Access Phone

ADI Limited

FCC ID: N6FSRT7010
Model: SRT7010/Isonex3000

EXHIBIT 1

Engineering Report

APREL Laboratories

Report on

Assessment of Compliance for Certification of Cellular telephone with Respect to FCC Rules & Regulations Parts 2 and 22

FCC ID: N6FSRT7010

ADI Limited

SRT7010/Isonex 3000

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Engineering Report

Subject: **Assessment of Compliance for Certification of Cellular Telephone with Respect to FCC Rules & Regulations Parts 2 and 22**

Manufacturer: ADI LIMITED

FCC ID: **N6FSRT7010**

Equipment: **Desk Mount Cellular Telephone**

Model: **SRT7010/ISONEX 3000**

Client: **ADI LIMITED**

Address: 4 Talavera Road
North Ryde
New South Wales
Australia

Project #: ADIB-SRT7010-3060

Prepared By: APREL Laboratories,
Regulatory Compliance Division

Approved by: _____ Date: Dec. 9, 1998

Jay Sarkar
Director, Standards & Certification

Released by: _____ Date: Dec 9/98

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FCC ID: N6FSRT7010
Applicant: ADI LIMITED
Equipment: Desk Mount Cellular Telephone
Model: SRT7010/ISONEX 3000
Standard: FCC Rules and Regulations Part 2 & 22

ENGINEERING SUMMARY

This report contains the results of the engineering evaluation performed on an 800 MHz AMPS analog Desk Mount Cellular Telephone. The tests were carried out in accordance with FCC Rules and Regulations Part 2 and Part 22.

Based on the test results, it is certified that the product meets the requirements as set forth in the above specifications for certification.

Technical description of the Cellular Phone in accordance with the Commissions rules and regulations, FCC part 2 paragraph 2.983 are presented in page 7 of this report.

Summary of the Results

Test Description	Exhibit No.	Page No.	Test Set-up Figure No.	Results Summary
RF Power Output as Radiated Ref. Paragraph 2.985(a) Part 22.913(a)	2	13	15	**Passed**
Modulation Characteristics Ref. Paragraph 2.987 & Part 22.915	2	17	19	**Passed**
Audio Frequency Response Ref. Paragraph 2.987 & Part 22.915(d)(1)	2	23	25	**Passed**
Occupied Bandwidth Ref. Paragraph 2.989 & Part 22.917(b)(d)	2	29	31	**Passed**
Spurious Emissions at Antenna Terminals Ref. Paragraph 2.991 & Part 22.917(e)(f)	2	44	47	**Passed**
Field Strength of Spurious Radiation Ref. Paragraph 2.993 & Part 22.917(e)	2	50	54	**Passed**
Frequency Stability Ref. Paragraph 2.995	2	55	56	**Passed**

FCC SUBMISSION INFORMATION

FCC ID:	**N6FSRT7010**
Electronic Serial Number:	E3002762 (HEX)
Equipment:	Desk Mount Cellular Telephone
Model:	SRT7010/ISONEX 3000
For:	Certification
Applicant:	ADI Limited 4 Talavera Road North Ryde New South Wales 2113 Australia
Manufacturer:	ADI Limited 4 Talavera Road North Ryde New South Wales 2113 Australia
Test Laboratory:	APREL Laboratories 51 Spectrum Way Nepean, Ontario Canada K2R 1E6

MANUFACTURER'S DATA

Equipment Type:	Desk Mount Cellular Telephone
Model:	SRT7010/ISONEX 3000
Electronic Serial Number:	E3002762 (HEX)
Reference:	FCC Rules and Regulations Parts 2 and Part 22
Manufacturer:	ADI LIMITED
Power Source:	13.6 VDC 3.5 Amps. Wall mounted p/s with 120 VAC input
Development Stage of Unit:	Production

GENERAL SPECIFICATIONS

1.	Frequency Range:	824 - 849 MHz (Transmitter), 869 - 894 MHz (Receiver)
2.	Number of Channels:	832
3.	Standard Duty Cycle:	Continuous
4.	Channel Spacing:	30 kHz
5.	Rated Transmitted: Output Power	30 mW – 3W
6.	Type of Modulation:	FM
7.	Antenna Impedance	50 Ω

CHANNELS TESTED

Channel #384	836.52 MHz
Channel #799	824.04 MHz
Channel #991	848.97 MHz

INTRODUCTION

General

This report describes the results of the tests conducted on a Desk Mount Cellular Telephone, model SRT7010/ISONEX 3000 manufactured by ADI LIMITED.

Test Facility

The tests were performed for ADI LIMITED by APREL Laboratories at APREL's EMI facility located in Nepean, Ontario, Canada. The laboratory operates an (3m and 10m) Open Area Test Site (OATS). The measurement facility is calibrated in accordance with ANSI C63.4-1992.

A description of the measurement facility in accordance with the radiated and AC line conducted test site criteria per ANSI C63.4-1992 is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations.

APREL's registration number is 31040/SIT (1300F2)

APREL is accredited by Standard Council of Canada, under NAPTO program (ISO Guide 25). APREL is also accredited by Industry Canada (formerly DOC) and recognised by the Federal Communications Commissions (FCC).

Standard

The evaluation and analysis were conducted in accordance with FCC Rules and Regulations Parts 2 and 22.

Test Equipment

The test equipment used during the evaluation is listed in Appendix A. Calibration of all test equipment's are performed at 12 months intervals. All equipment used is calibrated or verified in accordance with the intent of AQAP-6/MIL-STD-45662.

Environmental Conditions

Measurements were conducted under normal laboratory conditions including open area test site.

- Temperature: 23 °C ± 2
- Relative Humidity: 30 - 50 %
- Air Pressure: 101 kPa ± 3

TECHNICAL DESCRIPTION OF THE EQUIPMENT

Ref.: FCC Part2 paragraph 2.983

Range of Operating Power Levels
Ref: Paragraph 2.983 (d)(3)

30 mW — 3 W

Maximum Power Rating
Ref: Paragraph 2.983 (d)(4)

3 W

DC Voltages and Currents into Final Amplifier
Ref: Paragraph 2.983 (d)(5)

DC Voltage: 13.6 V
DC Current: The dc current into the final amplifier can not be measured because that part of the circuit can not be isolated without compromising the integrity of the unit and invalidating the test results.

Function of Semiconductors and Active Circuit Devices
Ref: Paragraph 2.983 (d)(6)

Reference Designator	Type	Function
POWER SUPPLY		
V25		Input transient suppression
V5	BZX84C18	Battery input overvoltage protection
V3	2N6507	Battery input overvoltage protection
V40	MBR51100	Snubber circuit
V41	MUR5140T3	+75V Rectifier
V43	MUR5140T3	-48V Rectifier
V44	MBR51100	-5V Rectifier
V46	MBR51100	Feedback rectifier
N12		+5V Voltage Regulator
N19	LM2577M	Switching power supply/controller

RF (TRANSMITTER)

N2	SAS230	RF Power Control Error Amplifier
N6		RF Power Amplifier
N17	LM317	+3.3V Voltage Regulator
N16	UMA1015M	Dual PLL Synthesizer (serves TX and RX)
N9	LM317	+8V Voltage Regulator
G3		Voltage Controlled Oscillator
G4	TX0525	9.6MHz Reference Oscillator
V1	BAT545	RF Power Control Detector
V24	PDTC114ET	RF Power Amplifier Shutdown
V23	BC848B	RF Power Amplifier Shutdown
V26, V32	PDTC114ET	Control Functions
V27, V33	PDTA114ET	Control Functions

RF (RECEIVER)

V28	BC558B	Low Noise Amplifier
V30		Low Noise Amplifier
V34	BC558	Low Noise Amplifier
V36	BF984	1-st Downconverter (mixer)
V29	BF984	1-st LO Amplifier
V45	BF5505	2-nd LO
V38	BZX84C5V1	LNA +10V reference
V39	BZX84C5V1	LNA +10V reference
N15	LM317	+3.3V Voltage Regulator
N18	SA606	IF Processor (Amplifier, 1-st to 2-nd IF Converter, FM Demodulator)
G2		Voltage Controlled Oscillator

BASEBAND

D6	UMA1000LT	Modem and Data Processor
D8	74HC6323A	9.6MHz Divider for Data Processor
N3	LM317	+4.3V Voltage Regulator
N5	SA5753DK	Analog Audio Processing
N8	SA5752DK	Analog Audio Processing

LINE INTERFACE UNIT

D5	14069UB	Ring Signal Amplifier
N11	LM2904D	20Hz Low Pass Filter
N12	L3220	Line Interface Functions
N13	LM2904D	Line Interface Buffer
N14	L3092	Line Interface Functions

CONTROL - DTMF

N1	MT88L705	DTMF Decoder
V4	PDTC114ET	Driver

AMPS SRT – CONTROL – INDICATORS

V5, V8, V13, V15, V19	PDTC114ET	Indicator Drivers
V16, V18	PDTA114ET	Indicator Drivers

CONTROL – MAIN

N4	LM317	+3.3V Voltage Regulator
D3	80CL560	CPU
D4	PSD312L-25JI	EPROM
D7	14538B	Reset Delay/Powerdown Control
D1	X24C02	EPROM
D2	X24C02	EPROM
D5	14069UB	Serial Port Buffer
V10	BZX84C5V1	Serial Port Spike Protection
V14	BZX84C5V1	Serial Port Spike Protection
V17	PDTC114ET	Reset Delay
V20	BZX84C5V1	Serial Port Spike Protection
V21	BZX84C5V1	Serial Port Spike Protection
V12, V22	BC848B	Serial Port Buffer
V11	BC858B	Serial Port Buffer

Complete Circuit Diagram
Ref: Paragraph 2.983 (d)(7)

See EXHIBIT 5.

Instruction Book
Ref: Paragraph 2.983 (d)(8)

See EXHIBIT 9.

Tune-up Procedure at Nominal Operating Power
Ref: Paragraph 2.983 (d)(9)

See EXHIBIT 9.

Circuitry and Devices for Determining and Stabilizing Frequency
Ref: Paragraph 2.983 (d)(10)

Means for Frequency Determination and Stabilization:

Frequency Stabilization is achieved with the Temperature Compensated Crystal Oscillator (TCXO) working as the Reference Oscillator. The output frequency is 9.6MHz ±2.5ppm over the operating temperature range. The Reference Oscillator is designated as G4 on the sheet #4 "RF (TRANSMITTER)" of the schematic diagram.

The Transmitter output frequencies are generated directly by the Frequency Synthesizer as shown on sheet # 4 of the schematic diagram.

The Receiver 1-st Local Oscillator frequencies are higher then received frequencies by 86.85MHz and are generated by the Frequency Synthesizer as shown on sheet # 5 of the schematic diagram.

Both synthesizers are using the 9.6MHz Reference Oscillator as the Frequency Reference.

Circuits for Suppression of Spurious Radiation, Limiting of Modulation, and Limiting of Power
Ref: Paragraph 2.983 (d)(11)

(i) Suppression of Spurious Radiation:

The Spurious Emissions are suppressed using appropriate shielding and filtering techniques. The antenna diplexer is used as the bandpass filter for the transmitter as shown on sheet # 4 of the schematic diagram.

(ii) Limiting of FM Deviation:

The transmitter is equipped with the system to automatically limit the frequency deviation to ±12kHz. This function is performed by software controlled specialized audio processing

integrated circuits N5 and N8 as shown on sheet # 7 of the schematic diagram. These circuits also include pre-emphasis and audio filtering.

(iii) Limiting of RF Power

The RF Output Power of the Transmitter is controlled by the circuitry shown on sheet # 4 of the schematic diagram.

The main components of the circuitry are Stripline Directional Coupler with the detector diode V1 located at the output of the RF Power Amplifier and the error amplifier N2 tied to the control input VAPC of the RF Power Amplifier.

Test Data
Ref: Paragraph: 2.983(e)

All applicable test data are provided in the section Test Results of this Engineering Report. See EXHIBIT 1.

Equipment Identification Plate/Label
Ref: Paragraph 2.983(f)

Equipment identification label is provided in the exhibits. See EXHIBIT 3.

Photographs of the Equipment
Ref: Paragraph 2.983(g)

Photographs of the equipment under test are provided in the exhibits. See EXHIBIT 7.

TEST RESULTS

FOR

Desk Mount Cellular Telephone SRT7010/ISONEX 3000

(SRT/ACCESSPHONE)

ADI Limited

Test: **RF Power Output as Radiated(ERP)**

Ref.: **FCC Part 2 paragraph 2.985(a) and Part 22 paragraph 22.913(a)**

Criteria: The effective radiated power of the mobile transmitter must not exceed 7 Watts. The equipment must employ means to limit the power to the minimum necessary to maintain successful communications. Power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in 2.983(d)(5).

Set-up: See Figure No. 1.

Environmental Conditions: Temperature: 23 °C ± 2.
Air pressure: 101 ± 3 kPa

Equipment: See Appendix A.

Procedure: RF Power Measurement by Radiated Method (ERP):

Test site: The radiated RF power measurement was taken at APREL Laboratory's open area test site (OATS). This open area test site is calibrated to ANSI C63.4 document and a description of the measurement facility is on file with the Federal Communications Commission and is in compliance with the requirement of Section 2.948 of the Commissions rules and regulations.(FCC File No.: 31040/SIT)

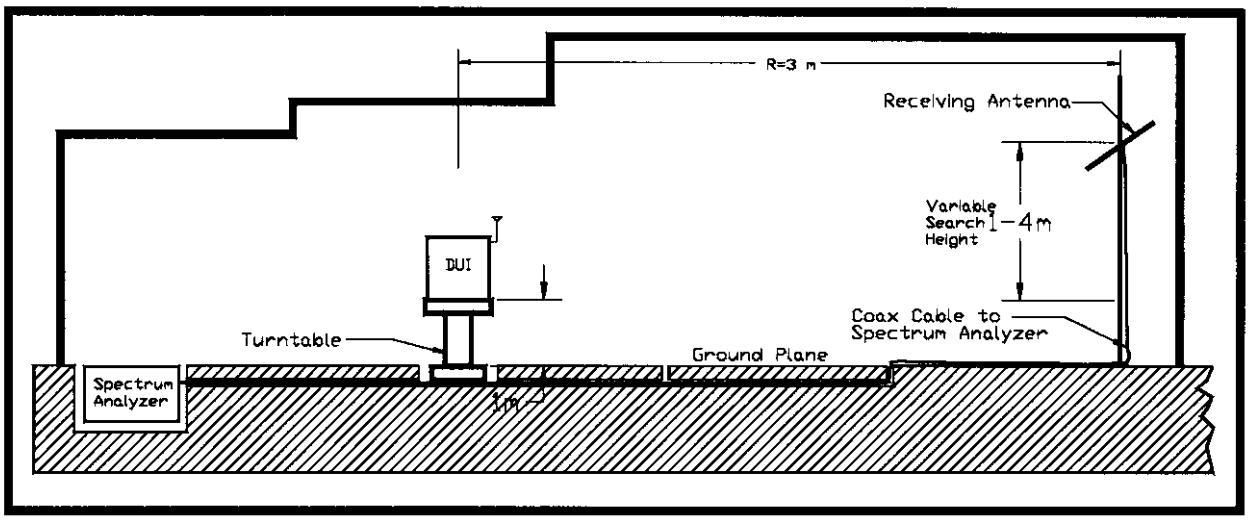
The test was set-up as illustrated in Fig.1. The mobile was configured to operate at maximum power (power level 0) with carrier unmodulated. The equipment under test was placed on a turntable positioned 3 meters away from the calibrated receiving antenna, which in turn was connected to the spectrum analyzer.

For each transmitter frequency, the receiver signal was **maximised** by rotating the turntable and adjusting the height of the receiving antenna. To obtain the actual ERP, the mobile was replaced by a half-wave vertically polarised antenna, RF power amplifier and signal generator. The center of the dipole antenna was placed in the same location as the mobile. The signal generator level was adjusted until the

reading on the spectrum analyzer was identical to that obtained when the mobile was on the turntable. The output of power amplifier was disconnected from the dipole and connected to an RF power meter. The effective radiated power was read directly form the power meter. DC power supplied to the RF output amplifier was also measured.

Results: **PASSED.** See Table 1.

Set Up Figure 1
Effective Radiated Power



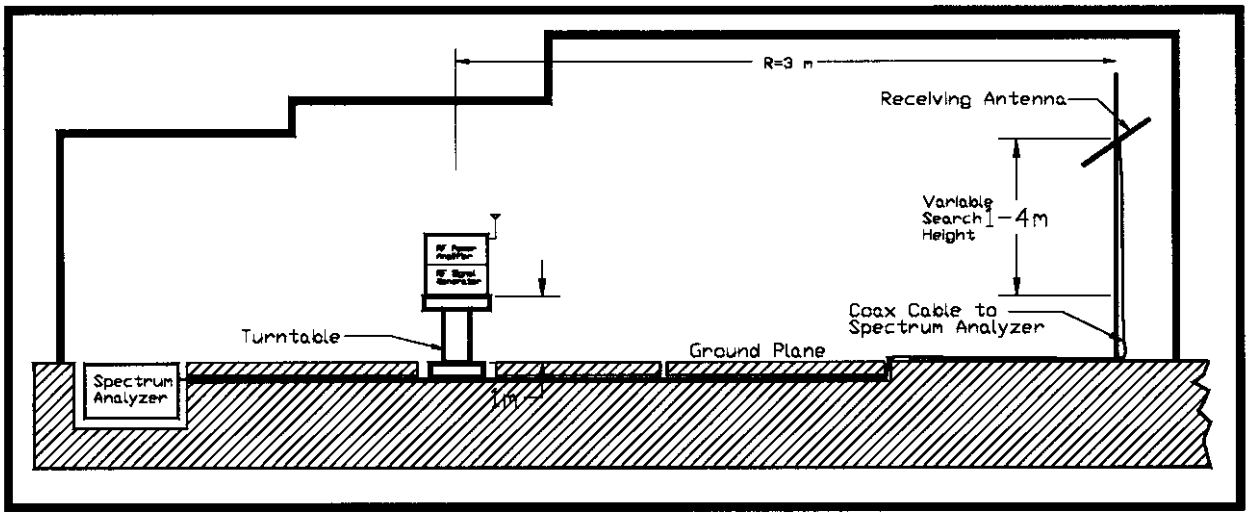


Table 1
RF Output Power Measurement
ERP

Channel No.	Nominal Transmit Frequency	Manufacturer's Rated Output Power (Power Level: 0)	Measured Output Power (ERP) (Power Level: 0)	DC Voltage Into final Amplifier	DC Current Into final Amplifier
	(MHz)	(mW)	(mW)	(V)	(A)
384	836.52	3000	2454	13.6	*
799	848.97	3000	2754	13.6	*
991	824.04	3000	2344	13.6	*

* Note: DC voltage into the final amplifier is 13.6 VDC. The dc current into the final amplifier can not be measured because that part of the circuit can not be isolated without compromising the integrity of the unit and invalidating the test results.

Test: **Modulation Characteristics**

Ref.: **FCC Part 2 paragraph 2.987 and Part 22 paragraph 22.915**

Criteria: a) The levels of the modulating signals shall be set to the following values:

(1) The instantaneous frequency deviations shall not exceed the rated system frequency deviation of ± 12 kHz ± 10 %

(2) The instantaneous frequency deviation resulting from the supervisory audio tones (SAT) must be ±2 kHz ± 10 %.

(3) The instantaneous frequency deviation resulting from the Signalling Tone (ST) must be ±8 kHz ± 10 %.

(4) The instantaneous frequency deviation resulting from wideband data signals must be ±8 kHz ± 10%.

b) Deviation limitation circuitry. Cellular transmitters must be equipped with circuitry that automatically prevents modulation levels for voice transmission from exceeding the limits specified above.

Set-up: See Figure No. 2.

Environmental Conditions: Temperature: 23 °C ± 2.
Air pressure: 101 ± 3 kPa

Equipment: See Appendix A.

Procedure: In order to confirm the modulation characteristics of the sample unit, the audio signal was injected to the transmitter via the standard telephone device connection RJ-11. This RJ-11 connector is provided for the telephone for voice communication and dialling. The antenna was detached and a RF communication test set was connected to the RF connector of the device under test through a 50Ω cable. The modulation characteristics were checked with the carrier modulated by voice (main

modulation), supervisory audio tone (SAT), signalling tone, and wideband data (WBD). The worst case data was recorded with voice modulation.

The transmitter was set to a channel near the centre of the band and adjusted for full rated system deviation. The audio input frequency was set to 300 Hz; the signal level was then varied from 90 dBµV to 138 dBµV in steps of 3 dB. The frequency deviation was measured and recorded for each signal level. The test was repeated for a modulation signal of 1000 Hz and 3000 Hz. A family of curves for the frequency deviation versus the modulation input voltage is shown in plot 1.

Results: **PASSED.** See Tables 2 & 3 and Plot 1.

It can be seen from the modulation deviation plot (plot 1) that a deviation level of 12 kHz ± 10% (10.8 — 13.8 kHz) is achieved. Modulation deviation of 11.7 kHz was achieved at 1000 Hz at an input level of 123.0 dBuV.

Set up Figure No.2
Modulation Limiting

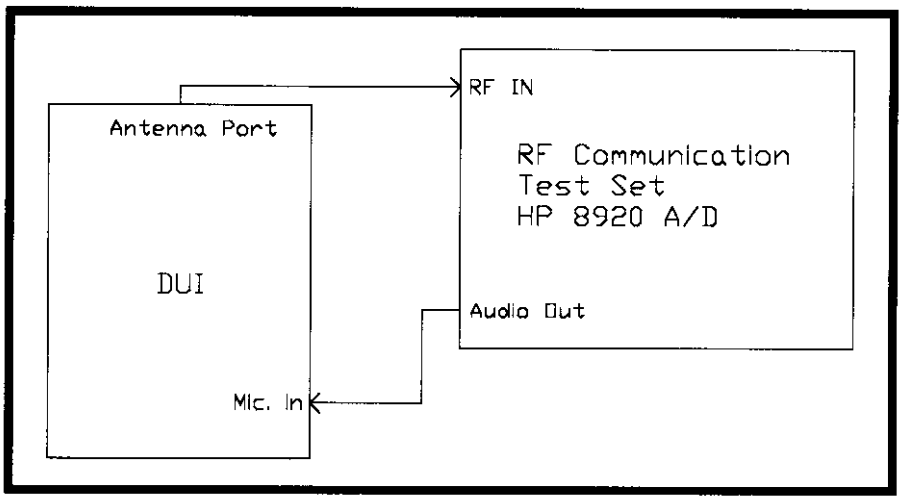


Table 2
Modulation Limiting
Frequency Deviation vs. Amplitude
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0

Injected Signal (dBμV)	Frequency Deviation (kHz)		
	at 300 Hz	at 1000 Hz	at 3000 Hz
90.0	0.1	0.7	1.9
93.0	0.1	1.0	2.7
96.0	0.2	1.4	3.8
99.0	0.3	1.9	5.4
102.0	0.4	2.7	7.7
105.0	0.5	3.8	8.4
108.0	0.7	5.4	8.7
111.0	1	7.6	8.8
114.0	1.5	10.9	8.9
117.0	2.2	11.5	9.0
120.0	3	11.6	9.1
123.0	4.3	11.7	9.2
126.0	8.5	11.6	9.2
129.0	9.8	11.6	9.2
132.0	9.5	11.5	9.2
135.0	9.6	11.4	9.2
138.0	9.3	11.4	9.2

Plot #1
Modulation Characteristics

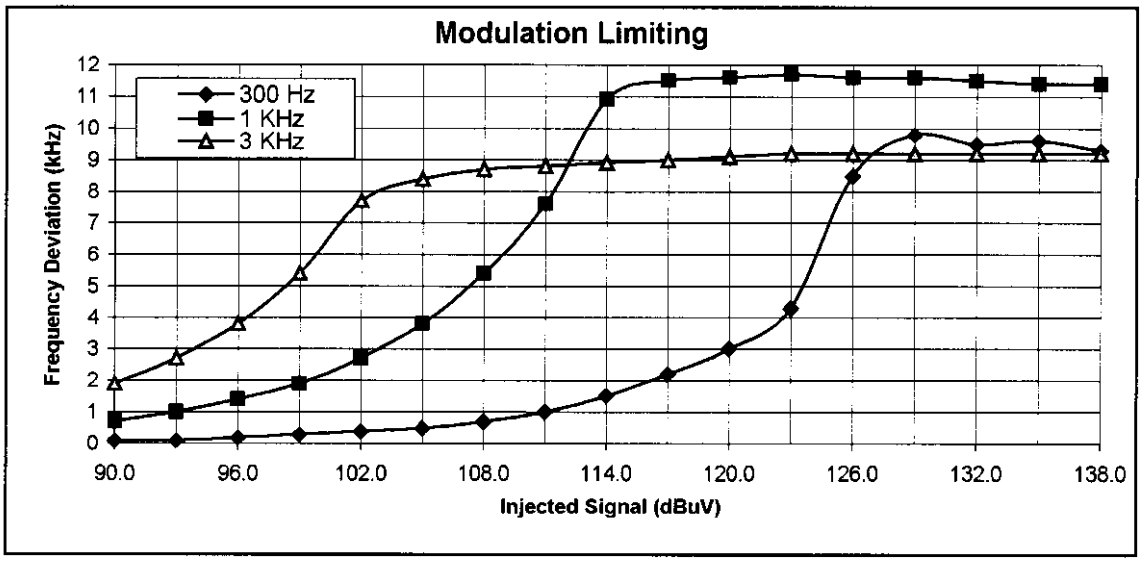


Table 3
Frequency Deviation
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0

Signal	Measured Frequency Deviation (± kHz)	Limit Frequency Deviation (± kHz)
SAT (6000 Hz)	2.0	1.8 – 2.2
ST (10 kHz)	7.8	7.2 – 8.8
Wideband data	8.0	7.2 – 8.8

Test: **Audio Frequency Response**

Ref.: **FCC Part 2 paragraph 2.987 (a) and Part 22 paragraph 22.915(d)(1)**

Criteria: Voice modulated communication equipment:

a) A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. The pre-emphasis characteristic will have a nominal +6 dB/octave response between 300 and 3000 Hz (22.906.a.4).

b) For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter shall be submitted to show that radio telephony signals applied to the modulator from the modulation limiter is attenuated as a function of frequency as specified below in Table 4. For mobile stations, these signals must be attenuated, relative to the level at 1 kHz as defined by Table below.

Table 4
Audio Filter Characteristics
Attenuation vs. Frequency of LPF

Frequency Band	Attenuation (Minimum)
3.0 kHz – 5.9 kHz	40 log (f/3) dB
5.9 kHz – 6.1 kHz	35 dB
6.1 kHz – 15.0 kHz	40 log (f/3) dB
> 15 kHz	28 dB

Note: f is the frequency of the signal in kHz.

Set-up: See Figure No. 3. In order to confirm the modulation characterisation of the device under test, the radio signal was injected to the transmitter via the standard telephone device connection RJ-11. This RJ-11 connection is provided for the telephone for voice communication and dialling. The antenna was detached and a RF communication test set was connected to the RF Communication Test Set was connected to the RF connector of the device under test through a 50 ohm cable.

Environmental Conditions: Temperature: 23 °C ± 2.
Air pressure: 101 ± 3 kPa.

Equipment: See Appendix A.

Procedure: a. The transmitter was operated with the compressor disabled. The standard test receiver of the RF Communication Test Set was set without standard 750 μs de-emphasis, with expandor disabled, and without C-message weighted filter. A sine wave signal was applied to the transmitter external audio port, the modulating frequency varied from 100 to 5000 Hz, and the demodulated audio level was recorded in Table 5.

To test the audio low-pass filter characteristics: the audio input frequency was adjusted to 1000 Hz, and the input level was set to 20 dB greater than that required to produce ± 8 kHz deviation. Note the output level on the test receiver. Using this output level as reference (0 dB), the modulating frequency was varied from 3000 Hz to 20,000 Hz, and the demodulated audio level was recorded in Table 6.

Results: **PASSED.** See Tables 5 & 6, and Plots 2 & 3.

Set up Figure No.3

Audio Frequency Response

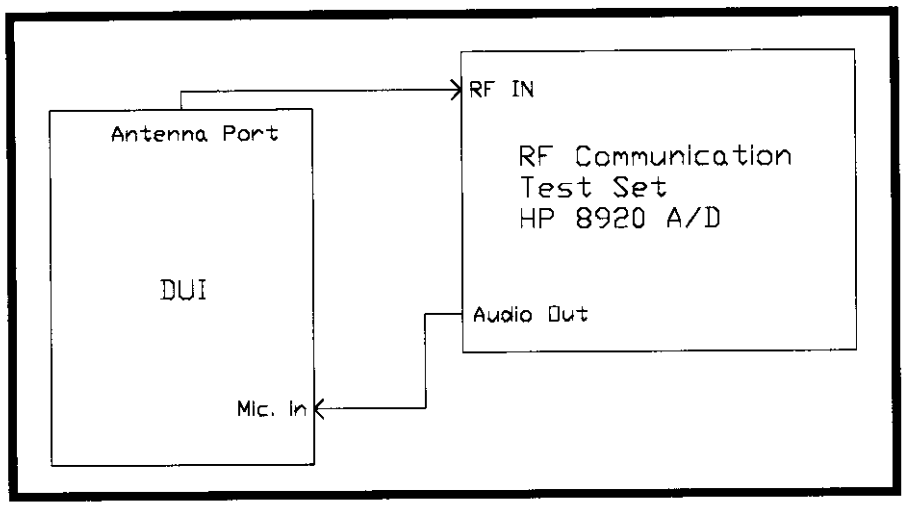


Table 5
Audio Frequency Response
Channel: 384
Power Level: 0

Frequency (kHz)	Demodulated Audio Level (dB)
0.1	-23.6
0.2	-15.7
0.3	-9.7
0.4	-6.2
0.5	-5.0
0.6	-3.4
0.7	-2.4
0.8	-1.7
1	0.0 **(Reference)**
1.5	3.5
2	5.6
2.5	6.8
3	8.0
4	-15.0
5	-28.0

Plot #2
Audio Frequency Response

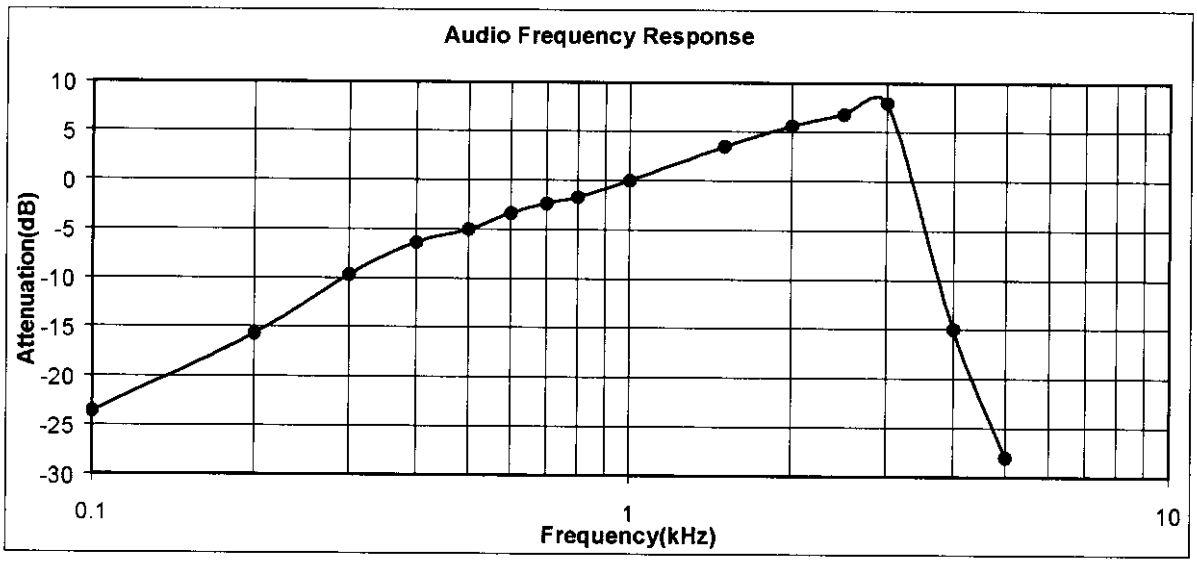
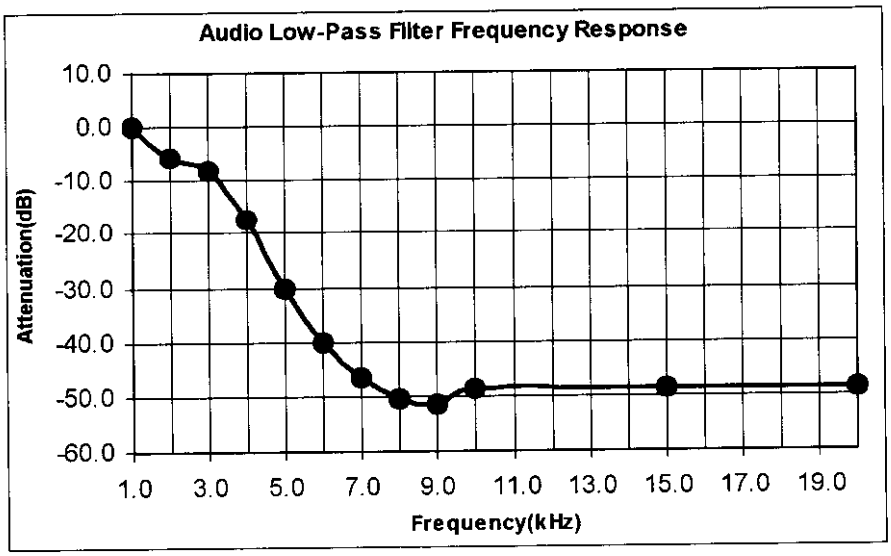


Table 6
Audio Low-Pass Filter Frequency Response
Channel: 384
Power Level: 0

Frequency (kHz)	Demodulated Audio Level (dB)
1.0 (ref.)	0.0
2.0	-5.6
3.0	-8.0
4.0	-17.2
5.0	-30.2
6.0	-40.2
7.0	-46.5
8.0	-50.5
9.0	-51.5
10.0	-48.5
15.0	-48.5
20.0	-48.5

Plot #3
Audio Low-Pass Filter Frequency Response



Test: **Occupied Bandwidth**

Ref.: **FCC Part 2 paragraph 2.989 and Part 22 paragraph 22.917(b)(d)**

Criteria: **F3E/F3D (Voice/ST, SAT) emission mask for use with audio filter:** The mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz : at least 26 dB.

(2) On any frequency removed from the carrier frequency by more than 45 kHz, up to the first multiple of the carrier: at least 60 dB or 43 + 10 log (P) dB, whichever is the lesser attenuation.

F1D emission mask (Wide Band Data):
The mean power of emission must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz: at least 26 dB.
(2) On any frequency removed from the carrier frequency by more than 45 kHz but not more than 90 kHz: at least 45 dB.
(3) On any frequency removed from the carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency: at least 60 dB or 43+10 log (P) dB, whichever is the lesser attenuation.

Set-up: See Figure No. 4.

Environmental Conditions: Temperature: 23 °C ± 2.
Air pressure: 101 ± 3 kPa

Equipment: See Appendix A.

Procedure: The first step in the procedure was to measure the unmodulated career with the setup of Figure 4. and record the peak level as a reference (0dB). Then the modulation measurements were performed with the same test setup.

When the carrier was modulated with voice, the modulating 2500 Hz sinusoidal signal was injected to the transmitter via the standard telephone device connection RJ-11. This RJ-11 connector is provided for the telephone for voice communication To produce the tones ST, SAT, ST+SAT, Voice + SAT etc and WBD, the carrier was modulated in sequence using the appropriate test command.

a) For voice and SAT measurements, the transmitter compressor was disabled and the DUI was modulated by a 2500 Hz sinusoidal signal with an input level 13.5 greater than that required to produce ± 8 peak frequency deviation at 1000 Hz. The 6000 Hz SAT signal was enabled.

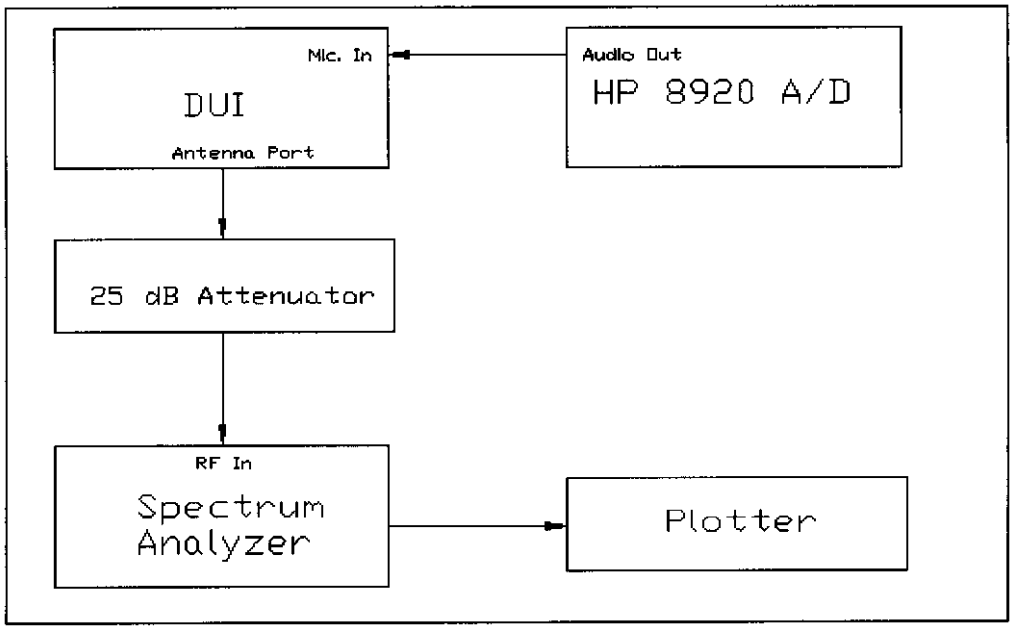
b) For SAT and ST (Signalling Tone) measurements, voice was muted, the compressor, SAT (6000 Hz) and Signalling Tone (10 kHz) were enabled.

c) For wideband data measurements, the transmitter was modulated with a 10 kilobit/second data pattern at ± 8 kHz peak frequency deviation.

d) All BW measurements were performed at both highest power (level 0) output level and lowest (level 7) output level modes.

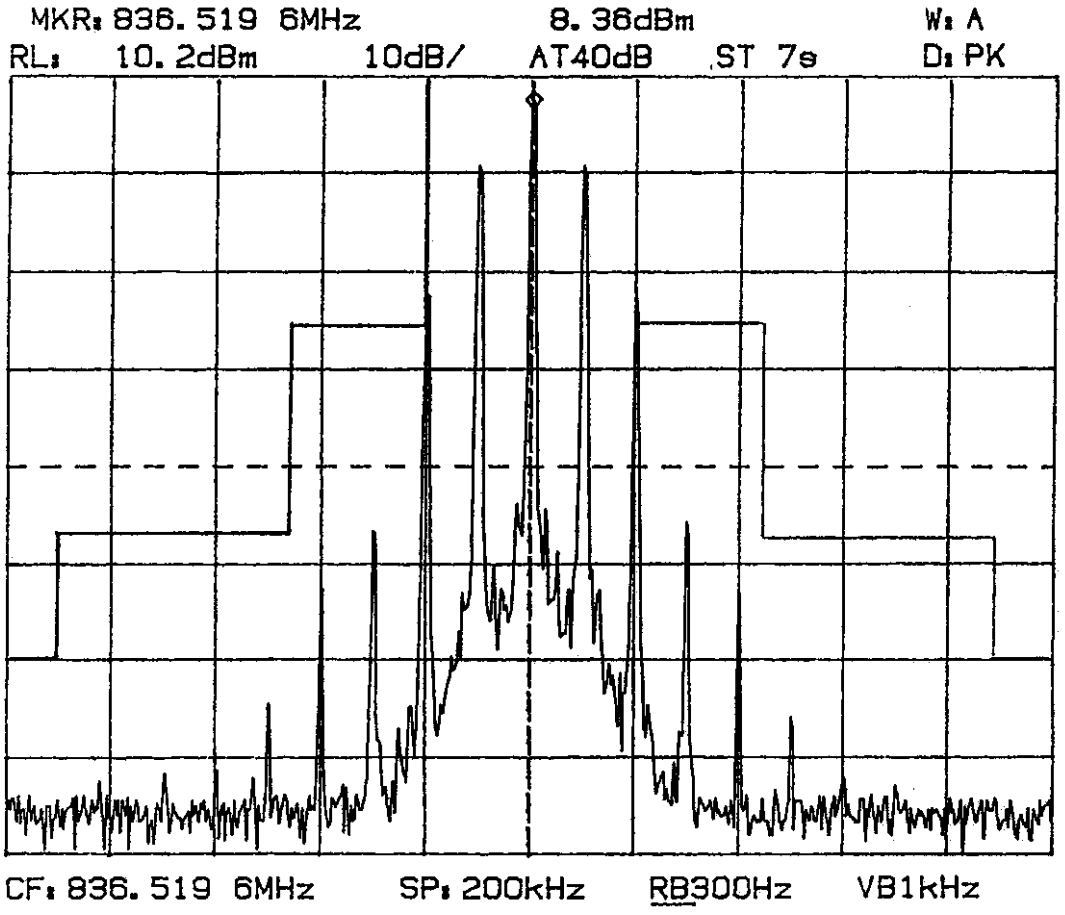
Results: **PASSED.**

Set Up Figure 4
Occupied Bandwidth Set Up



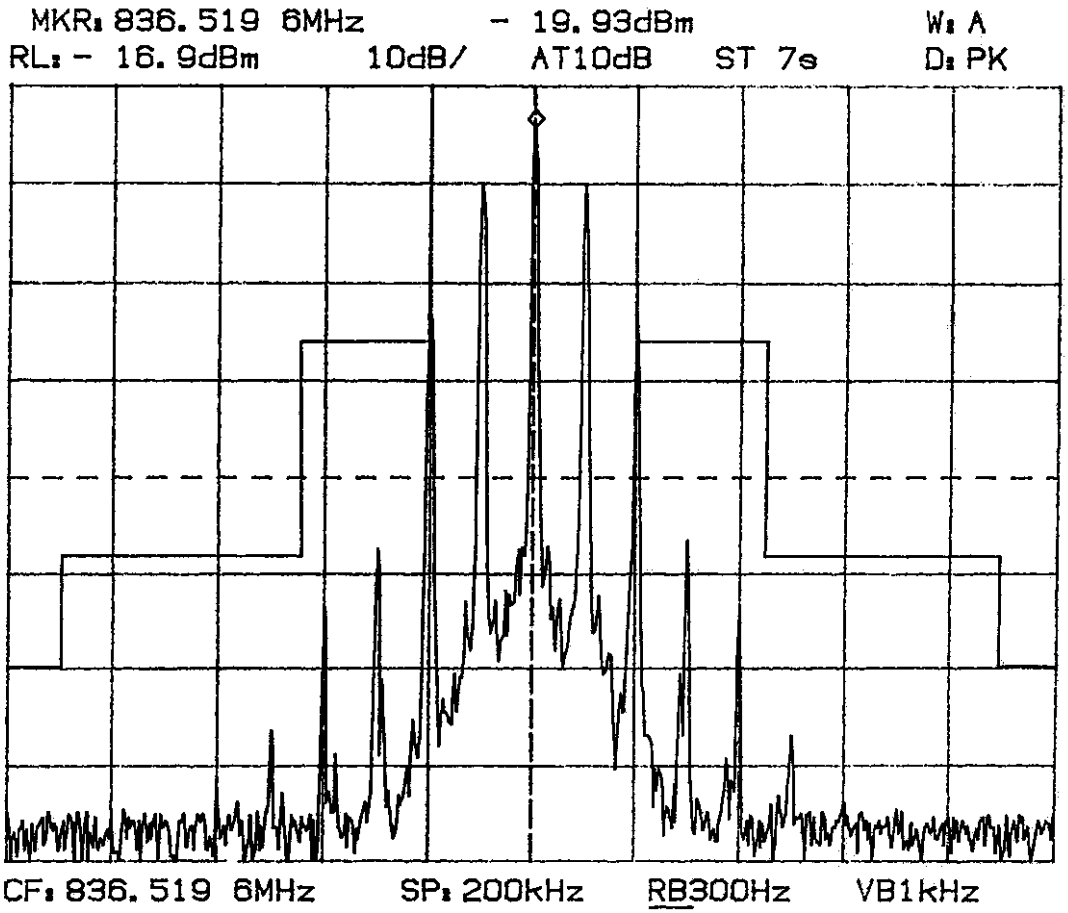
PLOT #4.a

Occupied Bandwidth
ST
Channel No.: 384
Transmit Frequency: 836.52 MHz
Power Level: 0



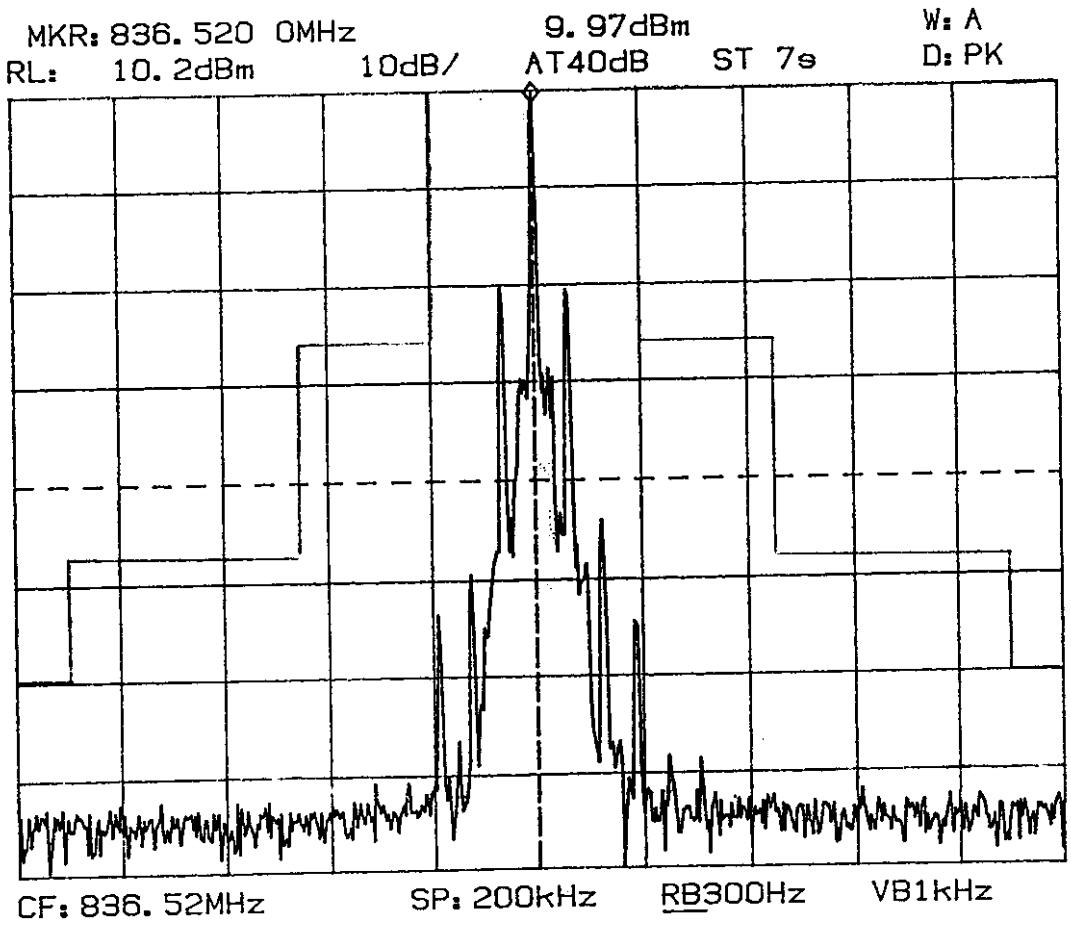
PLOT #4.b

Occupied Bandwidth
ST
Channel No.: 384
Transmit Frequency: 836.52 MHz
Power Level: 7



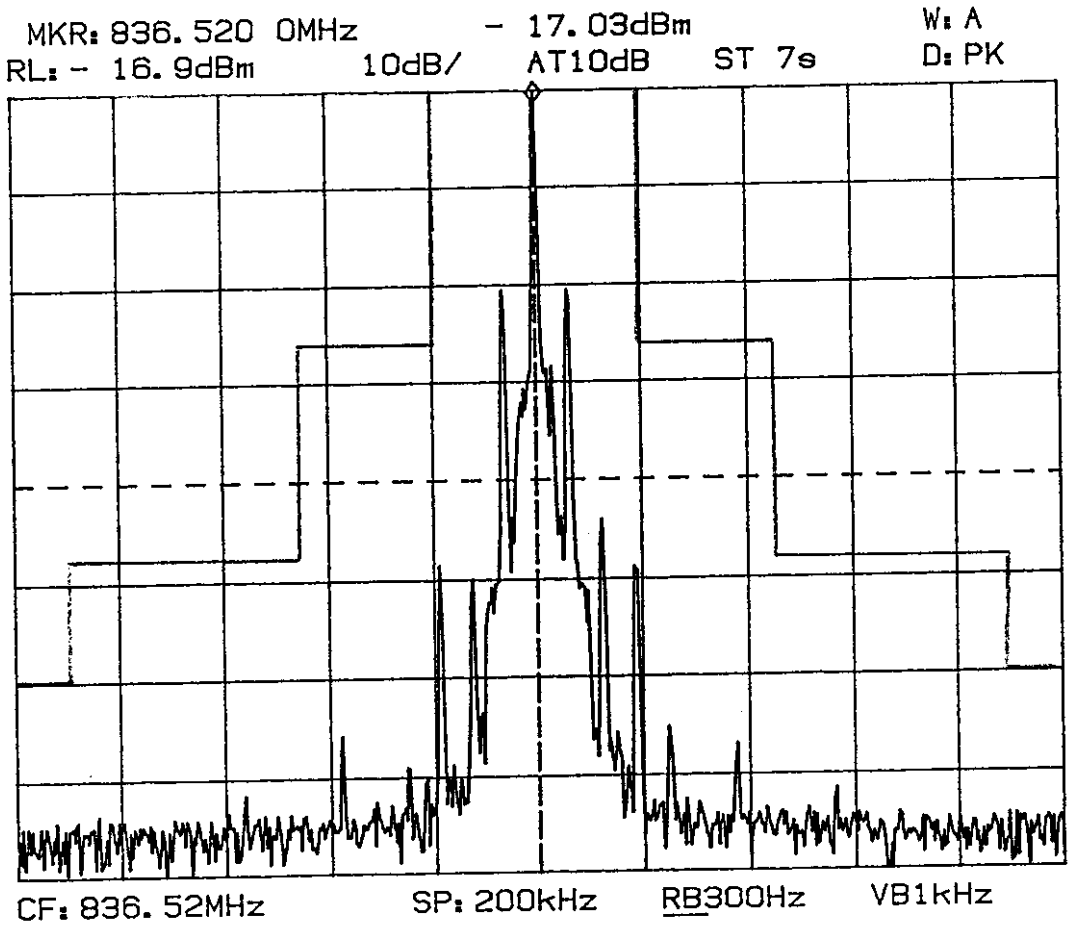
PLOT #5.a

Occupied Bandwidth
SAT (6000 Hz)
Channel No.: 384
Transmit Frequency: 836.52 MHz
Power Level: 0



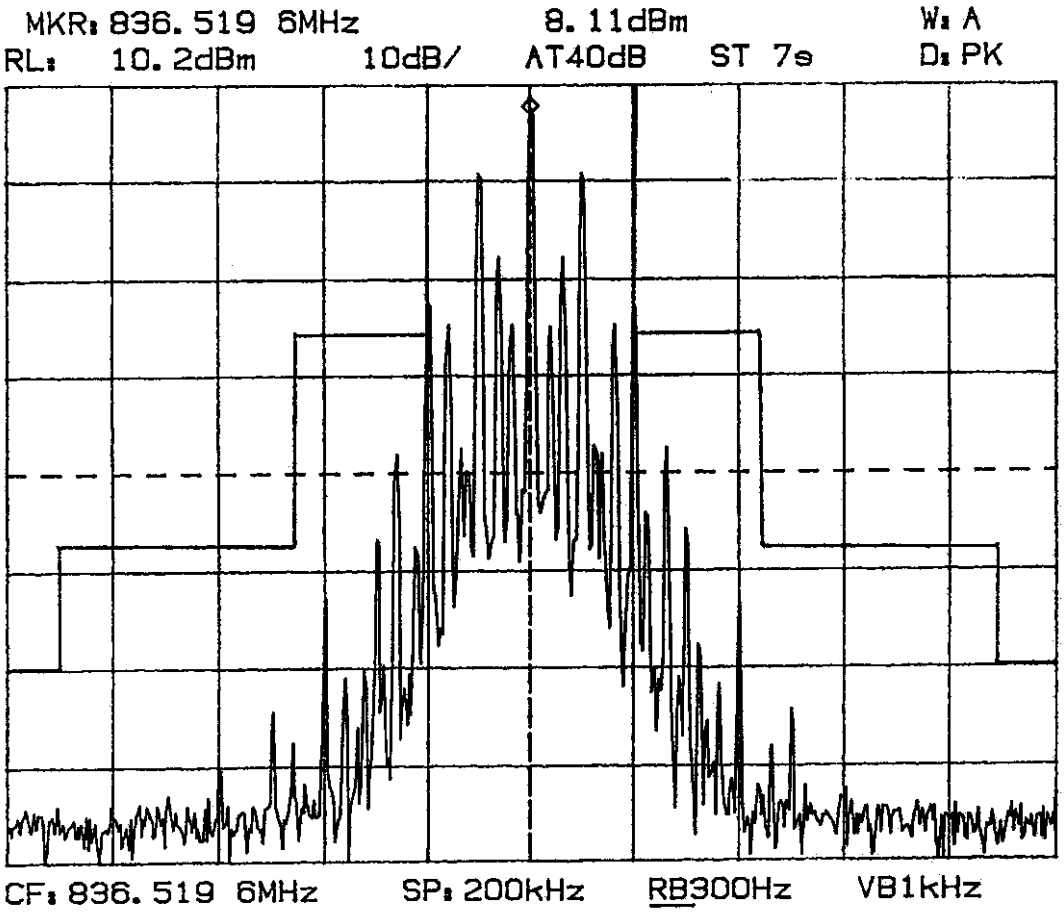
PLOT #5.b

Occupied Bandwidth
SAT (6000 Hz)
Channel No.: 384
Transmit Frequency: 836.52 MHz
Power Level: 7



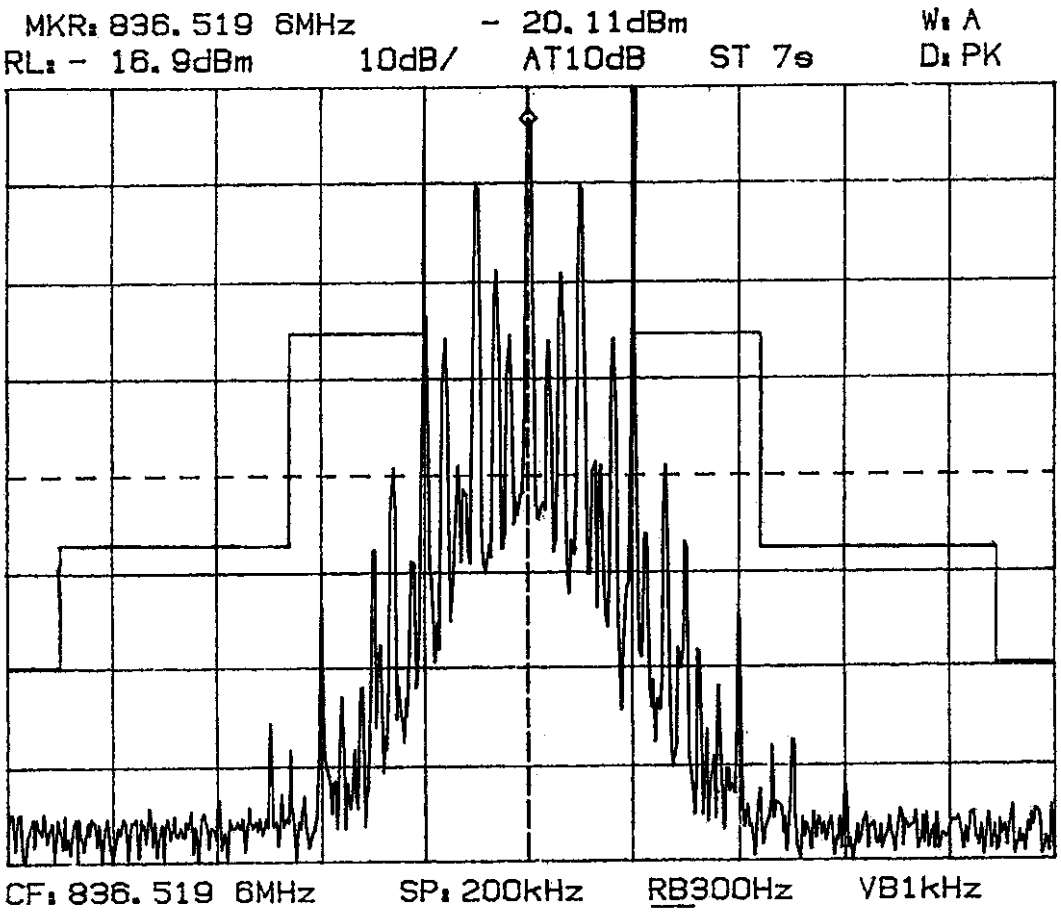
PLOT #6.a

Occupied Bandwidth
ST and SAT (6000 Hz)
Channel No.: 384
Transmit Frequency: 836.52 MHz
Power Level: 0



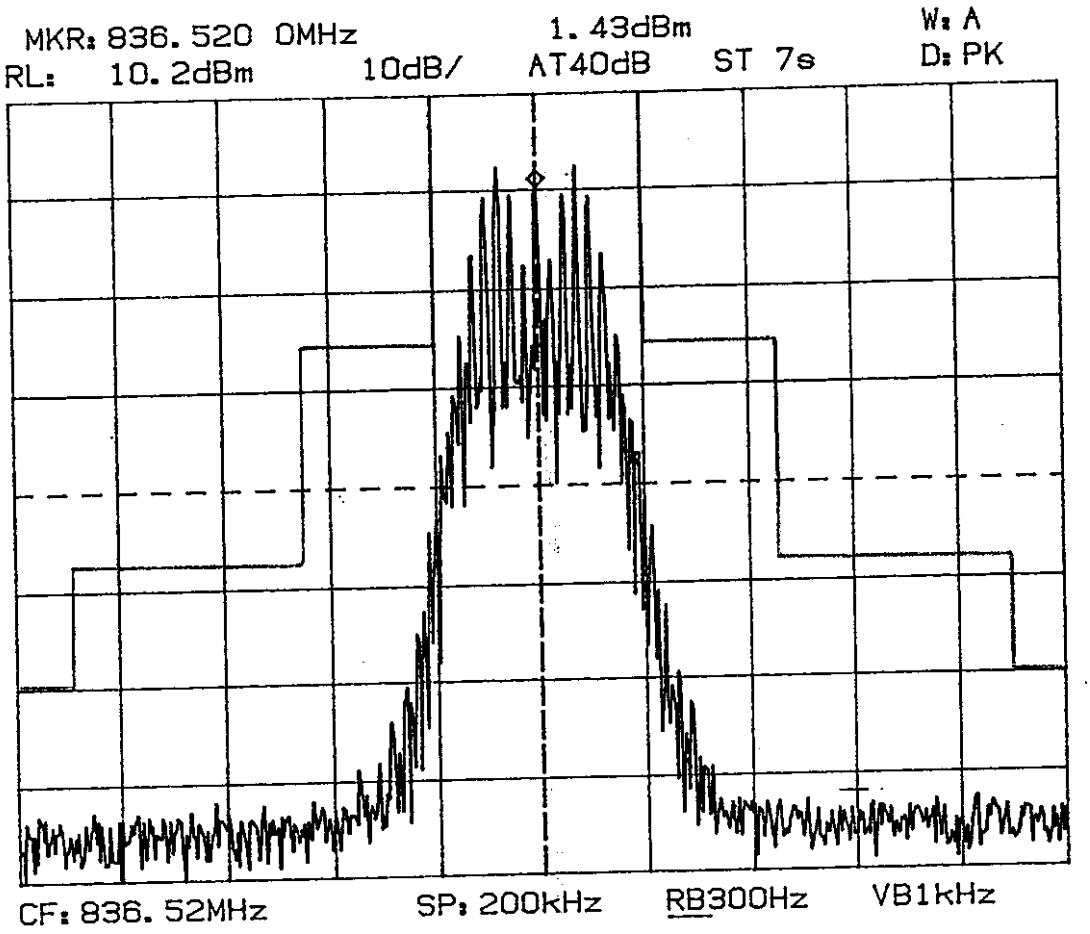
PLOT #6.b

Occupied Bandwidth
ST and SAT (6000 Hz)
Channel No.: 384
Transmit Frequency: 836.52 MHz
Power Level: 7



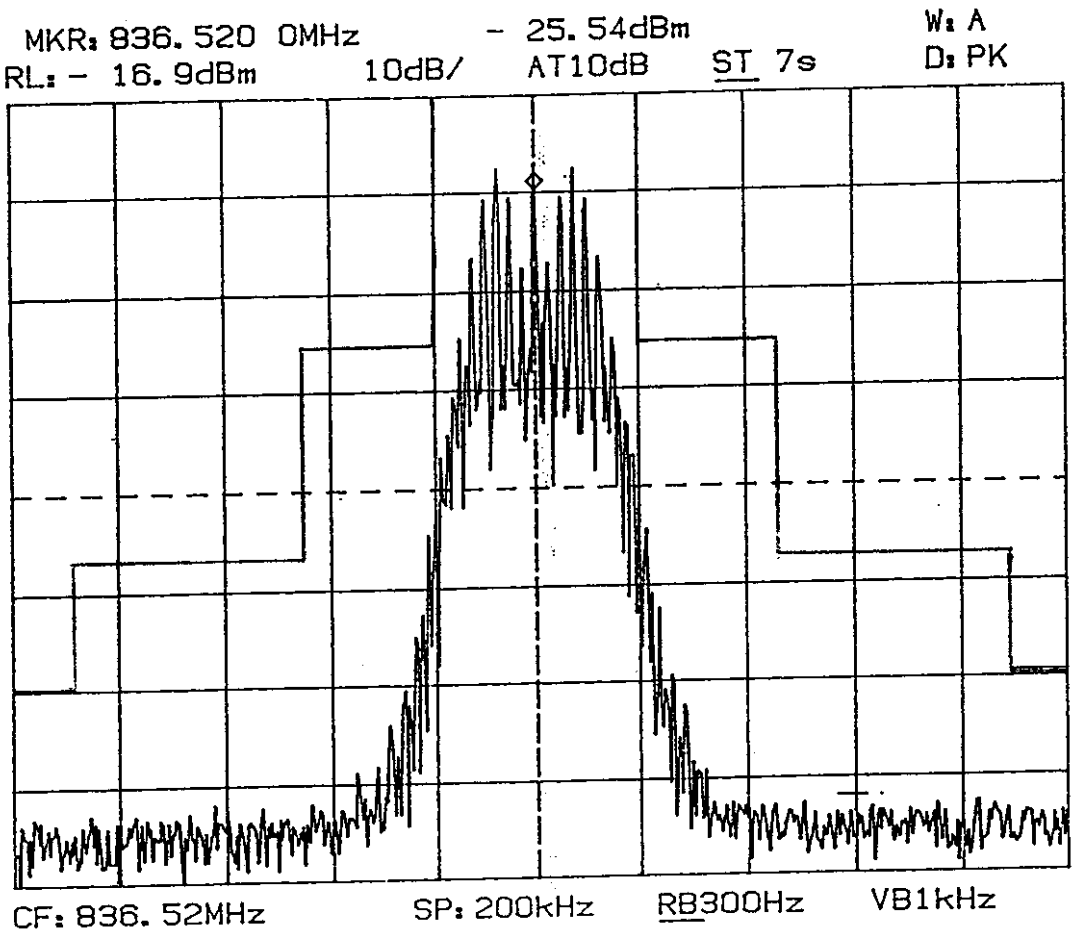
PLOT #7.a

Occupied Bandwidth
Voice and SAT (6000 Hz)
Channel No.: 384
Transmit Frequency: 836.52 MHz
2.5 kHz Tone @ 126.4 dBµV
Power Level: 0



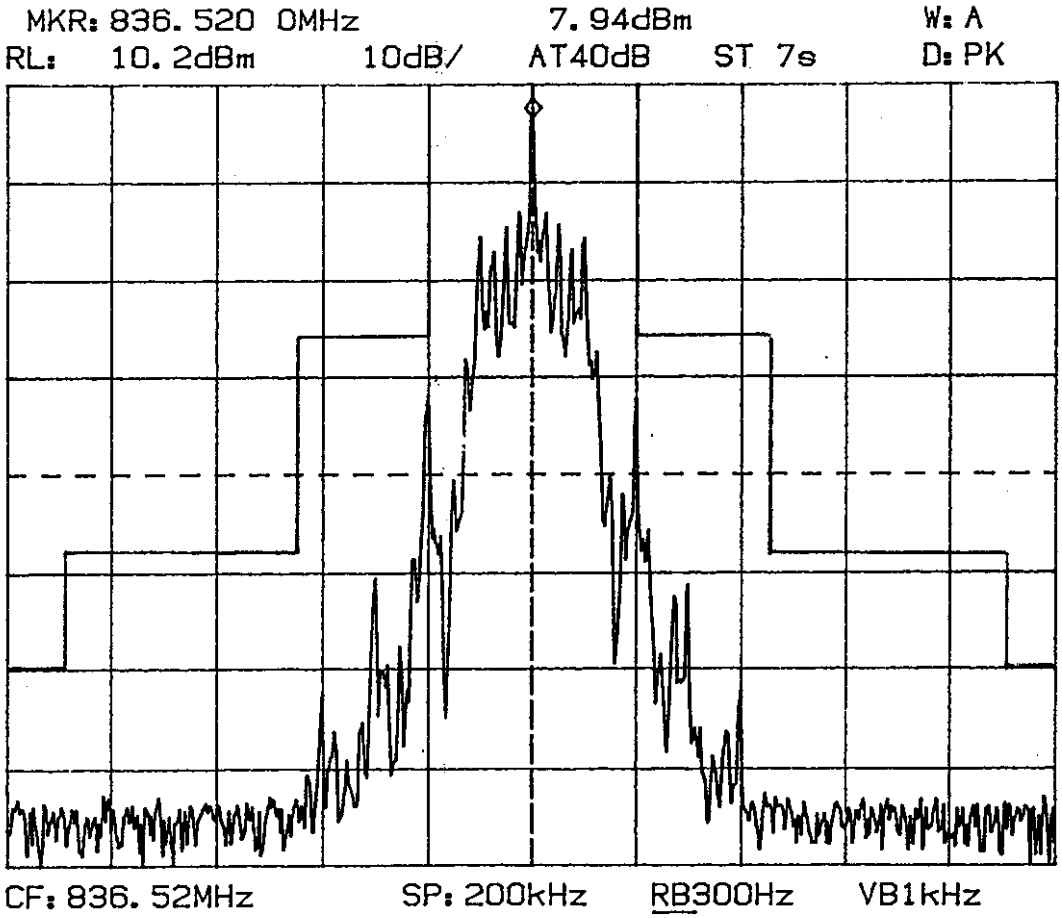
PLOT #7.b

Occupied Bandwidth
Voice and SAT (6000 Hz)
Channel No.: 384
Transmit Frequency: 836.52 MHz
2.5 kHz Tone @ 126.4 dBµV
Power Level: 7



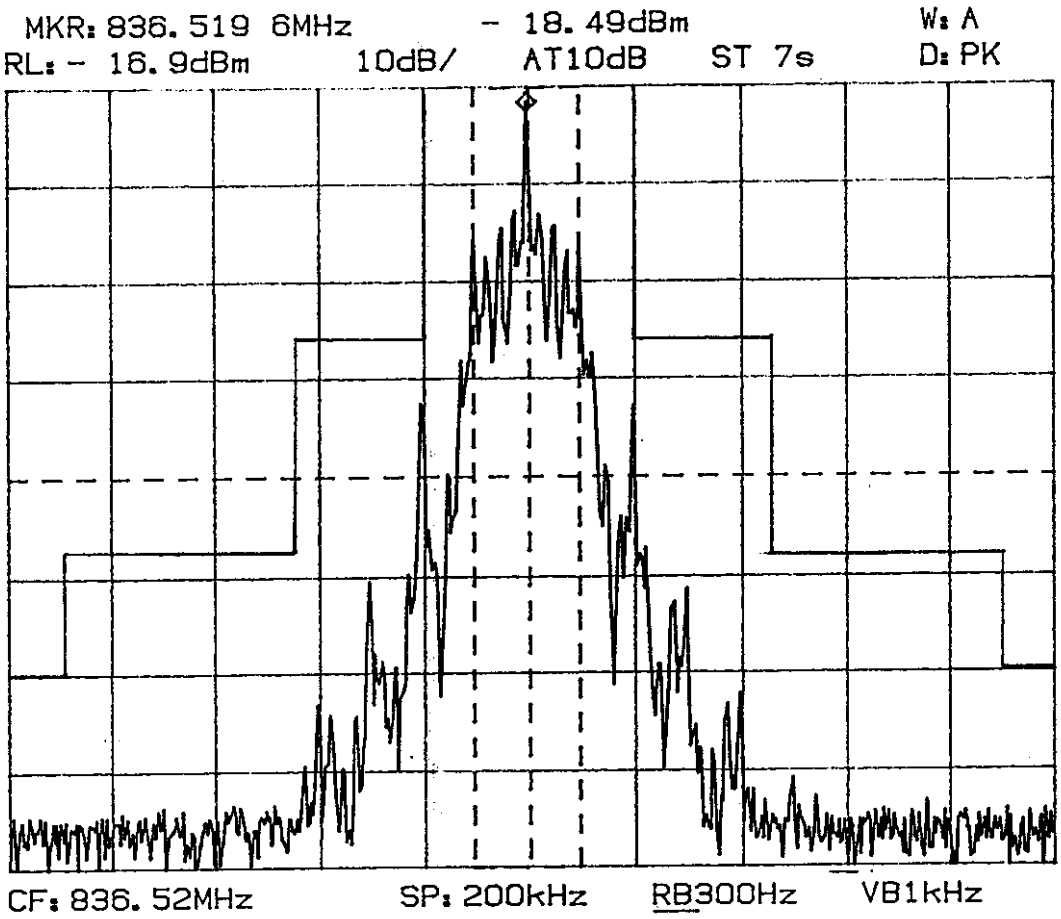
PLOT #8.a

Occupied Bandwidth
Wideband Data
Channel No.: 384
Transmit Frequency: 836.52 MHz
Power Level: 0



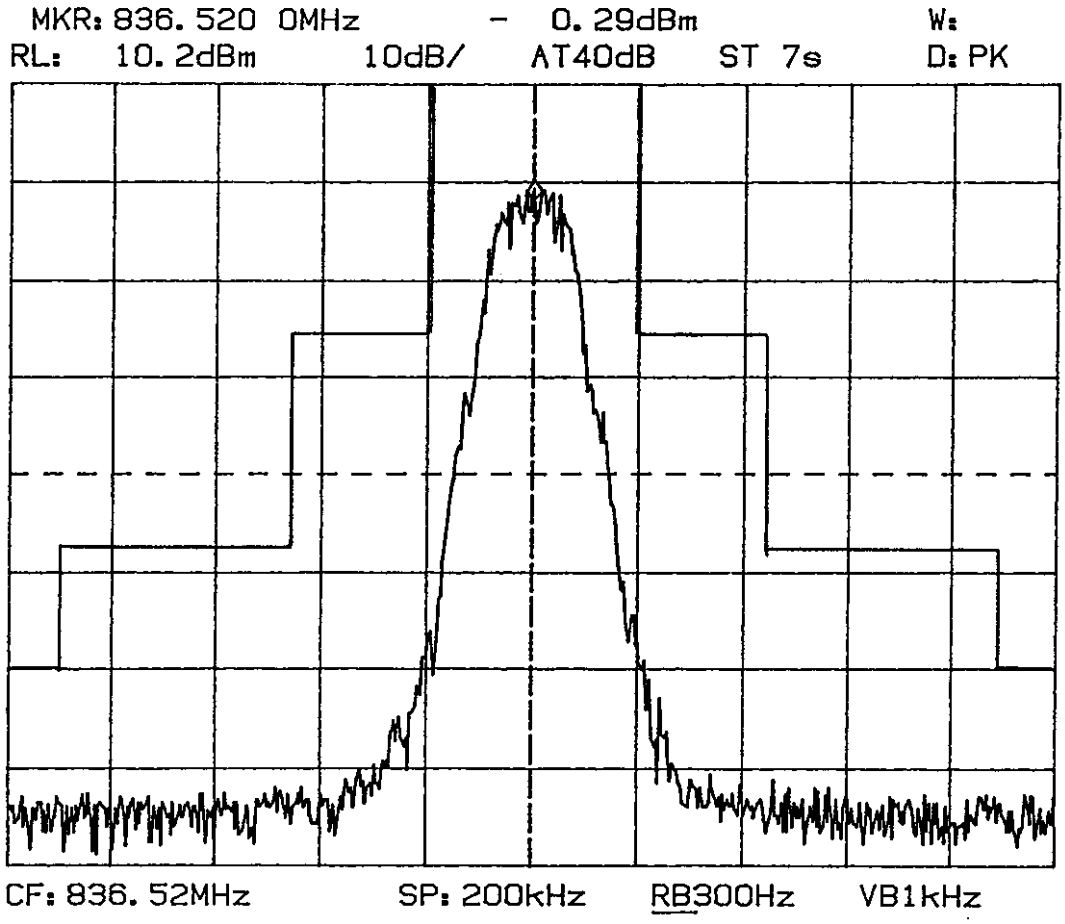
PLOT #8.b

Occupied Bandwidth
Wideband Data
Channel No.: 384
Transmit Frequency: 836.52 MHz
Power Level: 7



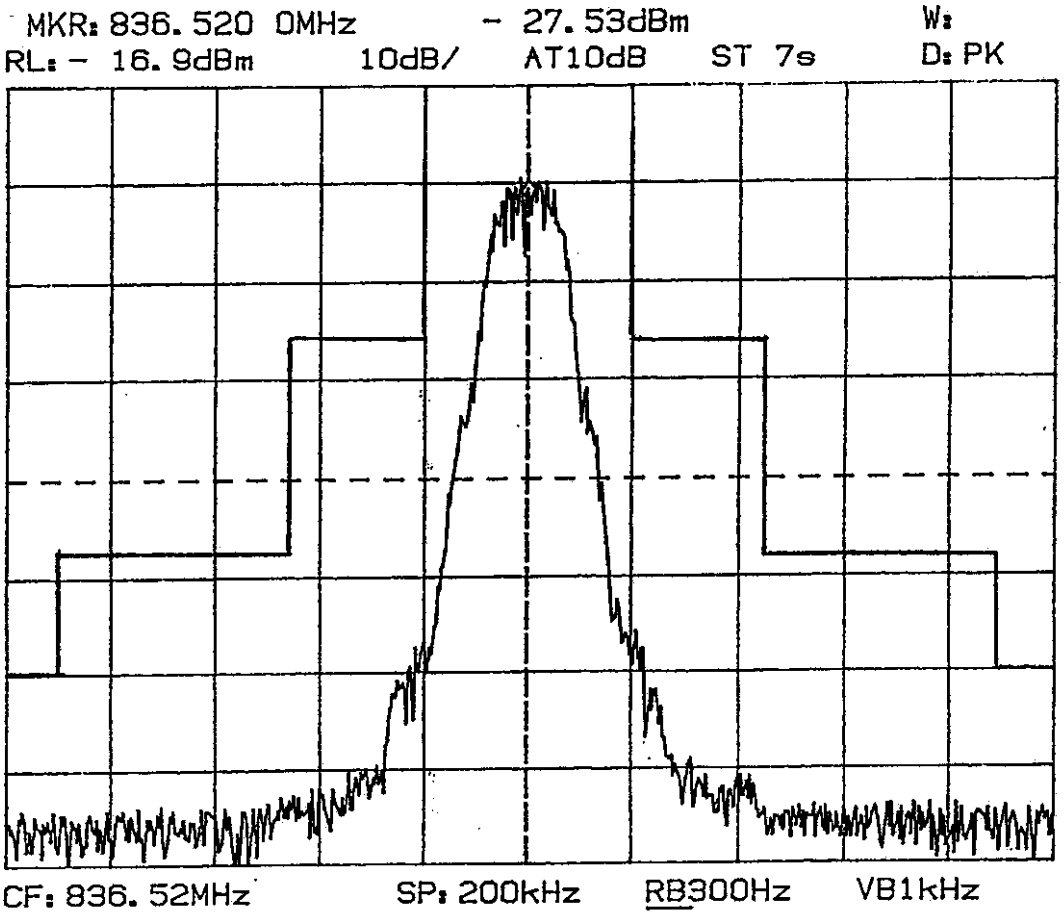
PLOT #9.a

Occupied Bandwidth
DTMF and SAT (6000 Hz)
Channel No.: 384
Transmit Frequency: 836.52 MHz
Power Level: 0



PLOT #9.b

Occupied Bandwidth
DTMF and SAT (6000 Hz)
Channel No.: 384
Transmit Frequency: 836.52 MHz
Power Level: 7



Test: **Spurious Emissions at Antenna Terminal**

Ref.: **FCC Part 2 paragraph 2.991 and Part 22 paragraph 22.917(e)(f)**

Criteria: Part 22.917(e): Out of band emissions. The mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P) on any frequency twice or more than twice the fundamental frequency of the mobile by: at least 43 + 10 log (P) dB. This is calculated to be -13 dBm.

Part 22.917(f): Mobile emissions in base frequency range (869 – 894 MHz). The mean power of any emissions appearing in the base station frequency range from cellular mobile transmitters operated must be attenuated to a level not to exceed -80 dBm at the transmit antenna connector.

Set-up: See Figure No. 5 & 6.

Environmental Conditions: Temperature: 23 °C ± 2.
Air pressure: 101 ± 3 kPa.

Equipment: See Appendix A.

Procedure: The mobile was configured to operate at maximum power and applicable modulation applied to the transmitter. The mobile was coupled to the spectrum analyzer through a 25 dB attenuator and directly to the HP8920 A/D. The spectrum was searched from 9 kHz to the 10^{th} harmonic of the operating frequency. In the band 869 – 894 MHz the spurious emissions was measured using a resolution bandwidth of 30 kHz.

Compliance with these requirements is based on the use of the spectrum analyzer employing the resolution band widths of: 1) when operating in the SAT mode, 300 Hz for any emission not more than 45kHz removed from the carrier frequency and 30 kHz for any emission more than 45kHz removed from the carrier frequency; 2) when operating in the wideband data made or ST mode, 300Hz for any emission not more than 60 kHz removed from the carrier frequency and 30 kHz for any emission more than 60 kHz removed from the carrier frequency.

Part 2.991: Measurements required — Spurious emissions at antenna terminals — The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in paragraph 2.989 as appropriate. The magnitude of spurious emissions that are attenuated more than 20 dB below the permissible value need not be specified.

Part 2.997: Frequency Spectrum to be investigated — In all of the spurious emissions measurements of spurious emissions at antenna terminals (2.991) and Field Strength of Spurious Emissions, the Spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least to the 10^{th} harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower if the equipment operates below 10 GHz (the mobile under test operates below 10 GHz).

The amplitude of spurious emissions, which are attenuated more than 20 dB below the permissible value, need not be reported.

Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

Measurements given in the spurious emissions test result tables contain: spectrum analyzer reading, correction factor, and final reading. The final spurious emission levels are derived from the analyzer measurement and the correction factor (20 dB attenuator and cable loss) as shown in the following example:

Sample Calculation:

A. Spectrum analyzer reading (Direct measurement)

At 1668.0 MHz a spurious level of –56.9 dBm is measured.

B. Correction factor (25.1 dB attenuator and cable loss)

Cable loss: 0.10 dB
25 dB attenuator: 25 dB
Total Correction Factor: 0.10 + 25 = 25.1 dB

C. Spurious Emission Level (Spurious Emissions at Antenna Terminal)

C=A+B
C= - 56.9 dBm + 25.1 dB
C= - 31.8 dBm

D. The criteria level.

Pt is manufacturer's rated transmitter power, 3 Watts (34.8 dBm)

D = Pt - (43 + (10 log P)
D = 34.8 dBm - (43 + (10 log 3 W))
D = 34.8 dBm – 47.8 dB
D = -13 dBm

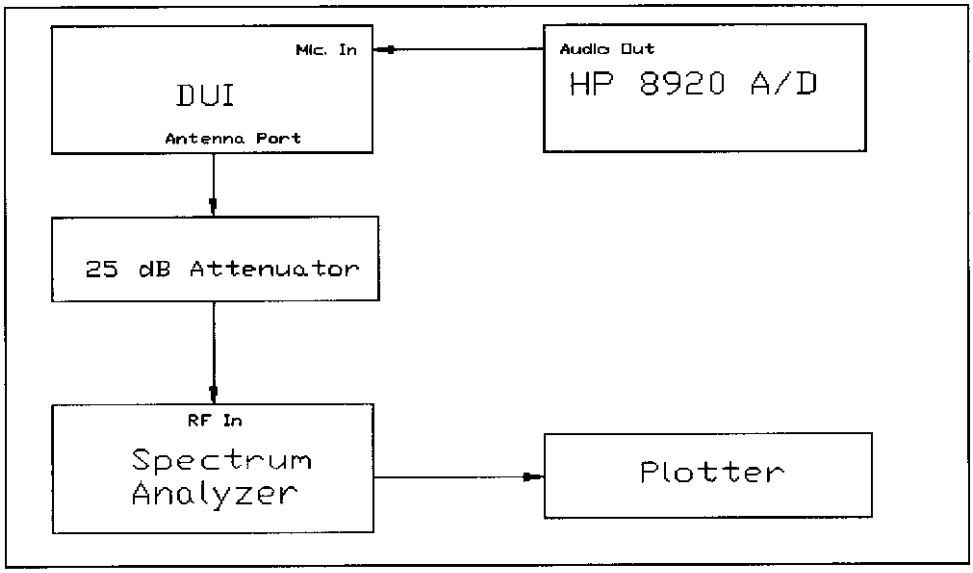
Criteria (reference) level is -13 dBm

E = Margin (spurious emission below the reference level)

E = D - C
E = (-13 dBm) – (-31.8 dBm)
E = 18.8 dB

Results: **PASSED.** See Table 7 & 8.

Set Up Figure 5
Spurious Emissions at Antenna Terminal



Set Up Figure 6
Spurious Emissions at Antenna Terminal
Spurious Emissions measurement between 869 – 894 MHz.

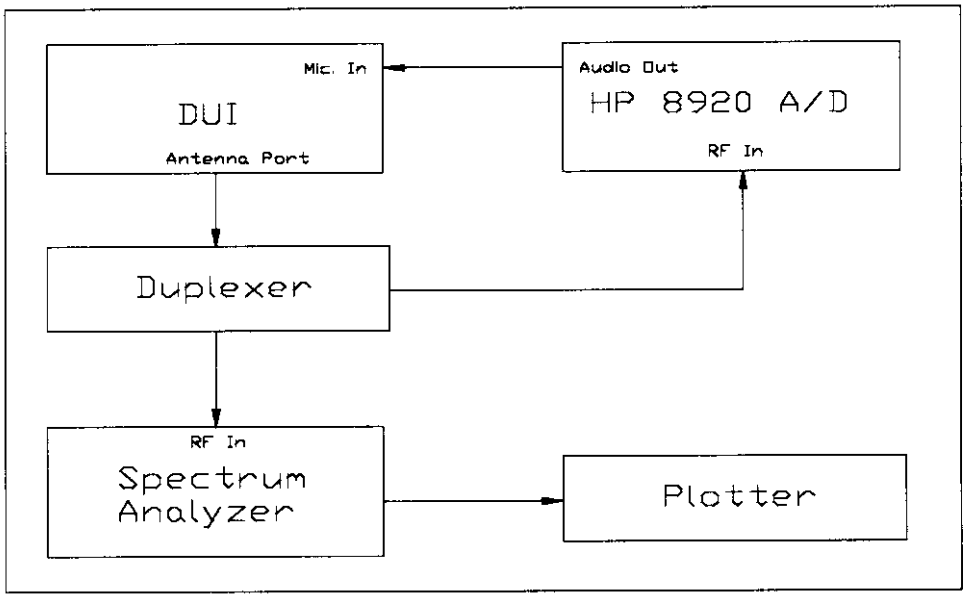


Table 7
Spurious Emissions at Antenna Terminal
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0

Frequency (MHz)	Measured Level (dBm) "A"	Correction Factor (dB) "B"	Spurious Emission Level (dBm) "C"	Criteria Level (dBm) "D"	Margin (dB) "E
1668	-56.9	25.1	-31.8	-13	18.8

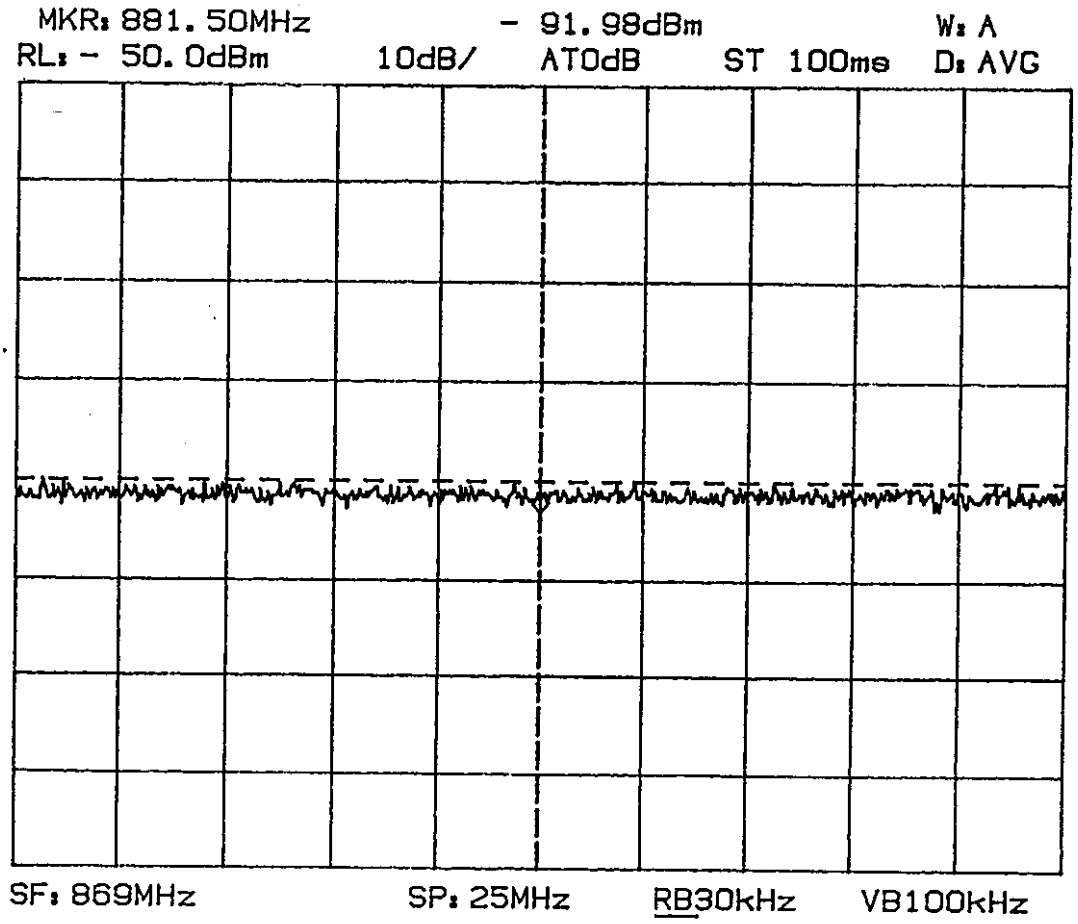
No other signal were detected.

Table 8
Mobile Emissions in Base Frequency Band
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0

Frequency (MHz)	Measured Level (dBm) "A"	Correction Factor (dB) "B"	Spurious Emission Level (dBm) "C"	Criteria Level (dBm) "D"	Margin (dB) "E
836 – 894	< -90	5.4	< -84.6	-80	> 4.6

No mobile spurious emissions were detected with 30 kHz Resolution Bandwidth in the base station frequency range (869 – 894 MHz). See Plot No.: 10.

Plot #10
Mobile Emissions in Base Frequency Band
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0



Test: **Field Strength of Spurious Radiation**

Ref.: **FCC Part 22 subpart H, Paragraph 22.917(e) and Part 2.993**

Criteria: On any frequency twice or more than twice the fundamental frequency of the mobile, the mean power of spurious emissions shall be attenuated below the power of the unmodulated carrier by at least 43 + 10 log (P) dB.

This was calculated to be 84.6 dBμV/m at 3 meters.

Set-up: See Figure No. 7.

Environmental Conditions: Temperature: 23 °C ± 2.
Air pressure: 101 ± 3 kPa

Procedure: The final measurements were taken at APREL Laboratory's open area test site (OATS) measurement facility. This open area test site is calibrated to ANSI C63.4 document and a description of the measurement facility is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations. (FCC File No.: 31040/SIT).

The mobile was configured to operate at maximum power with appropriate modulation. The mobile was keyed on channel 384 (836.52 MHz).

Prior to final measurements in the OATS, preliminary radiated spurious emissions were scanned in a shielded enclosure at a distance of 1 m using a broadband Discone antenna and horn antenna in order to determine the characteristic frequencies of the field strength of spurious emissions. Based on this information, measurements were performed in the OATS at these characteristic frequencies using calibrated antennas.

The transmitter output was fed to a HP 8920 A/D RF Communication Test Set and the output power was noted for reference. A 50 Ω dummy load was attached to the antenna connector. All field strength measurements were made with spectrum analyzer and the appropriate calibrated antenna for the frequency range of 9 kHz up to 10th harmonics of the transmit frequency (See equipment list for the calibrated antenna used).

The equipment under test was placed on a turntable positioned 3 meters away from the calibrated receiving antenna, which in turn was connected to the spectrum analyzer. For each identified frequency, the received signal was maximised by the positioning of the turntable and the height of the antenna. The process was repeated for both horizontal and vertical polarization.

Information submitted includes the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antenna.

Measurements given in the spurious emissions test result tables contain: analyzer reading, correction factor, and final reading. The final field strength level are derived from the analyzer measurement and the correction factor (antenna factor and cable loss) as shown in the following example:

Sample Calculation (not actual measurement):

A. Spectrum analyzer reading (Direct measurement)

At 32.20 MHz a spurious level of 17.65 dBμV @ 3 meters is measured.

B. Correction factor (antenna factor and cable loss)

Cable loss: 0.66 dB
Antenna factor: 13.60 dB
Total Correction Factor: 0.66 + 13.60 = 14.26 dB/m

C. Final Reading (Field Strength of spurious emission)

C=A+B
C= 17.65 dBμV + 14.26 dB
C= 31.91 dBμV/m @ 3 meters

D. The criteria level.

The field intensity which would be produced by the transmitter carrier operating into a half-wave dipole antenna (gain of 1.64), at a distance of 3 m was calculated using the following formula:

$$\text{Field Strength of carrier (dB}\mu\text{V/m)} = 10\log_{10}\left(\frac{PtG}{4\pi r^2}\right) + 146 \text{ dB}$$

Pt is transmitter power, 3 Watts
G is gain, 1.64
r is distance, 3 meters

$$\text{Field Strength of carrier (dB}\mu\text{V/m)} = 10\log_{10}\left(\frac{(3\text{ W})(1.64)}{4\pi(3\text{ m})^2}\right) + 146\text{ dB}$$

Field Strength of carrier = 132.4 dBμV/m

D = Field Strength of carrier - (43 + (10 log P))
D = 132.4 dBμV/m - (43 + (10 log 3))
D = 84.6 dBμV/m @ 3 meters

Criteria (reference) level at 3 meters from 3 Watts into half-wave dipole antenna is 84.6 dBμV/m

E = Margin (spurious emission below the reference level)

E = D - C
E = 84.6 dBμV/m -31.91 dBμV/m
E = 52.7 dB (This is not actual reading, but an sample to show the calculation)

Results: **PASSED.** See Tables 9 & 10.

Table 9
Spurious Emission Levels
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0
Antenna Polarization: Horizontal

Frequency (MHz)	Measured Level (dBμV)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Criteria Level (dBμV/m)	Margin (dB)
	"A"	"B"	"C"	"D"	"E"
—	—	—	—	84.6	—

No spurious were detected.

Table 10
Spurious Emission Levels
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0
Antenna Polarization: Vertical

Frequency (MHz)	Measured Level (dBμV)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Criteria Level (dBμV/m)	Margin (dB)
	"A"	"B"	"C"	"D"	"E"
—	—	—	—	84.6	—

No spurious were detected.

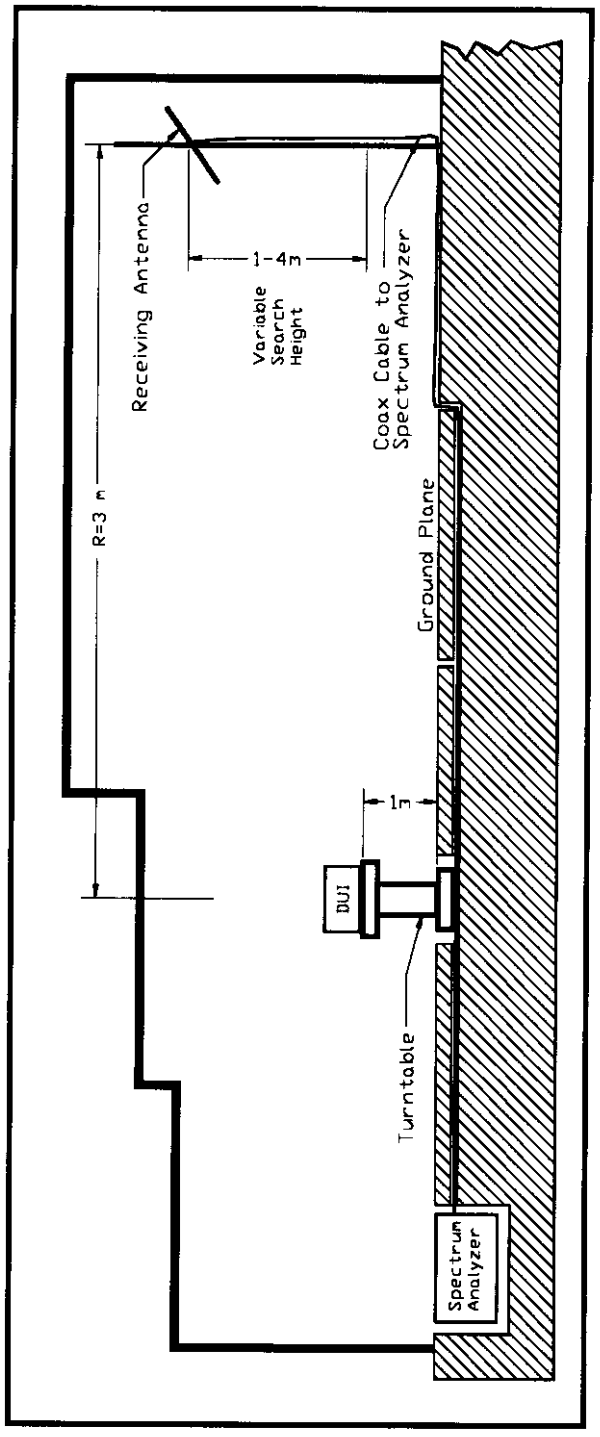


Fig. 7: Test set up for the radiated emission measurement in open site.
50 Ω termination connected directly to DUI antenna connector.

Test: **Frequency Stability**

Ref.: **FCC Part 2 paragraph 2.995**

Criteria: ± 2.5 ppm

Set-up: See Figure No. 8.

Environmental Conditions: Temperature: Paragraph 2.995(a)(1) and (b)
Air pressure: 101 ± 3 kPa

Equipment: See Appendix A.

Procedure: Temperature

The frequency of the transmitter, operating at room ambient temperature (+25°C), was adjusted to the nominal assigned frequency, as per the manufacturer's instructions.

The transceiver was placed in an environmental chamber, with the primary power turned off. The temperature of the chamber was varied over the range of -30°C to +50°C stabilising the temperature every 10°C. At each 10°C step the transmitter was keyed on, at full power. The transmitter frequency was measured every minute for a period of 10 minutes or until sufficient measurements were obtained to indicate clearly that the frequency had stabilised. The test set-up for frequency stability measurements is shown in Figure 8.

Power Supply Voltage:

The primary supply voltage was varied in 15% steps above and below the nominal 13 VDC, with transmitter output frequency being recorded for each supply voltage setting from 85% of nominal to 115% of nominal. Table 11 shows the frequency variation versus supply voltage change.

Results: **PASSED.** See Table 11.

Set Up Figure 8
Transmitter Test Under Environmental Conditions

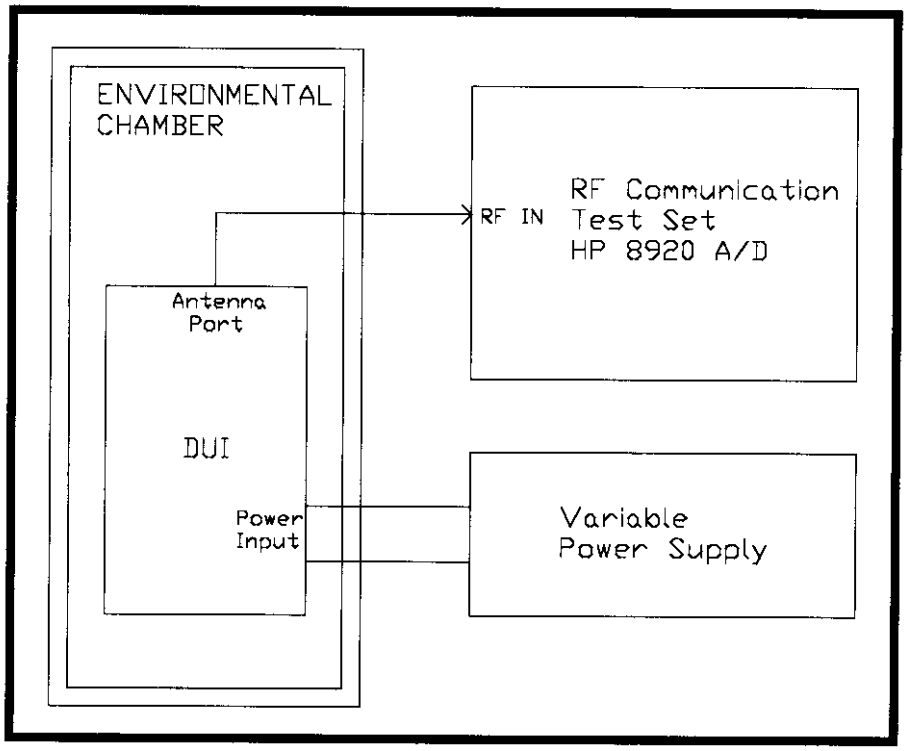


Table 11
Frequency Stability
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0

Environmental Chamber Temperature (°C)	Frequency Deviation (ppm)		
	Power Supply Setting		
	85 %	100 %	115 %
+ 50	- 0.04	0.38	0.51
+ 40	- 0.45	0.03	0.24
+ 30	- 0.96	- 0.43	- 0.19
+ 20	-0.65	- 0.65	- 0.48
+ 10	- 0.96	- 0.42	- 0.33
0	-0.80	-0.14	-0.12
- 10	- 0.17	0.54	0.42
-20	0.61	1.15	1.12
-30	0.27	0.16	0.16

APPENDIX A

List of Test Equipment

List of Equipment

Description	Manufacturer	Model #	Asset #	Cal . Due Data
Power Supply	Hewlett-Packard	6237B	100387	Jan 6, 1999
Spectrum Analyzer	Tektronix	492	100949	Aug 3, 1999
Spectrum Analyzer	Anritsu	MS2601A	100479	Jun 15, 1999
RF Communication Test Set	Hewlett-Packard	HP 8920 A/D	301289	Sep 13, 1999
20 dB Attenuator	Narda	4779-20	301370	May 18, 1999
Duplexer	APREL Inc.	1020P	301371	Sep 13, 1999
Discone Antenna	Antenna Research	SAS-1/D	100397	May 4, 1999
Bi-conical Antenna	Eaton	94455-1	100156	Sep 19, 1999
Double Ridged Guided Horn Antenna	APREL Inc.	A1	100400	May 15, 1999
Log-Periodic Antenna	APREL Inc.	ALP1	100761	May 2, 1999
Turntable with Controller	EMCO	1060-1.241	100506	CNR
Computer Controlled Antenna Position Mast	EMCO	1051-12	100507	CNR
OATS	APREL Inc.	3m & 10m	N/A	N/A
Shielded Room	Universal Shielding	6/15/87	101329	May 1, 1999
Environmental Chamber with Micro Tenn Programmable Computer	Tenney	TR14-3	100636	Sep 19, 1999
Digital Multimeter	Fluke	8010A	---	Sep 11,1999