REPORT OF MEASUREMENTS

FOR

CELLULAR SPECIALTIES, INC.

BI-DIRECTIONAL AMPLIFIER

MODEL: 610smr

FCC ID: NVRCSI610-01

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:	**610smr**
FCC ID Number:	**FCC ID: NVRCSI610-01**
Applicable Test Standard:	**FCC Parts 2 & 90 SMR Operations and 90.219 Use of Signal Boosters**
Device Classification:	**Mobile**
EUT Frequency Range:	**Uplink: 806 MHz to 821MHz** **Downlink: 851MHz to 866MHz**
EUT Gain:	**Uplink: 79.9dB** **Downlink: 79.0dB**
Measured Power Output at maximum input, single channel	**Uplink: +34.2dBm = 2.6W** **Downlink: +39.1dBm = 8.1W**
Power Output Rating Based on Intermodulation Data (For Certification Grant):	**Uplink: +28.8dBm = 750mW** **Downlink: +30.6dBm = 1.15W**
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:

# Channels	Uplink (dBm)	Downlink (dBm)
1	28.8	30.6
2	24.8	26.6
3	22.5	24.3
4	20.8	22.6
5	19.5	21.3
6	18.5	20.3
7	17.6	19.4
8	16.8	18.6
9	16.1	17.9
10	15.5	17.3
11	15.0	16.8
12	14.5	16.3
13	14.0	15.8
14	13.6	15.4
15	13.2	15.0
16	12.8	14.6

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 1frequency 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)
813.5	-45.7	34.2

DOWNLINK (Power Input @ max input):

Frequency (MHz)	Input (dBm)	Output (dBm)
858.5	-39.8	39.2

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 specified input power levels 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 9GHz. 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 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 emission was measured using the substitution method specified in TIA/EIA-603. The frequency range of the test was 30MHz - 9GHz. 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	0 - 140VAC	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
3130	20dB Attenuator	Narda	DC - 18 GHz	768-20	1/25/02	1/25/03
4995	Signal Generator	Marconi Instru.	10 kHz - 1 GHz	2022	10/24/01	10/24/02
3008	Signal Generator	Gigatronics	50MHz - 18GHz	900/0.05-18	11/20/01	11/20/02
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22 GHz	8593EM	2/13/02	2/13/03
530A	AM/FM Signal Generator	Marconi Instru.	10 kHz - 1.2 GHz	2023	7/10/02	7/10/03
3138	10dB Atten. (50ohm)	Narda	DC - 5GHz	768-10	4/18/02	4/18/03

Occupied Bandwidth

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
530A	AM/FM Signal Generator	Marconi Instru.	10 kHz - 1.2 GHz	2023	10/24/01	10/24/02
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22 GHz	8593EM	2/13/02	2/13/03
3130	20dB Attenuator	Narda	DC - 18 GHz	768-20	1/25/02	1/25/03
3138	10dB Atten. (50ohm)	Narda	DC - 5GHz	768-10	4/18/02	4/18/03

RF Power Output

EN	Type	Manufacturer	Description	Model No.	Cal Date	Due Date
530A	AM/FM Signal Generator	Marconi Instru.	10 kHz - 1.2 GHz	2023	10/24/01	10/24/02
4895	Spectrum Analyzer	Hewlett Packard	9kHz - 22GHz	8593EM	2/13/02	2/13/03
3130	20dB Attenuator	Narda	DC - 18 GHz	768-20	1/25/02	1/25/03
3138	10dB Atten. (50ohm)	Narda	DC - 5GHz	768-10	4/18/02	4/18/03

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
530A	AM/FM Signal Generator	Marconi Instru.	10 kHz - 1.2 GHz	2023	10/24/01	10/24/02
3130	20dB Attenuator	Narda	DC - 18 GHz	768-20	1/25/02	1/25/03
3138	10dB Atten. (50ohm)	Narda	DC - 5GHz	768-10	4/18/02	4/18/03

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
3001	Tuned Dipole Antenna	Empire Devices	200 MHz - 400 MHz	T2	8/8/00	8/8/03
3002	Tuned Dipole Antenna	Empire Devices	400 MHz - 1 GHz	T3	8/8/00	8/8/03
3130	20dB Attenuator	Narda	DC - 18 GHz	768-20	1/25/02	1/25/03
3138	10dB Atten. (50ohm)	Narda	DC - 5GHz	768-10	4/18/02	4/18/03
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
4202	Biconilog	EMCO	26 MHz - 2 GHz	3142	7/25/02	7/25/03
530A	AM/FM Signal Generator	Marconi Instru.	10 kHz - 1.2 GHz	2023	10/24/01	10/24/02
713	EMI Test Receiver	Rohde & Schwarz	20Hz - 26.5 GHz	ES126	7/19/02	7/19/03
5001	Sweep Oscillator	Hewlett Packard	.01 - 20.4GHz	8350B	2/25/02	2/25/03
5001	Oscillator Plug-In	Hewlett Packard	.01 - 20 GHz	83592A	2/25/02	2/25/03