213.04	42.9	V	-40.2	1.9	5.8	3.6	-38.4	-13.0	-25.4	
319.60	32.7	V	-47.1	2.1	6.0	3.9	-45.3	-13.0	-32.3	
CW Low Ch										
70.64	38.6	H	-48.8	1.2	-1.7	-3.8	-53.8	-13.0	-40.8	
105.84	44.9	H	-36.8	1.4	-1.4	-3.6	-41.7	-13.0	-28.7	
141.04	49.2	H	-31.1	1.5	-0.8	-2.9	-35.6	-13.0	-22.6	
176.24	45.2	H	-36.4	1.7	2.7	0.6	-37.5	-13.0	-24.5	
211.76	45.6	H	-37.6	1.9	5.8	3.6	-35.8	-13.0	-22.8	
317.68	38.9	H	-40.0	2.1	6.0	3.9	-38.3	-13.0	-25.3	
70.64	33.6	V	-51.0	1.2	-1.7	-3.8	-56.0	-13.0	-43.0	
106.16	45.9	V	-35.7	1.4	-1.5	-3.6	-40.7	-13.0	-27.7	
141.36	46.4	V	-34.6	1.5	-0.7	-2.9	-39.0	-13.0	-26.0	
176.24	39.2	V	-42.7	1.7	2.7	0.6	-43.8	-13.0	-30.8	
211.44	44.0	V	-39.2	1.9	5.8	3.6	-37.4	-13.0	-24.4	
317.68	39.6	V	-40.3	2.1	6.0	3.9	-38.5	-13.0	-25.5	

2.1055 Frequency Stability

Requirement/Limit: Section 22.355

Frequency Tolerance : .002% (20 parts per million)

The TX VCO is 10 MHz, obtained from an oscillator module manufactured by Trimble Navigation Ltd. Known as "Thunderbolt". This oscillator is highly stable over temperature and time with a frequency variance of 1 part in 10^{-12} . Thunderbolt data sheet is provided in a separate attachment.

Test Site

All testing was performed at Compliance Certification Services either by me or under my supervision. Conducted and radiated emissions were performed using test equipment with calibration traceable to NIST, and following test procedures accepted by the industry.

THOMAS N. COKENIAS
Consultant, EMC&Radio Type Approvals
Agent for Trimble Navigation Ltd.