ENGINEERING TEST REPORT

ON:
THE BLICK COMMUNICATIONS LTD.
"LDC RADIO CONCENTRATOR"

FCC ID: N4RLDC

IN ACCORDANCE WITH:
FCC PART 90, SUBPART I
PRIVATE LAND MOBILE TRANSMITTER
OPERATING UNDER THE EXEMPTION OF 90.217

PROJECT NO.: 8R00429

TESTED FOR:

BLICK COMMUNICATIONS LTD.
15 COFTON ROAD
MARSH BARTON, EXETER, DEVON
EX2 8QW, UK

TESTED BY:

KTL OTTAWA INC.
3325 RIVER ROAD, R.R. 5
OTTAWA, ONTARIO K1V 1H2

NVLAP

NVLAP LAB CODE: 100351-0

JULY 1998

This document contains 39 pages including this one.

Table of Contents

Table of Contents, continued

Section 1. Summary of Test Results

Manufacturer: Blick Communications Ltd.

Model No.: LDC

Serial No.: 12345678

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 90, Subpart I.

☒ New Submission

☐ Class II Permissive Change

☐ Production Unit

☒ Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.
See " Summary of Test Data".

NVLAP

NVLAP LAB CODE: 100351-0

TESTED BY: _____ DATE: 10 Sept. 1998
Tom Tidwell, Senior Technologist

APPROVED BY: _____ DATE: Sept 10, 98
Russell Grant, Technologist

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	90.217	120 mW	9.6 mW	Complies
Audio Frequency Response	TIA EIA-603.3.2.6	N/A	N/A	N/A
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6	N/A	N/A	N/A
Modulation Limiting	TIA EIA-603.3.2.6	N/A	N/A	N/A
Occupied Bandwidth	90.217(b)	-30 dBc	<-30 dBc	Complies
Spurious Emissions at Antenna Terminals	90.217(b)	-30 dBc	<-30 dBc	Complies
Field Strength of Spurious Emissions	90.217(b)	-30 dBc	<-30 dBc	Complies
Frequency Stability	90.213	N/A	N/A	N/A
Transient Frequency Behavior	90.214	N/A	N/A	N/A

Footnotes For N/A's: This equipment is exempt from the technical requirements set forth in Part 90, Subpart I per 90.217. This testing is to verify that the equipment complies with the requirements of 90.217 (b).

Test Conditions: Temperature: 25 °C
Humidity: 54 %

Section 2. General Equipment Specification

Transmitter

Supply Voltage Input:	12 Vdc (Vehicle Battery)
Frequency Range:	170.955 MHz (Fixed)
Tunable Bands:	N/A
Necessary Bandwidth:	3.4 kHz [(300 bps x 2) + (1.4 kHz x 2)]
Type(s) of Modulation:	**F3E (Voice)** ☐ **F1D** ☒ **F2D** ☐ **D7W (QAM)** ☐ **Other** ☐
Data Rate(s)	300 bps
Emission Designator:	3K40F1D
Output Impedance:	50 ohms
RF Power Output (rated):	10 mW
Duty Cycle:	N/A
Channel Spacing(s):	12.5 kHz
Operator Selection of Operating Frequency:	N/A
Power Output Adjustment Capability:	N/A
Note:	The antenna is provided with a standard length of antenna with a reverse-gender TNC connector to mate with the E.U.T. antenna port.

Receiver

Frequency Range:	170.955 MHz
Tunable Bands:	N/A
Local Oscillator:	Direct Conversion
1st IF:	N/A
2nd IF:	N/A
Operator Selection of Operating Frequency:	N/A

Description of Modifications For Class II Permissive Change

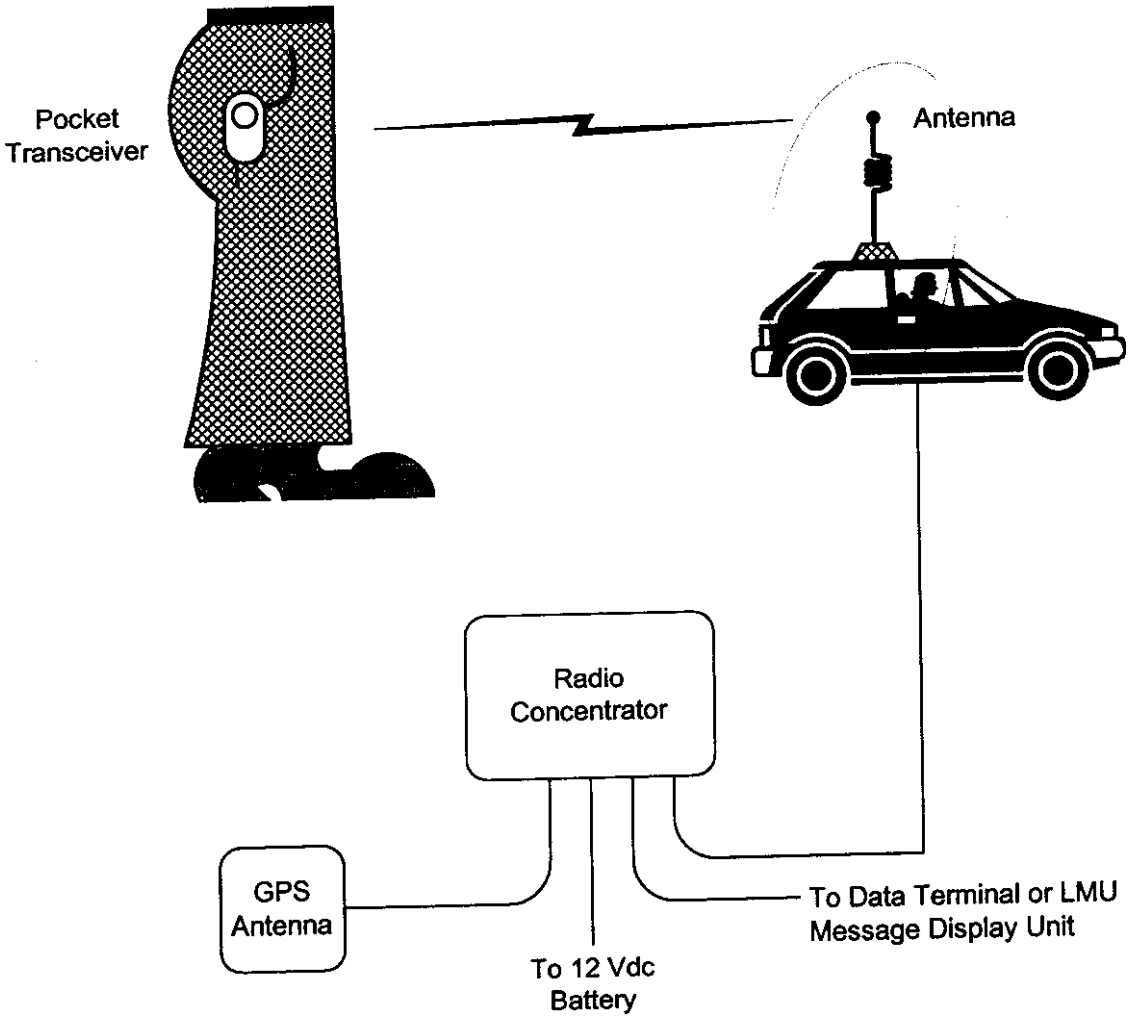
Modifications Made During Testing

NOT APPLICABLE

Theory of Operation

The pocket transceiver is a low power radio that operates at a fixed frequency of 170.955 MHz. When the transmit button is pressed, a short alarm transmission is sent to the vehicle mounted radio concentrator (< 1 sec.).

System Diagram



Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: Tom Tidwell	DATE: July 31, 1998

Test Results: Complies.

Measurement Data:

Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Measured/Rated (dB)
170.955	N/A	N/A	N/A

The measured peak field strength on an installed radio was 107.2 dBμV/m. This equates to 9.6 mW E.R.P. This measurement was made on a radio with the supplied coaxial cable length and with the supplied antenna mounted on a 0.05 x 0.5m groundplane.

$$\text{E.R.P.} = \frac{V^2 R^2}{30G}$$

$$\text{E.R.P.} = \frac{0.2291^2 x 3^2}{30(1.64)}$$

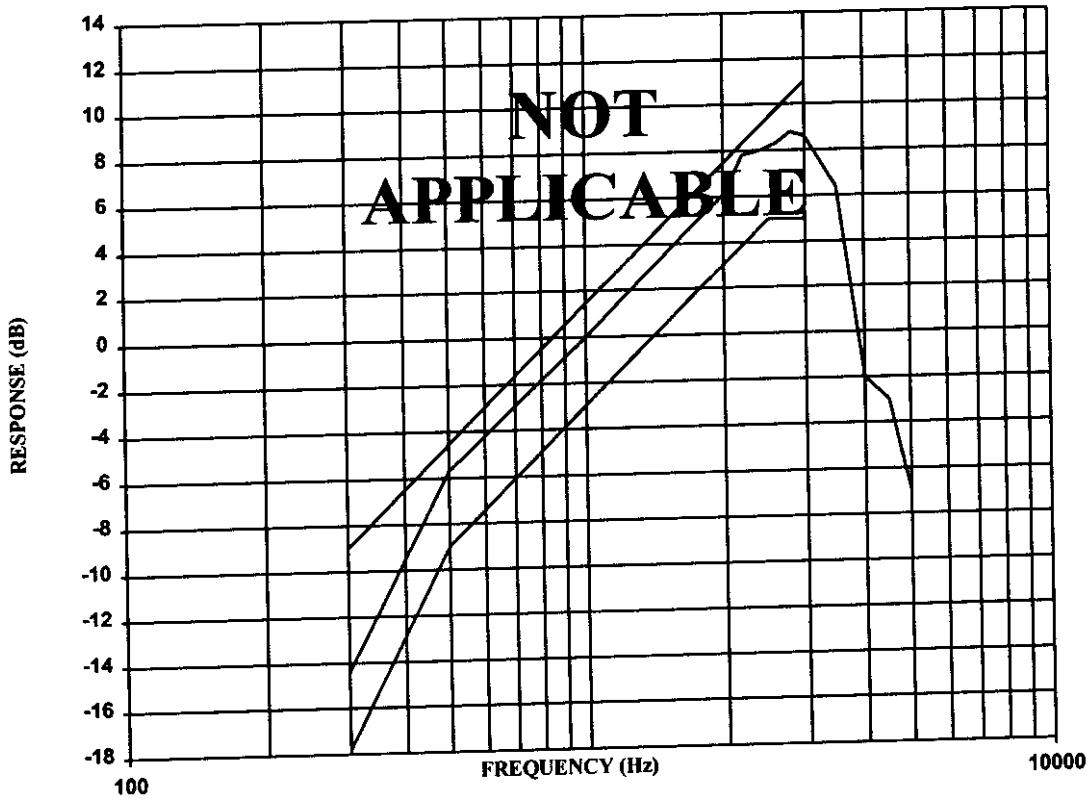
E.R.P. = 0.0096W

E.R.P. = 9.6 mW

Rated E.R.P. = 10 mW

Section 4. Audio Frequency Response

NAME OF TEST: Audio Frequency Response	PARA. NO.: 2.987(a)
TESTED BY:	DATE:



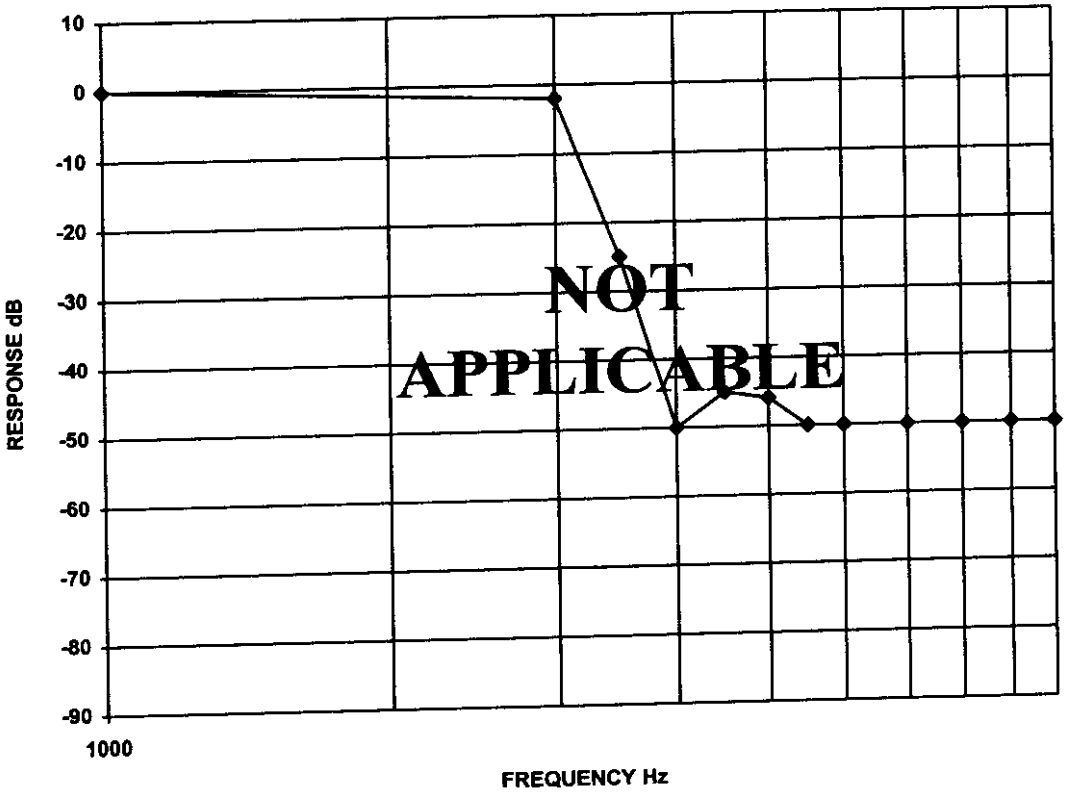
Audio Frequency Response

Frequency	300	600	900	1.2 k	1.5 k	1.8 k	2.1k	2.3 k	2.6 k	3.0 k	3.5 k	4 k

Frequency	4.5 k	5 k	5.5 k	6 k	6.5 k	7 k	7.5 k	8 k	8.5 k	9 k	9.5 k	10 k

Section 5. Audio Low-Pass Filter Response

NAME OF TEST: Audio Low-Pass Filter Response	PARA. NO.: 2.987(a)
TESTED BY:	DATE:

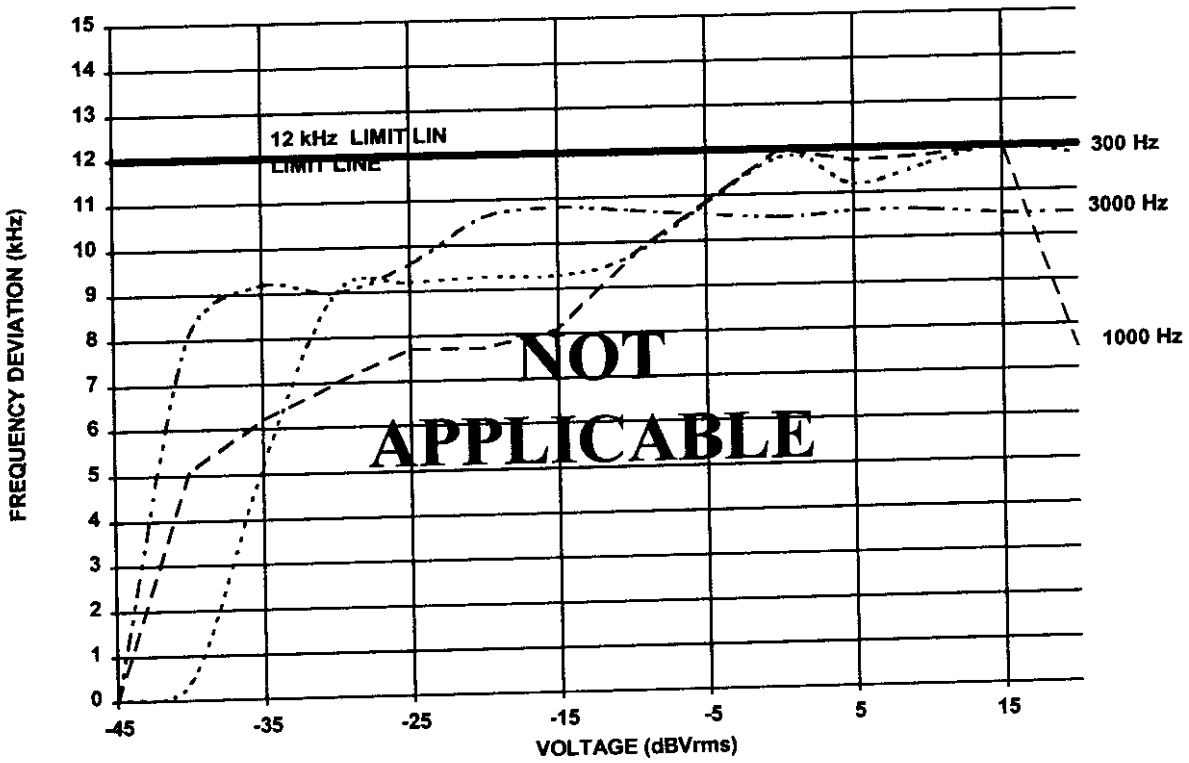


Audio Low-Pass Filter Response

Frequency	1k	3 k	3.5 k	4 k	4.5 k	5 k	5.5 k	6 k	7 k	8 k	9 k	10 k

Section 6. Modulation Limiting

NAME OF TEST: Modulation Limiting	PARA. NO.: 2.987(b)
TESTED BY:	DATE:



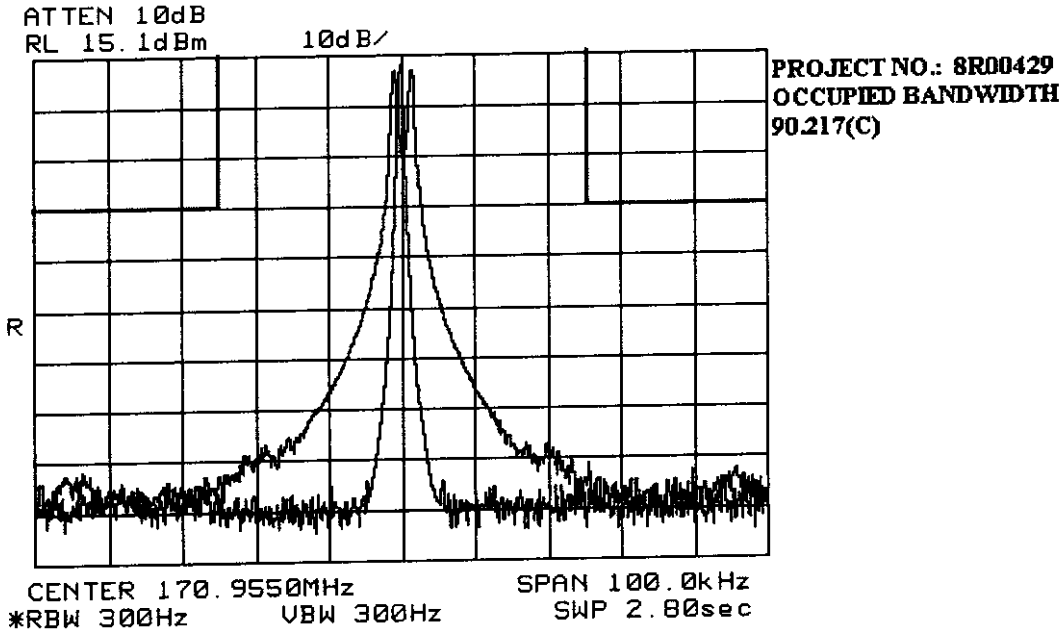
Maximum deviation for non-voice modulation 1.40 kHz.

Section 7. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: Tom Tidwell	DATE: July 30, 1998

Test Results: Complies.

Test Data: See attached graph(s).

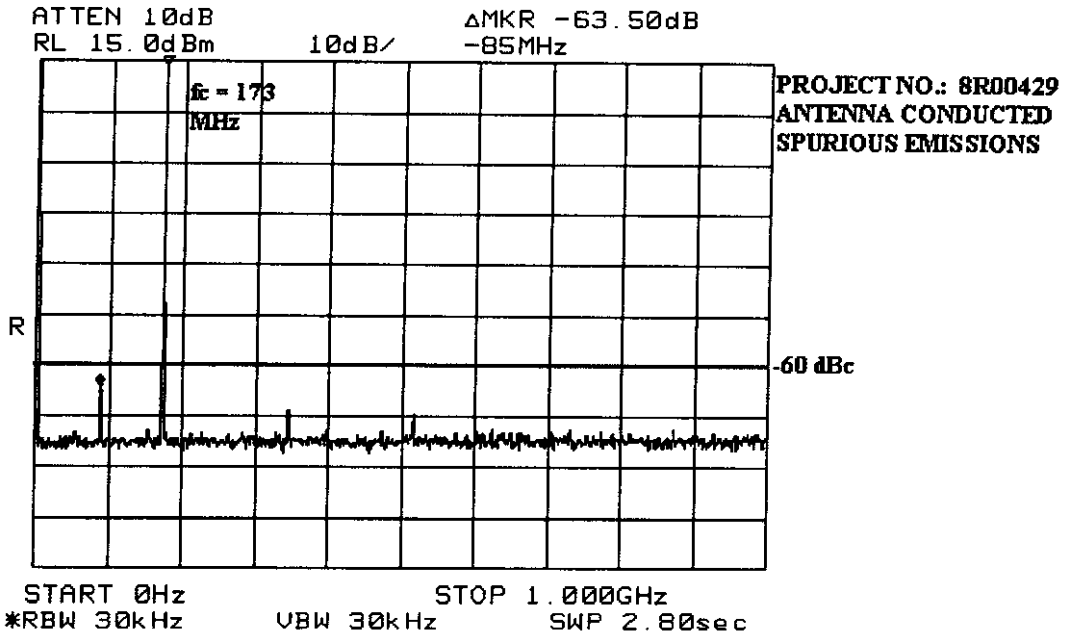

ATTEN 10dB
RL 15.1dBm
10dB/
R
PROJECT NO.: 8R00429
OCCUPIED BANDWIDTH
90.217(C)
CENTER 170.9550MHz
SPAN 100.0kHz
*RBW 300Hz
VBW 300Hz
SWP 2.80sec

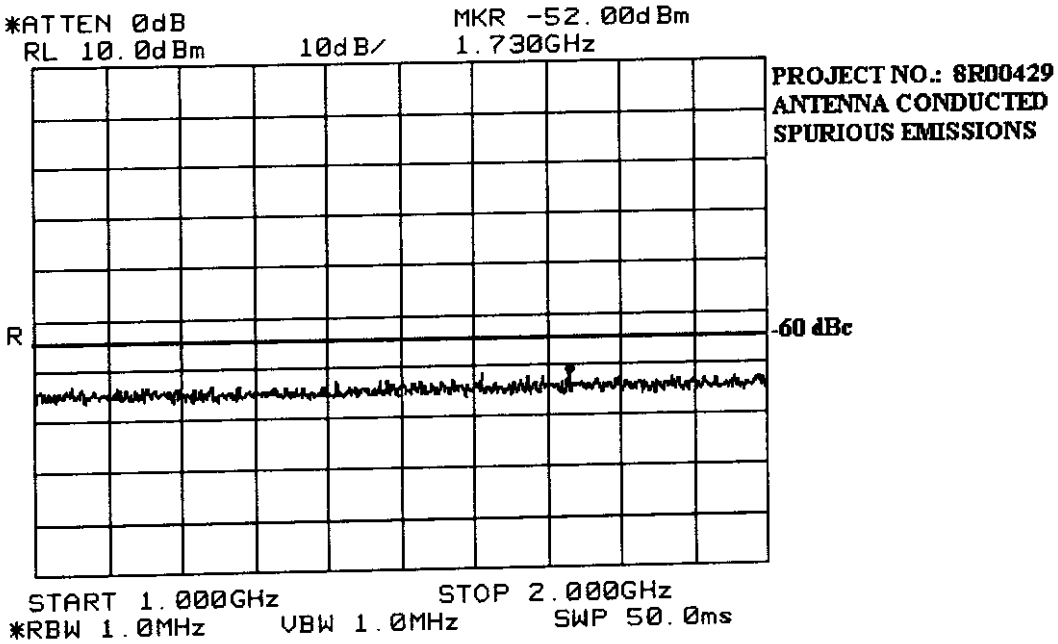
Section 8. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: Tom Tidwell	DATE: July 30, 1998

Test Results: Complies.

Test Data: See attached graph(s).


ATTEN 10dB
RL 15.0dBm
10dB/
ΔMKR -63.50dB
-85MHz
fc = 173 MHz
PROJECT NO.: 8R00429
ANTENNA CONDUCTED
SPURIOUS EMISSIONS
R
-60 dBc
START 0Hz
STOP 1.000GHz
*RBW 30kHz
VBW 30kHz
SWP 2.80sec


*ATTEN 0dB
RL 10.0dBm
10dB/
MKR -52.00dBm
1.730GHz
PROJECT NO.: 8R00429
ANTENNA CONDUCTED
SPURIOUS EMISSIONS
R
-60 dBc
START 1.000GHz
STOP 2.000GHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 50.0ms

Section 9. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: Tom Tidwell	DATE: July 31, 1998

Test Results: Complies.

Test Data: See attached table.

Test Data - Radiated Emissions

Distance: 3m		A tower		Receiver: 014		Detector: (1) 120 kHz		Q-Peak			
Freq. (MHz)	Ant. *	Pol. (V/H)	Ant. HGT. (m)	Table (deg.)	RCVD Signal (dBμV/m)	Ant. Factor (dB)**	Amp. Gain (dB)***	Dist. Corr. (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
170.963	B/C2	V	3		92.1	15.1			107.2	110.4	3.2*
170.963	B/C2	H	3		88.1	15.1			103.2	110.4	7.2
341.923	E/D3	V	3		1.2	22.7			23.9	82.3	58.4
341.923	E/D3	H	3		7.6	22.7			30.3	82.3	52.0
512.911	E/D4	V	3		-1.0	28.0			27.0	82.3	55.3
512.911	E/D4	H	3		-2.6	28.0			25.4	82.3	56.9
1025.78	Hrn2	V	5		6.2	28.2			34.4	54.0	19.6
1025.78	Hrn2	H	5		5.9	28.2			34.1	54.0	19.9

Notes:
The spectrum was search up to the 10th harmonic of the fundamental frequency.
B/C = Biconical, B/L = Biconilog, L/P = Log-Periodic, H = Horn, D/P = Dipole
* Includes cable loss when amplifier is not used.
** Includes cable loss. ( ) Denotes failing emission level.

Note: The fundamental emission was measured with the radio installed normally. All other emissions were measured with the transmitter operating at full output power into a 50 ohm coaxial load.

Section 10. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: Russell Grant	DATE: July 31, 1998

Test Results: Complies.

Measurement Data: See attached tables.

Frequency Stability

Variation With Frequency

	Frequency (MHz)				
Time (min.)	-30 øC	-20 øC	-10 øC	0 øC	10 øC
0.0	170.954737	170.954934	170.955184	170.955832	170.956108
0.5	170.954732	170.954952	170.955208	170.955846	170.956108
1.0	170.954727	170.954965	170.955221	170.955856	170.956109
1.5	170.954724	170.954975	170.955233	170.955865	170.956109
2.0	170.954721	170.954987	170.955252	170.955875	170.956110
2.5	170.954716	170.954998	170.955268	170.955885	170.956110
3.0	170.954714	170.955015	170.955281	170.955893	170.956110
3.5	170.954711	170.954026	170.955295	170.955902	170.956109
4.0	170.954707	170.954035	170.955310	170.955909	170.956109
4.5	170.954703	170.954044	170.955325	170.955916	170.956109
5.0	170.954699	170.954052	170.955345	170.955924	170.956108

	Frequency (MHz)			
Time (min.)	20 øC	30 øC	40 øC	50 øC
0.0	170.956002	170.955894	170.955522	170.955281
0.5	170.956001	170.955890	170.955521	170.955280
1.0	170.956000	170.955870	170.955520	170.955279
1.5	170.955999	170.955883	170.955519	170.955278
2.0	170.955997	170.955876	170.955519	170.955278
2.5	170.955996	170.955875	170.955518	170.955277
3.0	170.955996	170.955871	170.955518	170.955277
3.5	170.955995	170.955867	170.955517	170.955276
4.0	170.955994	170.955865	170.955516	170.955276
4.5	170.955994	170.955863	170.955516	170.955275
5.0	170.955993	170.955860	170.955515	170.955275

	Maximum Deviation	
Temperature	MHz	ppm
-30øC	0.000301	1.76
-20øC	0.000974	5.70
-10øC	0.000345	2.02
0øC	0.000924	5.40
10øC	0.001110	6.49
20øC	0.001002	5.86
30øC	0.000894	5.23
40øC	0.000522	3.05
50øC	0.000281	1.64

Frequency Stability, continued

Variation With Voltage

	Voltage		
Time (min.)	85% STV	STV	115% STV
0.0	170.956000	170.956002	170.955999
0.5	170.956002	170.956001	170.956001
1.0	170.956004	170.956000	170.956001
1.5	170.956005	170.955999	170.955998
2.0	170.956007	170.955997	170.955999
2.5	170.956006	170.955996	170.956001
3.0	170.956010	170.955996	170.956003
3.5	170.956011	170.955995	170.956001
4.0	170.956009	170.955994	170.956002
4.5	170.956012	170.955994	170.955999
5.0	170.956013	170.955993	170.956000

	Maximum Deviation	
Voltage	MHz	ppm
85% STV	0.001013	5.93
100% STV	0.001002	5.86
115% STV	0.001002	5.86

Section 11. Transient Frequency Behaviour

NAME OF TEST: Transient Frequency Behaviour	PARA. NO.: 90.214
TESTED BY:	DATE:

Test Results: Complies/Does Not Comply.

Measurement Data: See attached graphs.

Section 12. Test Equipment List

CAL CYCLE	EQUIPMENT	MANUFACTURER	MODEL	SERIAL	LAST CAL.	NEXT CAL.	
1 Year	Spectrum Analyzer	Hewlett Packard	8565E	FA000981	May 20/98	May 20/99	
1 Year	Attenuator	Narda	768-20	9507	July 24/98	July 24/99	
1 Year	Receiver	Rohde & Schwarz	ESVP	892661/014	Mar. 31/98	Mar. 31/99	
2 Year	Horn Antenna	EMCO #2	3115	4336	Oct. 30/97	Oct. 30/99	
1 Year	Log Periodic Antenna	EMCO	LPA-25	1141	July 27/98	July 27/99	
1 Year	Dipole Antenna Set	EMCO	3121C	1029	Oct. 28/97	Oct. 28/98	
1 Year	Biconical (2) Antenna	EMCO	3109	9503-2894	June 2/98	June 2/99	
1 Year	Low Noise Amplifier	Avantek	AWT-8035	1005	Aug. 4/98	Aug. 4/99	

NA: Not Applicable
NCR: No Cal Required

ANNEX A

TEST METHODOLOGIES

NAME OF TEST: RF Power Output **PARA. NO.: 2.985**

Minimum Standard: Para. No. 90.205(a). The maximum allowable station ERP is dependent upon the stations HAAT and required service area and will be authorized in accordance with Table 1 of 90.205(d).

Method Of Measurement:

Detachable Antenna:
The peak power at antenna terminals is measured using an in-line peak power meter. Power output is measured with the maximum rated input level.

Integral Antenna:
If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts
E = the maximum measured field strength in V/m
R = the measurement range (3 meters)
G = the numeric gain of the transmit antenna in relation to an isotropic radiator

NAME OF TEST: Audio Frequency Response **PARA. NO.: 2.987(a)**

Test Method: TIA/EIA-603

Minimum Standard: TIA/EIA-603, Para. 3.2.6 from 300 Hz to 3000 Hz. The transmitter audio frequency response shall have a nominal 6 dB per octave pre-emphasis characteristic.

NAME OF TEST: Audio Low-Pass Filter Frequency Response **PARA. NO.: 2.987(a)**

Test Method: TIA/EIA-603

Minimum Standard: TIA/EIA-603

NAME OF TEST: Modulation Limiting **PARA. NO.: 2.987(a)**

Test Method: TIA/EIA-603

Minimum Standard: TIA/EIA-603

NAME OF TEST: Occupied Bandwidth **PARA. NO.: 2.989**

Minimum Standard: Para. No. 90.210, see table 1 below for applicable mask.

Table 1

Frequency Band (MHz)	Mask for equipment with Low Pass Filter	Mask for equipment without Low Pass Filter
Below 25	A or B	A or C
25 - 50	B	C
72 - 76	B	C
150 - 174	B, D or E	C, D or E
150 Paging only	B	C
220 - 222	F	F
421 - 512	B, D or E	C, D or E
450 paging only	B	H
806 - 821/ 851 - 866	B	G
821 - 824/ 866 - 869	B	H
896 - 901/ 935 - 940	I	J
902 - 928	K	K
929 - 930	B	G
Above 940	B	C
All other bands	B	C

Test Method:

RBW: 1% of emission bandwidth in 0 - 1 GHz range. 1 MHz at frequencies above 1 GHz.
VBW: $\Rightarrow$ RBW

The spectrum is search up to 10 times the fundamental frequency.

NAME OF TEST: Field Strength of Spurious **PARA. NO.: 2.993**

Minimum Standard: Para. No. 90.210, see table 1 for applicable mask.

Calculation of Field Strength Limit

An example of attenuation requirement of 50 + 10 Log P is equivalent to -20 dBm (1×10^{-5} Watts) at the antenna terminal. We determine the field strength limit by using the plane wave relation.

$GP/4\pi R^2 = E^2/120\pi$

For emissions ≤ 1 GHz:

G = 1.64 (Dipole Gain)
P = 10^{-5} Watts (Maximum spurious output power)
R = 3m (Measurement Distance)

$$E = \frac{\sqrt{30GP}}{R} = E = \frac{\sqrt{30 \times 1.64 \times 10^{-5}}}{3} = 0.00739 \text{ V / m} = 77.4 \text{ dB}\mu\text{V / m}$$

For emissions > 1 GHz:

G = 1 (Isotropic Gain)
P = 1×10^{-5} Watts (Maximum spurious output power)
R = 3m (Measurement Distance)

$$E = 77.4 - 20Log\sqrt{1.64} = 75.2 dB\mu V / m@3m$$

MASK	Spurious Limit	FS Limit Below 1 GHz	FS Limit Above 1 GHz
A,B,C,G,H,I	-13dBm	84.4 dBμV/m@3m	82.2 dBμV/m@3m
D,J	-20dBm	77.4 dBμV/m@3m	75.2 dBμV/m@3m
E,F,K	-25dBm	72.4 dBμV/m@3m	70.2 dBμV/m@3m

NAME OF TEST: Frequency Stability — PARA. NO.: 2.995

Minimum Standard: Para. No. 990.213. The transmitter carrier frequency shall remain within the assigned frequency below in ppm.

Table 2

Frequency Band (MHz)	Fixed And Base Stations	Mobile Stations	
		> 2 Watts o/p pwr	< 2 Watts o/p pwr
Below 25	100	100	200
25 - 50	20	20	50
72 - 76	5	-	50
150 - 174	5	5	5
220 - 222	0.1	1.5	1.5
421 - 512	2.5	5	5
806 - 821	1.5	2.5	2.5
821 - 824	1.0	1.5	15
851 - 866	1.5	2.5	2.5
866 - 869	1.0	1.5	1.5
869 - 901	0.1	1.5	1.5
902 - 928	2.5	2.5	2.5
929 - 930	1.5	-	-
935 - 940	0.1	1.5	1.5
1427 - 1435	300	300	300
Above 2450	-	-	-

NAME OF TEST: Transient Frequency Behaviour — PARA. NO.: 2.214

Minimum Standard:

Transient Frequency Behaviour for Equipment Designed to Operate on 25 kHz Channels

		Frequency ranges (MHz) All equipment					
		Base station and portable radios			Mobile Radios		
Time intervals [1,2]	Maximum Frequency difference[3] (kHz)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t_1[4]	± 25	5.0	10.0	20.0	5.0	10.0	5.0
t_2	± 12	20.0	25.0	50.0	20.0	25.0	20.0
t_3[4]	± 25	5.0	10.0	10.0	5.0	10.0	5.0

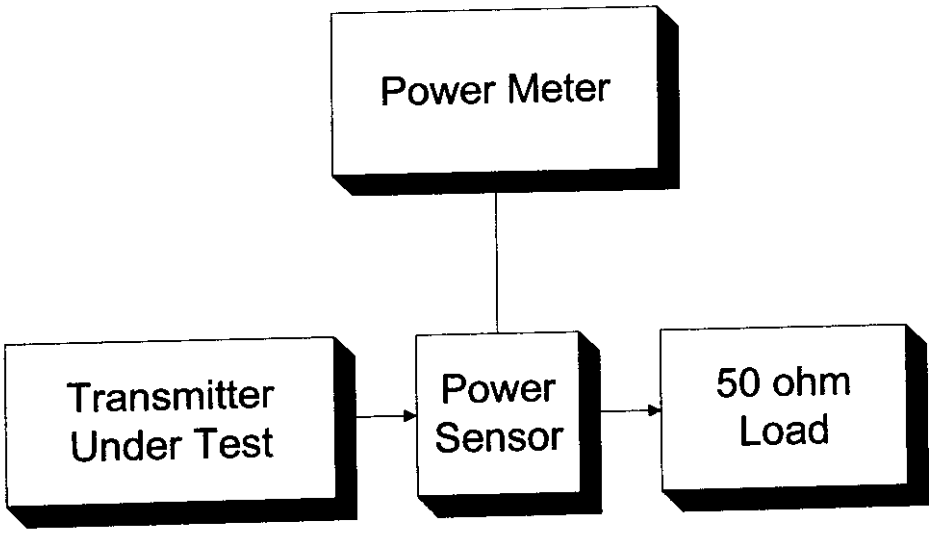
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz & 6.25 kHz Channels

	Maximum	Frequency ranges (MHz) All equipment		
Time intervals [1,2]	Frequency difference[3] (kHz)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t_1[4]	± 12.5 / ± 6.25	5.0	10.0	20.0
t_2	± 6.25 / ± 3.125	20.0	25.0	50.0
t_3[4]	± 12.5 / ± 6.25	5.0	10.0	10.0

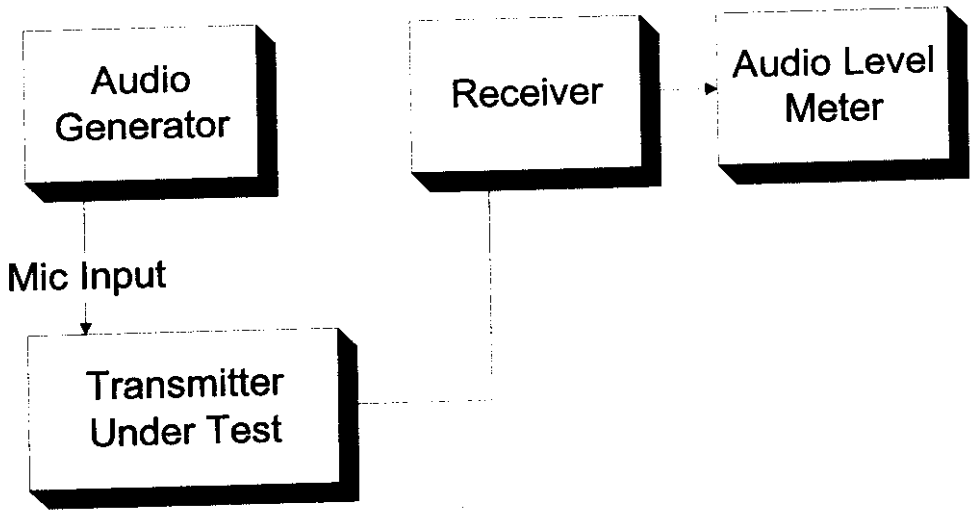
ANNEX B

TEST DIAGRAMS

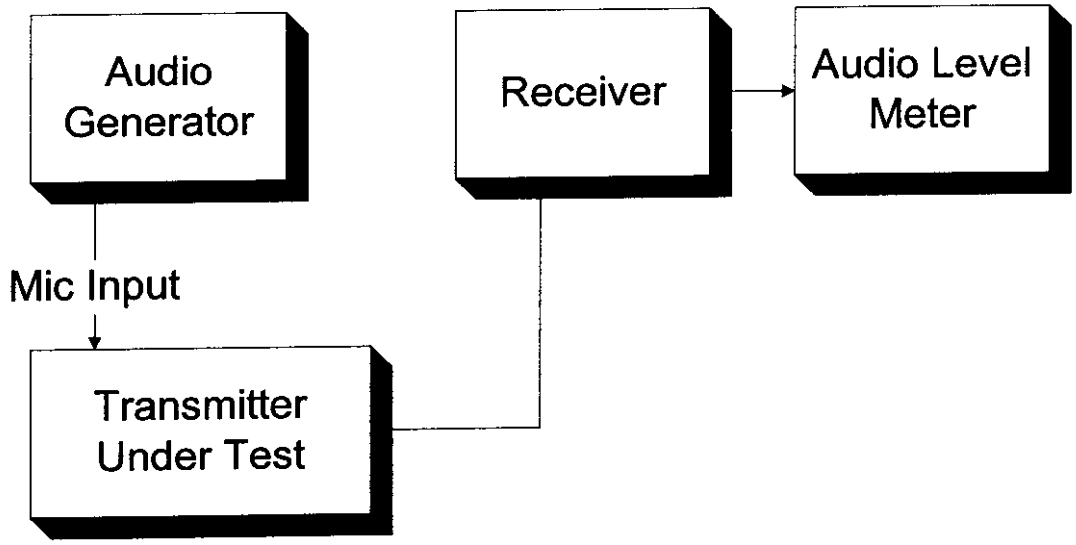
Para. No. 2.985 - R.F. Power Output



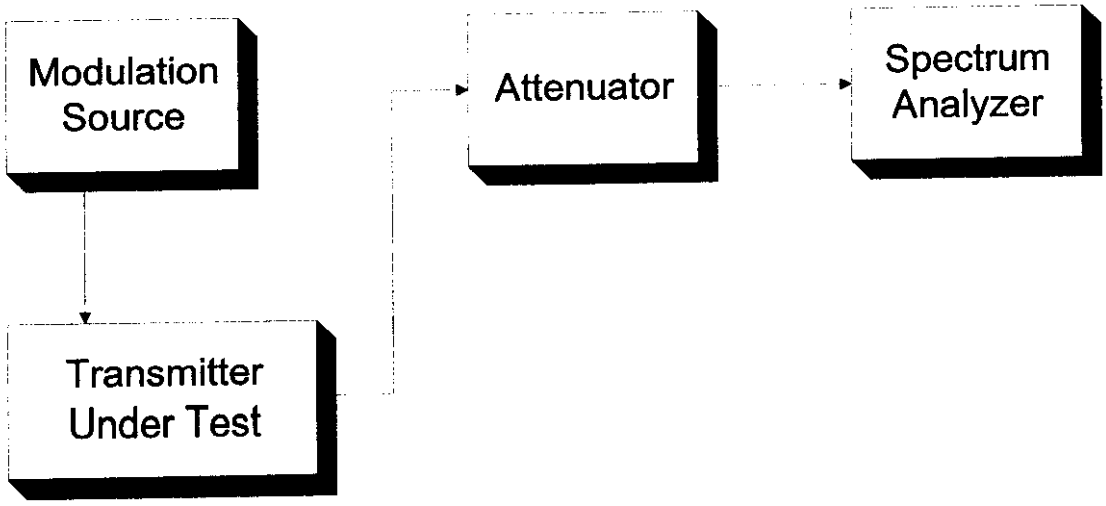
Para. No. 2.987(a) - Audio Frequency Response



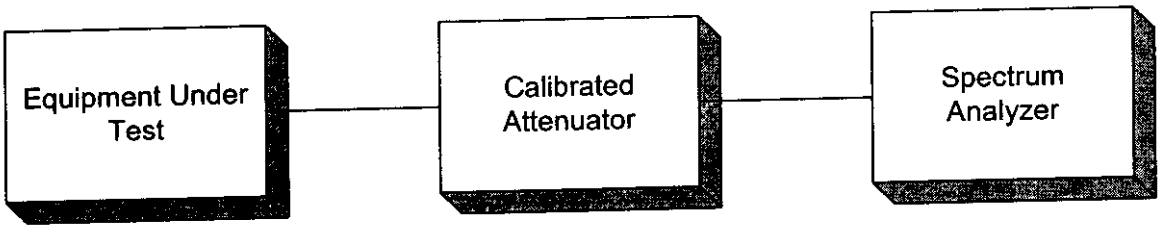
Para. No. 2.987(b) - Modulation Limiting



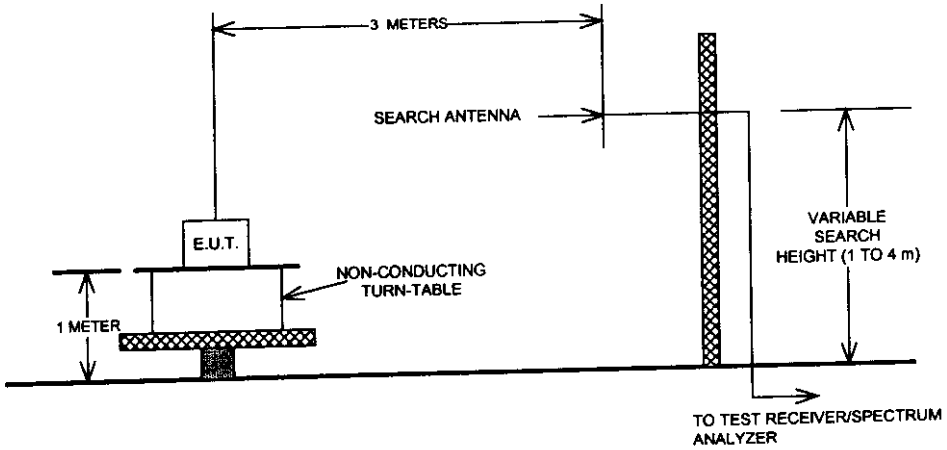
Para. No. 2.989 - Occupied Bandwidth



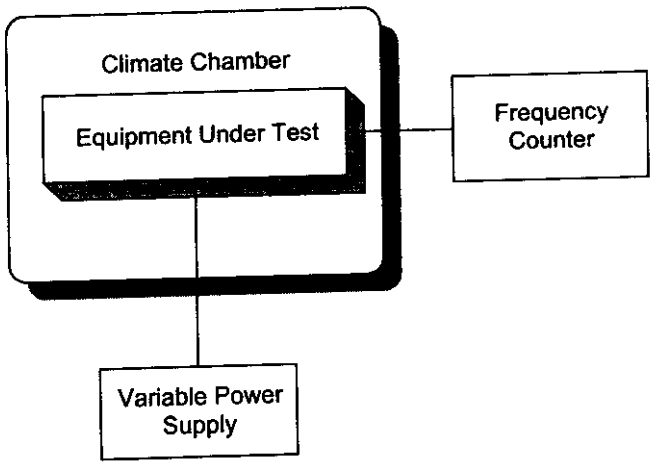
Para. No. 2.991 - Spurious Emissions at Antenna Terminals



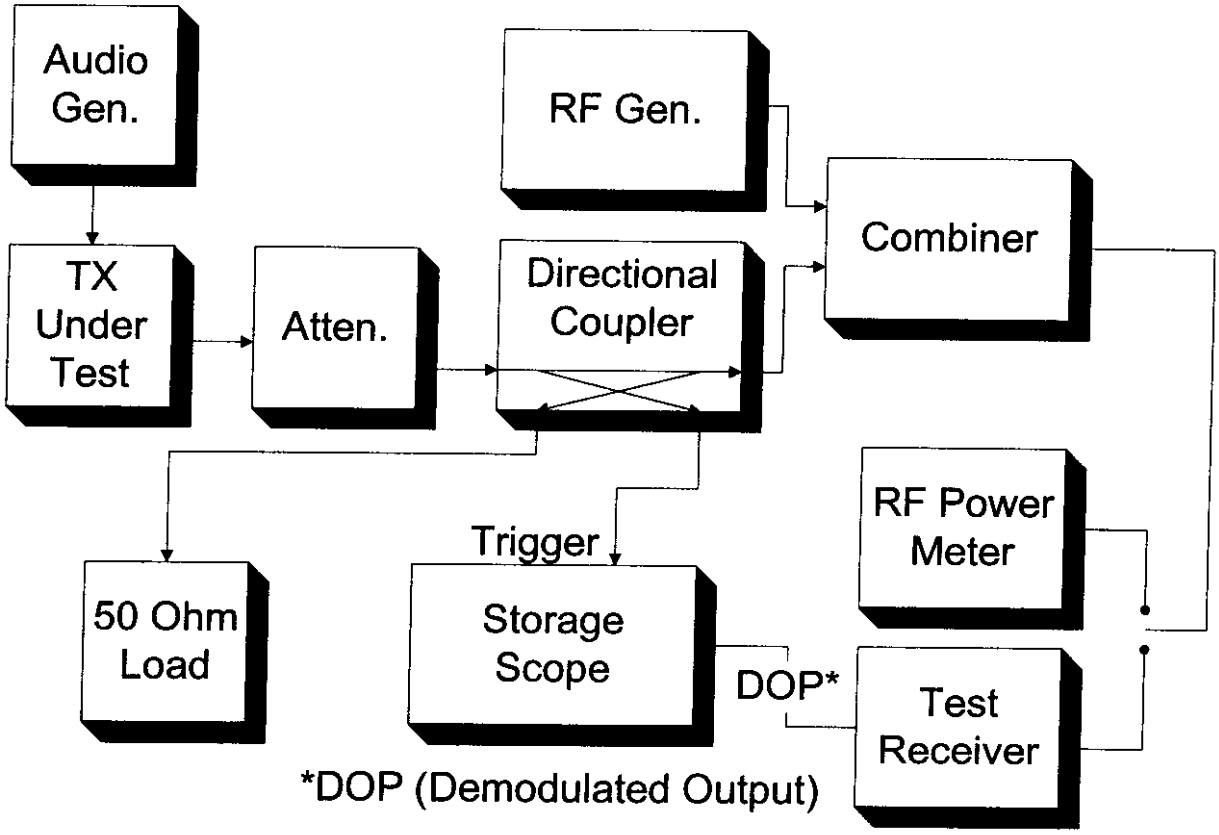
Para. No. 2.993 - Field Strength of Spurious Radiation



Para. No. 2.995 - Frequency Stability



Para. No. 90.214 - Transient Frequency Behaviour



Voice

This measurement was made using measurement procedure TIA/EIA Land Mobile FM or PM Communications Equipment Measurement and Performance Standards TIA/EIA-603 February 1993 Telecommunications Industry Association (American National Standard ANSI/TIA/EIA-603-1992 Approved: October 27, 1992) Para. no. 2.2 Methods of Measurement for Transmitters Para. no. 2.2.19 Transient Frequency Behaviour (page no. 83).

Data

This measurement was made using measurement procedure TIA/EIA Digital C4FM/CQPSK Transceiver Measurement Methods TSB102.CAAA Para. no. 2.2.17 Transient Frequency Behaviour (page no. 74).