

EXHIBIT 11 TEST RESULTS

11.1 Attestation

I certify that I have performed or witnessed the tests stated, and that the data presented herein are true and complete.



Ross Hicks

NOV-18-2003

Date

Vice President of Engineering
OpenCell Corp.

11.2 Test Instrumentation

Description	Model	Manufacturer
Spectrum Analyzer	8593E	Hewlett Packard
Power Meter	E4418B	Hewlett Packard
Power Sensor	8481H	Hewlett Packard
Vector Signal Generator	CS2010	Celerity
Attenuator	46-30-34	Weinschel
Attenuator	ATT-0219-10-NNN-02	Midwest Microwave
Attenuator	ATT-0333-20-SMA-02	Midwest Microwave
Coupler	2202B-30	Narda
Coupler	CK-48N	Microlab/FXR
Digital Multimeter	75	Fluke
Temperature Chamber	T20C-3	Tenney

Table 11-1 Test Instrumentation

11.3 Description of Input Signals and Modulation Types

The Celerity signal generator was used to accurately simulate RF input waveforms from the provider's Base Transceiver Station (BTS). Signals were injected into the Hub at power levels within normal operating ranges. Each modulation type was tested separately.

Protocol	Mod Type	Channel Bit Rate	Peak/Average Ratio dB	
			Single carrier	Max carriers
TDMA	$\pi/4$ DQPSK	48.6 kbps	3.2	9.7
CDMA	QPSK	1.228 Mcps (chip rate)	11.5	11.5
CDMA2000	QPSK	1.228 Mcps (chip rate)	11.5	11.5
GSM	GMSK	270.8 kbps	0.2	6.1
EDGE	8-PSK	812.5 kbps	3.5	9.5
iDEN	16QAM	64 kbps	9.1	10.3

Table 11-2 Input Signal Description

11.4 General Test Setups

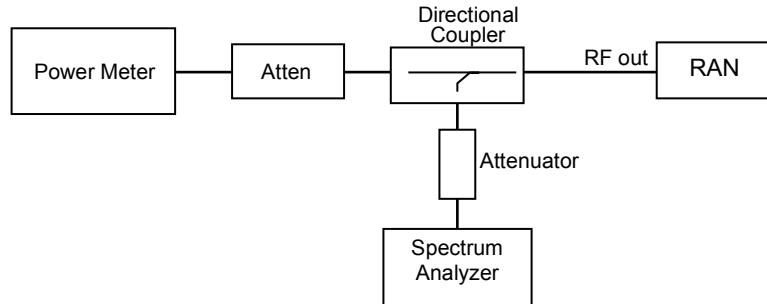


Figure 11-1 Test setup for power output, occupied bandwidth, and emission mask

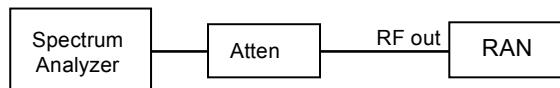


Figure 11-2 Test setup for conducted spurious emissions

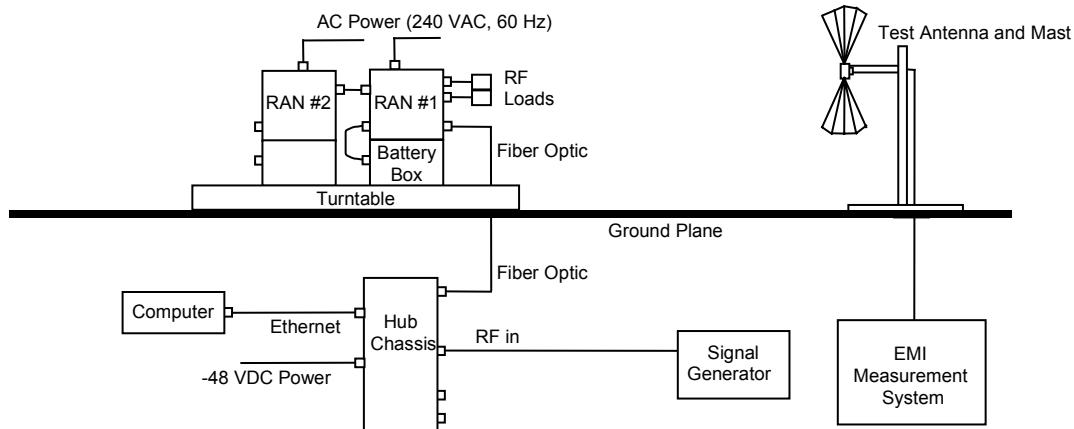


Figure 11-3 Test setup for radiated spurious emissions (also see separate report)

11.5 Power Output

11.5.1 Test Procedure

The RAN transmitter output was connected to the power meter and spectrum analyzer using a directional coupler and RF attenuators as shown in Figure 11-1.

The Celerity vector signal generator was used to inject actual system input signal levels and modulation types into the Hub.

Average power was measured using the power meter.

Peak power was measured by setting the analyzer to peak detector, max hold, with resolution bandwidth and video bandwidth set to 3 MHz. Peak power measurements were performed on a single carrier basis for each protocol within the PCS band.

11.5.2 Power Amplifiers

At room temperature, the gain of the Cellular/SMR Power Amplifiers (PA) is 57 dB (+/-0.5 dB) and the gain of the PCS Power Amplifiers is 60 dB (+/-0.5 dB). The PA outputs were tested at their maximum operating level which is 1.0 dB higher than the nominal operating output power levels. The Power Amplifiers were at the maximum input level for all tests.

It should be noted that any given PA will transmit only one modulation type. However, a RAN can have up to three PA outputs combined onto one RAN output port via the triplexer or quadplexer (passive devices). Each PA can have a different modulation type. Therefore, a single RAN output port will transmit different modulation types.

The testing performed where multiple PAs were combined to a single RAN output port used TDMA signals. The intermod performance of the PA is worst case using narrowband signals; thus the reason for using TDMA signals.

11.5.3 Results

Maximum rated power at any RAN RF output port is as shown in the table below. Less power may be present, depending on the number of tenants served and the specific protocols used.

RAN RF output port designation	Measured power level, dBm	Equivalent Power, watts	Reference Figure
PCS-P	47.3	53.7	Figure 11-64
PCS-D	47.3	53.7	Figure 11-66
Cell/SMR-D	42.5	17.8	Figure 11-67
Cell/SMR-P	39.5	17.8	Figure 11-42

Table 11-3 Measured Maximum Power per RF Port

Maximum power per tenant is as shown below. Each tenant resides within one specific PCS, cellular or SMR block.

Slightly less power is transmitted for other protocols.

Service	Maximum power level per tenant, dBm	Equivalent Power, watts	Reference Figures
PCS	42.5	17.8	Figure 11-15 Figure 11-27
Cellular	39.5	8.9	Figure 11-41 Figure 11-42
SMR	39.5	8.9	Figure 11-60 Figure 11-63

Table 11-4 Measured Maximum Power per Tenant (per Block)

The table below summarizes the measured power output data.

Protocol	Service	# carriers	Measured power level, dBm		Reference Figures
			Avg	Peak	
CDMA	PCS	1	41.5	52.5	Figure 11-5
CDMA	PCS	3	41.5		Figure 11-6
CDMA	PCS	6	41.5		Figure 11-7
CDMA2000	PCS	1	41.5	51.3	Figure 11-9
CDMA2000	PCS	3	41.5		Figure 11-10
CDMA2000	PCS	6	41.5		Figure 11-11
GSM	PCS	1	42.5	42.9	Figure 11-13
GSM	PCS	2	42.5		Figure 11-14 Figure 11-15
GSM	PCS	4	42.5		Figure 11-16
GSM	PCS	8	42.5		Figure 11-17
EDGE	PCS	1	42.5	46.1	Figure 11-19
EDGE	PCS	2	42.5		Figure 11-20 Figure 11-21
EDGE	PCS	4	42.5		Figure 11-22
EDGE	PCS	8	42.5		Figure 11-23
TDMA	PCS	1	42.5	45.7	Figure 11-25
TDMA	PCS	2	42.5		Figure 11-26 Figure 11-27
TDMA	PCS	6	42.5		Figure 11-28 Figure 11-29
TDMA	PCS	8	42.5		Figure 11-30
CDMA	Cell	1	38.5		Figure 11-32
CDMA	Cell	3	38.5		Figure 11-33
CDMA	Cell	6	38.5		Figure 11-34
CDMA2000	Cell	1	38.5		Figure 11-36
CDMA2000	Cell	3	38.5		Figure 11-37
CDMA2000	Cell	6	38.5		Figure 11-38
GSM	Cell	1	39.5		Figure 11-40
GSM	Cell	2	39.5		Figure 11-41
GSM	Cell	4	39.5		Figure 11-42
GSM	Cell	8	39.5		Figure 11-43
EDGE	Cell	1	39.5		Figure 11-45
EDGE	Cell	2	39.5		Figure 11-46
EDGE	Cell	4	39.5		Figure 11-47
EDGE	Cell	8	39.5		Figure 11-48
TDMA	Cell	1	39.5		Figure 11-50
TDMA	Cell	2	39.5		Figure 11-52

TDMA	Cell	6	39.5		Figure 11-54
TDMA	Cell	8	39.5		Figure 11-56
TDMA	Cell	3	39.5		Figure 11-53
iDEN	SMR	1	39.5		Figure 11-59
iDEN	SMR	2	39.5		Figure 11-60
iDEN	SMR	4	39.5		Figure 11-61
iDEN	SMR	6	39.5		Figure 11-62
iDEN	SMR	8	39.5		Figure 11-63
TDMA	PCS	6 each	47.3		Figure 11-64 Figure 11-66
TDMA	Cell/SMR	6 each	42.5		Figure 11-67

Table 11-5 Summary of Power Output Data

11.6 Occupied Bandwidth

11.6.1 Test Procedure

The RAN transmitter output was connected to the power meter and spectrum analyzer using a directional coupler and RF attenuators.

The Celerity vector signal generator was used to inject actual system input signal levels and modulation types into the Hub.

11.6.2 Results

Protocol	Service	Measured Occupied Bandwidth	Reference Figure
CDMA	PCS	1.26 MHz	Figure 11-4
CDMA2000	PCS	1.29 MHz	Figure 11-8
GSM	PCS	269 kHz	Figure 11-12
EDGE	PCS	263 kHz	Figure 11-18
TDMA	PCS	29.7 kHz	Figure 11-24
CDMA	Cellular	1.25 MHz	Figure 11-31
CDMA2000	Cellular	1.24 MHz	Figure 11-35
GSM	Cellular	248 kHz	Figure 11-39
EDGE	Cellular	243 kHz	Figure 11-44
TDMA	Cellular	28.5 kHz	Figure 11-49
iDEN	SMR	17.5 kHz	Figure 11-57 Figure 11-58 (mask)

Table 11-6 Occupied Bandwidth Results

11.7 Spurious Emissions at Antenna Terminals

11.7.1 Test Procedure

Tests were performed using the test setup of Figure 11-2.

Measurements were performed up to 9 GHz for fundamental in the cellular/SMR bands and to 20 GHz for fundamental emissions in the PCS band. All measurements at the carrier frequency and above were performed using average (sample) detection. Measurements at frequencies from 10 MHz up to the carrier frequency were performed using peak detection.

At measurement frequencies within 1 MHz of the carrier center, a resolution bandwidth equal to 1% or greater of the occupied bandwidth was used. At all other frequencies, measurements were performed using a 1 MHz resolution bandwidth.

The RAN power output level was at the rated maximum for all spurious emissions measurements (refer to Table 11-3 and Table 11-4).

11.7.2 Results

Out-of-block emissions are required to be a minimum of $43 + 10 \log(P)$ below the fundamental power, where P is the transmitter power in watts. This is equivalent to an absolute level of -13 dBm.

All emissions are below the required limit. The highest measured levels are tabulated below. References to spectrum plots are provided.

Test Condition	Fundamental Output Power, dBm	Spurious Emission Frequency, MHz	Spurious Emission Amplitude, dBm	Required Limit, dBm	Reference Figures
1 GSM	42.5	1930.0	-17.3	-13	Figure 11-13
2 GSM	42.5	1929.4	-22.7 (note 1)	-13	Figure 11-14
4 GSM	42.5	1935.8	-14.2 (note 1)	-13	Figure 11-16
1 CDMA	38.5	880.0	-18.0 (note 2)	-13	Figure 11-32
1 GSM	39.5	869.4	-17.0 (note 2)	-13	Figure 11-40
1 TDMA	39.5	888.1	-22.5	-13	Figure 11-51
6 TDMA	39.5	884.31	-21.5	-13	Figure 11-55
6 TDMA x 3 tenants	47.3	1929.95	-20.4	-13	Figure 11-65

6 TDMA x 2 tenants	42.5	894.0	-24.9	-13	Figure 11-68
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Note 1: Measured level is -16 dBm using channel power function with 1 MHz channel bandwidth

Note 2: At block edge

Table 11-7 Spurious Emissions Results

11.8 Frequency Stability

11.8.1 Test Procedure

A single CW tone at the center of each channel was injected into the Hub. A spectrum analyzer in “marker count” mode was used to record the frequency. To obtain the necessary measurement precision, the signal generator and the spectrum analyzer were locked to a common frequency reference.

Temperature and voltage variation tests were performed on the RAN Compact PCI (cPCI) chassis. This chassis contains all of the circuitry that governs frequency stability of the RAN transmitted output. The chassis is powered from 48 VDC, which is obtained from the 240 VAC-to-48 VDC power rectifier located inside the RAN. The 240 VAC RAN power input supplies only the rectifier, and no other circuits. **This hardware is identical to the hardware in Version 1 of the OpenCell system.**

Voltage variation tests were performed by varying the 48 VDC chassis input from 40 to 58 volts DC. This tested range is much greater than the expected variation of the 48 VDC bus. The input regulation of the rectifier is specified at better than 0.2%. Thus, for an AC input voltage swing of $\pm 15\%$, the output voltage is expected to vary by no more than 0.15 volts.

Temperature tests were performed over the range of -30 to $+60$ °C (system rated operating temperature range).

11.8.2 Results - Input Voltage Variation

Voltage, VDC	Measured Frequency, MHz	Expected Frequency, MHz	Delta, Hz
Cellular A block			
48	874.999973	875.000000	27
40	874.999977	875.000000	23
58	874.999977	875.000000	23
SMR			
48	858.499981	858.500000	19
40	858.499973	858.500000	27

58	858.500025	858.500000	25
PCS D block			
48	1947.499938	1947.500000	62
40	1947.499954	1947.500000	46
58	1947.499958	1947.500000	42

Table 11-8 Frequency Stability – Input Voltage Variation**11.8.3 Results - Temperature Variation**

Temperature, °C	Measured Frequency, MHz	Expected Frequency, MHz	Delta, Hz
Cellular A block			
-30	874.999965	875.000000	35
-20	874.999973	875.000000	27
-10	874.999981	875.000000	19
0	874.999981	875.000000	19
10	874.999971	875.000000	29
20	874.999973	875.000000	27
30	875.000029	875.000000	29
40	874.999977	875.000000	23
50	874.999973	875.000000	27
60	874.999973	875.000000	27
SMR			
-30	858.499979	858.500000	21
-20	858.500059	858.500000	59
-10	858.499971	858.500000	29
0	858.499969	858.500000	31
10	858.499971	858.500000	29
20	858.499981	858.500000	19
30	858.499981	858.500000	19
40	858.499973	858.500000	27
50	858.499977	858.500000	23
60	858.499982	858.500000	18
PCS D block			
-30	1947.499958	1947.500000	42
-20	1947.499978	1947.500000	22
-10	1947.499958	1947.500000	42
0	1947.499966	1947.500000	34
10	1947.499954	1947.500000	46

20	1947.499938	1947.500000	62
30	1947.499950	1947.500000	50
40	1947.499962	1947.500000	38
50	1947.499946	1947.500000	54
60	1947.499939	1947.500000	61

Table 11-9 Frequency Stability – Temperature Variation

11.9 Field Strength of Spurious Radiation

11.9.1 Test Procedure

Radiated emissions testing of the RAN was performed by Intertek Testing Services in accordance with ANSI C63.4-1992. Test frequency range was 30 MHz to 20 GHz. Refer to separate report.

11.9.2 Results

All detected emissions from the RAN were within Part 15 Class A limits. The Class A limit is considerably more stringent than the Part 22, 24, and 90 radiated spurious emissions limit of –13 dBm. Refer to separate report.

APPENDIX A Spectrum Plots

PCS CDMA

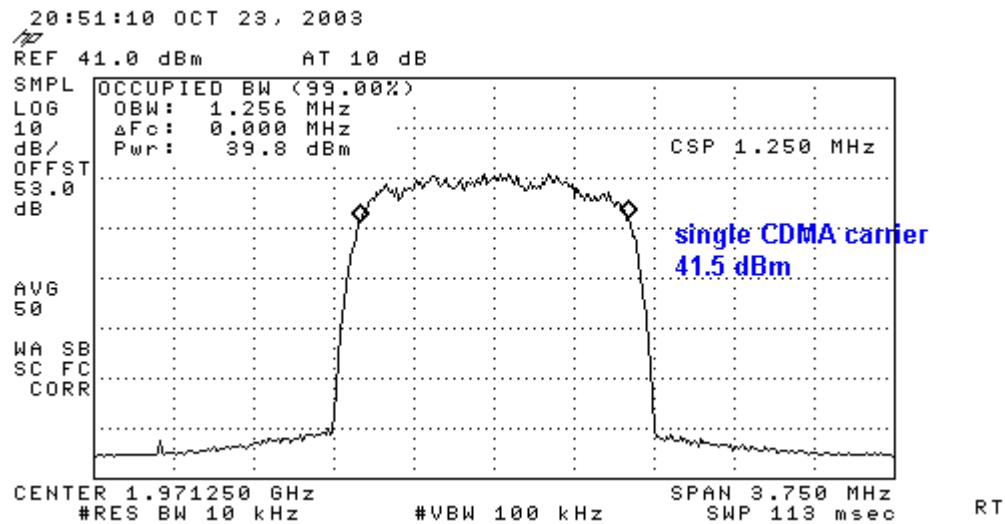


Figure 11-4 Single CDMA carrier, PCS F block, +41.5 dBm, occupied bandwidth

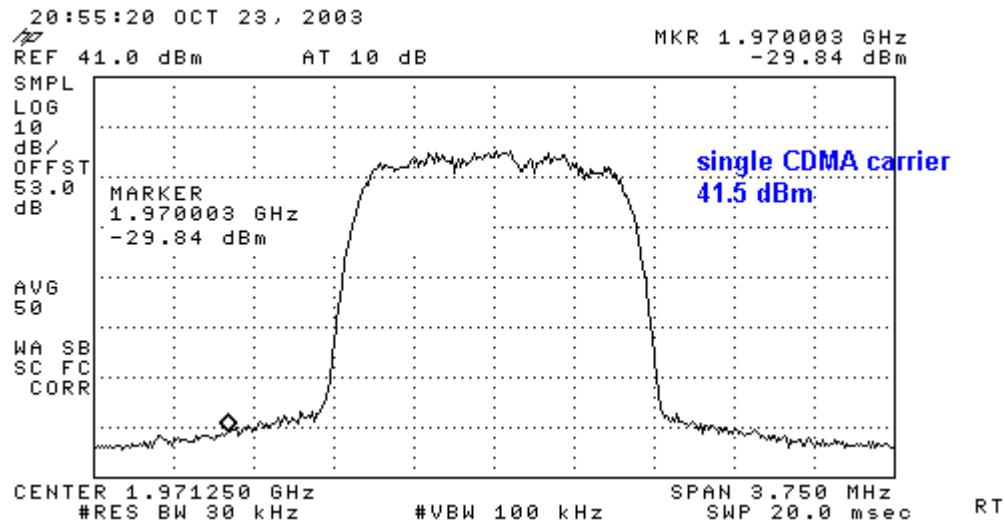


Figure 11-5 Single CDMA carrier, PCS F block, +41.5 dBm, block edge

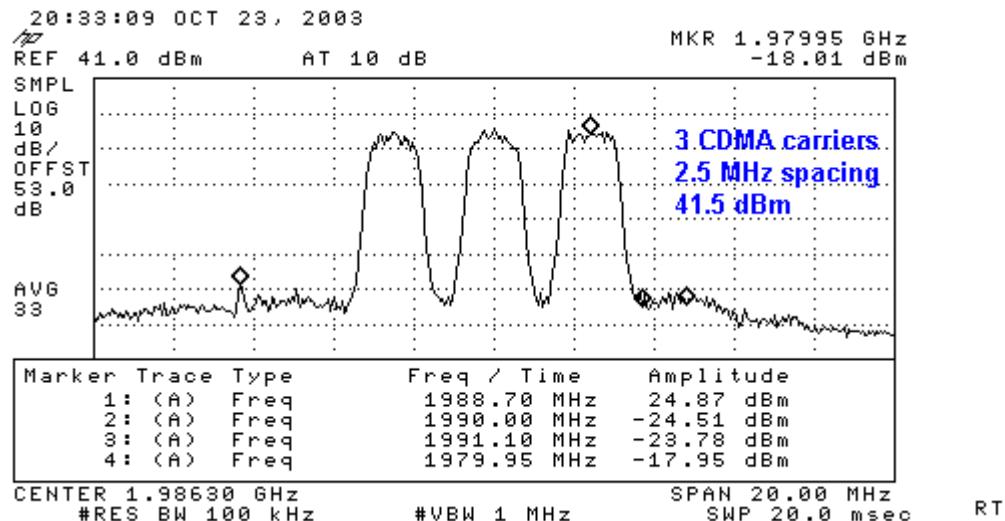


Figure 11-6 Three CDMA carriers, PCS C block, +41.5 dBm, block edge and spurious emission

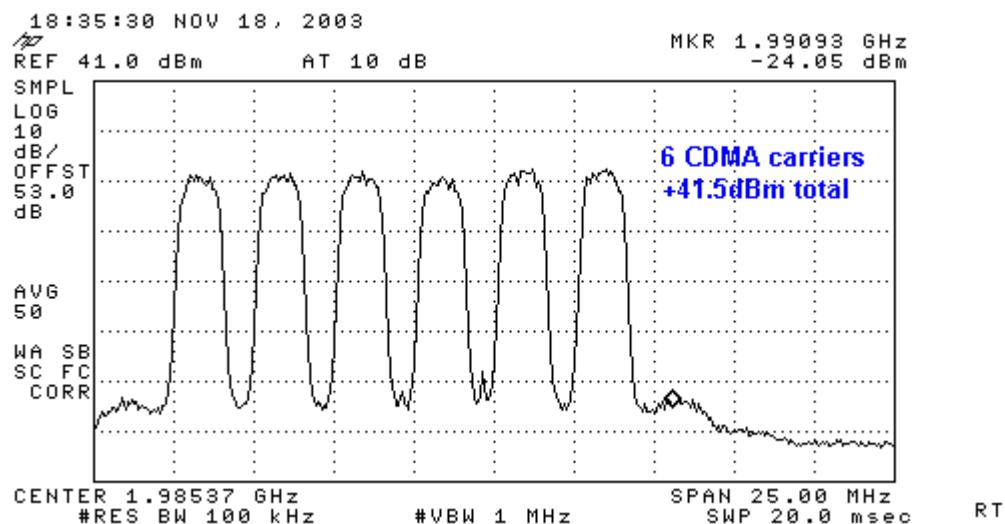


Figure 11-7 Six CDMA carriers, PCS C block, +41.5 dBm, block edge and spurious emission

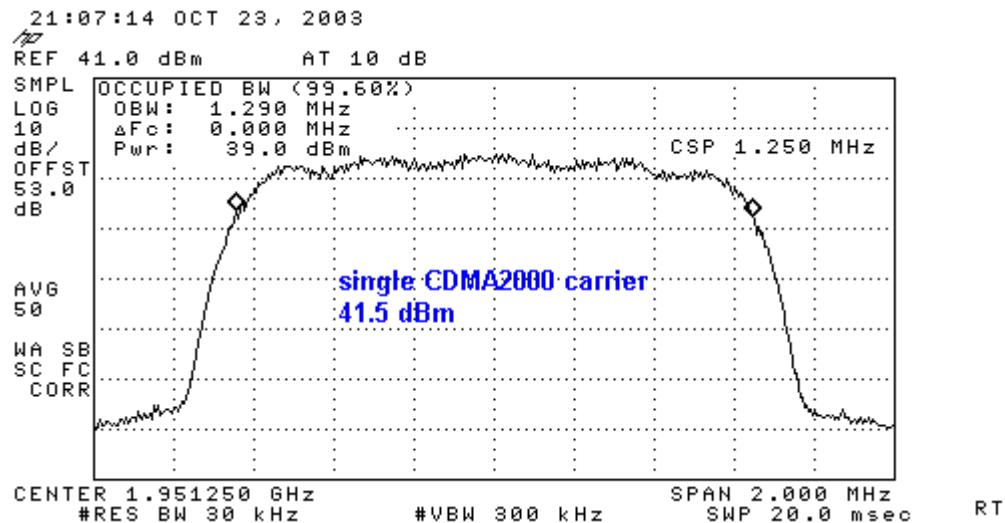


Figure 11-8 Single CDMA2000 carrier, PCS B block, +41.5 dBm, occupied bandwidth

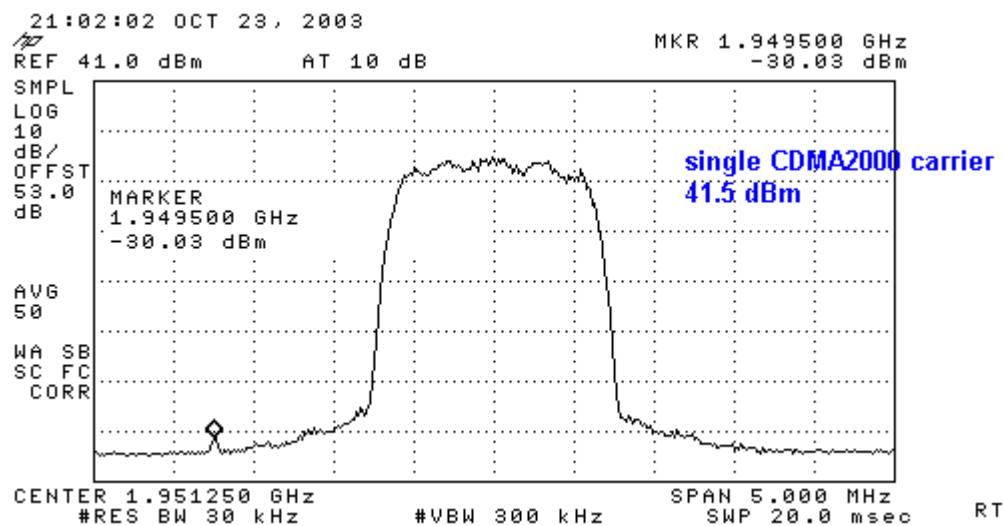


Figure 11-9 Single CDMA2000 carrier, PCS B block, +41.5 dBm, block edge

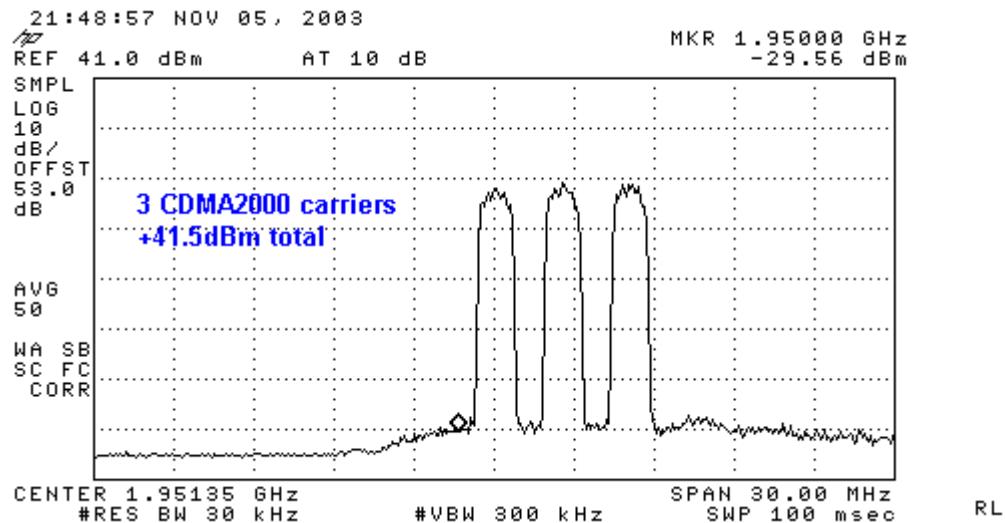


Figure 11-10 Three CDMA2000 carriers, PCS B block, +41.5 dBm

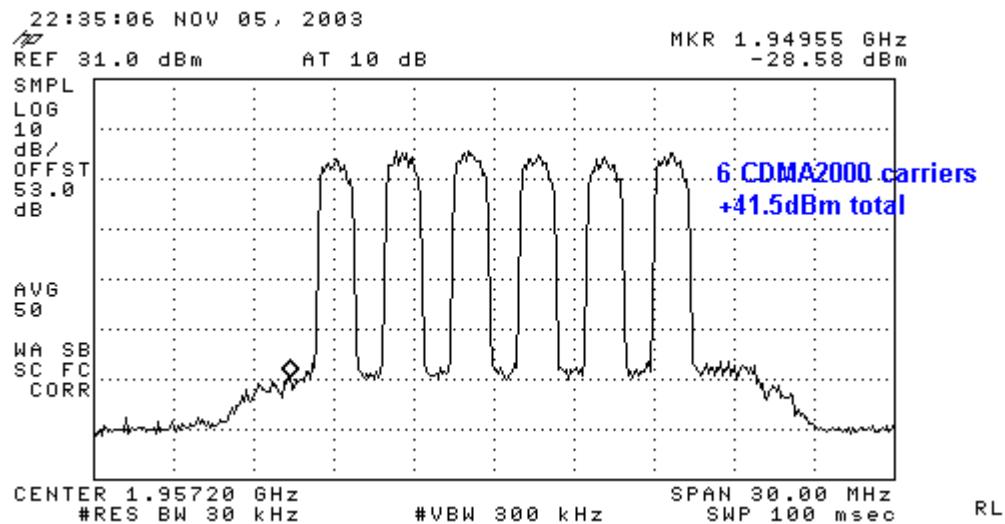


Figure 11-11 Six CDMA2000 carriers, PCS B block, +41.5 dBm

PCS GSM

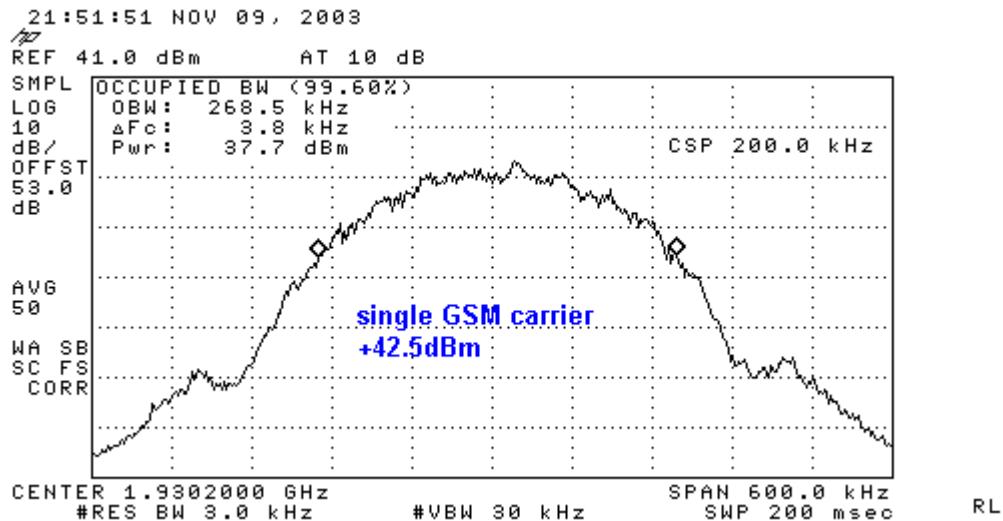


Figure 11-12 Single GSM carrier, PCS A block, +42.5 dBm, occupied bandwidth

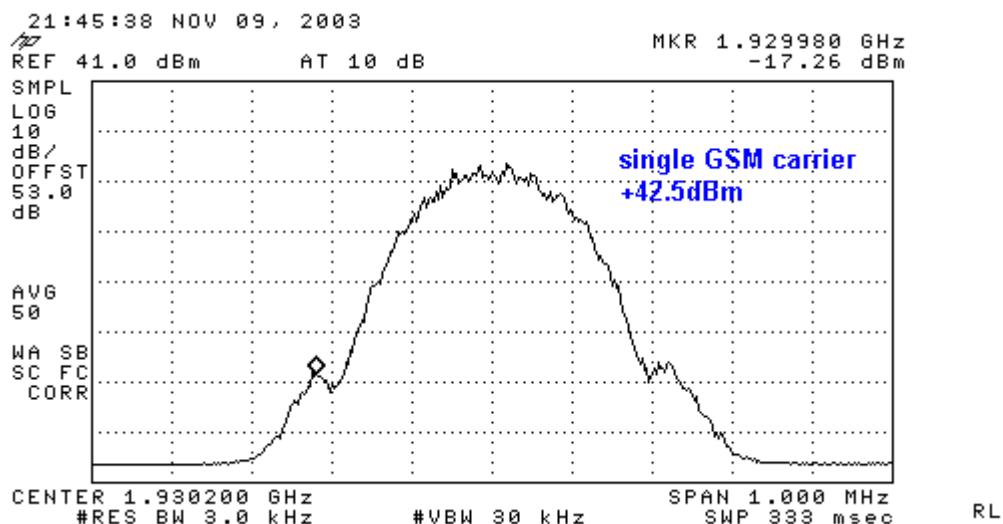


Figure 11-13 Single GSM carrier, PCS A block, +42.5 dBm, block edge

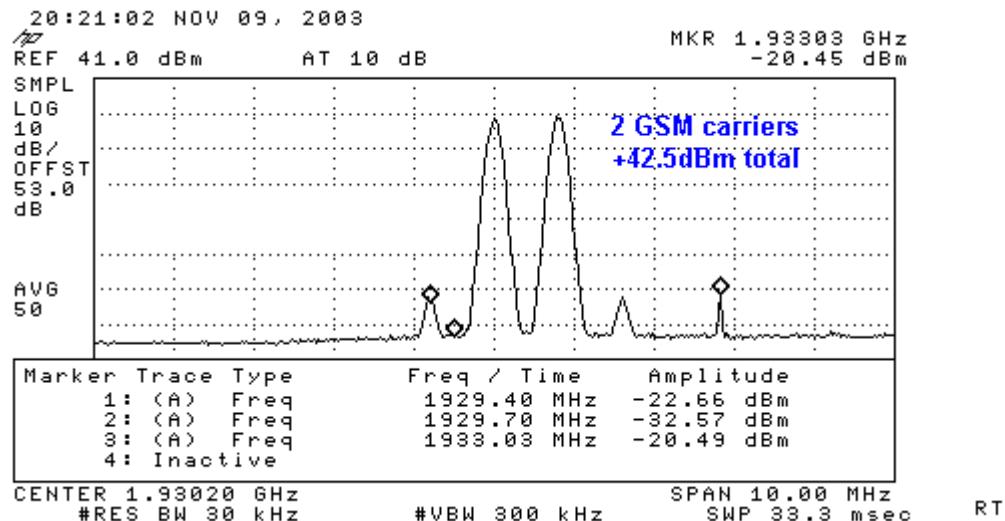


Figure 11-14 Two GSM carriers, PCS A block, +42.5 dBm

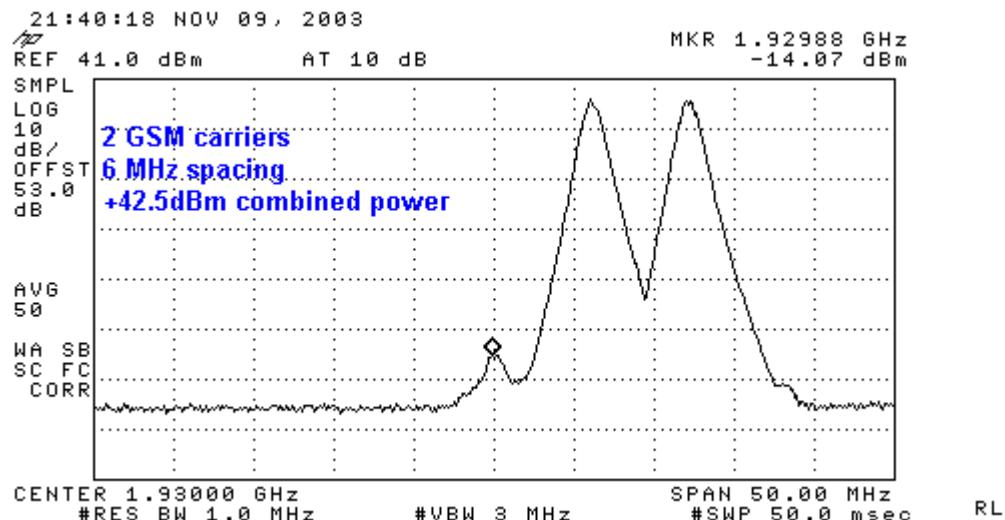


Figure 11-15 Two GSM carriers, PCS A block, +42.5 dBm

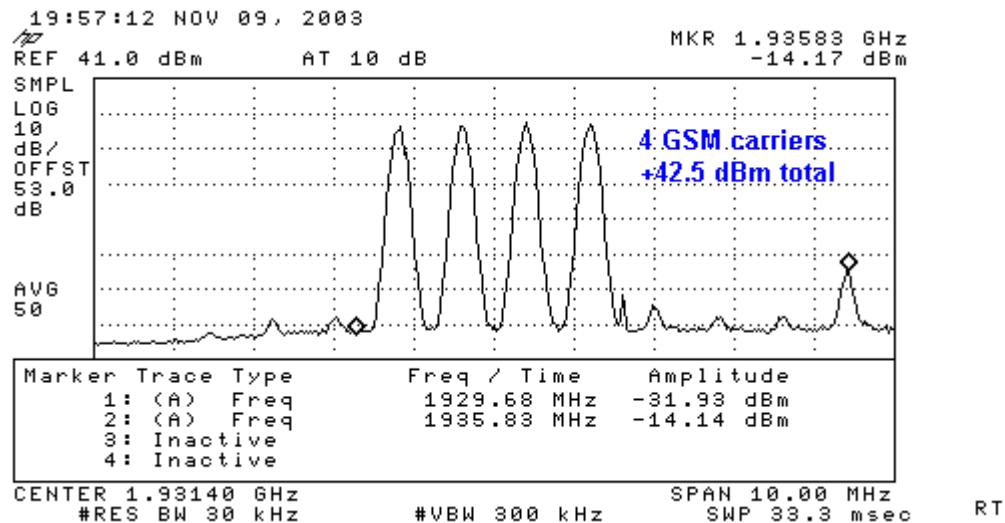


Figure 11-16 Four GSM carriers, PCS A block, +42.5 dBm, spurious emission

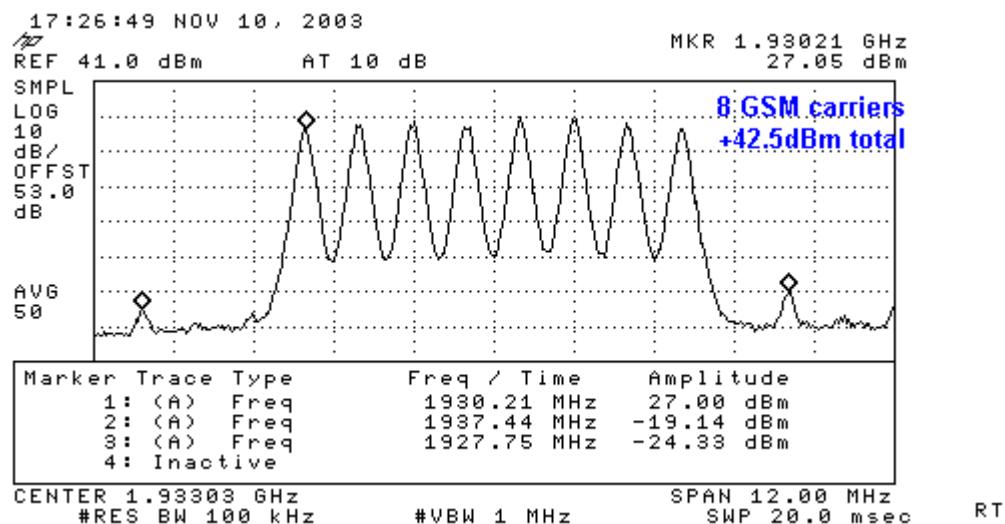


Figure 11-17 Eight GSM carriers, PCS A block, +42.5 dBm

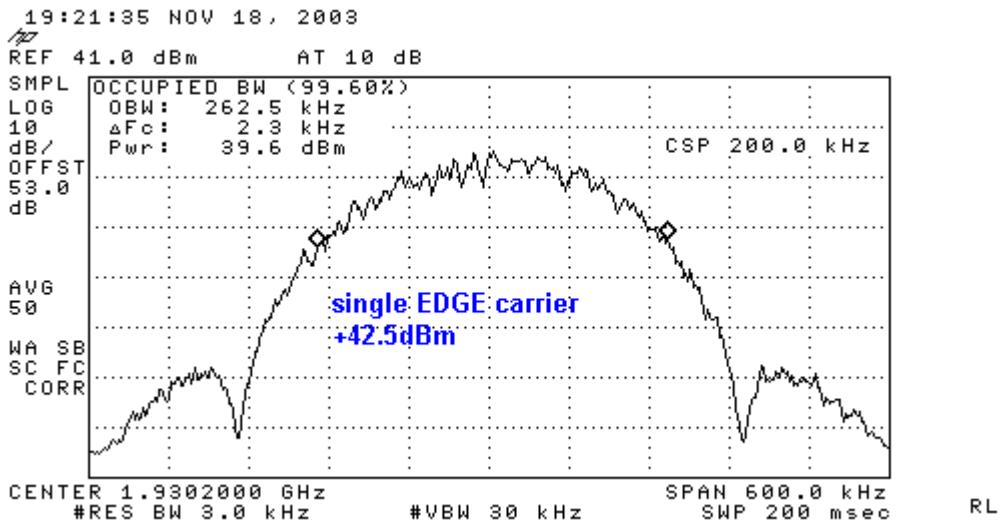
PCS EDGE

Figure 11-18 Single EDGE carrier, PCS A block, +42.5 dBm, occupied bandwidth

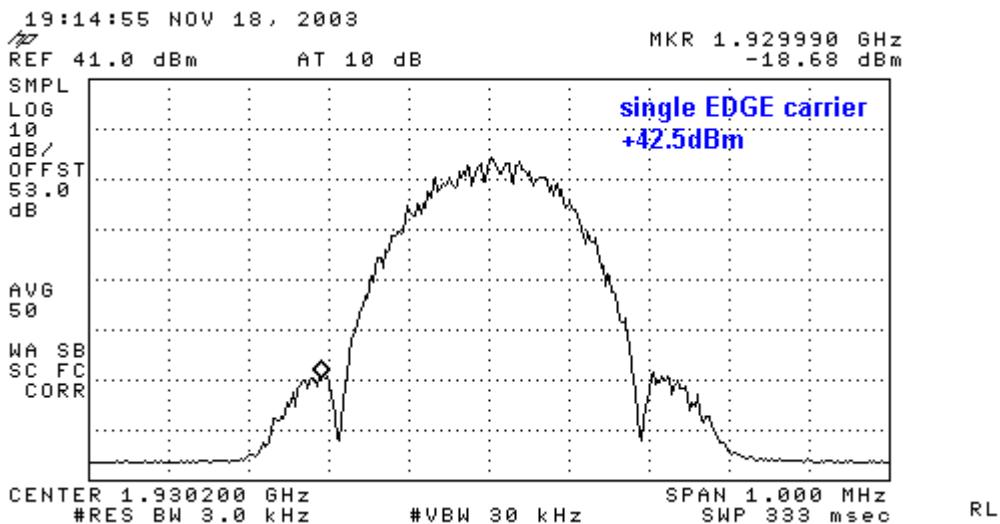


Figure 11-19 Single EDGE carrier, PCS A block, +42.5 dBm, block edge

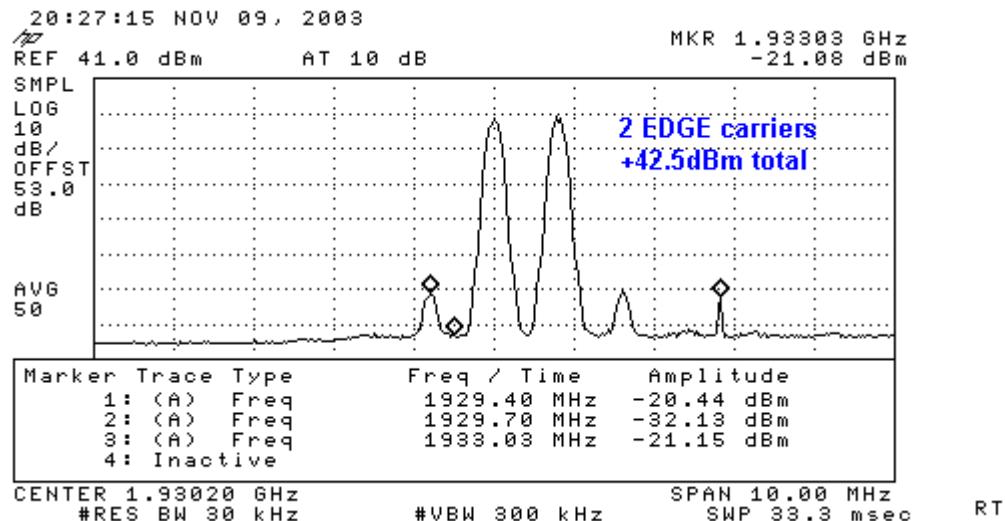


Figure 11-20 Two EDGE carriers, PCS A block, +42.5 dBm

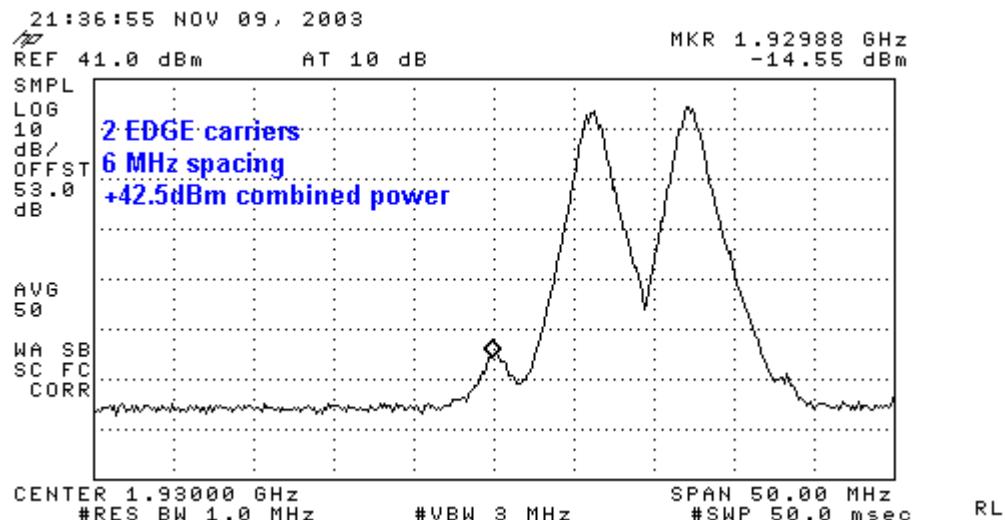


Figure 11-21 Two EDGE carriers, PCS A block, +42.5 dBm

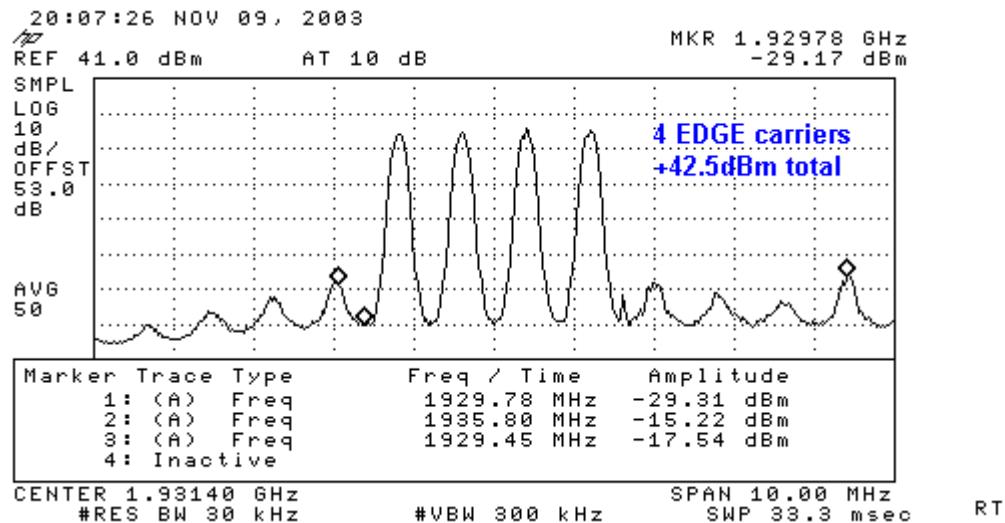


Figure 11-22 Four EDGE carriers, PCS A block, +42.5 dBm, spurious emission

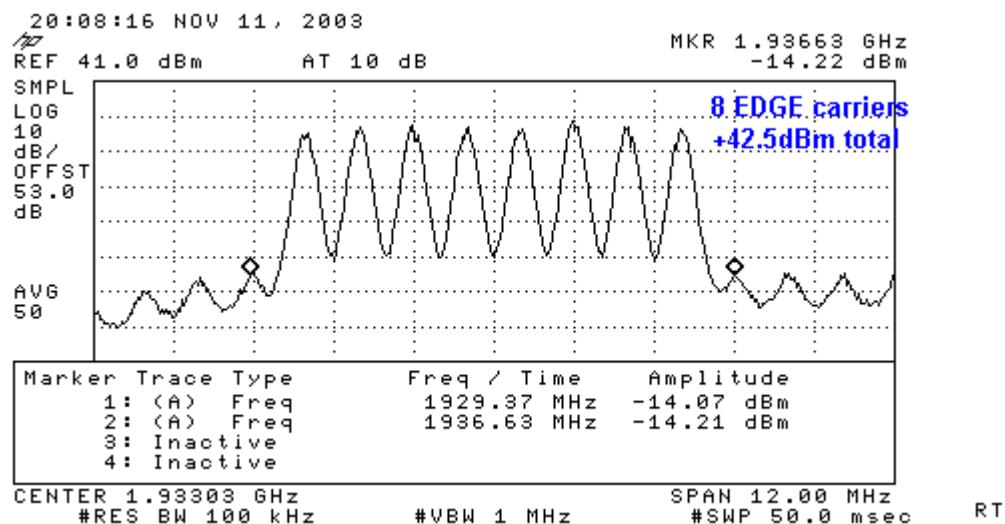


Figure 11-23 Eight EDGE carriers, PCS A block, +42.5 dBm

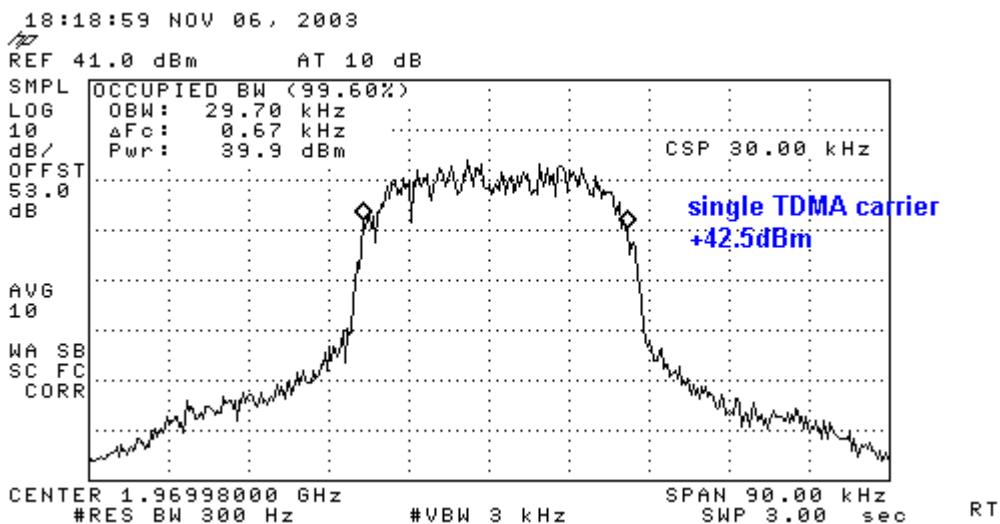
PCS TDMA

Figure 11-24 Single TDMA carrier, PCS E block, +42.5 dBm, occupied bandwidth

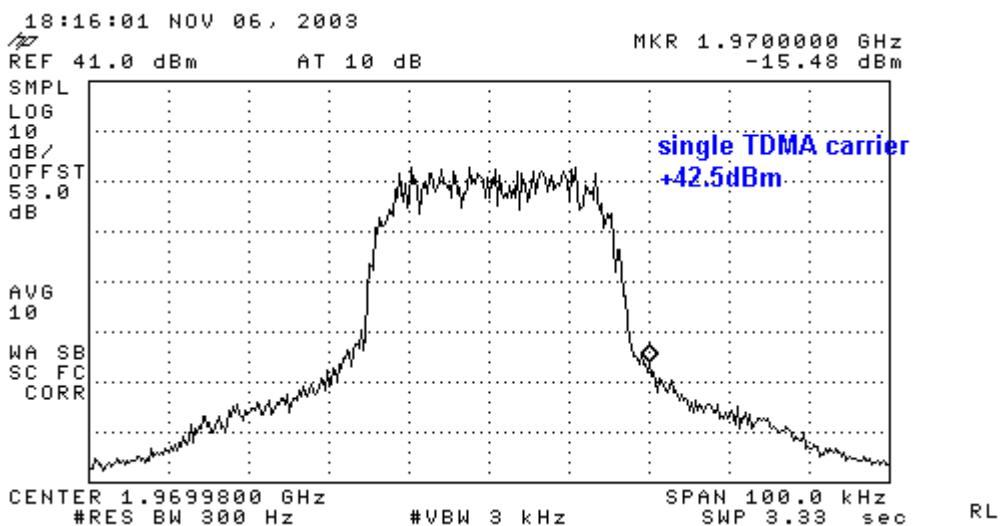


Figure 11-25 Single TDMA carrier, PCS E block, +42.5 dBm, block edge

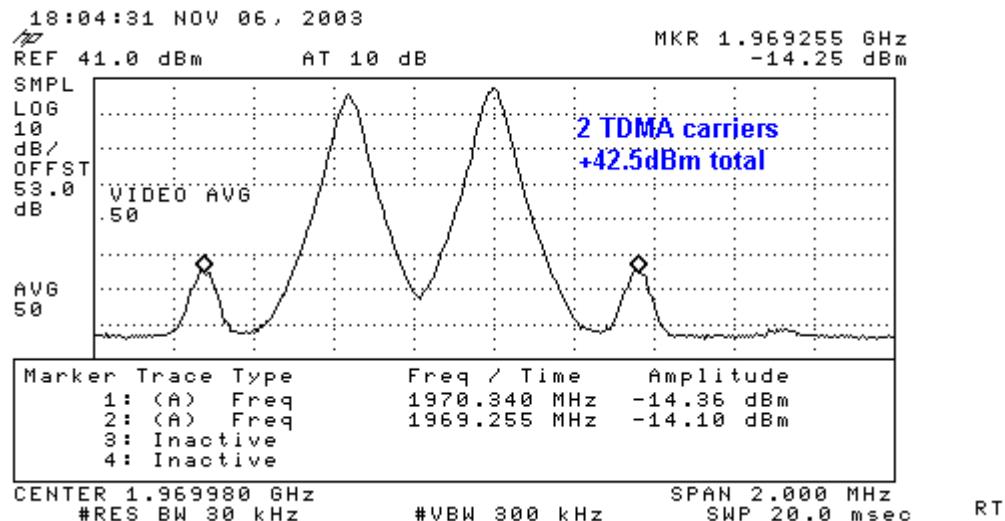


Figure 11-26 Two TDMA carriers, PCS E block, +42.5 dBm

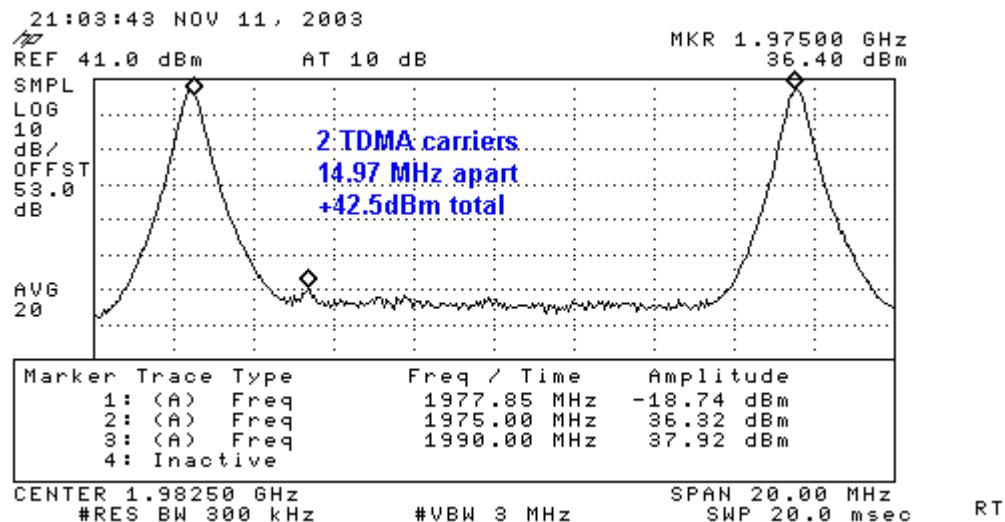


Figure 11-27 Two TDMA carriers, PCS C block, +42.5 dBm

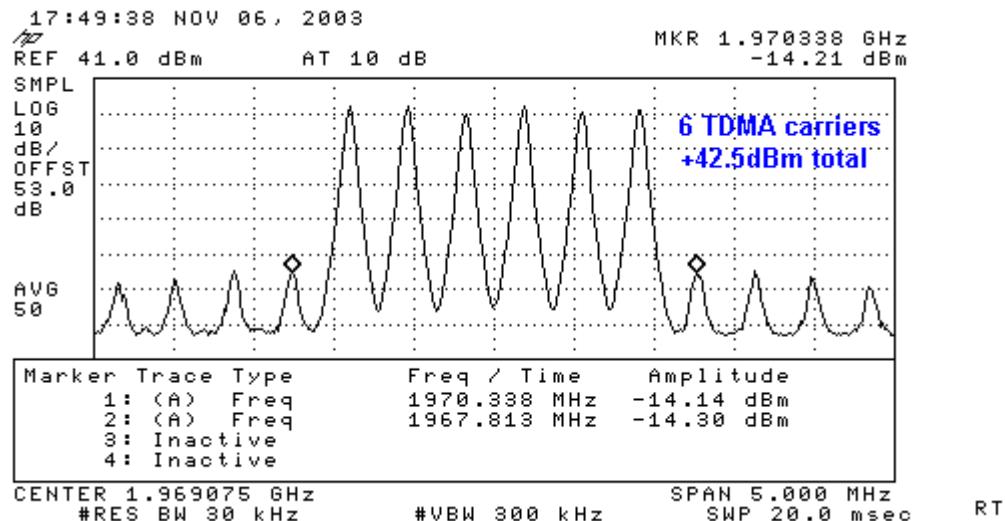


Figure 11-28 Six TDMA carriers, PCS E block, +42.5 dBm

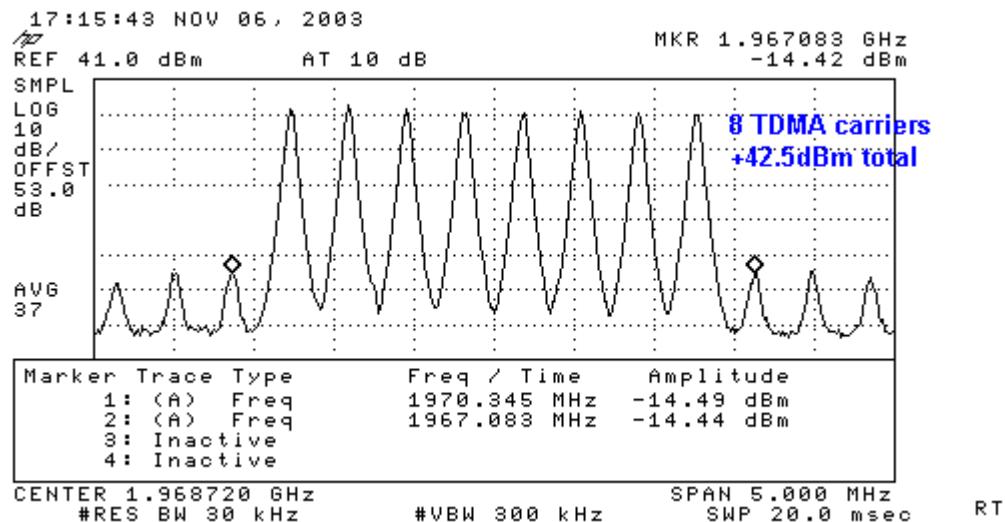


Figure 11-29 Six TDMA carriers, PCS D block, +42.5 dBm

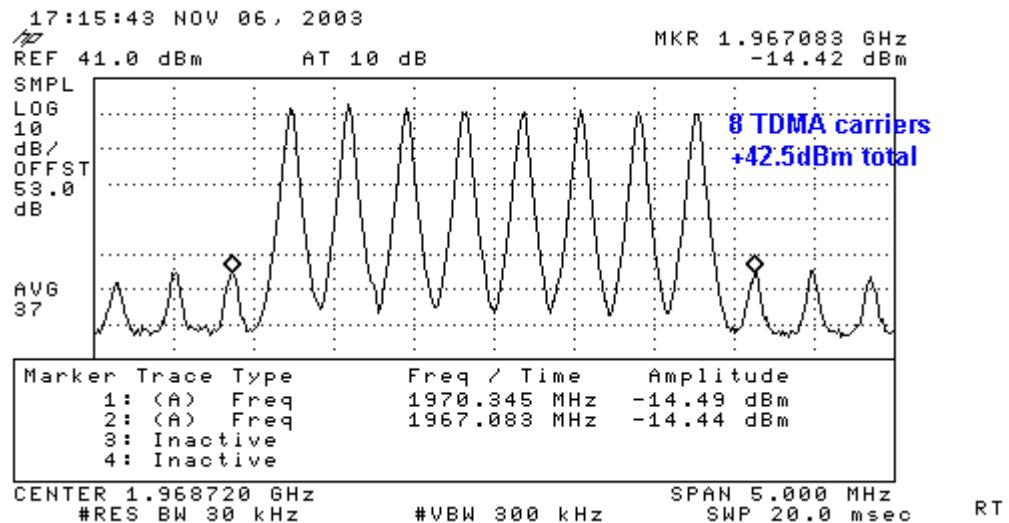


Figure 11-30 Eight TDMA carriers, PCS E block, +42.5 dBm

Cellular CDMA

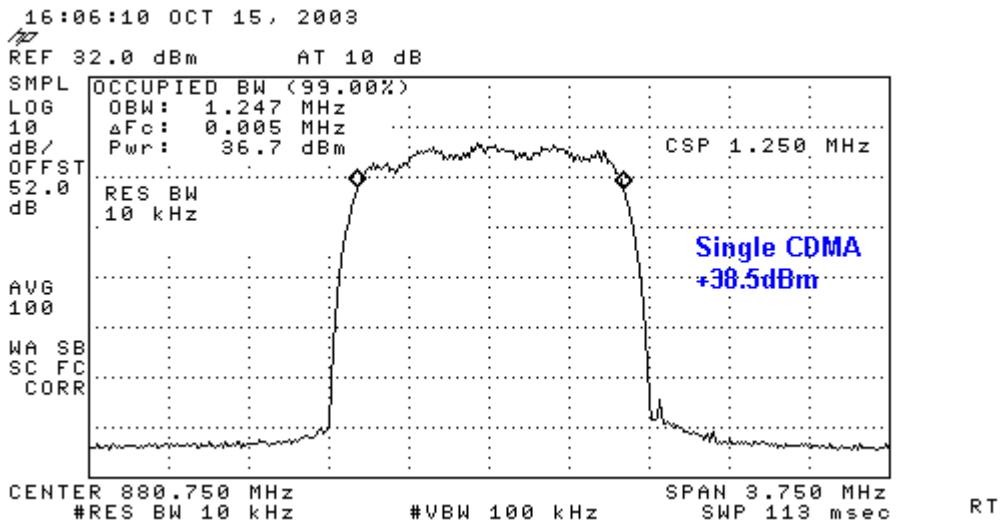


Figure 11-31 Single CDMA carrier, cellular B block, +38.5 dBm, occupied bandwidth

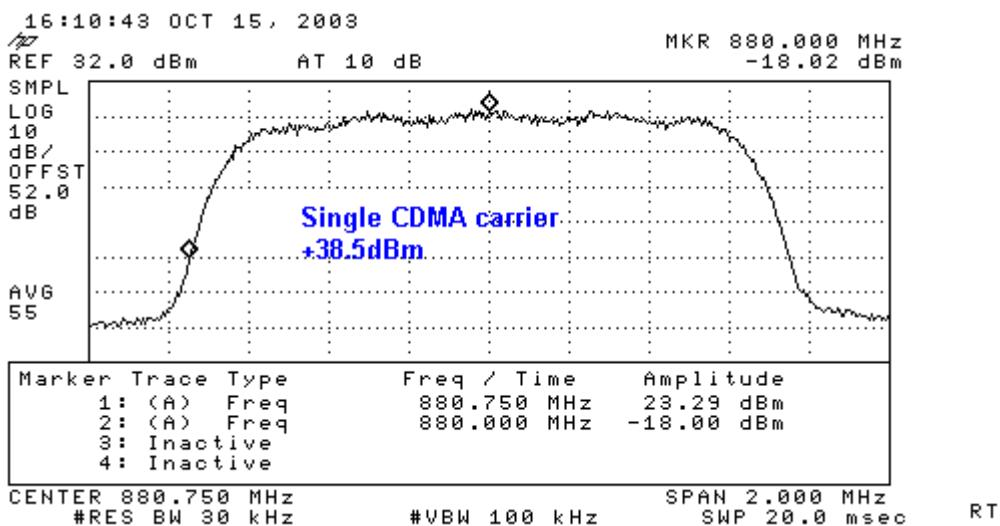


Figure 11-32 Single CDMA carrier, cellular B block, +38.5 dBm, block edge

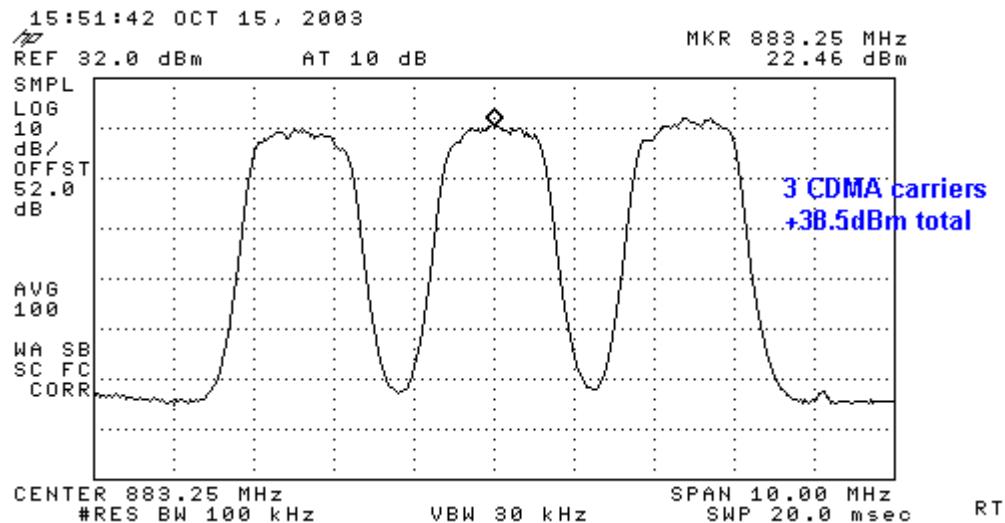


Figure 11-33 Three CDMA carriers, cellular B block, +38.5 dBm

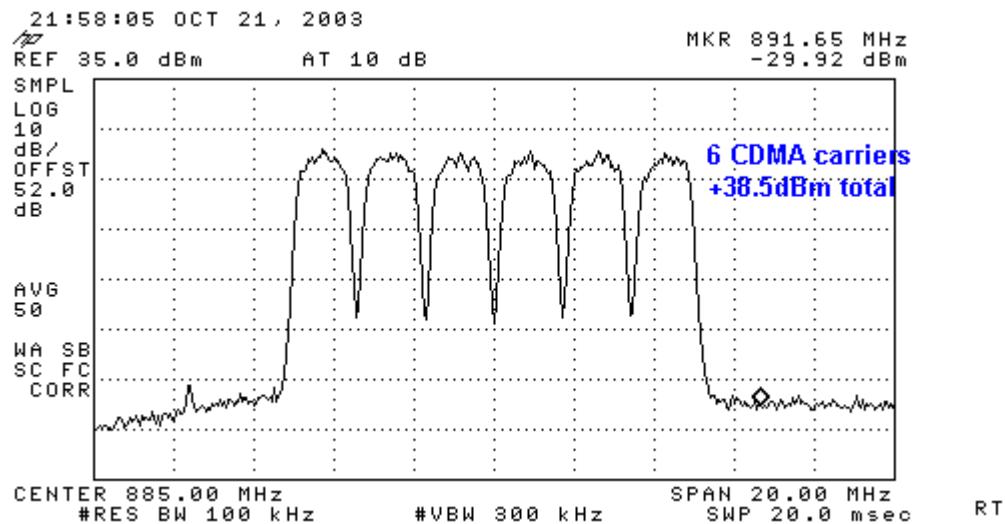


Figure 11-34 Six CDMA carriers, cellular B block, +38.5 dBm

Cellular CDMA2000

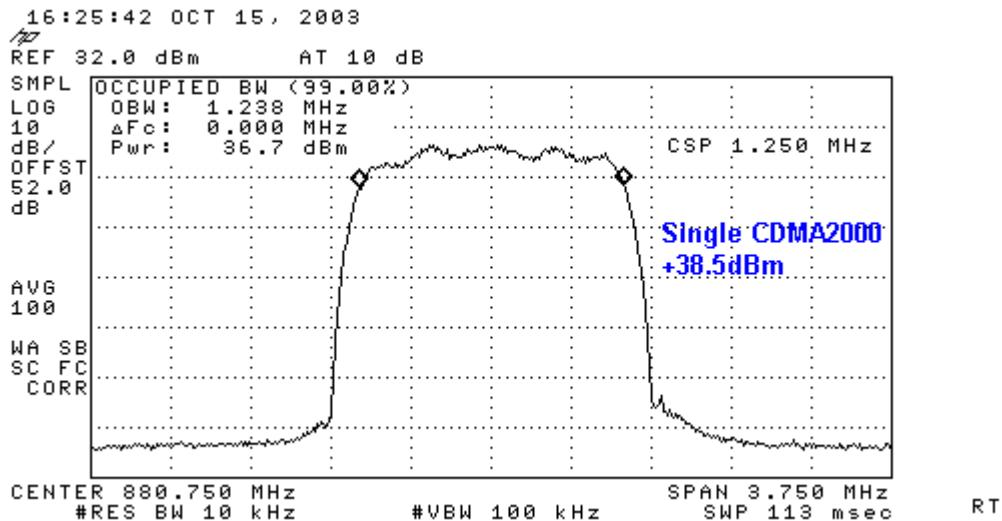


Figure 11-35 Single CDMA2000 carrier, cellular B block, +38.5 dBm, occupied bandwidth

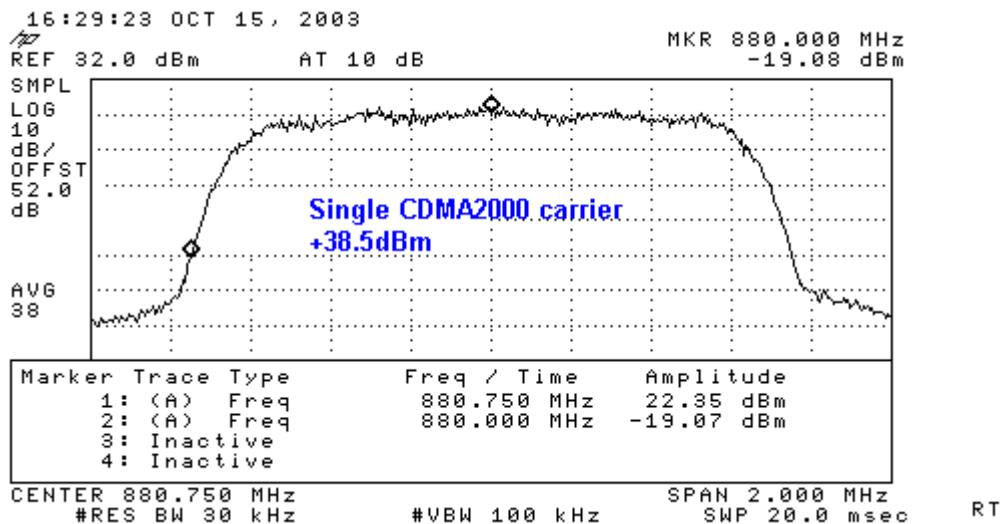


Figure 11-36 Single CDMA2000 carrier, cellular B block, +38.5 dBm, block edge

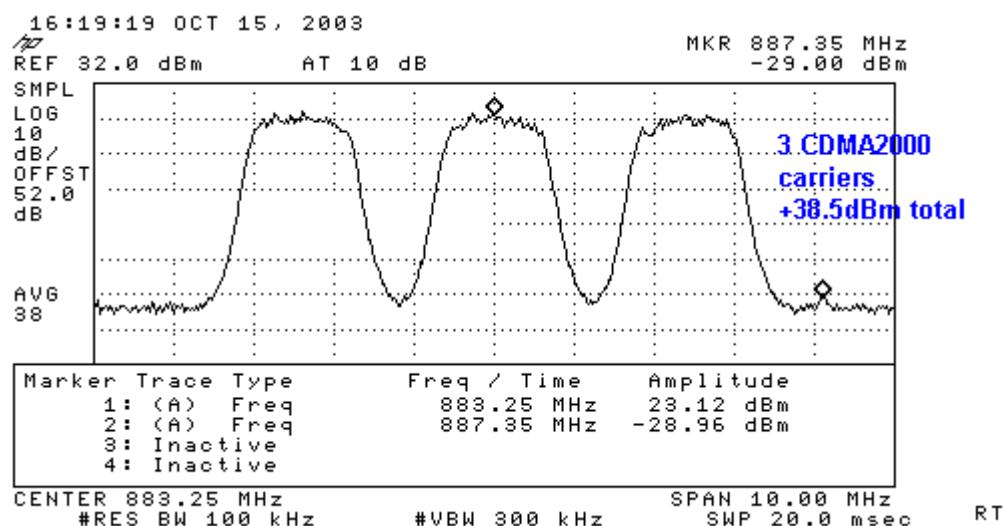


Figure 11-37 Three CDMA2000 carriers, cellular B block, +38.5 dBm

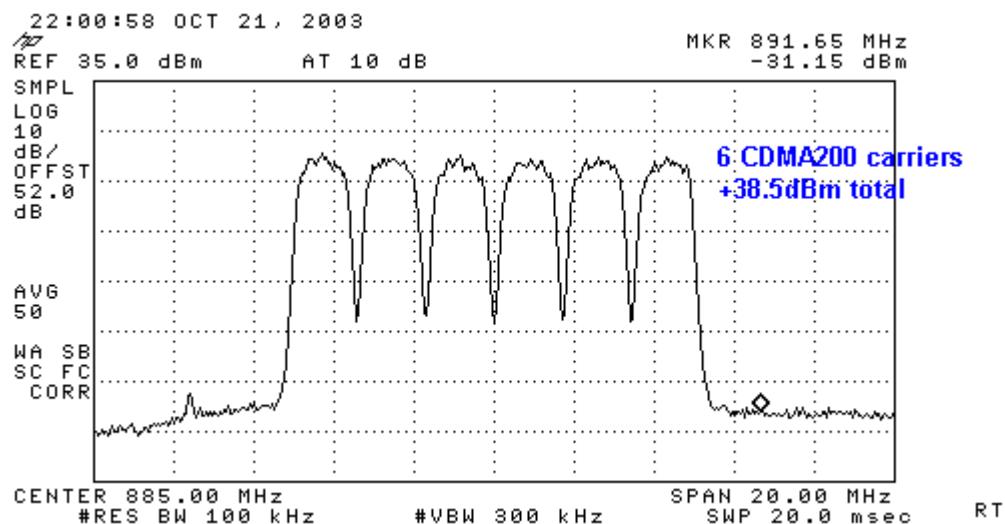


Figure 11-38 Six CDMA2000 carriers, cellular B block, +38.5 dBm

Cellular GSM

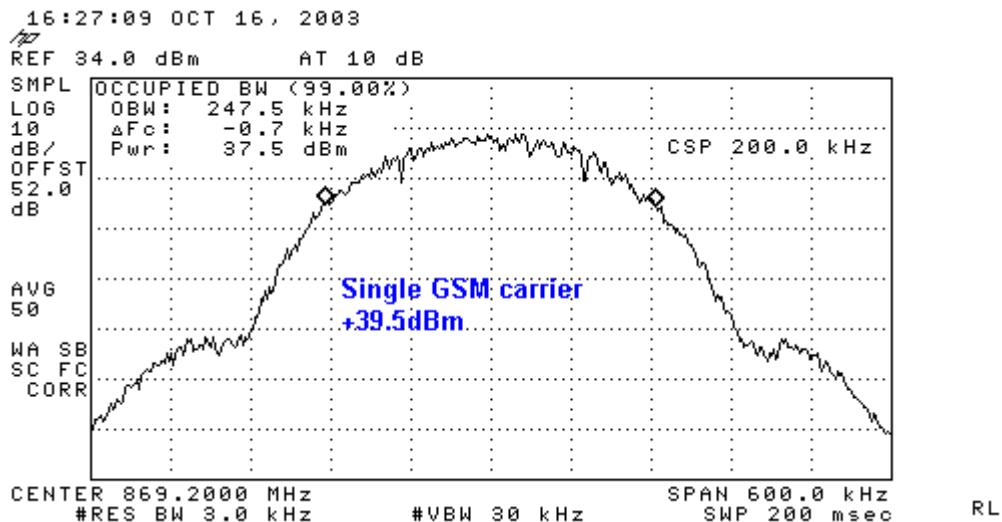


Figure 11-39 Single GSM carrier, cellular A block, +39.5 dBm, occupied bandwidth

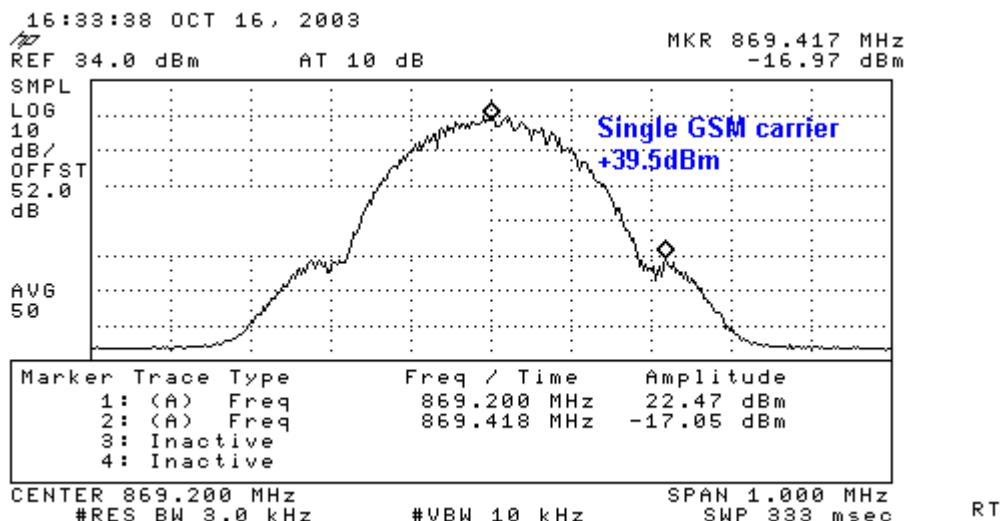


Figure 11-40 Single GSM carrier, cellular A block, +39.5 dBm, block edge

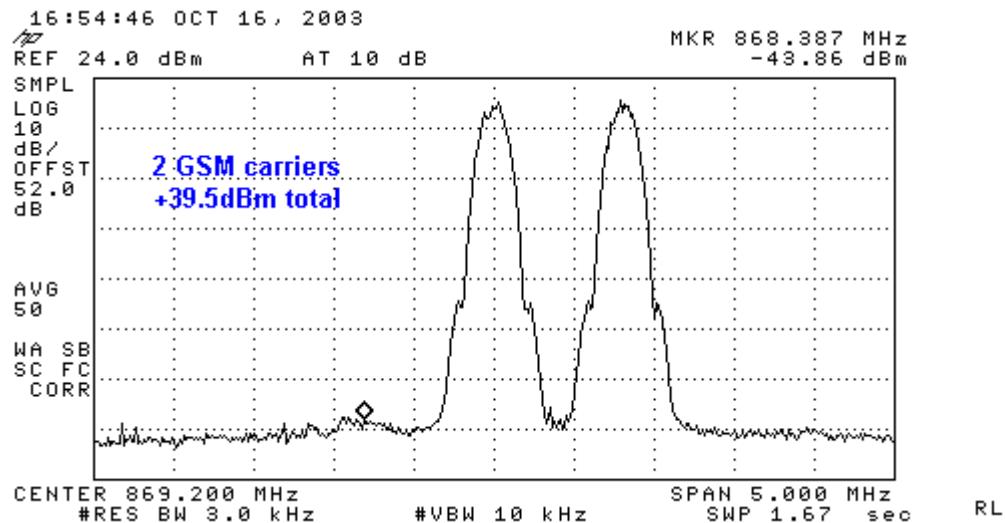


Figure 11-41 Two GSM carriers, cellular A block, +39.5 dBm

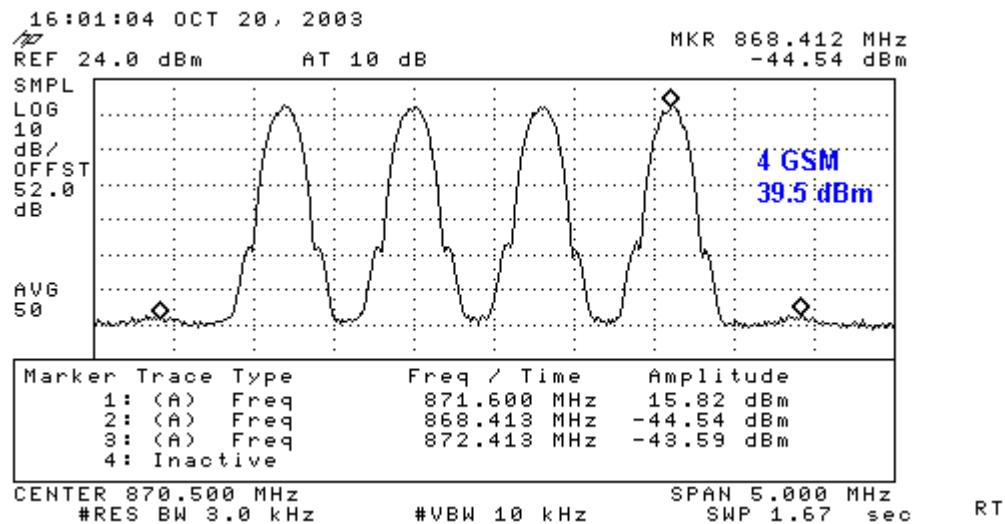


Figure 11-42 Four GSM carriers, cellular A block, +39.5 dBm

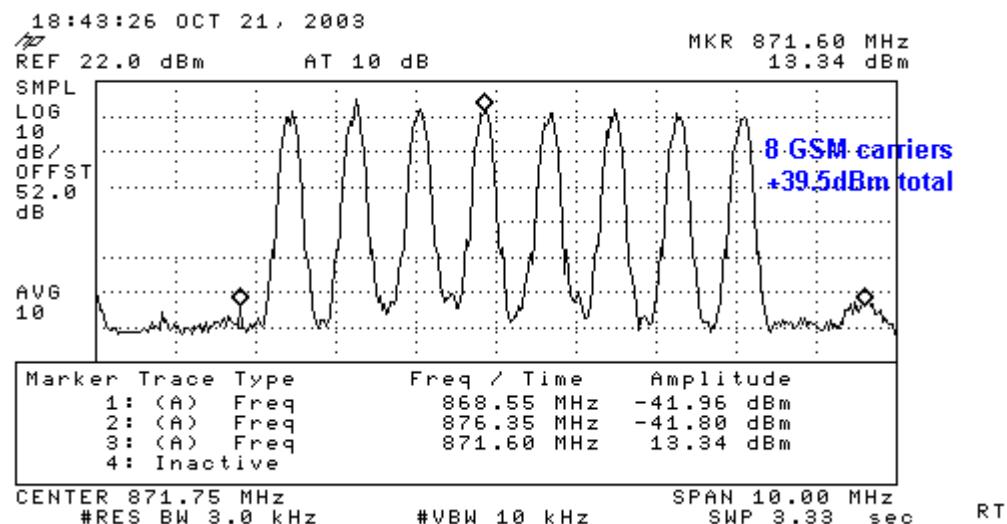


Figure 11-43 Eight GSM carriers, cellular A block, +39.5 dBm

Cellular EDGE

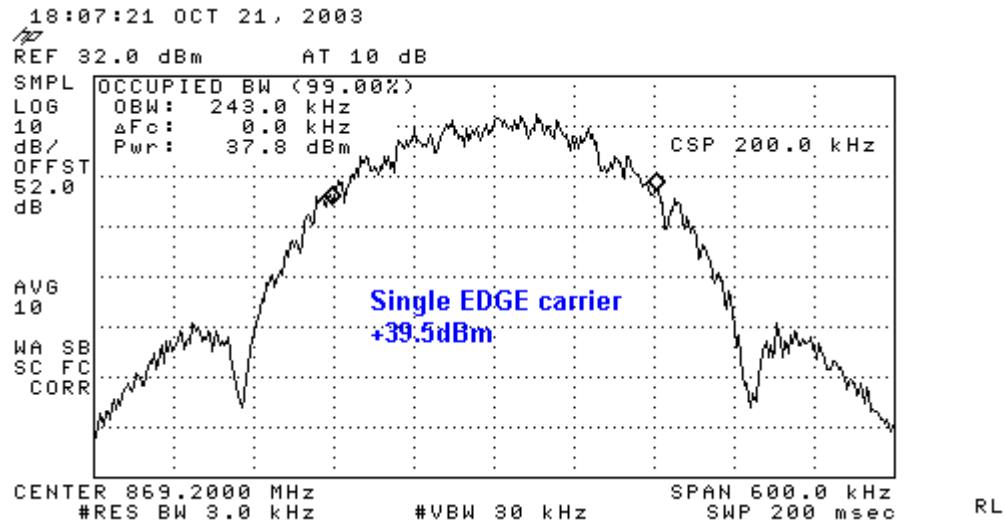


Figure 11-44 Single EDGE carrier, cellular A block, +39.5 dBm, occupied bandwidth

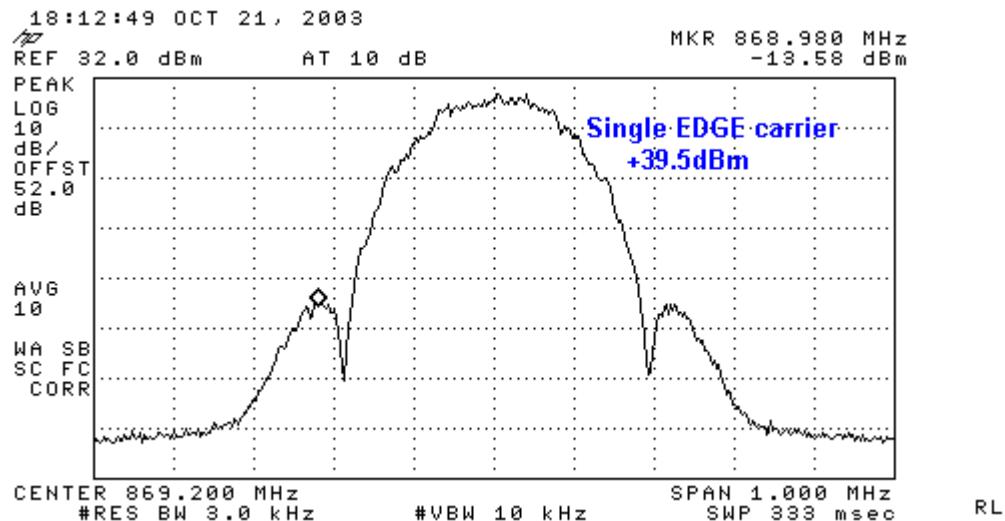


Figure 11-45 Single EDGE carrier, cellular A block, +39.5 dBm, block edge

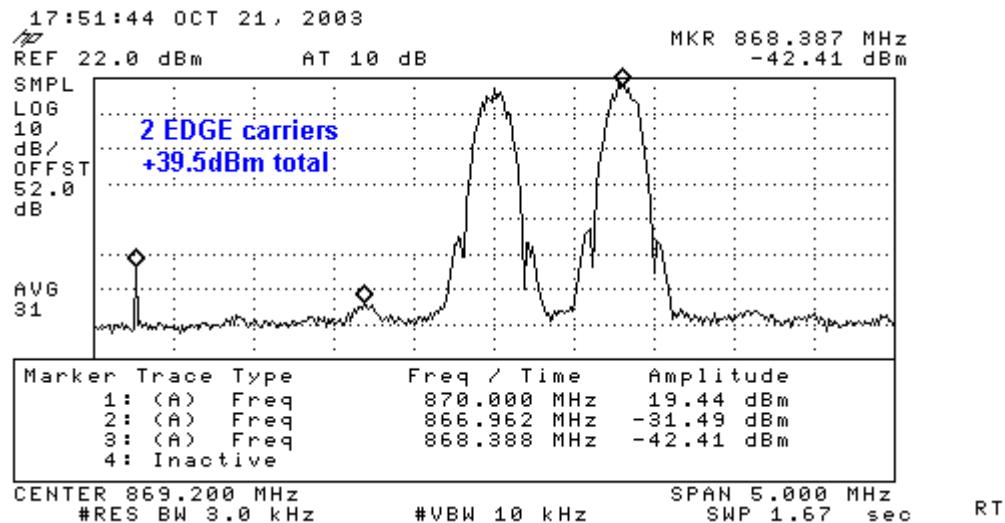


Figure 11-46 Two EDGE carriers, cellular A block, +39.5 dBm

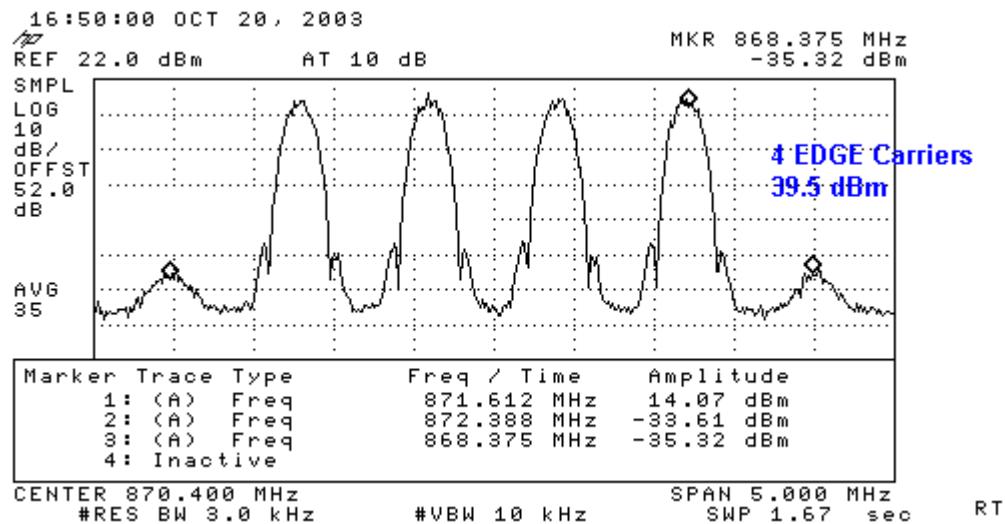


Figure 11-47 Four EDGE carriers, cellular A block, +39.5 dBm

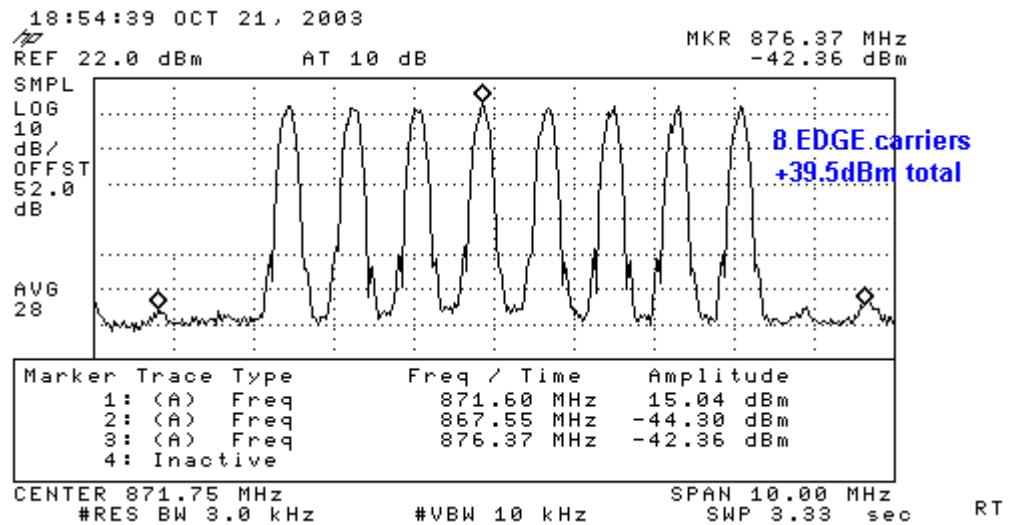


Figure 11-48 Eight EDGE carriers, cellular A block, +39.5 dBm

Cellular TDMA

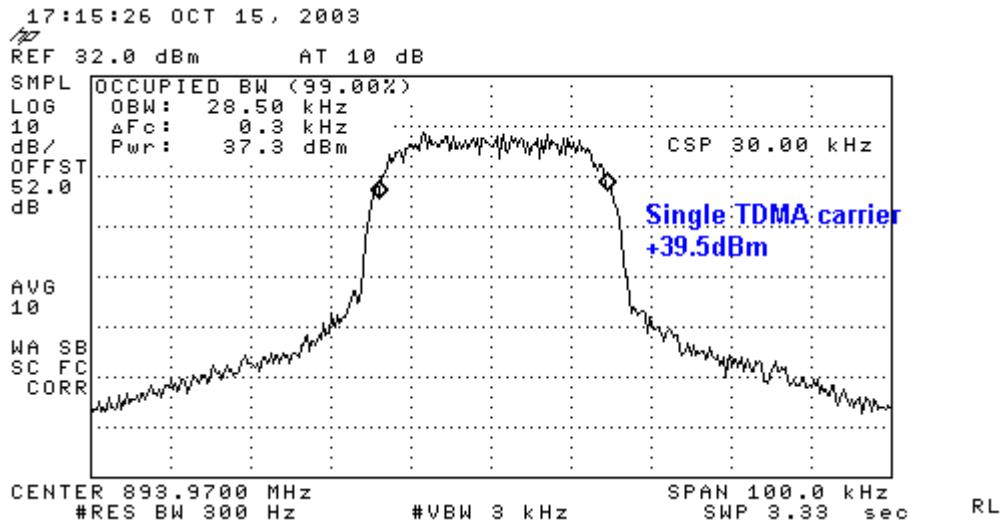


Figure 11-49 Single TDMA carrier, cellular B' block, +39.5 dBm, occupied bandwidth

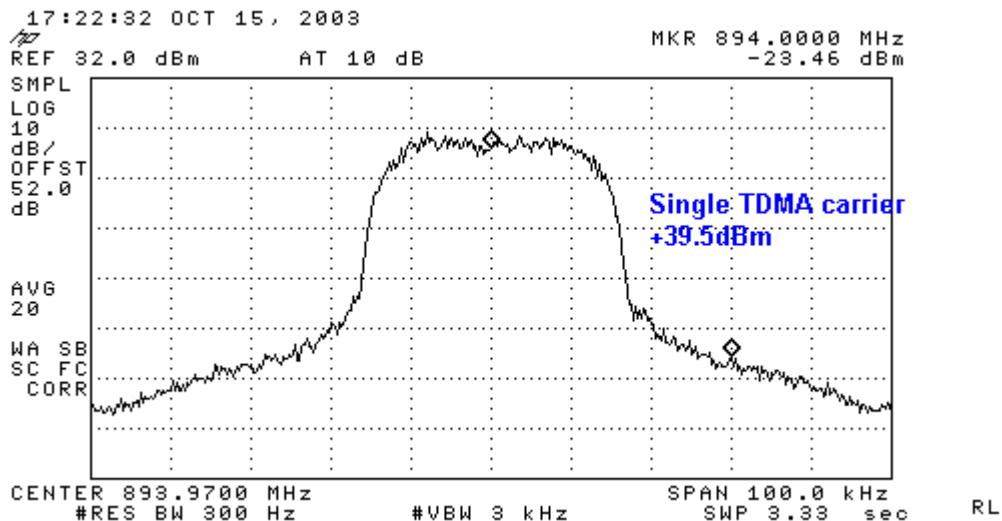


Figure 11-50 Single TDMA carrier, cellular B' block, +39.5 dBm, block edge

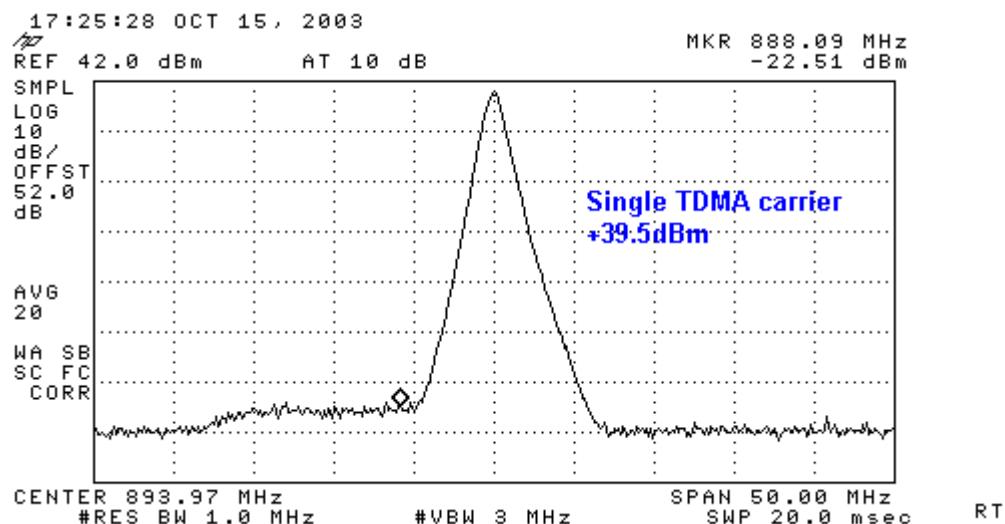


Figure 11-51 Single TDMA carrier, cellular B' block, +39.5 dBm

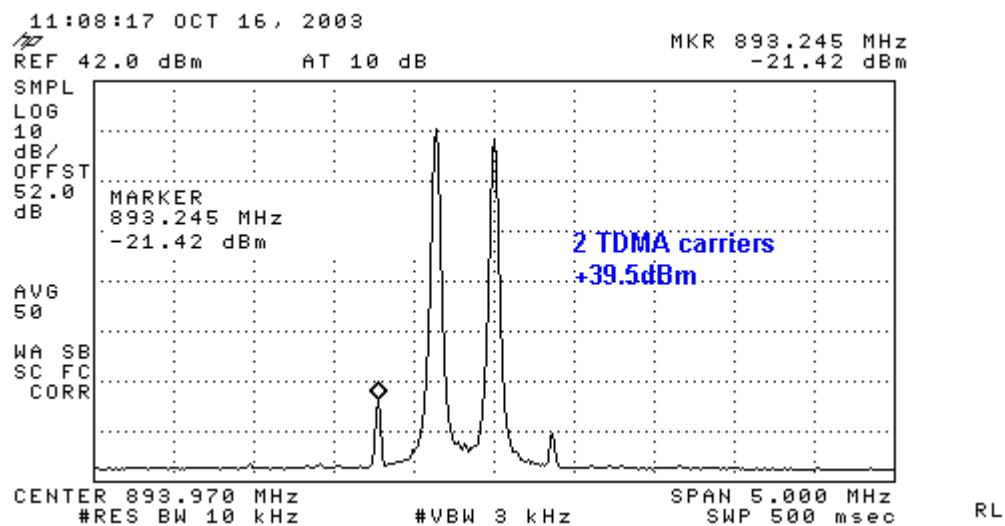


Figure 11-52 Two TDMA carriers, cellular B' block, +39.5 dBm

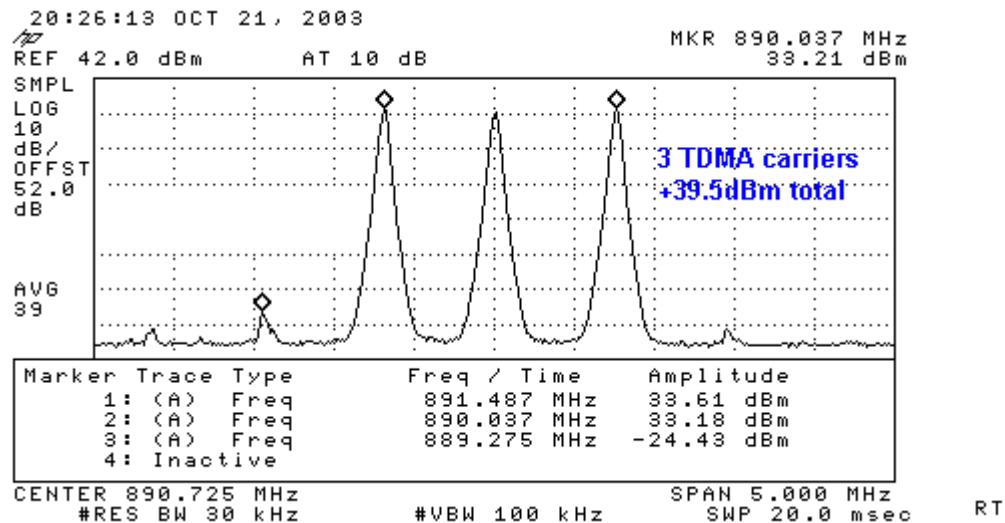


Figure 11-53 Three TDMA carriers, cellular A' block, +39.5 dBm

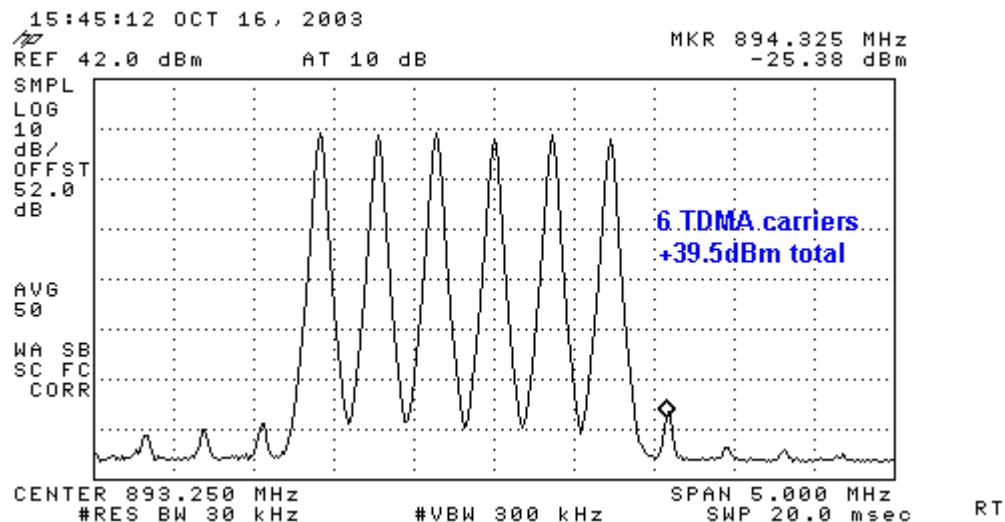


Figure 11-54 Six TDMA carriers, cellular B' block, +39.5 dBm

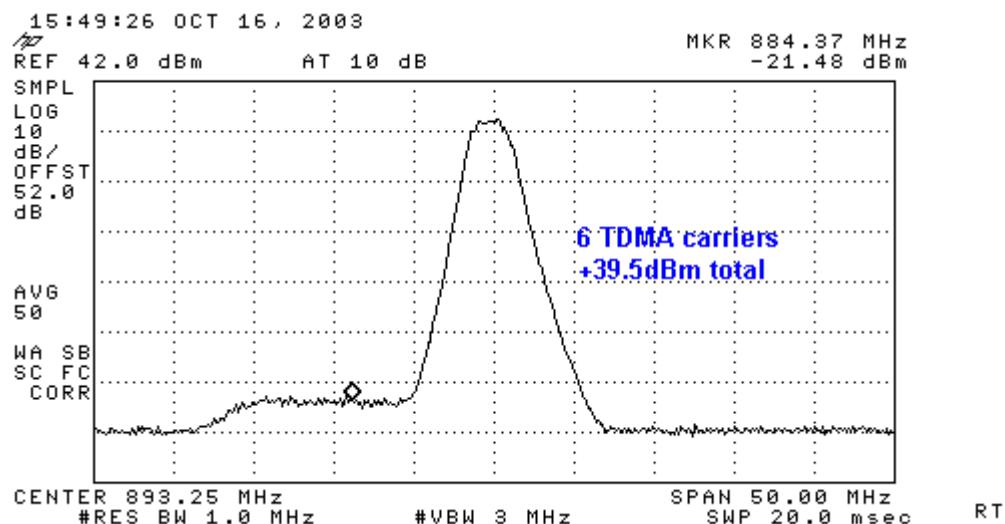


Figure 11-55 Six TDMA carriers, cellular B' block, +39.5 dBm, spurious emission

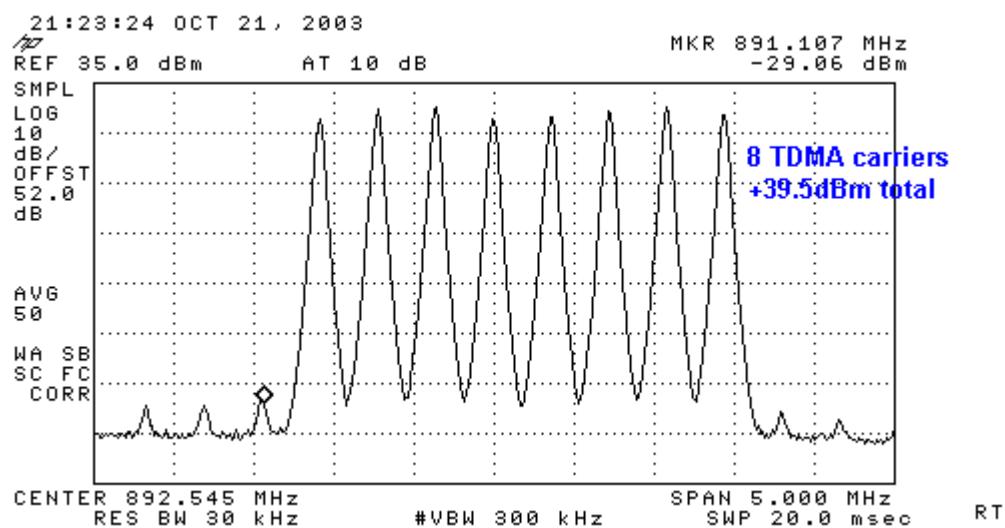
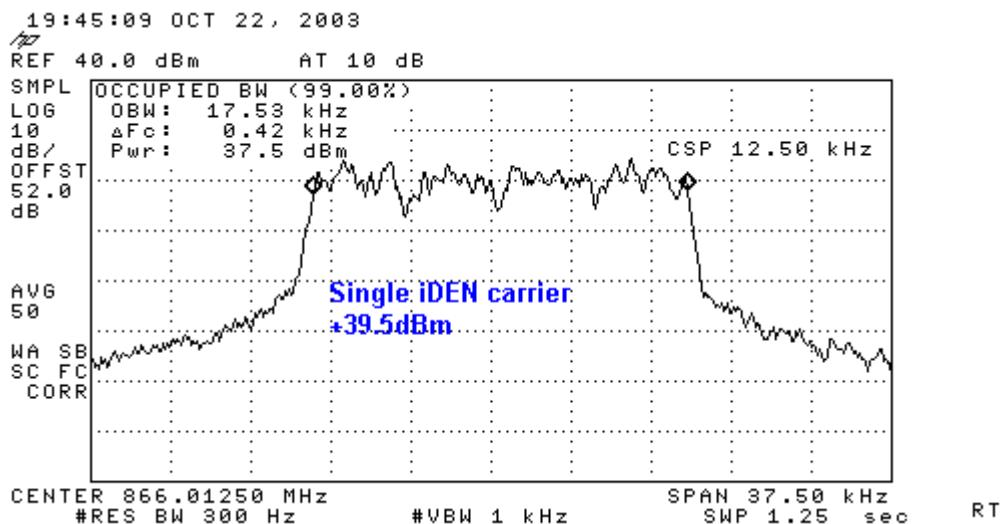
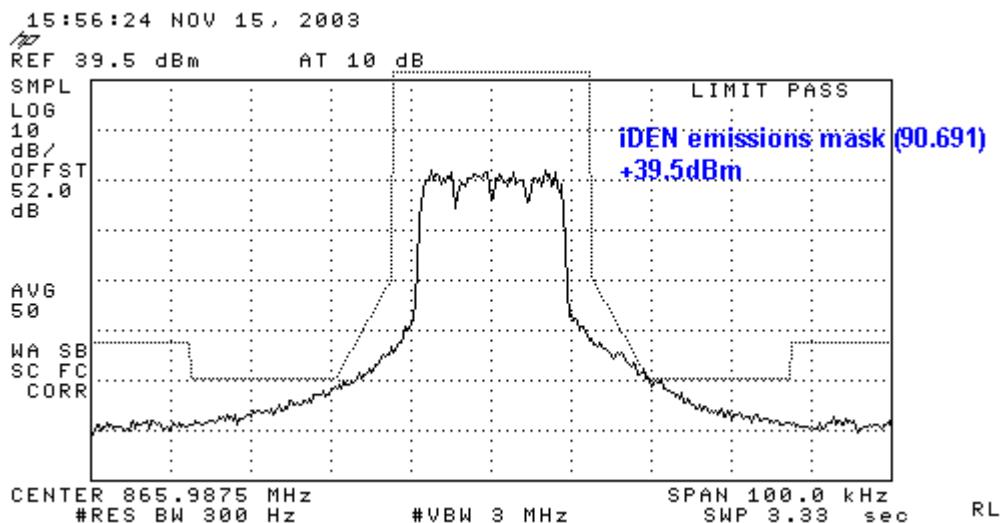


Figure 11-56 Eight TDMA carriers, cellular B' block, +39.5 dBm

SMR iDEN**Figure 11-57 Single iDEN carrier, SMR, +39.5 dBm, occupied bandwidth****Figure 11-58 Single iDEN carrier, SMR, +39.5 dBm, emissions mask of 47CFR 90.691**

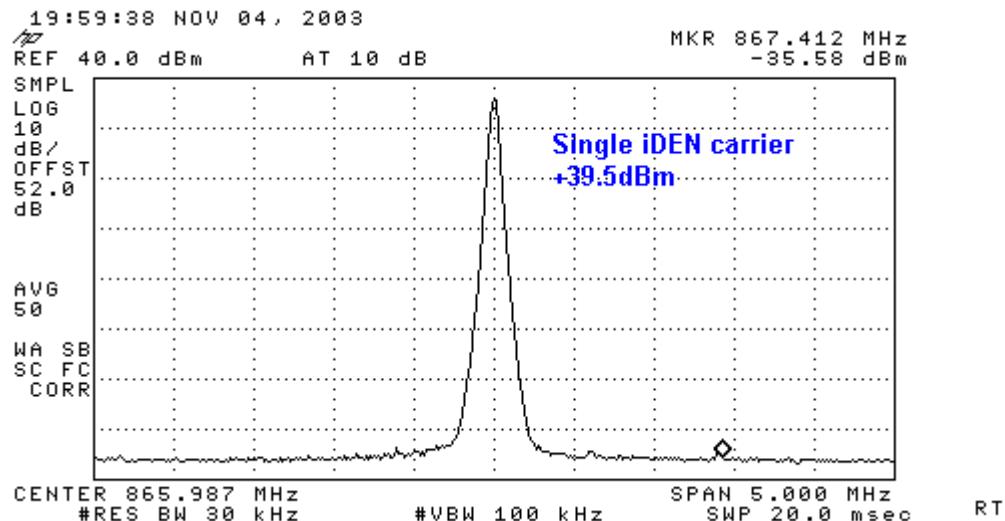


Figure 11-59 Single iDEN carrier, SMR, +39.5 dBm

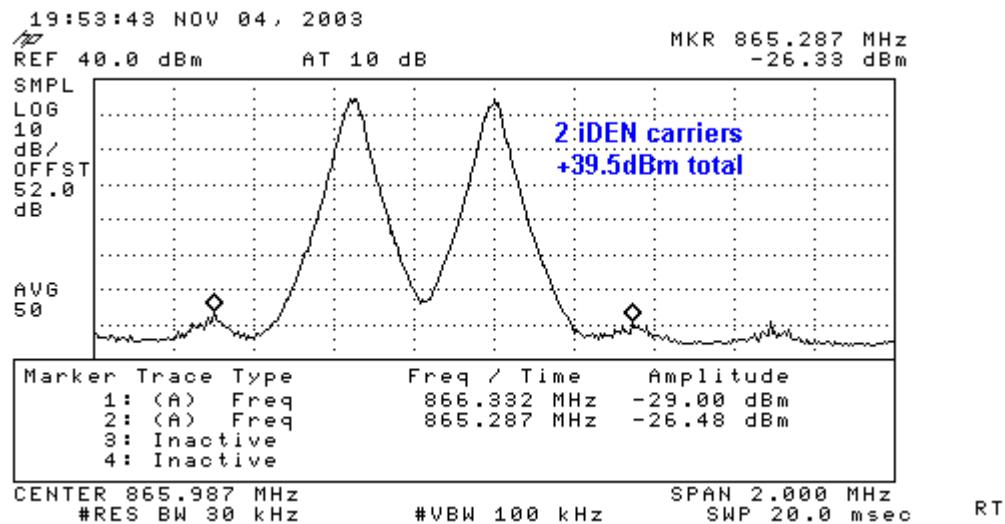


Figure 11-60 Two iDEN carriers, SMR, +39.5 dBm

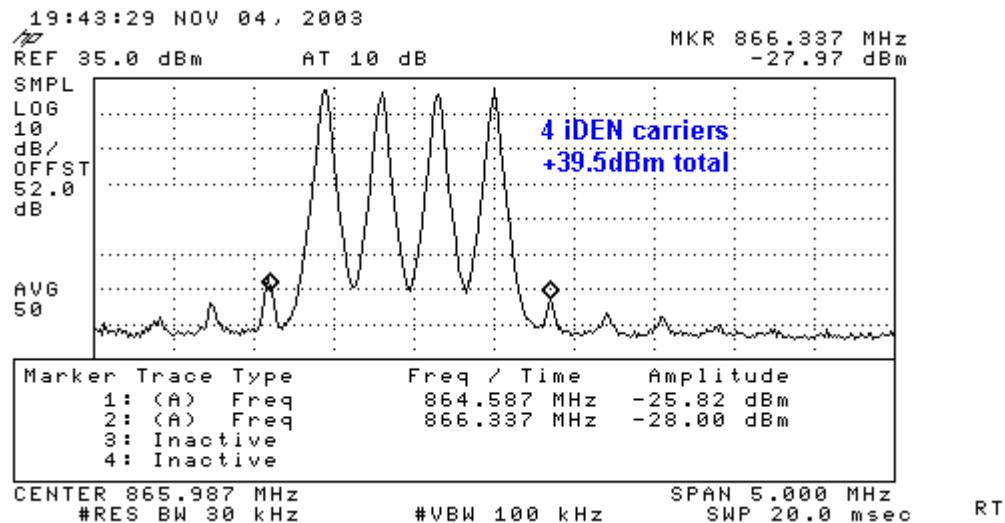


Figure 11-61 Four iDEN carriers, SMR, +39.5 dBm

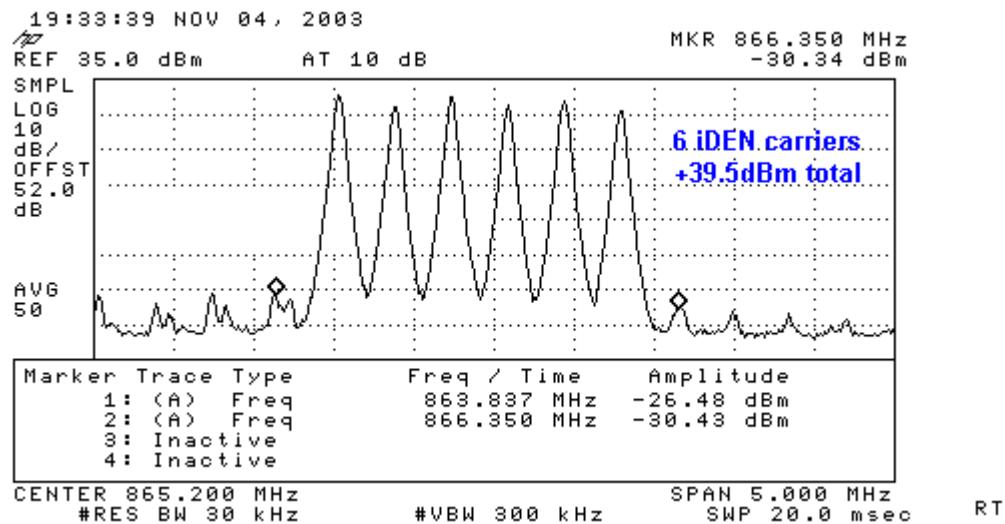


Figure 11-62 Six iDEN carriers, SMR, +39.5 dBm

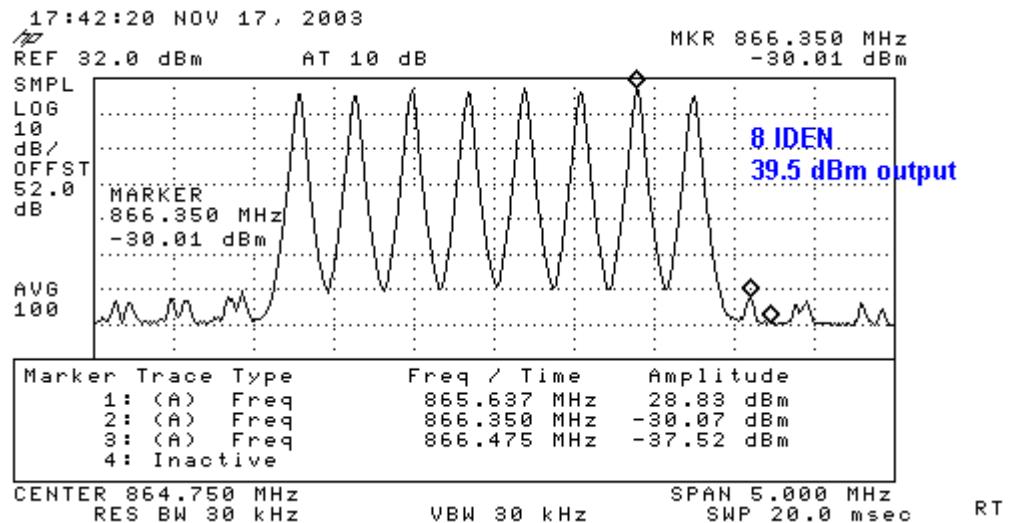


Figure 11-63 Eight iDEN carriers, SMR, +39.5 dBm

MULTIPLE TENANTS

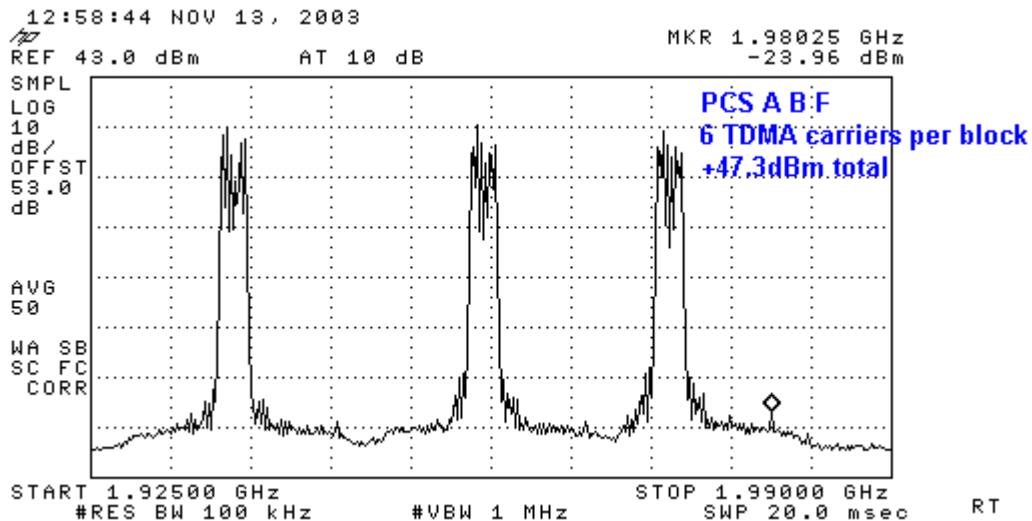


Figure 11-64 PCS Blocks A/B/F, six TDMA carriers per block, +47.3 dBm total

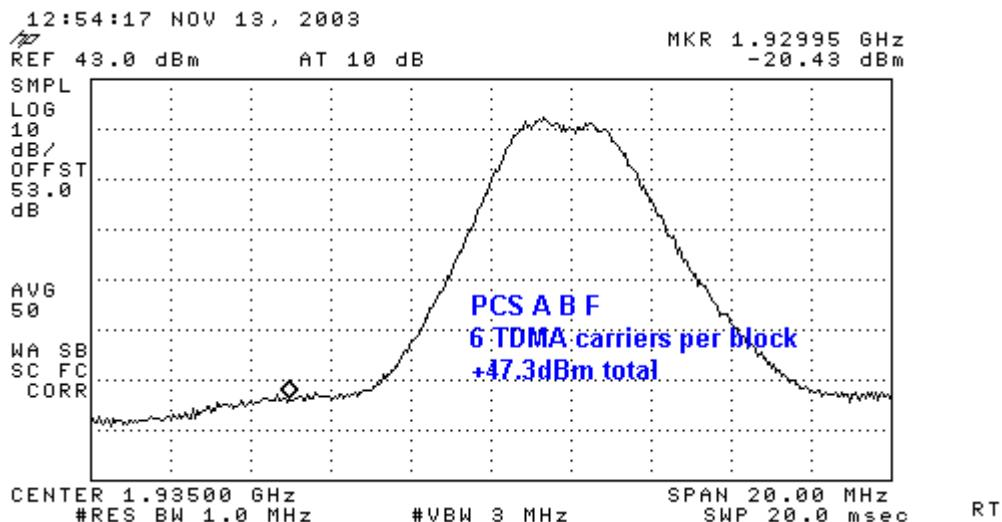


Figure 11-65 PCS Blocks A/B/F, six TDMA carriers per block, +47.3 dBm total, close-up of block A

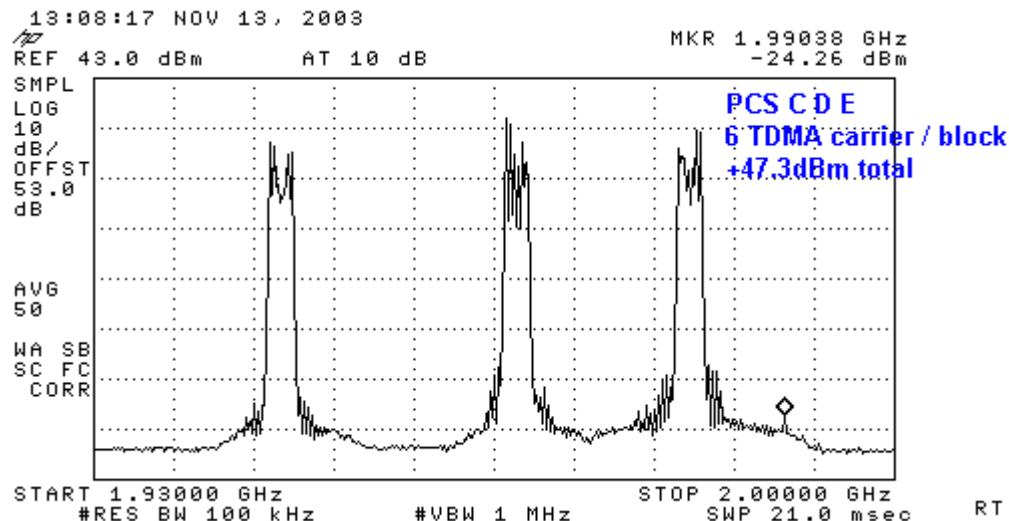


Figure 11-66 PCS blocks D/E/C, six TDMA carriers per block, +47.3 dBm total

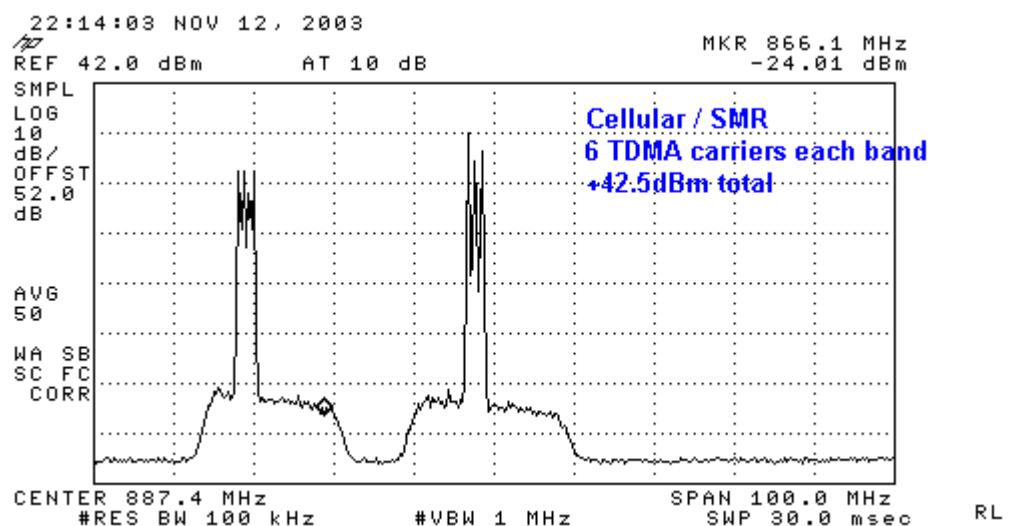


Figure 11-67 Cellular block B and SMR, six TDMA carriers per block, +42.5 dBm total

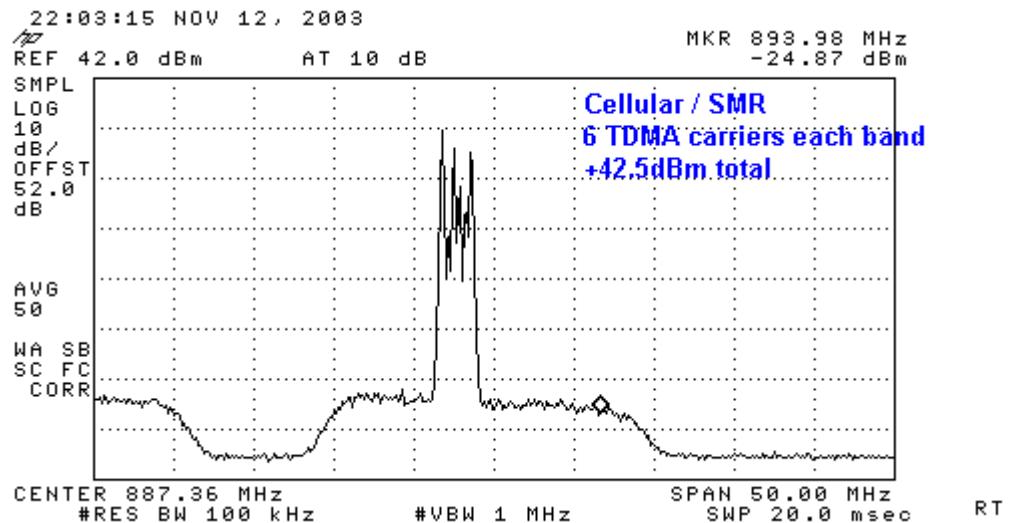


Figure 11-68 Cellular block B and SMR, six TDMA carriers per block, +42.5 dBm total, spurious emission