

KTL Test Report: 9L0385RUS

Applicant: Allen Telecom, Inc.
140 Vista Centre Drive
Forest, VA 24551

Equipment Under Test: EAC-2000D Digital Cellular Enhancer

FCC ID: BCR9GB2000

In Accordance With: **FCC Part 22, Subpart H**
Cellular Band Repeaters

Tested By: KTL Dallas Inc.
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75057-3136

Authorized By:

Tom Tidwell, RF Group Manager

Date:

Total Number of Pages: 34

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

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EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Section 1. Summary of Test Results

Manufacturer: Grayson Wireless

Model No.: EAC-2000D

Serial No.: NONE

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

These tests were conducted on a sample of the equipment for the purpose of demonstrating continued compliance with FCC Part 22, Subpart H following design change.

☐

New Submission

☒

Production Unit

☒

Class II Permissive Change

☐

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 LAB CODE: 100426-0

TESTED BY: _____ DATE: _____

Ron Gaytan

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EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	22.913(a)	500W ERP	15 W/ch. Fwd. .1 W/ch. Rvs.	Complies
Occupied Bandwidth (Voice & SAT)	22.917(c)	Mask C	N/A	N/A
Occupies Bandwidth (Wideband Data)	22.917(d)	Mask D	N/A	N/A
Occupied Bandwidth (ST)	22.917(d)	Mask D	N/A	N/A
Occupied Bandwidth (Digital)	None	None	Plot	Complies
Spurious Emissions at Antenna Terminals	22.917	-13 dBm	-14.1	Complies
Field Strength of Spurious Emissions	22.917	-13 dBm E.I.R.P.	N/A	N/A
Frequency Stability	22.355	1.5 ppm	N/A	N/A

Footnotes:

(1) Since the 45 watt amplifier module tested is the same form, fit, and function as the previous version with which the EAC2000 was certified, only those parameters that might be expected to change were re-tested.

Test Conditions:

Indoor Temperature: 23 °C
 Humidity: 27 %

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Section 2. General Equipment Specification

Supply Voltage Input: 230 VAC/60Hz

Frequency Range: **Downlink:** 869 – 894 MHz

Frequency Range: **Uplink:** 824 – 849 MHz

Type of Modulation and Designator:	CDMA (F9W)	GSM (GXW)	NADC (DXW)	CDPD (F9W)	AMPS (F8W, F1D)
	☐	☐	☒	☐	☒

Output Impedance: 50 ohms

Max Input Power: -40 dBm

RF Output (Rated): **Downlink:** 15 watts per channel / 150 watts total
 Uplink: .1 watt per channel / 1 watt total

Frequency Translation:	F1-F1	F1-F2	N/A
	☒	☒	☐

Band Selection:	Software	Duplexer Change	Fullband Coverage
	☒	☐	☒

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Description of Modifications For Class II Permissive Change

The A002015.G1 45 Watt Power Amplifier in the forward path is a replacement for the earlier 21-117-1 and 21-396-1 PAs used in the EAC-2000 AMPS repeater. The new amplifier is identical in form, fit and function, differing only in new identification labels on the outside of the PA.

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Theory of Operation

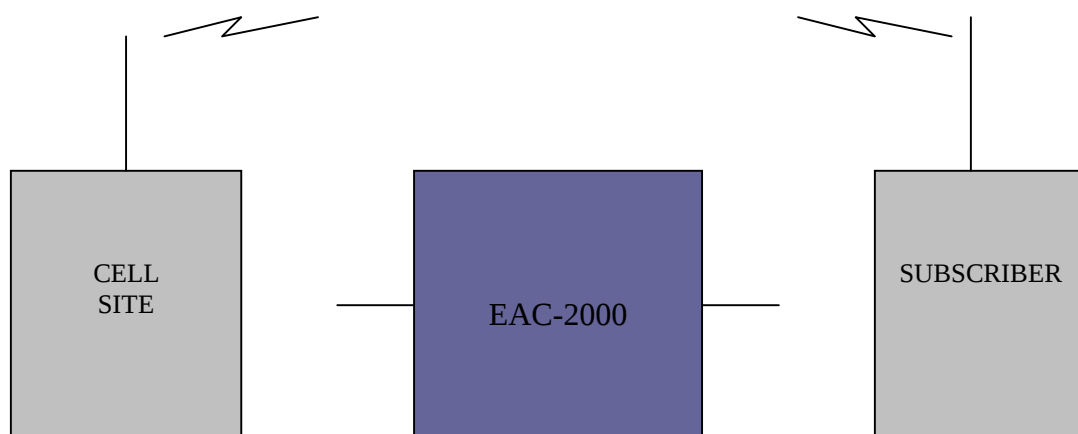
45 Watt PA

The input signal (-5 to +5 dBm) passes through variable attenuator U1, gain block U6, to class-A biased bipolar transistor Q3. That signal is further amplified by class-AB biased FETs Q4 and Q5.

The output is passed through a single-junction circulator N1, and the rated 45 Watts is routed to the PA output connector.

A directional coupler on the output feeds closed-loop power control detector D1, with associated temperature compensation U4. The signal is amplified and compared to a reference from U9 by U10 and U11; the resulting agc signal is fed back to attenuator U1. Four power levels can be set by external control through mux U5. Internal PA temperature is reported to the EAC-2000 by U8.

System Diagram



EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Section 3. RF Power Output

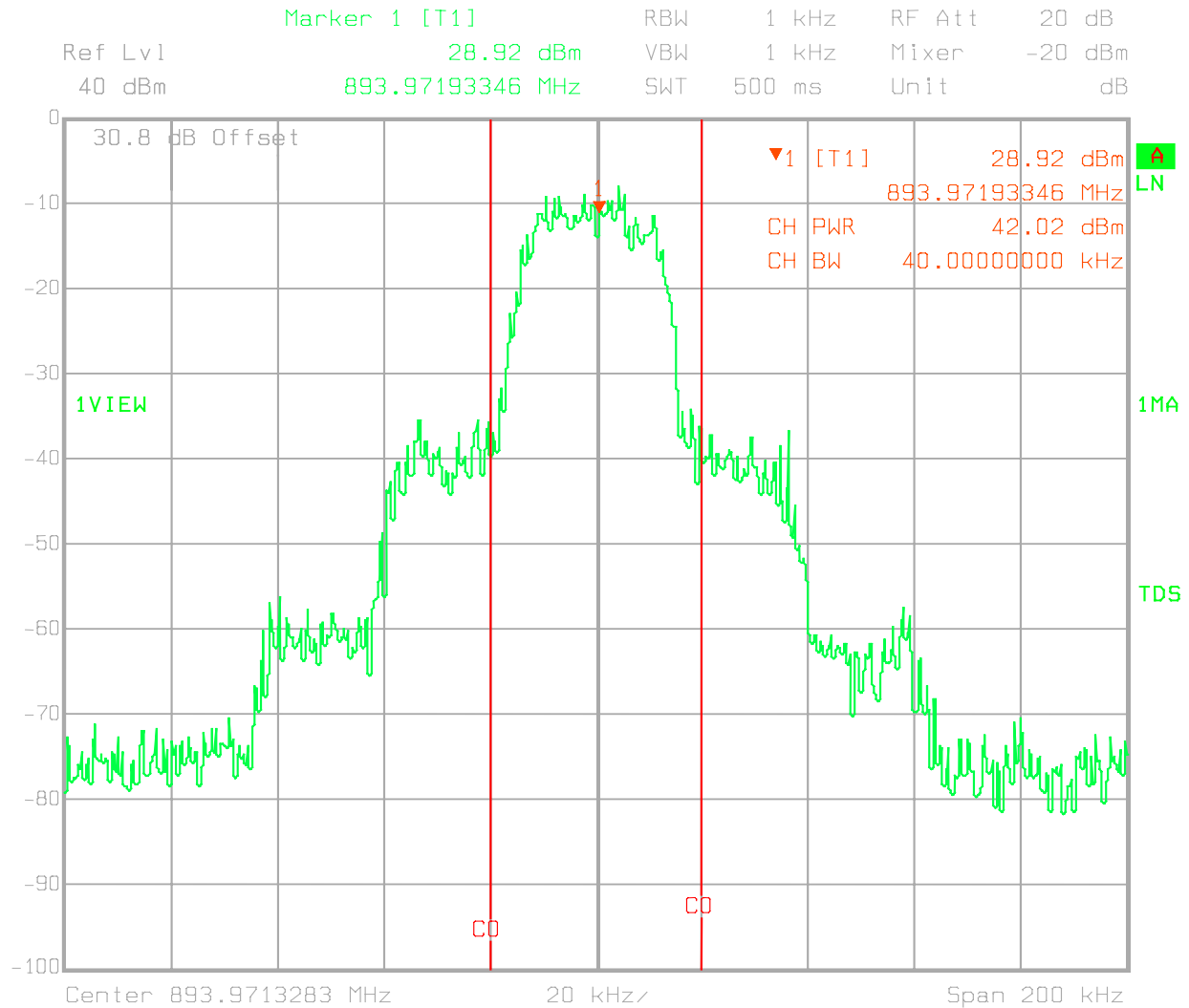
NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: Ron Gaytan	DATE: 11 Oct. 1999

Test Results: Complies.**Measurement Data:**

	Modulation Type	Per Channel Power Output (dBm)	Composite Power Output (dBm)
Uplink	AMPS	+20.0	+30.0
Downlink	AMPS	+42.0	+52.0
Uplink	CDMA	N/A	N/A
Downlink	CDMA	N/A	N/A
Uplink	GSM	N/A	N/A
Downlink	GSM	N/A	N/A
Uplink	NADC	+20.0	+30.0
Downlink	NADC	+41.8	+51.8
Uplink	CDPD	N/A	N/A
Downlink	CDPD	N/A	N/A

NOTE: The power output at channel 799 is reduced to 2 watts to comply with the $43 + 10\log(P)$ limit. At channels 991 – 798 (869.040 to 893.940 MHz), the power output is operated at 15 watts per channel.

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
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Title: 9L0385R CHANNEL POWER (CHANNEL 799)
Comment A: CP1.WMF
Date: 11.OCT.1999 9:30:21

Plot 1

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

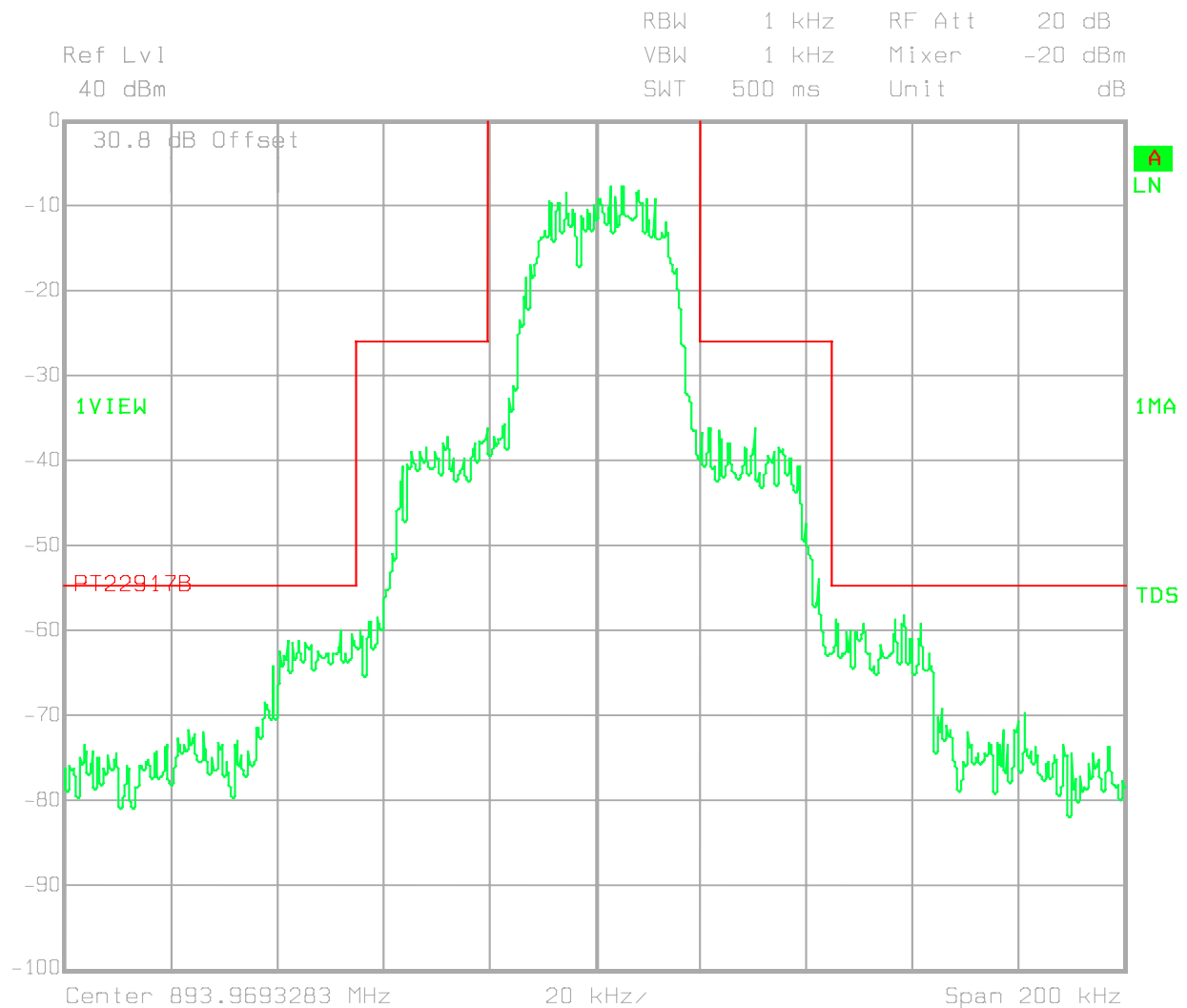
Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth (Digital Mod.)	PARA. NO.: 2.917(e)
TESTED BY: Ron Gaytan	DATE: 11 October, 1999

Test Results: Complies.

Test Data: See attached plots.

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000



Title: 9L0385R OCCUPIED BANDWIDTH (CHANNEL 799)
Comment A: MOR801B
Date: 11.OCT.1999 9:16:31

Plot 2

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

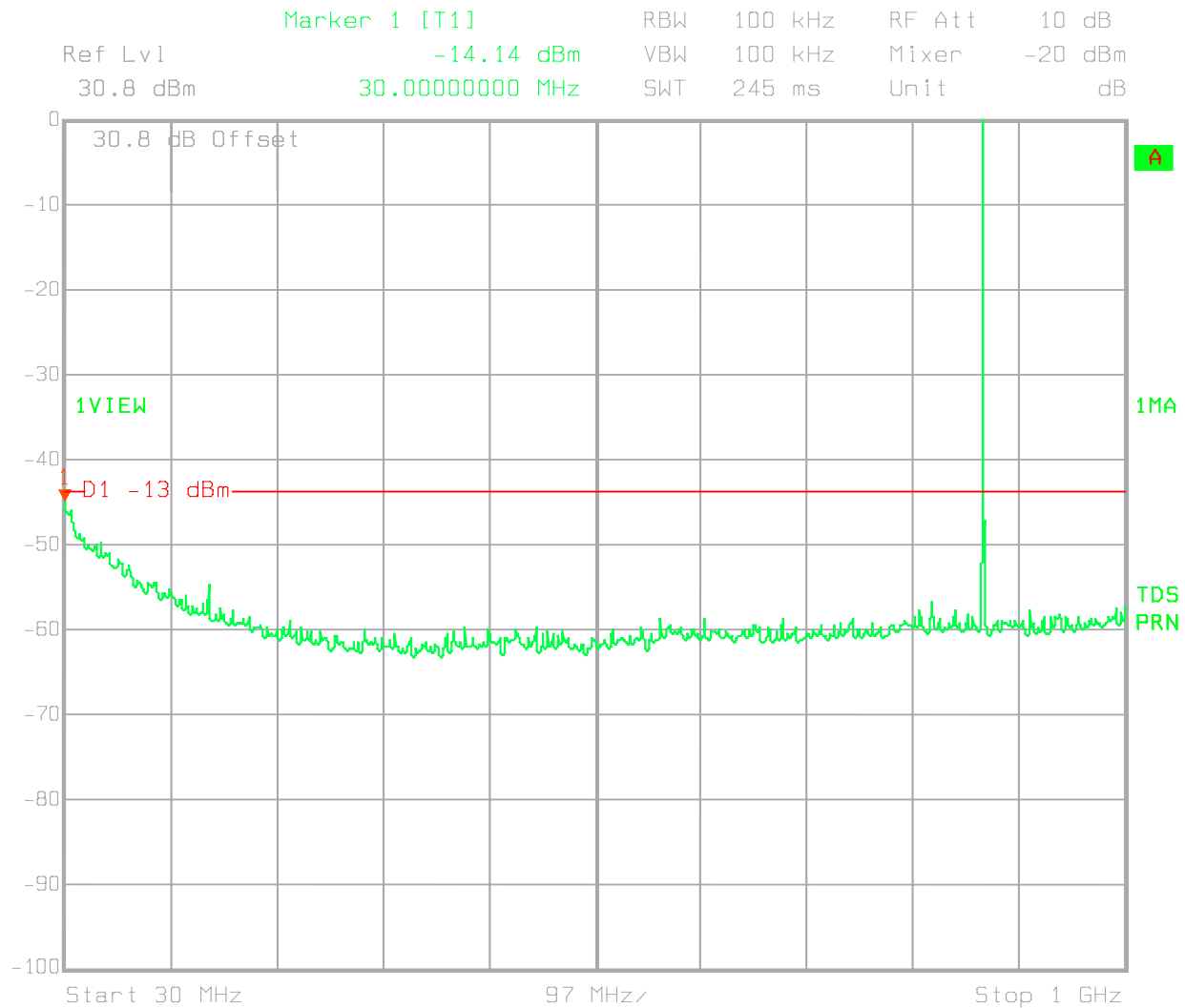
Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.917(e)
TESTED BY: Ron Gaytan	DATE: 11 October, 1999

Test Results: Complies.

Test Data: See attached plots

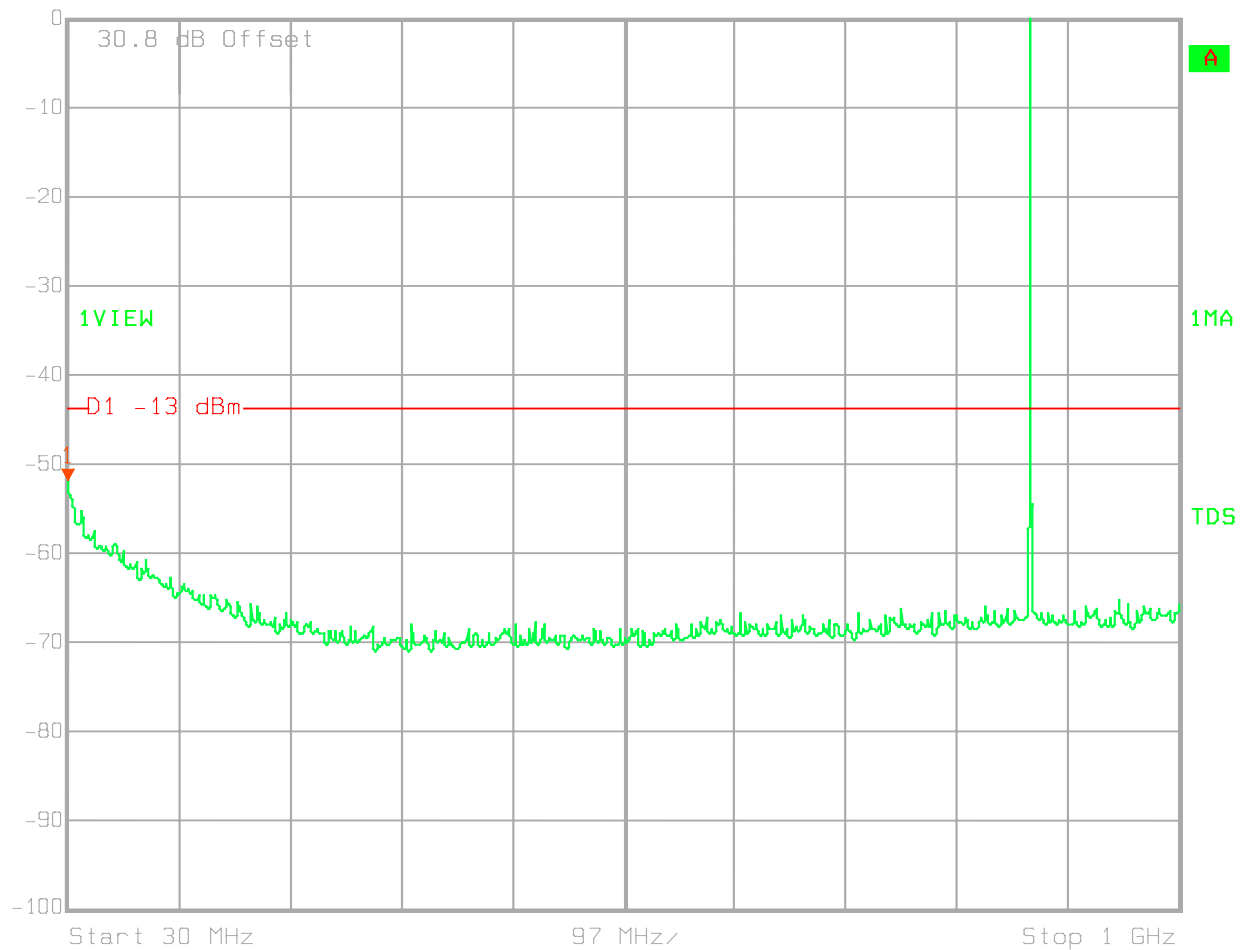
EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000



Title: 9L0385R ANTENNA PORT SPURIOUS EMISSIONS (CHANNEL 991)
Comment A: APSE1A.WMF
Date: 11.OCT.1999 11:10:54

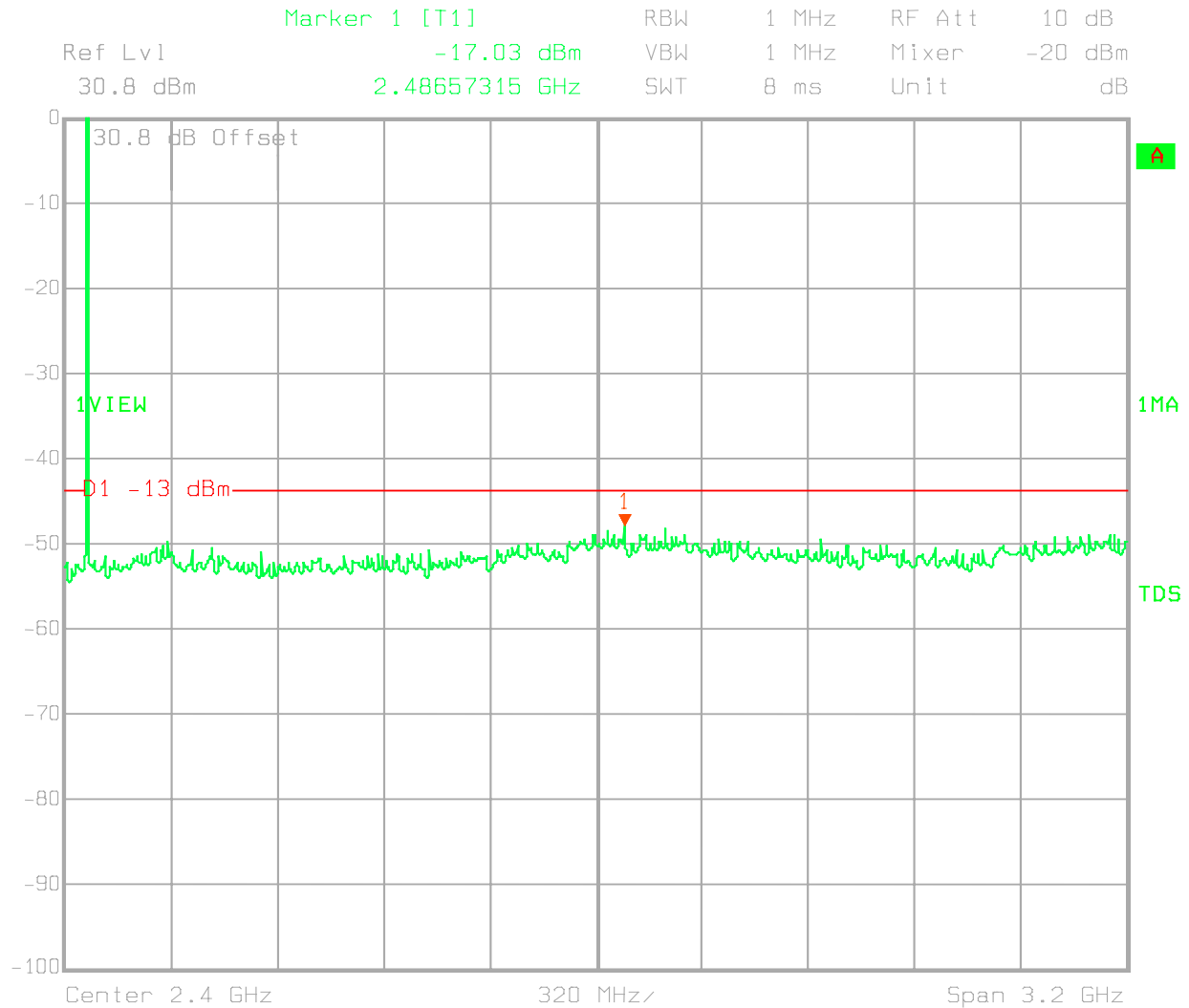
Plot 3

Marker 1 [T1]	RBW	30 kHz	RF Att	10 dB
Ref Lvl -21.10 dBm	VBW	30 kHz	Mixer	-20 dBm
30.8 dBm	30.00000000 MHz	SWT	2.7 s	Unit dB



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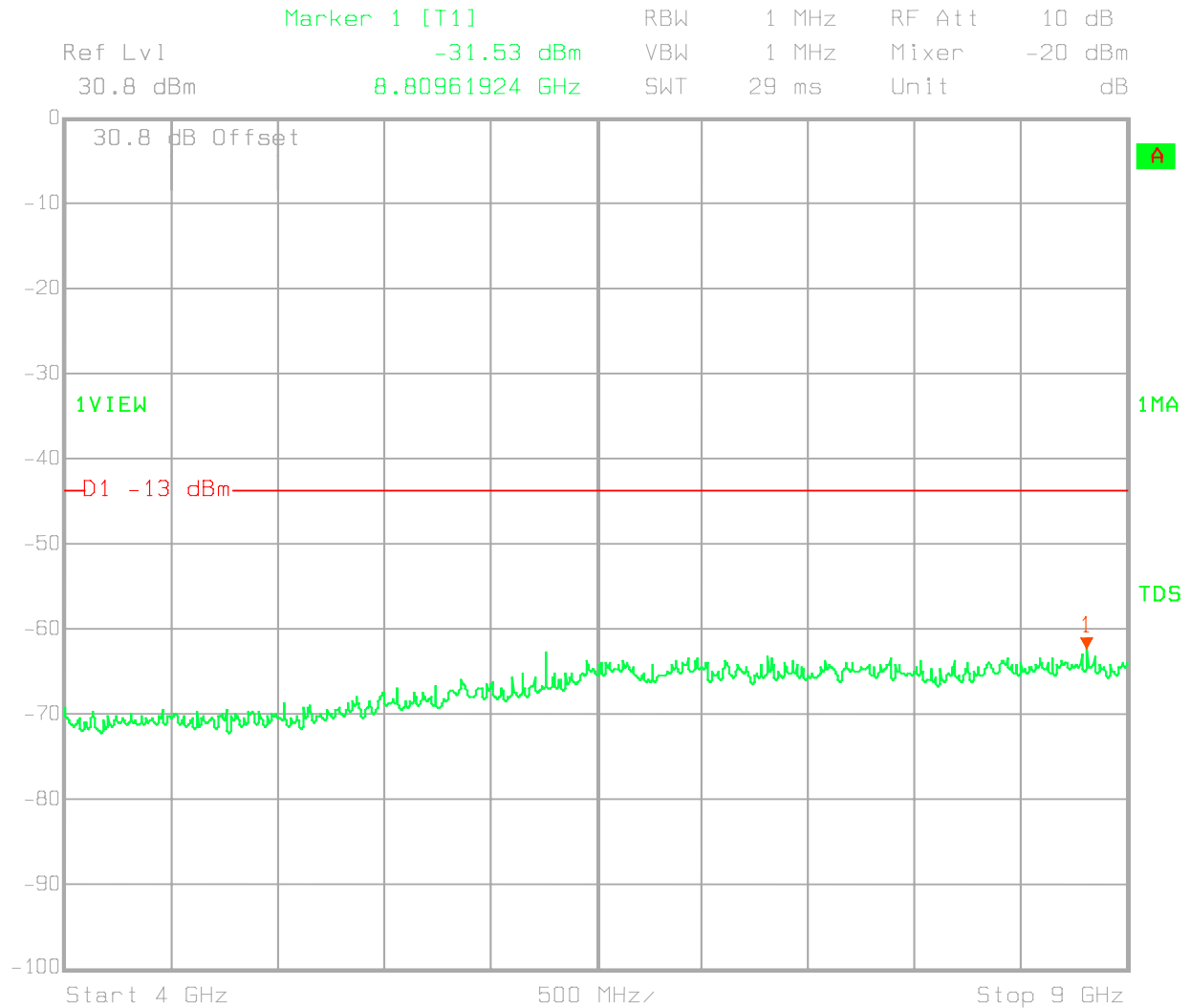
EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000



Title: 9L0385R ANTENNA PORT SPURIOUS EMISSIONS (CHANNEL 991)
Comment A: APSE2.WMF
Date: 11.OCT.1999 10:47:35

Plot 5

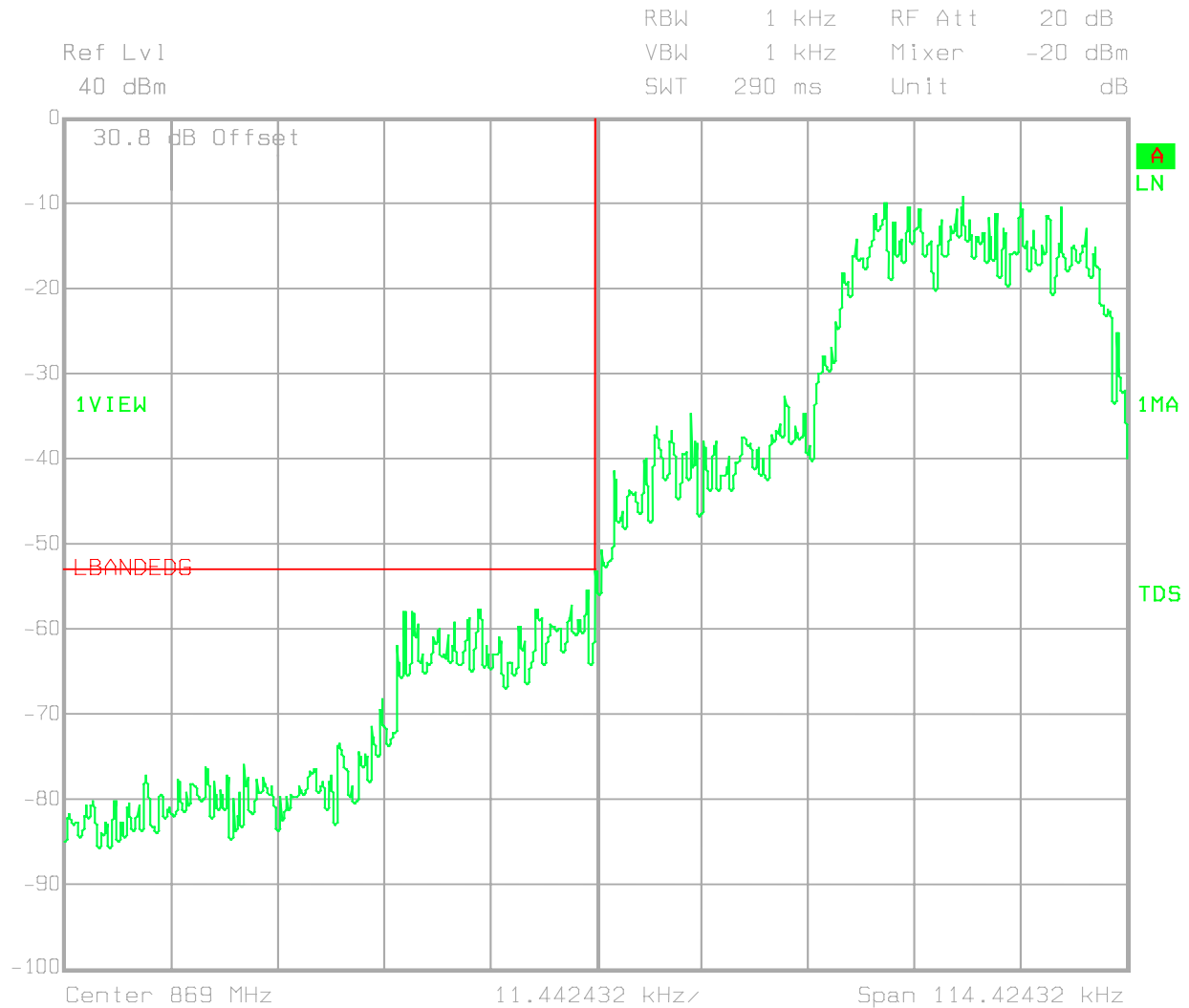
EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000



Title: 9L0385R ANTENNA PORT SPURIOUS EMISSIONS (CHANNEL 991)
Comment A: APSE3.WMF
Date: 11.OCT.1999 11:18:02

Plot 6

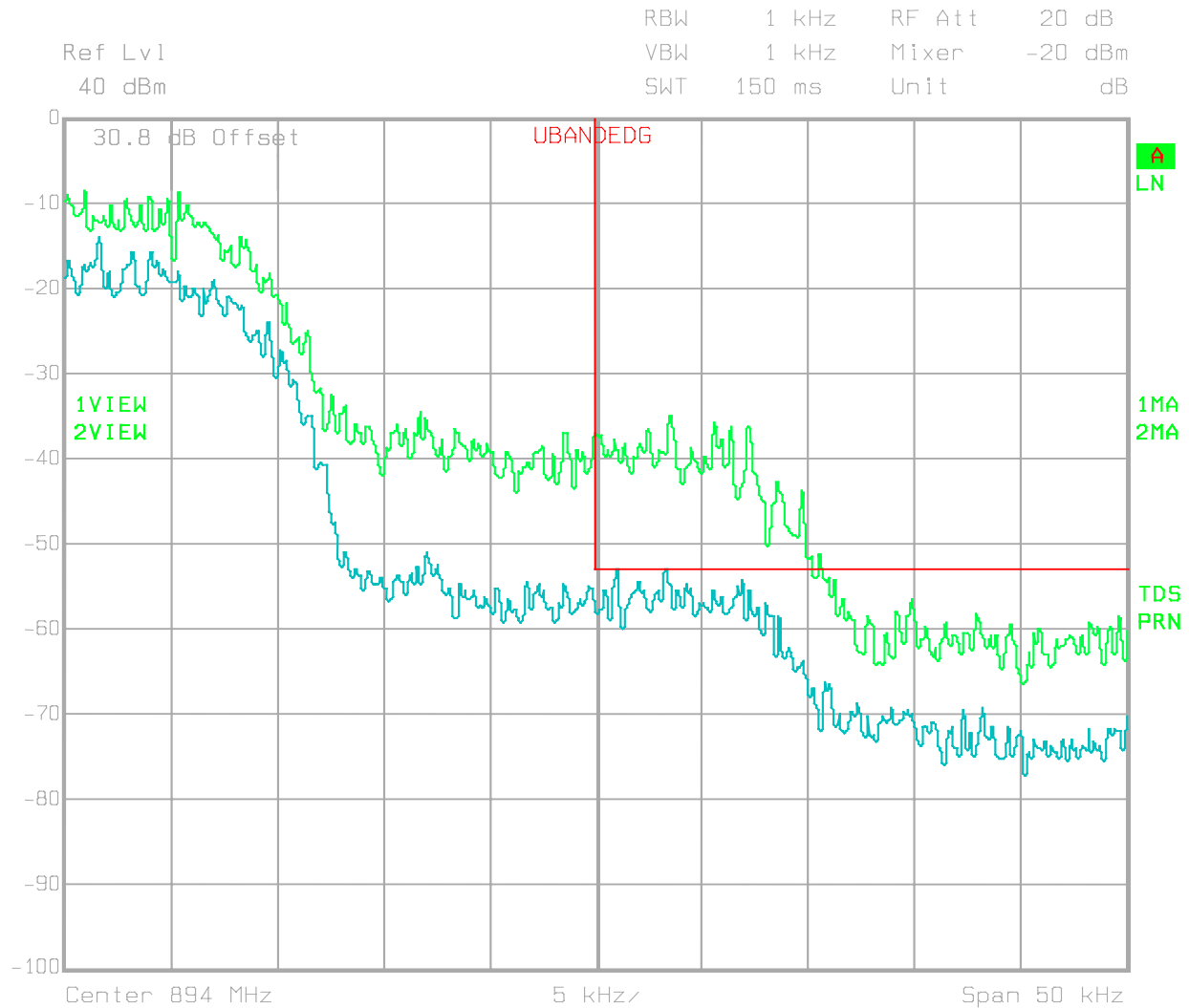
EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000



Title: 9L0385R LOWER BANDEGE (CHANNEL 991)
 Comment A: LBE1.WMF
 Date: 11.OCT.1999 10:11:23

Plot 7

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000



Title: 9L0385R UPPER BANDEDGE (CHANNEL 799)
 Comment A: UBE1.WMF
 Date: 11.OCT.1999 9:48:55

Plot 8

NOTE: The power output at channel 799 is reduced to 2 watts to comply with the $43 + 10\log(P)$ limit. At channels 991 – 798 (869.040 to 893.940 MHz), the power output is operated at 15 watts per channel.

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Section 6. Field Strength of Spurious

NAME OF TEST: Field Strength of Spurious	PARA. NO.: 2.917(e)
TESTED BY:	DATE:

Test Results:

The maximum field strength is _____ $\mu\text{V/m}$ @ _____ @ 3m.

Test Data:

Not Applicable

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Section 7. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 22.355
TESTED BY:	DATE:

Test Results:

Measurement Data:

Standard Test Frequency: _____ MHz
Standard Test Voltage: _____ Vdc

Not Applicable

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Section 8. Test Equipment List

	KTL ID	Description	Manufacturer Model Number	Serial Number	Calibration Date
1	G2632	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	06/14/99
2	G2736	SIGNAL GENERATOR	ROHDE & SCHWARZ SMIQ 03	DE22081	05/03/99
3	G1366	50 OHM LOAD	NARDA 27470	254	02/25/99
4	G1017	ATTENUATOR	NARDA 776B-20	NONE	09/30/99
5	G1018	ATTENUATOR	NARDA 776B-10	NONE	09/30/99
6	G3725	DUAL DIRECTIONAL COUPLER	NARDA 3020A	34366	05/19/99
7	G3726	DUAL DIRECTIONAL COUPLER	NARDA 3022	73393	05/19/99
8	G3727	DUAL DIRECTIONAL COUPLER	HEWLETT PACKARD 11692D	1212A03366	05/07/99
9	CF40	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	08/31/99
10	C111	CABLE, 3m	KTL Suhner	N/A	06/15/99

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FCC PART 22, SUBPART H
CELLULAR BAND REPEATERS
PROJECT NO.: 9L0385RUS

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

ANNEX A - TEST DETAILS

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

NAME OF TEST: RF Power Output	PARA. NO.: 2.1046
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Minimum Standard: Para. No. 22.913(a). The maximum effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 watts.

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:

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

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

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

NAME OF TEST: Occupied Bandwidth (Voice & SAT)	PARA. NO.: 2.1049
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Minimum Standard: 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

- (i) On any frequency removed from the carrier frequency by more than 12 kHz but not more than 20 kHz:

at least $117 \log(f_d/12)$

- (ii) On any frequency removed from the carrier frequency by more than 20 kHz, up to the first multiple of the carrier frequency:

at least $100 \log(f_d/11)$ dB or $43 + 10 \log(P)$ dB, whichever is the lesser attenuation.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: 300 Hz
VBW: $\geq$ RBW
Span: 100 kHz
Sweep: Auto
Mask: CELLF3E

Input Signal Characteristics (F3E/F3D):

RF level: Maximum recommended by manufacturer
AF1 frequency: 6 kHz
AF1 level: sufficient to produce 2 kHz deviation
AF2 frequency: 2.5 kHz
AF2 level: sufficient to produce 12 kHz deviation.

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

NAME OF TEST: Occupied Bandwidth (WB Data)	PARA. NO.: 2.1049
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Minimum Standard: 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) 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.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: 300 Hz

VBW: $\geq$ RBW

Span: 200 kHz

Sweep: Auto

Mask: CELLF1D

Input Signal Characteristics:

RF level: Maximum recommended by manufacturer

AF1 frequency: 10 kHz, random bit sequence

AF1 level: sufficient to produce 8 kHz deviation

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

NAME OF TEST: Occupied Bandwidth (ST)	PARA. NO.: 2.1049
--	--------------------------

Minimum Standard: 22.917(c) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) 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.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: 300 Hz

VBW: $\geq$ RBW

Span: 200 kHz

Sweep: Auto

Mask: CELLF1D

Input Signal Characteristics:

RF level: Maximum recommended by manufacturer

AF1 frequency: 10 kHz tone

AF1 level: sufficient to produce 8 kHz deviation

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

NAME OF TEST: Occupied Bandwidth (Digital Modulation) PARA. NO.: 2.1049

Minimum Standard: Not defined by FCC. Input vs. Output.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: CDMA (30 kHz), GSM (30 kHz), NADC (1 kHz) and CDPD (1 kHz)

VBW: $\geq$ RBW

Span: As required

Sweep: Auto

Mask:

Input Signal Characteristics:

RF level: Maximum recommended by manufacturer

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

NAME OF TEST: Spurious Emission at Antenna Terminals	PARA. NO.: 2.1051
---	--------------------------

Minimum Standard: Para. No. 22.917(e). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least $43 + 10 \log P$. This is equivalent to -13 dBm absolute power.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: 30 kHz (AMPS). As required for digital modulations.

VBW: $\geq$ RBW

Start Frequency: 0 MHz

Stop Frequency: 10 GHz

Sweep: Auto

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

NAME OF TEST: Field Strength of Spurious Radiation	PARA. NO.: 2.1053
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Minimum Standard:

Para. No. 22.917(e). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least $43 + 10 \log P$. This is equivalent to -13 dBm absolute power.

Calculation Of Field Strength Limit:

An example of attenuation requirement of $43 + 10 \log P$ is equivalent to -13 dBm (5×10^{-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)

$R = 3\text{m}$ (Measurement Distance)

$$E = \frac{\sqrt{30GP}}{R}$$

$$E = \frac{\sqrt{30 \times 1.64 \times 5 \times 10^{-5}}}{3} = 0.016533 \text{ V / m} = 84.4 \text{ dB}\mu\text{V / m}$$

For emissions > 1 GHz:

$G = 1$ (Isotropic Gain)

$P = 1 \times 10^{-5}$ Watts (Maximum spurious output power)

$R = 3\text{m}$ (Measurement Distance)

$$E = 84.4 - 20 \log \sqrt{1.64} = 82.3 \text{ dB}\mu\text{V / m@3m}$$

The spectrum is searched to 10 GHz.

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

NAME OF TEST: Frequency Stability**PARA. NO.: 2.1055**

Minimum Standard: Para. No. 22.355. The transmitter carrier frequency shall remain within the tolerances given in Table C-1.

Freq. Range (MHz)	Base, fixed	Mobile > 3 W	Mobile $\leq$ 3 W
821 to 896	1.5	2.5	2.5

Table C-1

Method Of Measurement:Frequency Stability With Voltage Variation:

The E.U.T. is placed in an environmental chamber and allowed to stabilize at +20 degrees Celsius for at least 15 minutes. The frequency counter and signal generator are phase locked with the same 10 MHz reference frequency by connecting the 10 MHz ref. out of the counter to the 10 MHz ref, in of the signal generator. With the voltage input to the E.U.T. set to 85% S.T.V., the frequency is measured in 30 second intervals for a period of 5 minutes. This procedure is repeated at 100% S.T.V. and 115% S.T.V.

Frequency Stability With Temperature Variation:

The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied in 10 degree steps from -30 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency is measured in 30 second intervals for a period of 5 minutes.

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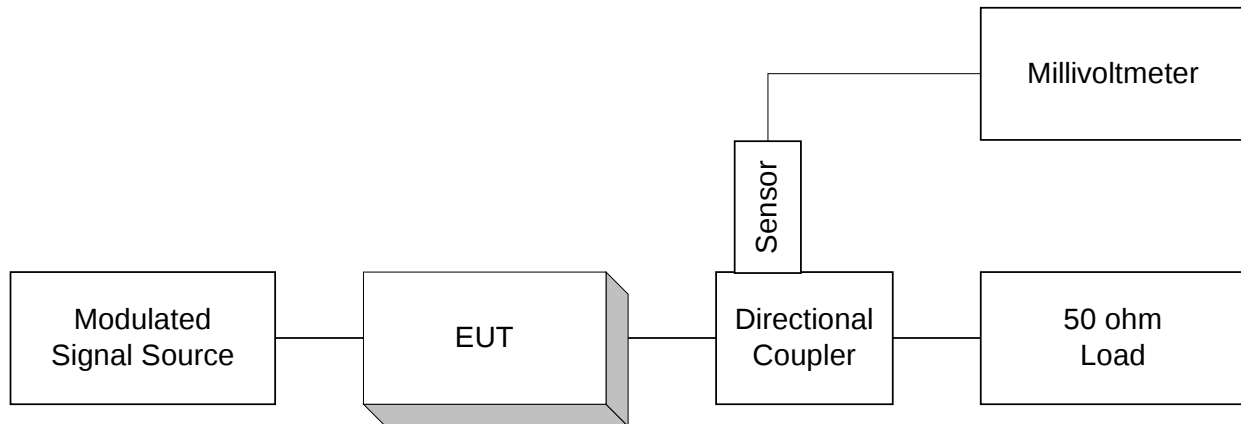
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CELLULAR BAND REPEATERS
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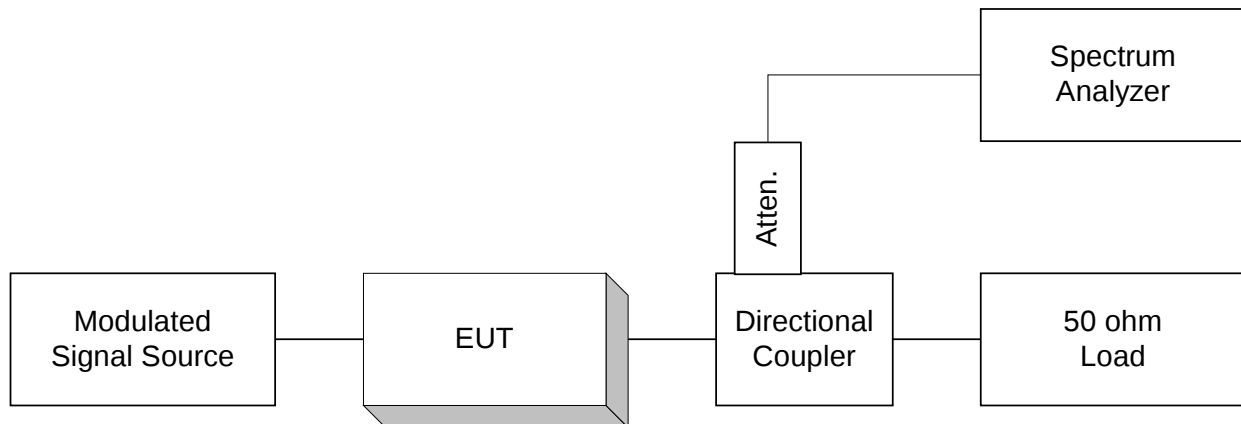
ANNEX B - TEST DIAGRAMS

EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

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

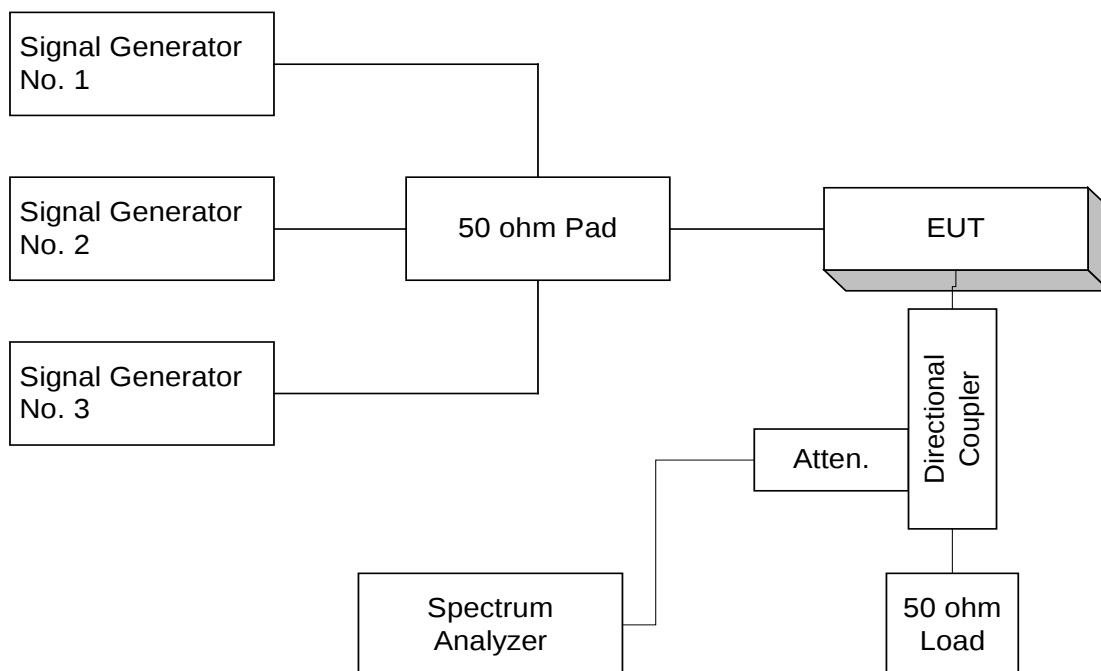
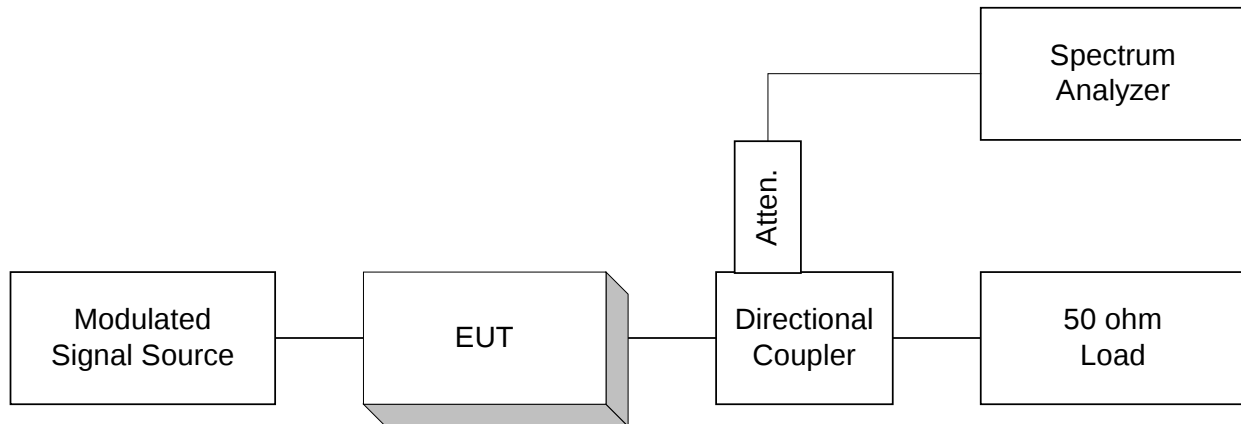


Para. No. 2.989 - Occupied Bandwidth



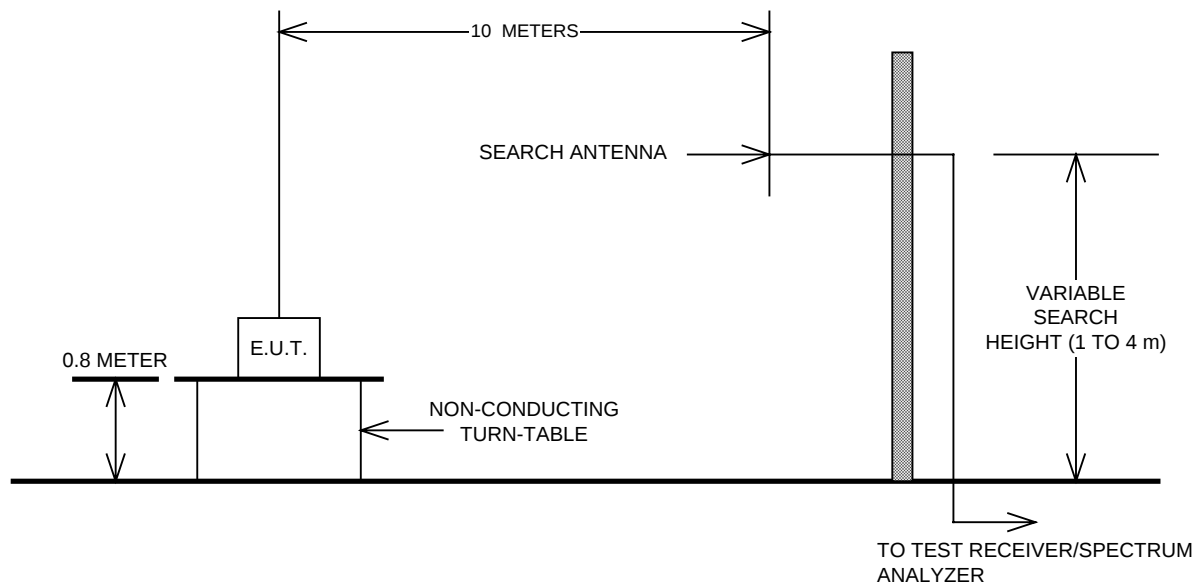
EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Para. No. 2.991 Spurious Emissions at Antenna Terminals



EQUIPMENT: EAC-2000D Digital Cellular Enhancer
FCC ID: BCR9GB2000

Para. No. 2.993 - Field Strength of Spurious Radiation



Para. No. 2.995 - Frequency Stability

