



Retlif Testing Laboratories

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REPORT OF MEASUREMENTS

FOR

CELLULAR SPECIALTIES, INC.

BI-DIRECTIONAL AMPLIFIER

MODEL: 510smr900

FCC ID: NVRCSI510-04

CERTIFICATION APPLICATION

Applicant/Manufacturer: **Cellular Specialties
670 North Commercial Street
Manchester, NH 03101**

Equipment under Test (EUT): **The EUT is a Bidirectional Amplifier used to amplify cellular signals in the Special Mobile Radio (SMR) Band.**

Model: **510smr900**

FCC ID Number: **FCC ID: NVRCSI510-04**

Applicable Test Standard: **FCC Parts 2 & 90 SMR Operations
and 90.219 Use of Signal Boosters**

Device Classification: **Mobile**

EUT Frequency Range: **Uplink: 896 MHz to 901MHz
Downlink: 935MHz to 940MHz**

EUT Gain: **Uplink: 58.8dB
Downlink: 57dB**

*Measured Power Output
at maximum input, single channel* **Uplink: +26.8dBm = 479mW
Downlink: +28dBm = 631mW**

*Power Output Rating Based
on Intermodulation Data
(For Certification Grant):* **Uplink: 458mW
Downlink: 458mW**

RF Exposure + Antenna Installation: **See Attached Installation/Users Manual and MPE Evaluation**

Power Ratings Per Channel: **See Report Section 1**

Measurements Required by FCC: **See Report Section 2 (Summary of Test Program)
and the following Test Report Data Attachments:**

- RF Power Output**
- Intermodulation Characteristics**
- Occupied Bandwidth**
- Spurious Emissions at Antenna Terminals**
- Effective Radiated Power of Spurious Radiation**
- Frequency Stability**

SECTION 1

ACTUAL POWER RATINGS PER CHANNEL:

<u># Channels</u>	<u>Uplink (dBm)</u>	<u>Downlink (dBm)</u>
1	28.0	28.0
2	24.0	24.0
3	21.7	21.7
4	20.0	20.0
5	18.7	18.7
6	17.7	17.7
7	16.8	16.8
8	16.0	16.0
9	15.3	15.3
10	14.7	14.7
11	14.2	14.2
12	13.7	13.7
13	13.2	13.2
14	12.8	12.8
15	12.4	12.4
16	12.0	12.0
17	11.6	11.6
18	11.3	11.3
19	11.0	11.0
20	10.7	10.7

SECTION 2

SUMMARY OF TEST PROGRAM

POWER OUTPUT

Measurement Procedure:

The uplink and downlink of the test sample were alternately connected through external attenuators to a spectrum analyzer. Each link had an unmodulated signal sent to the input. The level of the input signal was adjusted to achieve maximum output power of the amplifier.

Testing was performed at 1 frequency within each passband (uplink and downlink). The levels of the input signals and maximized output power levels were recorded and are shown below.

UPLINK (Power Input @ max input):

Frequency (MHz)	Input (dBm)	Output (dBm)
898.5	-32	26.8

DOWNLINK (Power Input @ max input):

Frequency (MHz)	Input (dBm)	Output (dBm)
937.5	-29	28.0

For complete test data, see electronic Test Report Attachment, **RF Power Output Data**.

INTERMODULATION CHARACTERISTICS

Measurement Procedure:

Three CW signals were injected, in turn, to the uplink and downlink via a three way power combiner. Two signals were close together and at the low end of the passband, one signal was close to the high end of the passband. The output of each signal generator was adjusted so that the three output fundamental frequencies were equal in magnitude. At the input power levels used all intermodulation products were at -13dBm or below. The requested power rating of the device for the certification grant is derived by summing the levels of the three input signals for each the uplink and downlink.

For complete test data, including actual X/Y plots of intermodulation signals, see electronic Test Report Attachment, **Intermodulation Characteristics Data**.

OCCUPIED BANDWIDTH

Measurement Procedure:

The test sample does not have any frequency generating circuits therefore measurements were made to compare the input signal to the output signal. The signal generator output was connected to the spectrum analyzer with a power level which was ascertained during the Power Output test. A 16kHz square wave FM 1kHz modulated signal (simulated TDMA) was then applied to the carrier. Waveforms were then noted on an X-Y plot. Next, the signal generator was connected to the EUT and the output of the EUT was connected to the spectrum analyzer. The output waveform after amplification was then compared to the emission mask requirement for TDMA signals (46dB down at plus and minus one channel spacing, 30kHz) Testing was performed at one frequency within each passband (uplink and downlink).

For complete test data, see electronic Test Report Attachment, **Occupied Bandwidth Data**.

An explanation of the data is as follows: There are two signals superimposed on each plot, one signal is the waveform before modulation, the other is the modulated carrier. In each case the center of the grid shows a narrowband signal projecting out from the center of the modulation envelope. This signal is actually the stored unmodulated signal.

ANTENNA CONDUCTED EMISSIONS

Measurement Procedure:

The signal generator output was connected in turn to the uplink and downlink input ports of the EUT. The input power level was at the level which was ascertained during the Power Output test. A spectrum analyzer was connected to the output of the EUT. The input test frequencies used were one frequency within each passband (uplink and downlink). The level of any spurious emission was recorded. Testing was performed in the frequency range of 30MHz to 9.5GHz. The spurious emissions limit is -13dBm as specified in FCC Part 90.

For complete test data, including harmonic and spurious emissions measured at antenna terminal, see electronic Test Report Attachment, **Antenna Conducted Data**.

EFFECTIVE RADIATED POWER OF SPURIOUS RADIATION

Measurement Procedure:

The test sample was placed on a 80cm high wooden test stand which was located 3 meters from the test antenna on an FCC listed test site. A signal generator was connected to the uplink input of the amplifier. The signal generator output was set to provide the input power level necessary to achieve maximum output power of the amplifier at 1 frequency within each passband (uplink and downlink). The effective radiated power of each out of band spurious emissions was measured using the substitution method specified in TIA/EIA-603. Field strength measurements of each out of band emission were taken and recorded. The frequency range of the test was 30MHz - 9.5GHz. The limit for out of band spurious emissions is -13dBm as specified in Part 90.

For complete test data, see electronic Test Report Attachment, **Radiated Emissions Data**.

FREQUENCY STABILITY MEASUREMENTS

Measurement Procedure (Frequency vs. Voltage):

As the test sample does not have any frequency determining circuits testing was performed only frequency versus input voltage measurements were performed. The RF output of the signal generator was set to a frequency within each passband (uplink and downlink) of the test sample, and the output of the test sample was connected to a spectrum analyzer. The AC input voltage to the test sample was varied plus and minus 15% in 5% increments while the output frequency from the test sample was measured and compared to the input frequency.

For complete test data, see electronic Test Report Attachment, **Frequency Stability Data**.

SECTION 3 EQUIPMENT LISTS

Frequency Stability

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22GHz	8593EM	2/13/02	2/13/03
4963	Attenuator	Hewlett Packard	DC - 18 GHz	8491A	10/15/01	10/15/02
4995	Signal Generator	Marconi Instru.	10 kHz - 1 GHz	2022	10/24/01	10/24/02
5013	Variac	Powerstat	n/a	116B	5/30/02	5/30/03
520N	Digital Multimeter	Wavetek	N/A	25XT	2/28/02	8/28/03

Intermodulation Characteristics

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
4961	Attenuator	Narda	DC - 18 GHz	757C-30dB	11/7/01	11/7/02
4995	Signal Generator	Marconi Instru.	10 kHz - 1 GHz	2022	10/24/01	10/24/02
5001	Sweep Oscillator	Hewlett Packard	.01 - 20.4 GHz	8350B	2/25/02	2/25/03
5001	Oscillator Plug-In	Hewlett Packard	.01 - 20 GHz	83592A	2/25/02	2/25/03
530A	AM/FM Signal Generator	Marconi Instru.	10 kHz - 1.2 GHz	2023	7/9/01	7/9/02
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	7/9/01	7/9/02

Occupied Bandwidth

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
4961	Attenuator	Narda	DC - 18 GHz	757C-30dB	11/7/01	11/7/02
530A	AM/FM Signal Generator	Marconi Instru.	10 kHz - 1.2 GHz	2023	7/9/01	7/9/02
713	EMI Test Receiver	Rohde & Schwarz	20 Hz - 26.5 GHz	ESI26	7/9/01	7/9/02

RF Power Output

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22GHz	8593EM	2/13/02	2/13/03
4963	Attenuator	Hewlett Packard	DC - 18 GHz	8491A	10/15/01	10/15/02
4995	Signal Generator	Marconi Instru.	10 kHz - 1 GHz	2022	10/24/01	10/24/02

Spurious Emissions at Antenna Terminals

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22GHz	8593EM	2/13/02	2/13/03
4963	Attenuator	Hewlett Packard	DC - 18 GHz	8491A	10/15/01	10/15/02
4995	Signal Generator	Marconi Instru.	10 kHz - 1 GHz	2022	10/24/01	10/24/02

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FCC ID: NVRCSI510-04

SECTION 3 (Continued)

EQUIPMENT LISTS

Spurious Radiated Emissions

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
3000	Tuned Dipole Antenna	Empire Devices	20 MHz - 200 MHz	T1	8/8/00	8/8/03
3008	Signal Generator	Gigatronics	50 MHz - 18 GHz	900/0.05-18	11/20/01	11/20/02
3116	Pre-Amplifier	Miteq	0.1 GHz - 18 GHz	AFS42-35	4/22/02	4/22/03
3117	Power Supply	B&K Precision	0-30 Vdc, 3.0 A	1630	2/25/02	2/25/03
3119	Pre-Amplifier	Retlif	10 kHz - 1 GHz	RET-PA-SW	7/3/01	7/3/02
3258	Double Ridge Guide	EMCO	1 - 18 GHz	3115	5/6/02	5/6/03
4003	Double Ridge Guide	Tensor	1 GHz - 18 GHz	4015	1/3/02	1/3/03
4029	Test Site Attenuation	Retlif	3 / 10 Meters	RNH	8/3/01	8/3/02
4202	Biconilog	EMCO	26 MHz - 2 GHz	3142	7/16/01	7/16/02
4921	Graphics Plotter	Hewlett Packard	N/A	7550A	8/29/01	8/29/02
4985	Transient Generator	Elgar	60/400 Hz	TG-704A-1D	2/28/02	2/28/03
4995	Signal Generator	Marconi Instru.	10 kHz - 1 GHz	2022	10/24/01	10/24/02

RETLIF TESTING LABORATORIES

TABULAR DATA SHEET

Test Method:

RF Power Output

Customer:

Cellular Specialties, Inc.

Job No:

R-3974N

Test Sample:

Bidirectional Amplifier

Model No:

510 SMR900

Serial No:

n/a

Test Specification:

FCC Part 2

Paragraph: 2.1046

Operating Mode:

Amplifying input signal

Technician:

T. Firkowski

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Date:

5/30/02

Notes:

Uplink Frequency: 898.5 MHz

Downlink Frequency: 937.5 MHz

[illegible]

RETLIF TESTING LABORATORIES

EMISSIONS DATA SHEET

Test Method:

Spurious Emissions at the Antenna Terminals 30 MHz to 9.5 GHz

Customer:

Cellular Specialties, Inc.

Job No:

R-3974N

Test Sample:

Bidirectional Amplifier

Model No:

510 SMR900

Serial No:

	n/a
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Test Specification:

FCC Part 2

Paragraph: 2.1051

Operating Mode:

Amplifying input signal

Technician:

T. Firkowski

Date:

5/30/02

Notes:

Uplink Frequency 898.5 MHz

Downlink Frequency 937.5 MHz

[illegible]

RETLIF TESTING LABORATORIES

EMISSIONS DATA SHEET

Test Method:	Spurious Radiated Emissions (ERP) 30 MHz to 9.5 GHz		
Customer:	Cellular Specialties, Inc.	Job No:	R-3974N
Test Sample:	Bidirectional Amplifier		
Model No:	510 SMR900	Serial No:	n/a
Test Specification:	FCC Part 2.1053/90.209 Paragraph: n/a		
Operating Mode:	Amplifying input signal		
Technician:	T. Firkowski	Date:	5/29/02
Notes:	Uplink Frequency Range: 896 - 901 MHz Tested at 898.5 MHz Peak Detector		

[illegible]

EUT emissions observed throughout the given frequency spectrum were recorded & evaluated. Emission levels closest to the limit are listed on this data sheet.

RETLIF TESTING LABORATORIES

EMISSIONS DATA SHEET

Test Method:	Spurious Radiated Emissions (ERP) 30 MHz to 9.5 GHz		
Customer:	Cellular Specialties, Inc.	Job No:	R-3974N
Test Sample:	Bidirectional Amplifier		
Model No:	510 SMR900	Serial No:	n/a
Test Specification:	FCC Part 2.1053/90.209 Paragraph: n/a		
Operating Mode:	Amplifying input signal		
Technician:	T. Firkowski	Date:	5/29/02
Notes:	Downlink Frequency Range: 935 - 940 MHz Tested at 937.5 MHz Peak Detector		

[illegible]

RETLIF TESTING LABORATORIES

EMISSIONS DATA SHEET

Test Method:

Frequency Stability

Customer:

Cellular Specialties, Inc.

Job No:

R-3974N

Test Sample:

Bidirectional Amplifier

Model No:

510 SMR900

Serial No:

n/a

Test Specification:

FCC Part 2

Paragraph: 2.1055

Operating Mode:

Amplifying input signal

Technician:

T. Firkowski

Date:

5/30/02

Notes:

Uplink Frequency 898.5 MHz

Nominal Voltage = 115 VAC

Downlink Frequency 937.5 MHz

[illegible]



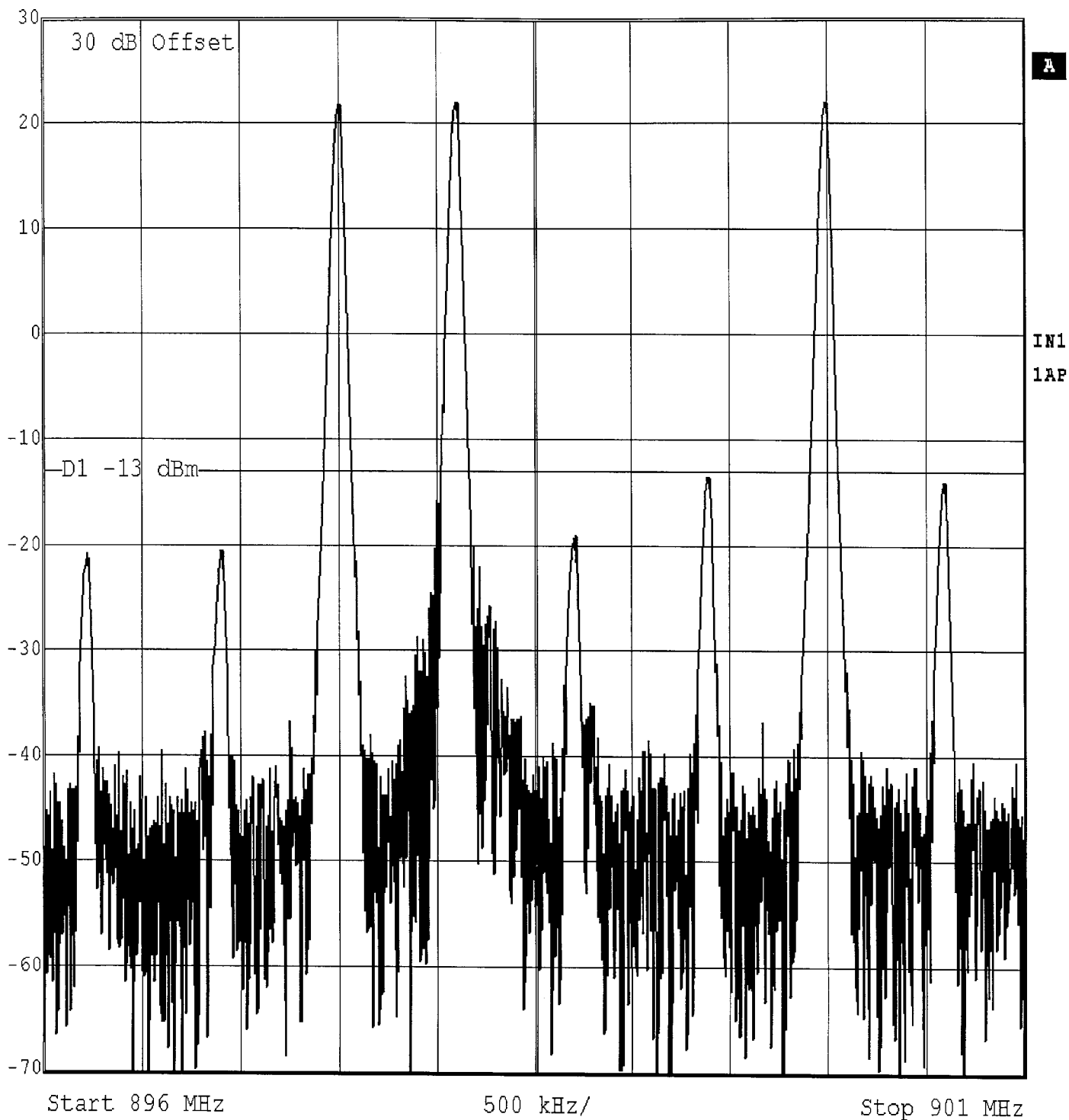
Ref Lvl

30 dBm

RBW 30 kHz RF Att 30 dB

VBW 100 kHz

SWT 14 ms Unit dBm



Date: 20.JUN.2002 07:22:59

Customer: Cellular Specialties, Inc.
Test Sample: Bidirectional Amplifier
Model No: 510 SMR900
Test Method: Intermodulation Characteristics, FCC Part 2, para 2.1047
Notes: Uplink Frequency Band: 896 - 901 MHz

Date: 6/20/02

Tech: T. Firkowski

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RBW 30 kHz RF Att 10 dB

Ref Lvl

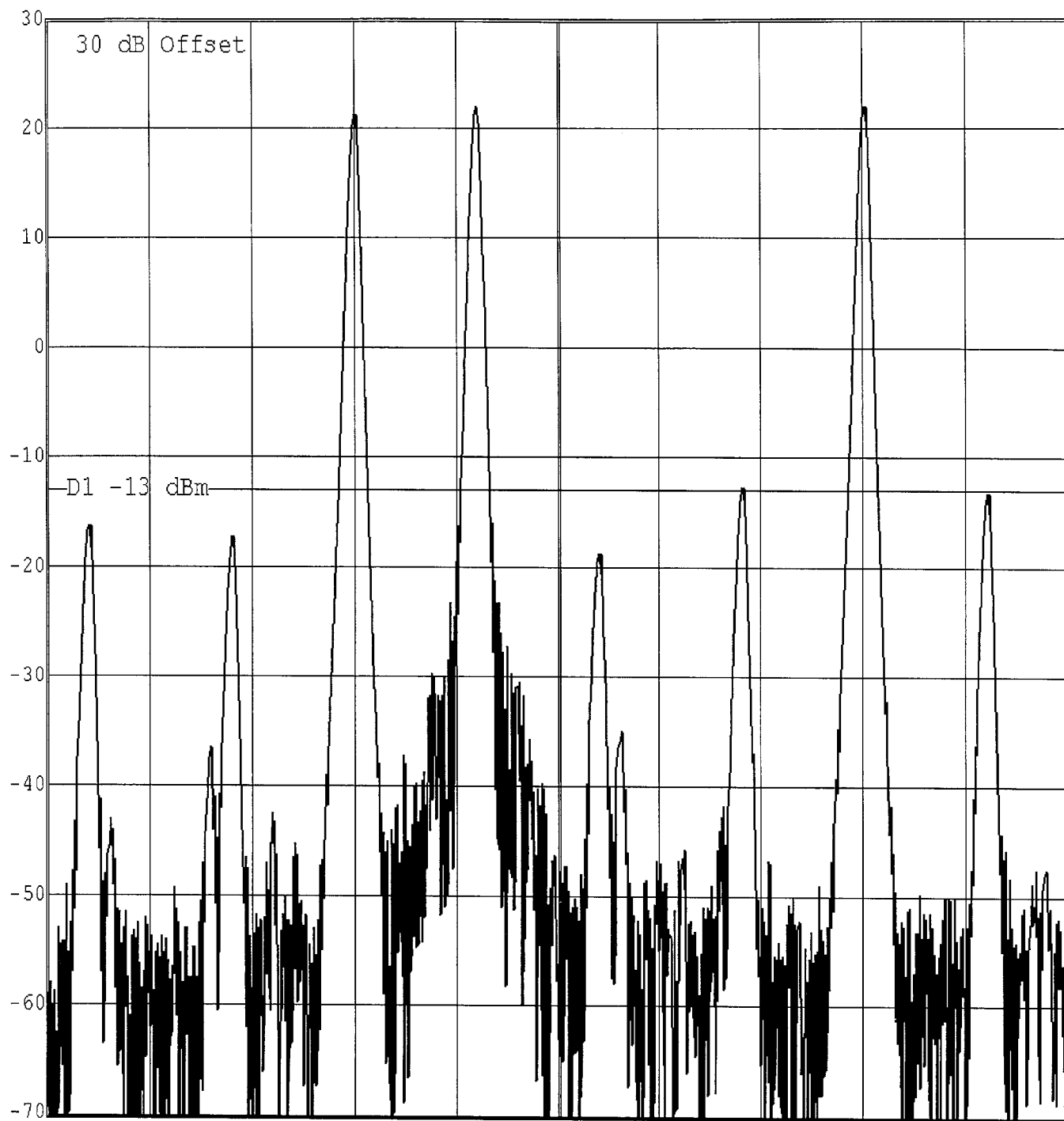
VBW 100 kHz

30 dBm

SWT 14 ms

Unit

dBm



A

IN1
1AP

Start 935 MHz

500 kHz/

Stop 940 MHz

Date: 20.JUN.2002 07:34:03

Customer: Cellular Specialties, Inc.
Test Sample: Bidirectional Amplifier
Model No: 510 SMR900
Test Method: Intermodulation Characteristics, FCC Part 2, para 2.1047
Notes: Downlink Frequency Band: 935 - 940 MHz

Date: 6/20/02

Tech: T. Firkowski

Sheet 2 of 2

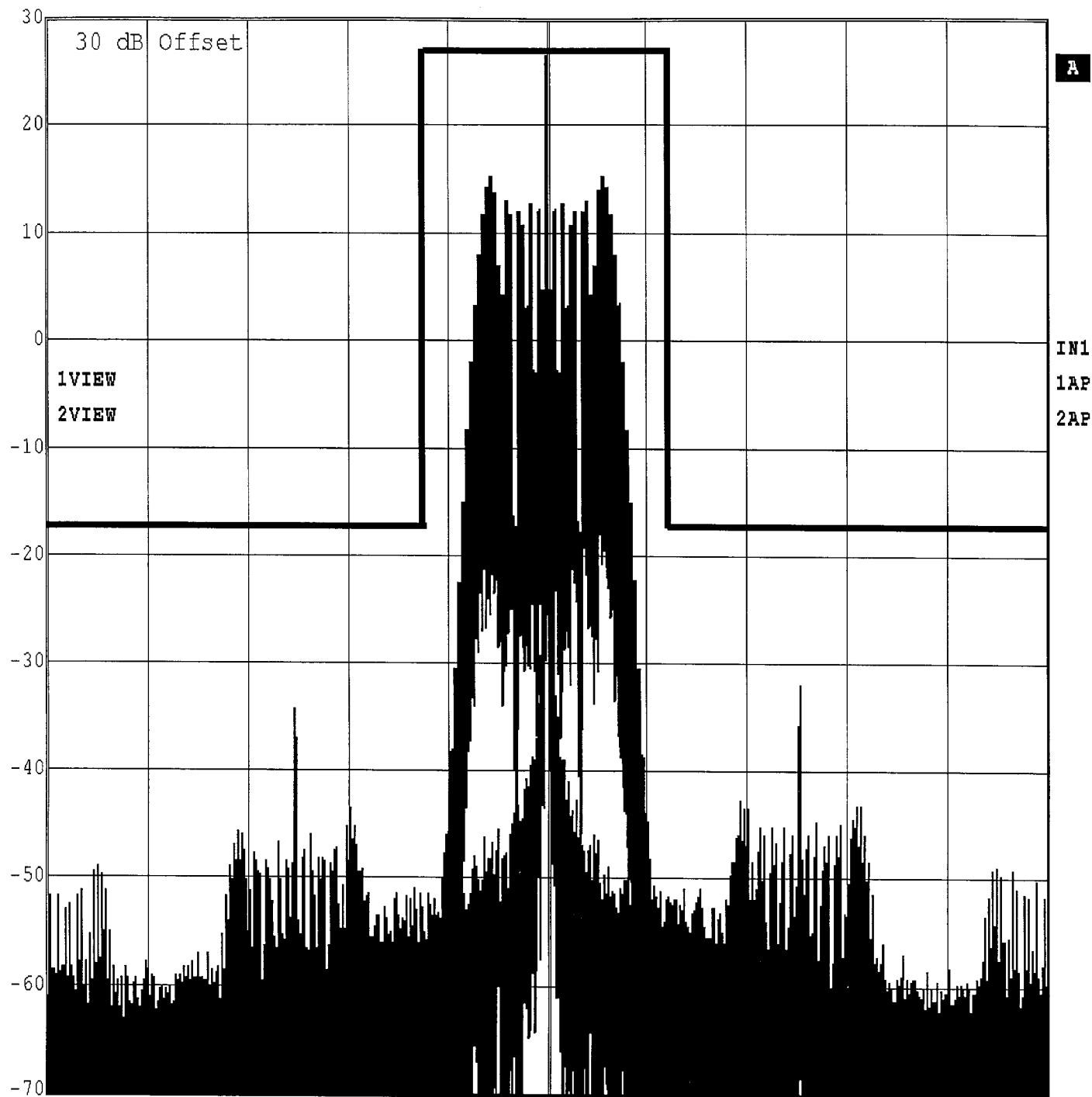
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Ref Lvl
30 dBm

RBW 300 Hz RF Att 10 dB
VBW 1 kHz
SWT 14 s Unit dBm



Center 898.5 MHz

25 kHz/

Span 250 kHz

Date: 20.JUN.2002 07:44:38

Customer: Cellular Specialties, Inc.
Test Sample: Bidirectional Amplifier
Model No: 510 SMR900
Test Method: Occupied Bandwidth, FCC Part 2, para 2.1049
Notes: Uplink Frequency 898.5 MHz
Modulation: TDMA

Date: 6/20/02

Tech: T. Firkowski

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Ref Lvl

30 dBm

RBW

300 Hz

RF Att

10 dB

VBW

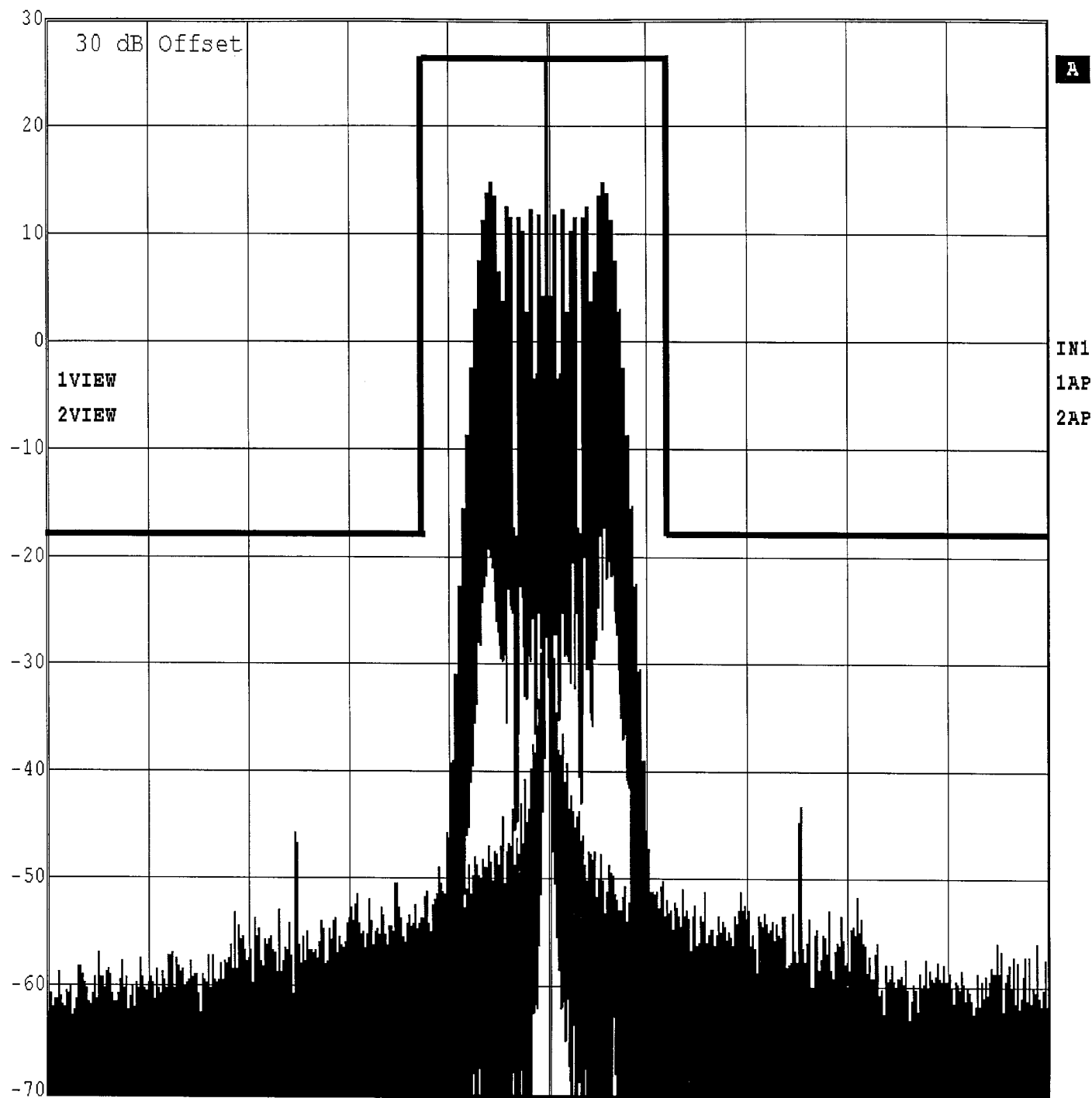
1 kHz

SWT

14 s

Unit

dBm



Center 937.5 MHz

25 kHz/

Span 250 kHz

Date: 20.JUN.2002 07:47:09

Customer:

Cellular Specialties, Inc.

Test Sample:

Bidirectional Amplifier

Model No:

510 SMR900

Test Method:

Occupied Bandwidth, FCC Part 2, para 2.1049

Notes:

Downlink Frequency 937.5 MHz

Modulation: TDMA

Date:

6/20/02

Tech:

T. Firkowski

Sheet

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of

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