

EXHIBIT 7 TEST RESULTS

7.1 Attestation

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

Michael Prussel 5-10-02
Michael A. Prussel Date
Regulatory Compliance Engineer

7.2 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 7-1 Test Instrumentation

7.3 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	
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
iDEN	16QAM	64 kbps	9.1	10.3

Table 7-2 Input Signal Description

7.4 General Test Setups

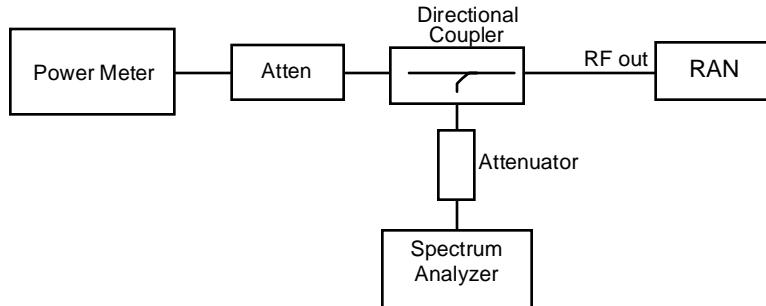


Figure 7-1 Test setup for power output, occupied bandwidth, and emission mask

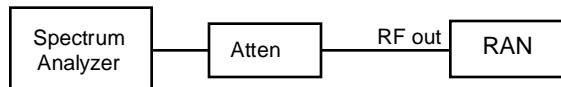


Figure 7-2 Test setup for conducted spurious emissions

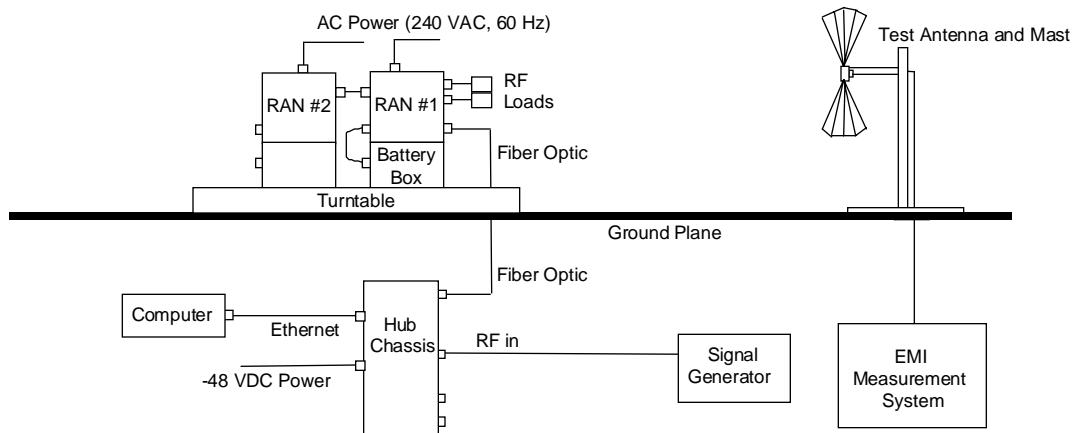


Figure 7-3 Test setup for radiated spurious emissions (also see separate report)

7.5 Power Output

7.5.1 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 7-1.

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.

7.5.2 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	41.4	13.8	Figure 7-49
PCS-D	41.4	13.8	Figure 7-51
Cell/SMR-D	38.7	7.4	Figure 7-52
Cell/SMR-P	35.9	3.9	Figure 7-32

Table 7-3 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	36.9	4.9	Figure 7-15 Figure 7-21
Cellular	35.9	3.9	Figure 7-31 Figure 7-32
SMR	35.8	3.8	Figure 7-45 Figure 7-48

Table 7-4 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	35.7	46.7	Figure 7-5
CDMA	PCS	3	35.9		Figure 7-6
CDMA	PCS	6	35.9		Figure 7-7
CDMA2000	PCS	1	35.7	45.5	Figure 7-9
CDMA2000	PCS	3	35.8		Figure 7-10
CDMA2000	PCS	6	36.0		Figure 7-11
GSM	PCS	1	36.6	37.0	Figure 7-13
GSM	PCS	2	36.8		Figure 7-14 Figure 7-15
GSM	PCS	4	36.6		Figure 7-16
GSM	PCS	8	36.7		Figure 7-17
TDMA	PCS	1	36.7	39.9	Figure 7-19
TDMA	PCS	2	36.9		Figure 7-20 Figure 7-21
TDMA	PCS	6	36.6		Figure 7-22 Figure 7-23
TDMA	PCS	8	36.7		Figure 7-24
CDMA	Cell	1	34.6		Figure 7-26
CDMA	Cell	3	34.6		Figure 7-27
CDMA	Cell	6	34.5		Figure 7-28
GSM	Cell	1	35.8		Figure 7-30
GSM	Cell	2	35.9		Figure 7-31
GSM	Cell	4	35.9		Figure 7-32
GSM	Cell	8	35.7		Figure 7-33
TDMA	Cell	1	35.7		Figure 7-35
TDMA	Cell	2	35.5		Figure 7-37
TDMA	Cell	6	35.4		Figure 7-39
TDMA	Cell	8	35.6		Figure 7-41
TDMA	Cell	3	35.6		Figure 7-38
iDEN	SMR	1	35.7		Figure 7-44
iDEN	SMR	2	35.8		Figure 7-45
iDEN	SMR	4	35.7		Figure 7-46
iDEN	SMR	6	35.7		Figure 7-47
iDEN	SMR	8	35.8		Figure 7-48
TDMA	PCS	6 each	41.4		Figure 7-49 Figure 7-51

TDMA	Cell/SMR	6 each	38.7		Figure 7-52
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Table 7-5 Summary of Power Output Data

7.6 Occupied Bandwidth

7.6.1 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.

7.6.2 Results

Protocol	Service	Measured Occupied Bandwidth	Reference Figure
CDMA	PCS	1.33 MHz	Figure 7-4
CDMA2000 1XRTT	PCS	1.32 MHz	Figure 7-8
GSM	PCS	245 kHz	Figure 7-12
TDMA	PCS	28 kHz	Figure 7-18
CDMA	Cellular	1.27 MHz	Figure 7-25
GSM	Cellular	246 kHz	Figure 7-29
TDMA	Cellular	28 kHz	Figure 7-34
iDEN	SMR	18 kHz	Figure 7-42
			Figure 7-43 (mask)

Table 7-6 Occupied Bandwidth Results

7.7 Spurious Emissions at Antenna Terminals

7.7.1 Test Procedure

Tests were performed using the test setup of Figure 7-2.

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 7-3 and Table 7-4).

7.7.2 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	36.6	1930.0	-14.1	-13	Figure 7-13
2 GSM	36.8	1929.4	-25.9 (note 1)	-13	Figure 7-14
4 GSM	36.6	1933.4	-24 (note 1)	-13	Figure 7-16
1 CDMA	34.6	880.0	-15.3 (note 2)	-13	Figure 7-26
1 GSM	35.8	869.0	-17.0 (note 2)	-13	Figure 7-30
1 TDMA	35.7	886.8	-19.4	-13	Figure 7-36
6 TDMA	35.4	883.9	-20.1	-13	Figure 7-40
6 TDMA x 3 tenants	41.4	1929.75	-18.8	-13	Figure 7-50
6 TDMA x 2 tenants	38.7	876.1	-24.3	-13	Figure 7-53

Note 1: Measured level is -16 dBm using channel power function with 1 MHz channel bandwidth

Note 2: At block edge

Table 7-7 Spurious Emissions Results

7.8 Frequency Stability

7.8.1 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.

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).

7.8.2 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 7-8 Frequency Stability – Input Voltage Variation

7.8.3 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 7-9 Frequency Stability – Temperature Variation**7.9 Field Strength of Spurious Radiation****7.9.1 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.

7.9.2 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

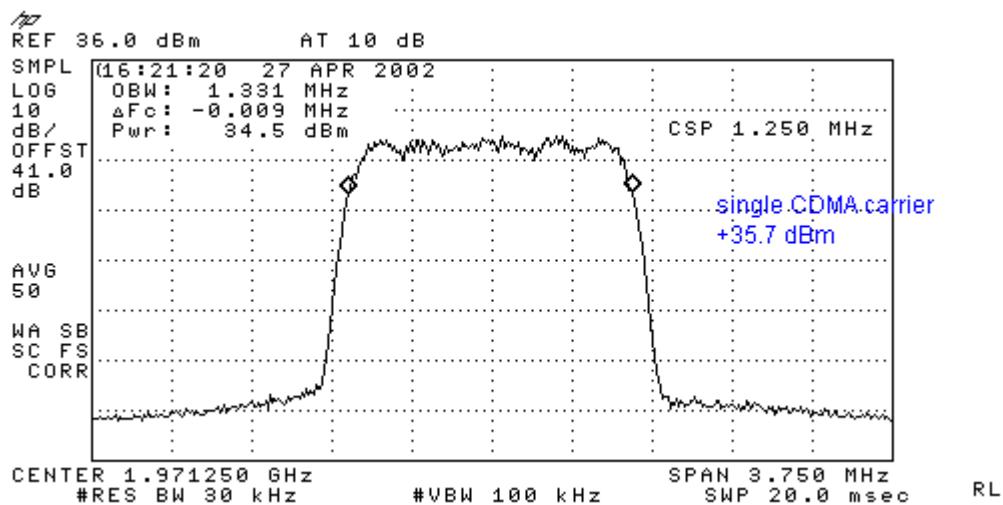


Figure 7-4 Single CDMA carrier, PCS F block, +35.7 dBm, occupied bandwidth

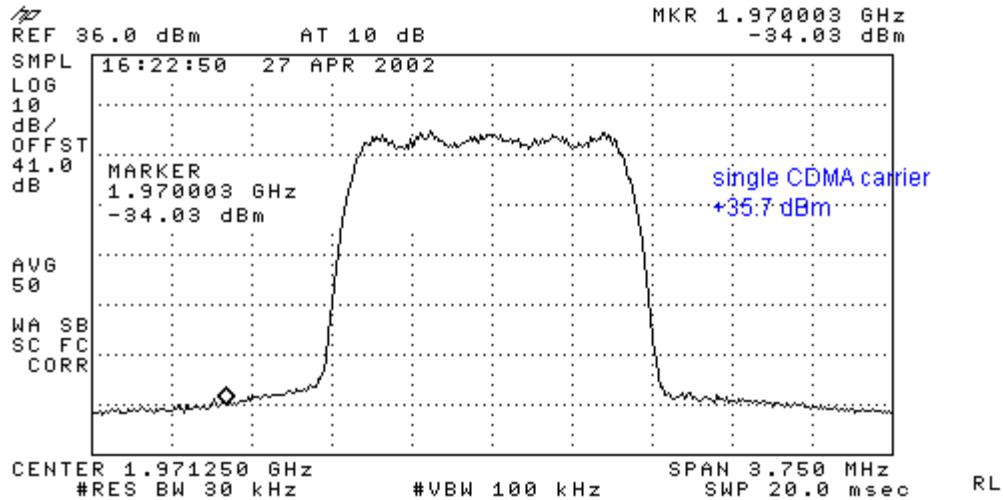


Figure 7-5 Single CDMA carrier, PCS F block, +35.7 dBm, block edge

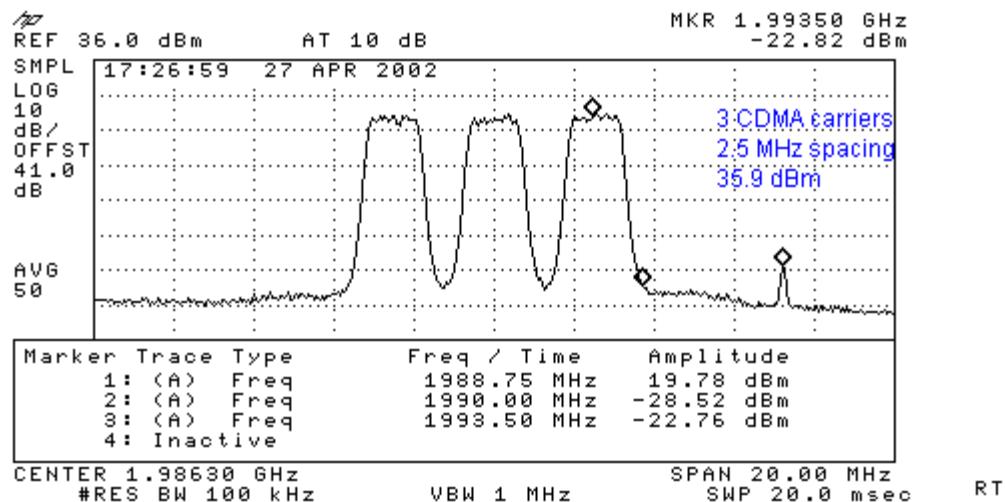


Figure 7-6 Three CDMA carriers, PCS C block, +35.9 dBm, block edge and spurious emission

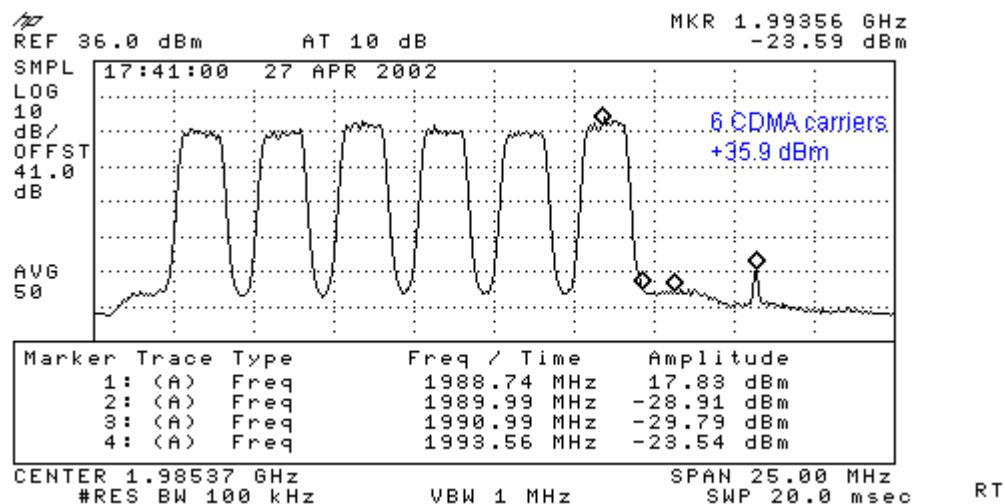


Figure 7-7 Six CDMA carriers, PCS C block, +35.9 dBm, block edge and spurious emission

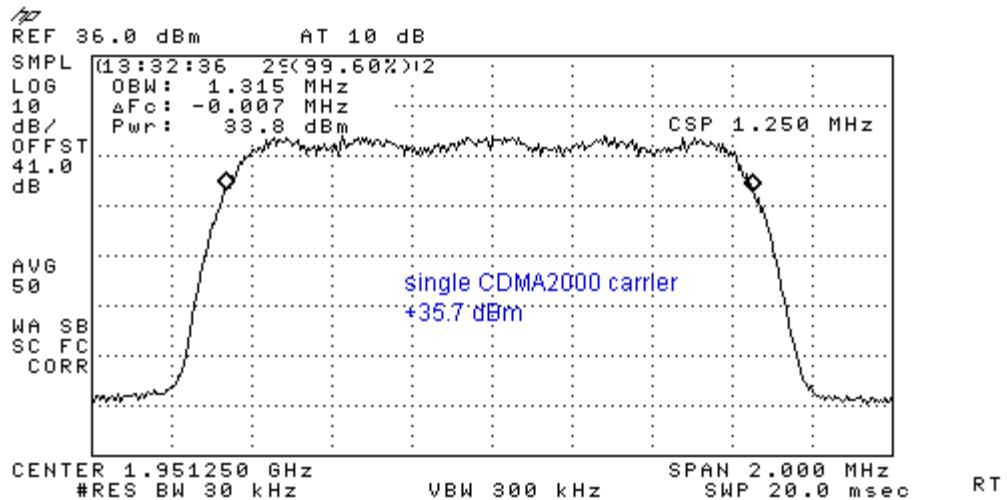


Figure 7-8 Single CDMA2000 carrier, PCS B block, +35.7 dBm, occupied bandwidth

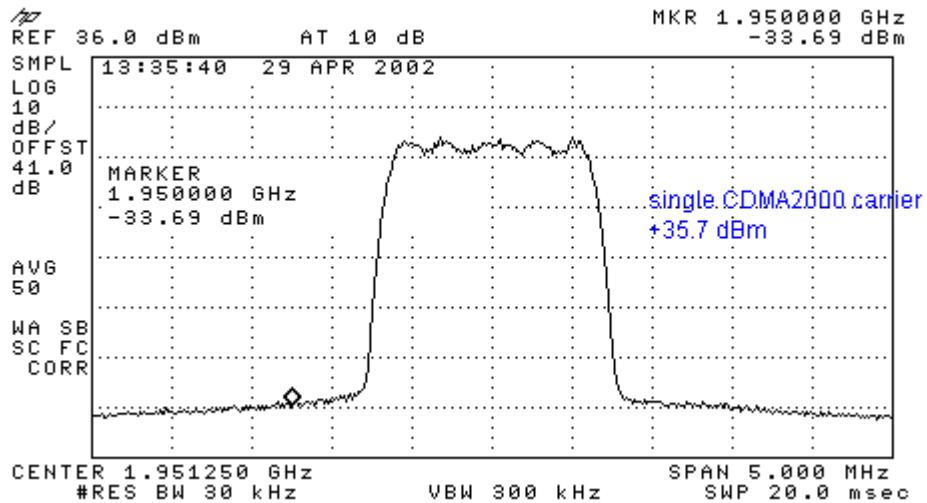


Figure 7-9 Single CDMA2000 carrier, PCS B block, +35.7 dBm, block edge

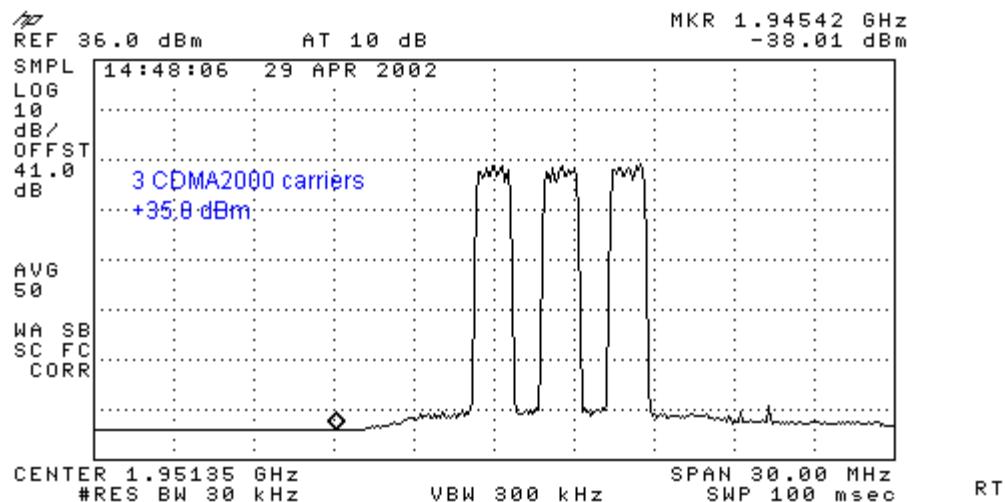


Figure 7-10 Three CDMA2000 carriers, PCS B block, +35.7 dBm

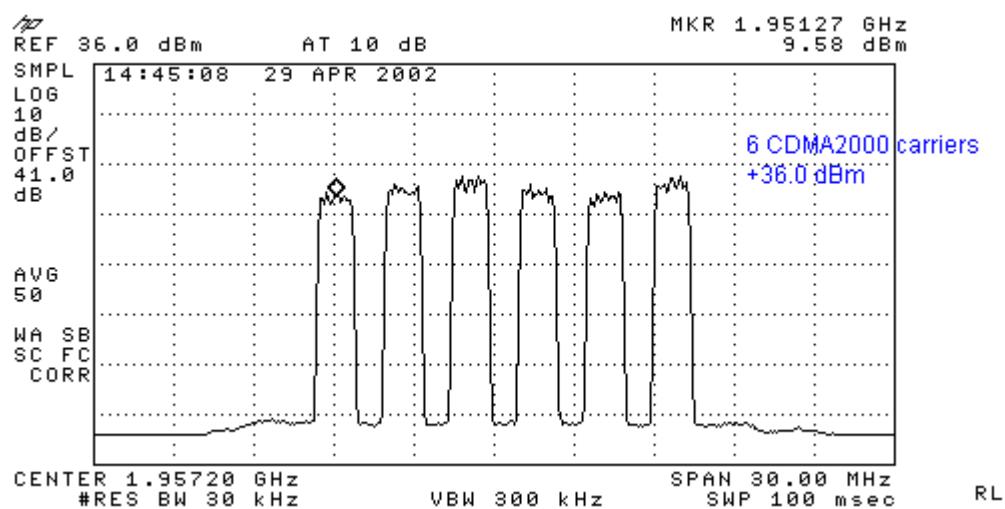


Figure 7-11 Six CDMA2000 carriers, PCS B block, +36.0 dBm

PCS GSM

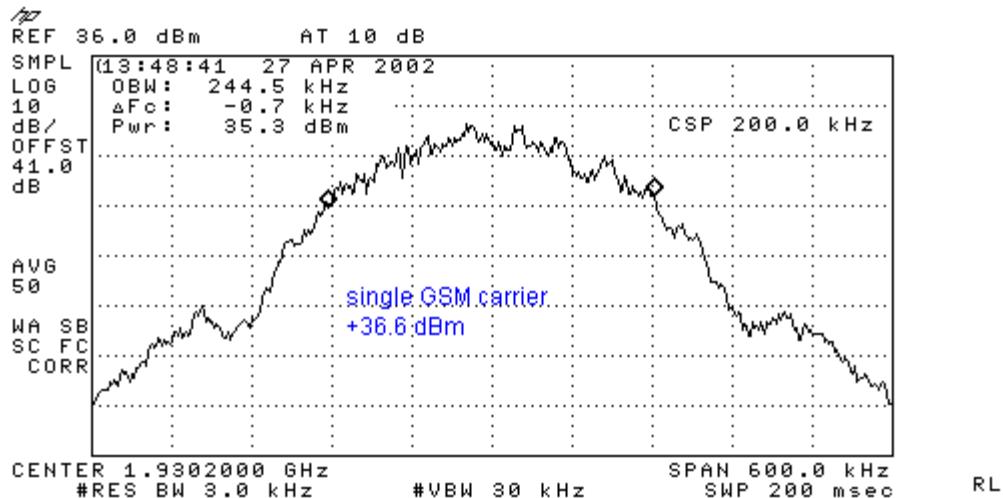


Figure 7-12 Single GSM carrier, PCS A block, +36.6 dBm, occupied bandwidth

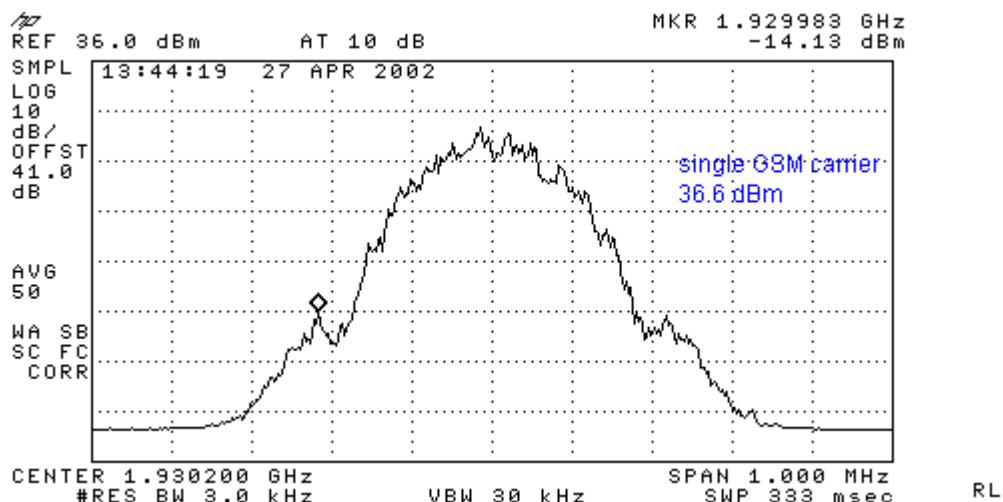


Figure 7-13 Single GSM carrier, PCS A block, +36.6 dBm, block edge

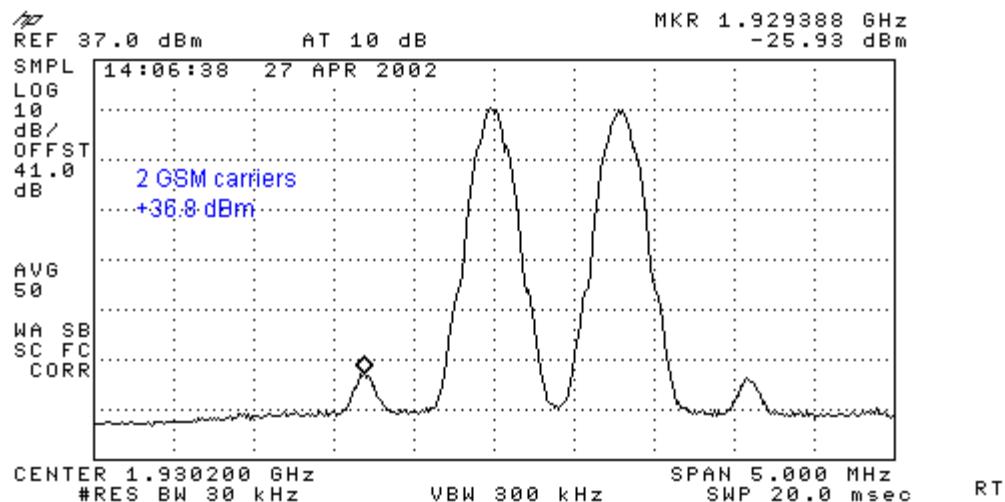


Figure 7-14 Two GSM carriers, PCS A block, +36.8 dBm

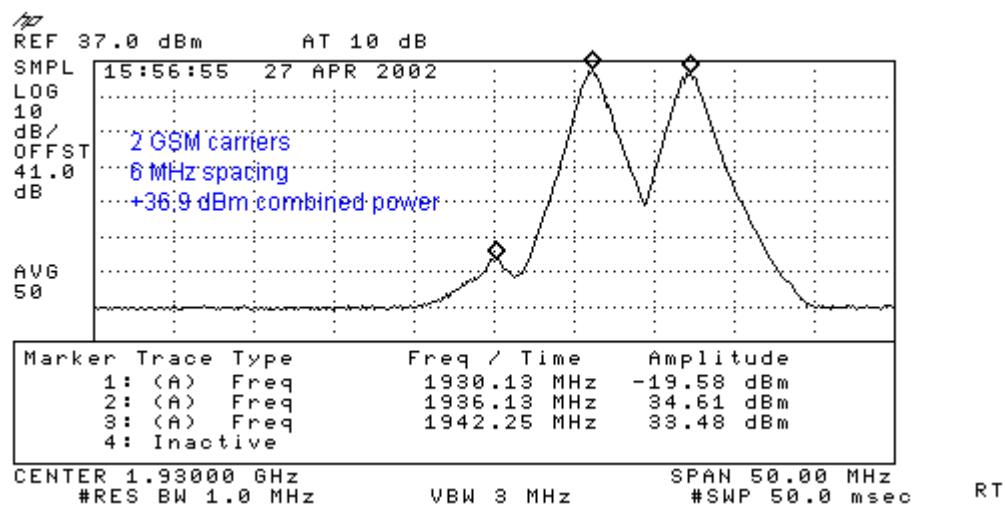


Figure 7-15 Two GSM carriers, PCS A block, +36.9 dBm

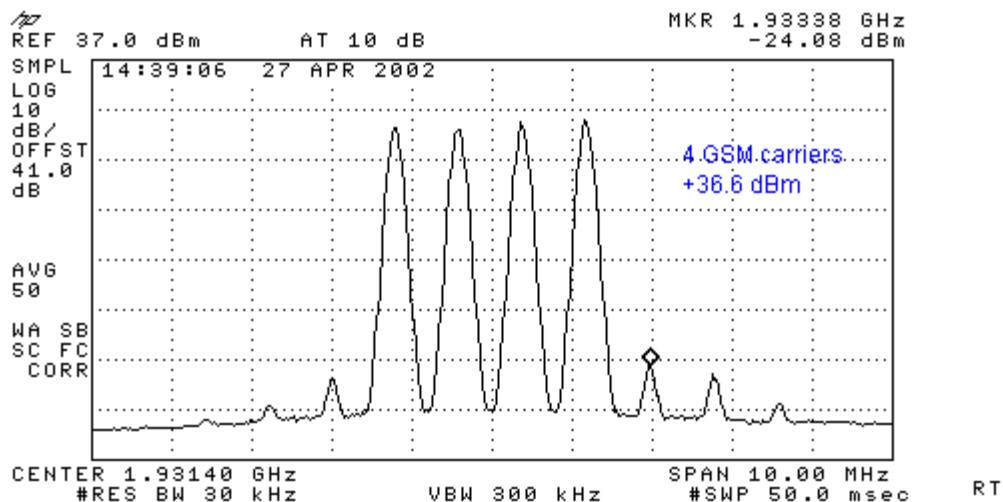


Figure 7-16 Four GSM carriers, PCS A block, +36.6 dBm, spurious emission

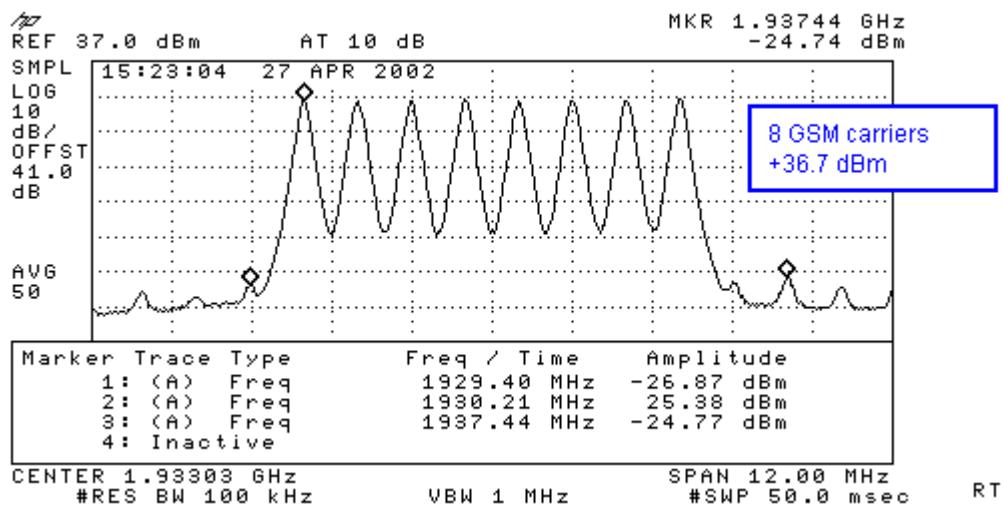


Figure 7-17 Eight GSM carriers, PCS A block, +36.7 dBm

PCS TDMA

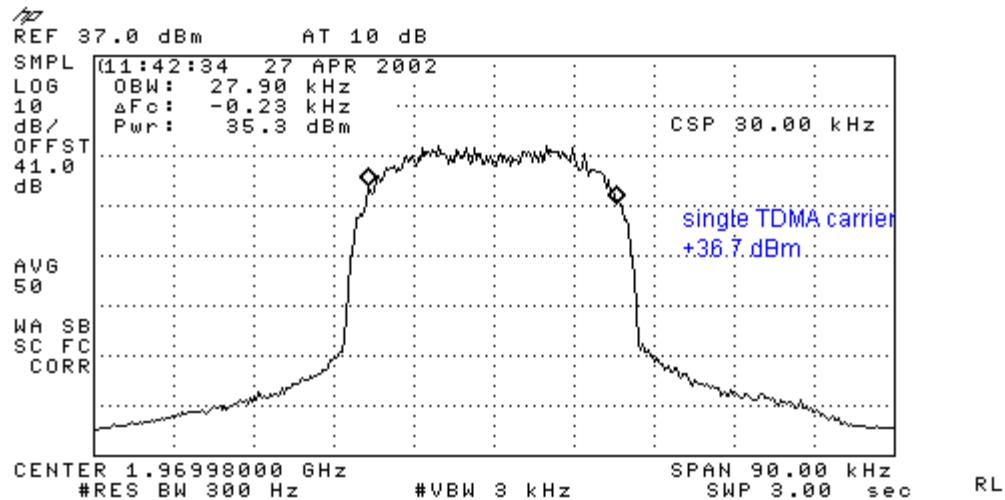


Figure 7-18 Single TDMA carrier, PCS E block, +36.7 dBm, occupied bandwidth

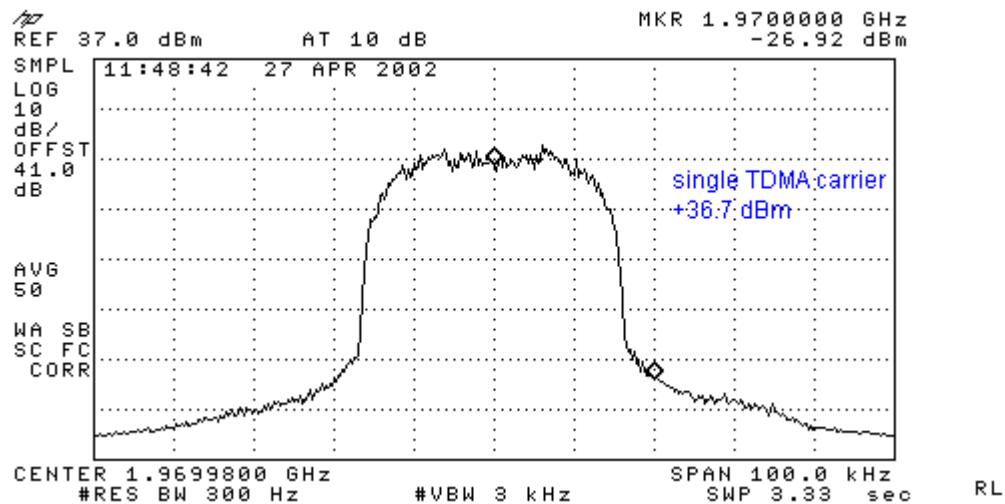


Figure 7-19 Single TDMA carrier, PCS E block, +36.7 dBm, block edge

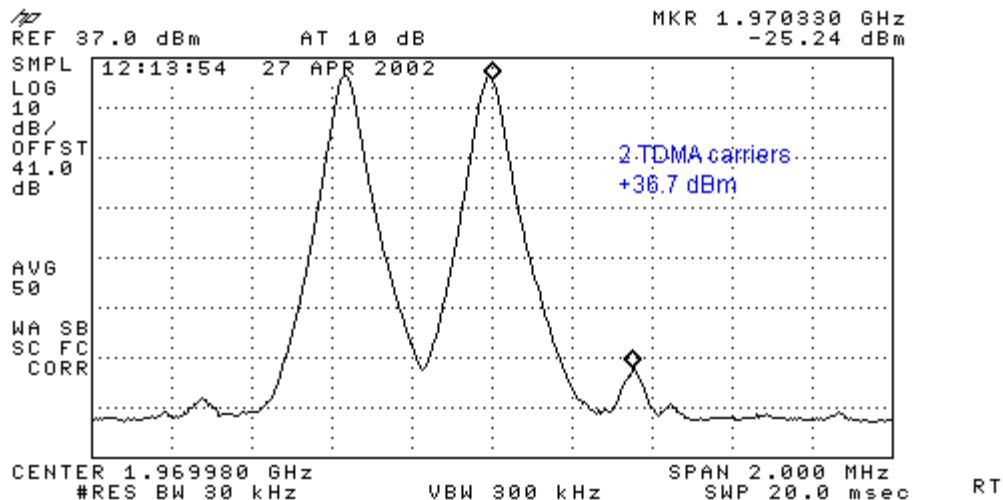


Figure 7-20 Two TDMA carriers, PCS E block, +36.7 dBm

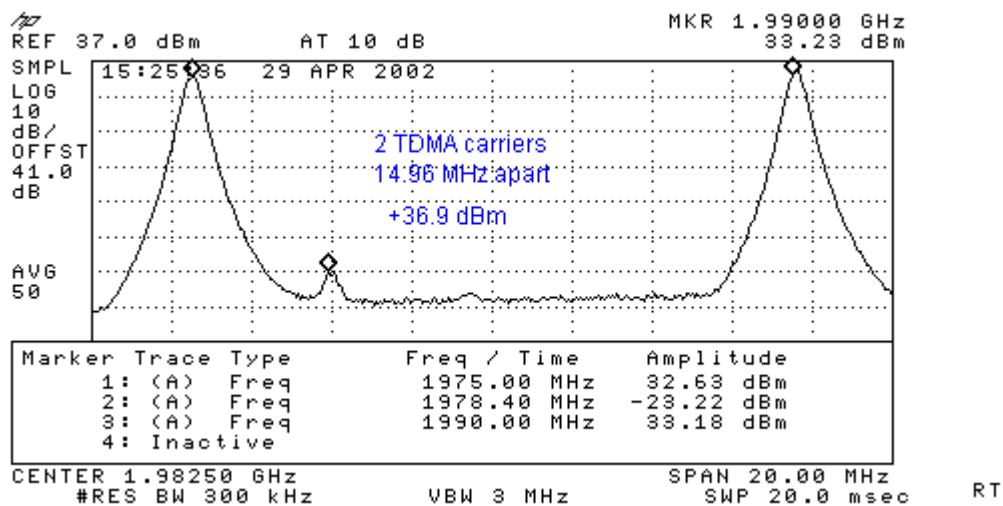


Figure 7-21 Two TDMA carriers, PCS C block, +36.9 dBm

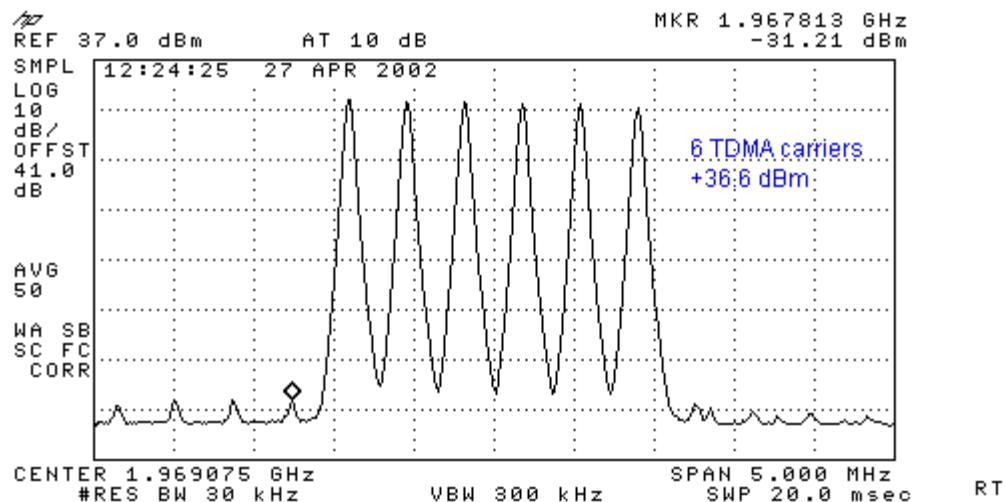


Figure 7-22 Six TDMA carriers, PCS E block, +36.6 dBm

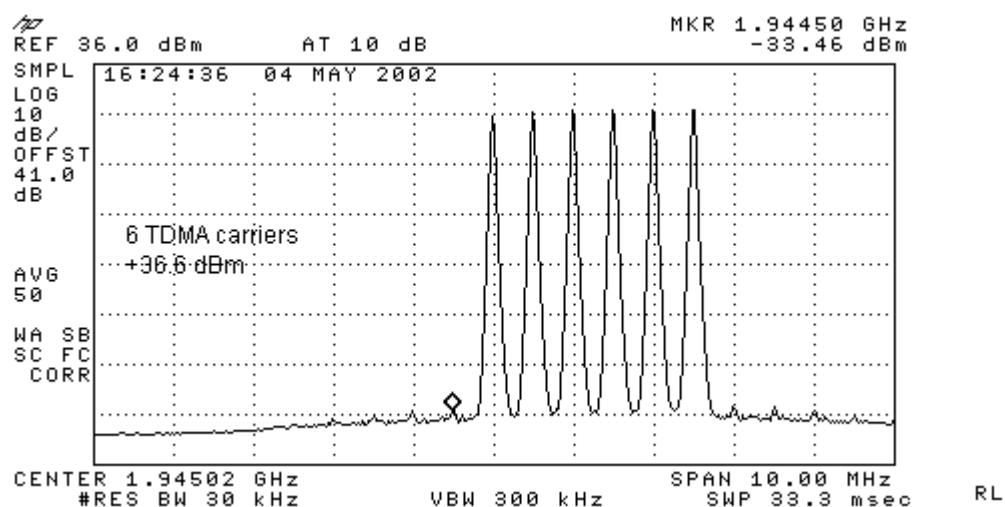


Figure 7-23 Six TDMA carriers, PCS D block, +36.6 dBm

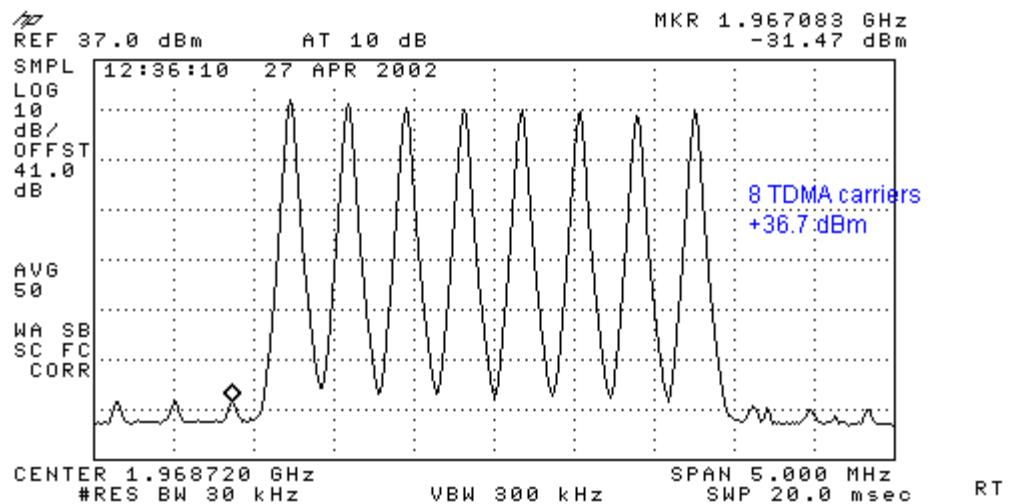


Figure 7-24 Eight TDMA carriers, PCS E block, +36.7 dBm

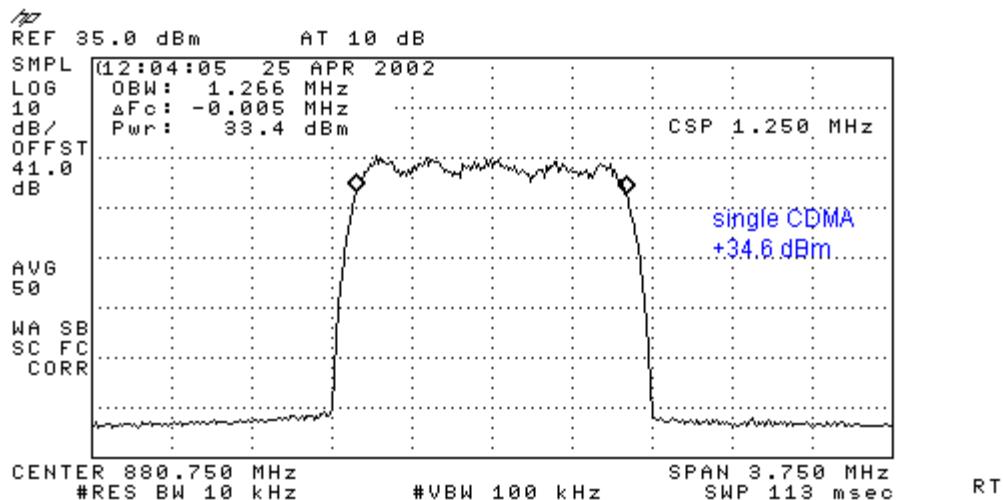
Cellular CDMA


Figure 7-25 Single CDMA carrier, cellular B block, +34.6 dBm, occupied bandwidth

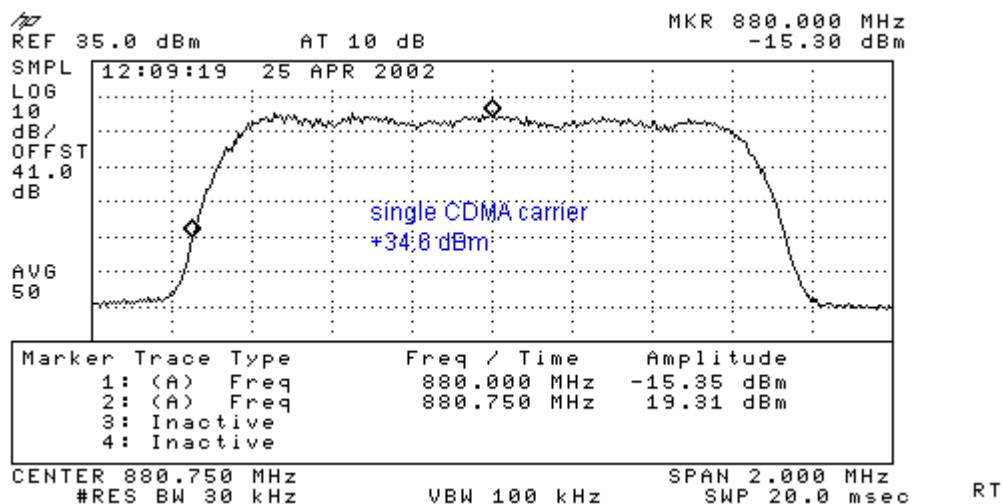


Figure 7-26 Single CDMA carrier, cellular B block, +34.6 dBm, block edge

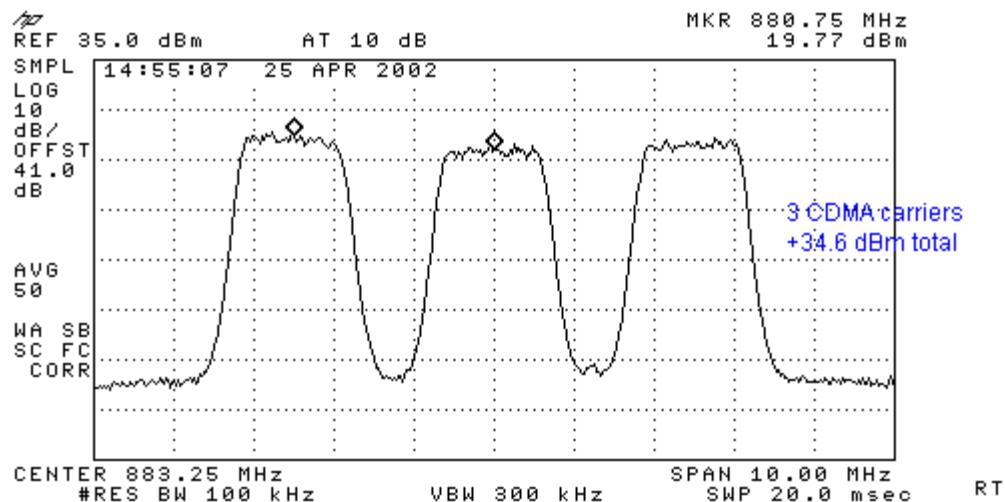


Figure 7-27 Three CDMA carriers, cellular B block, +34.6 dBm

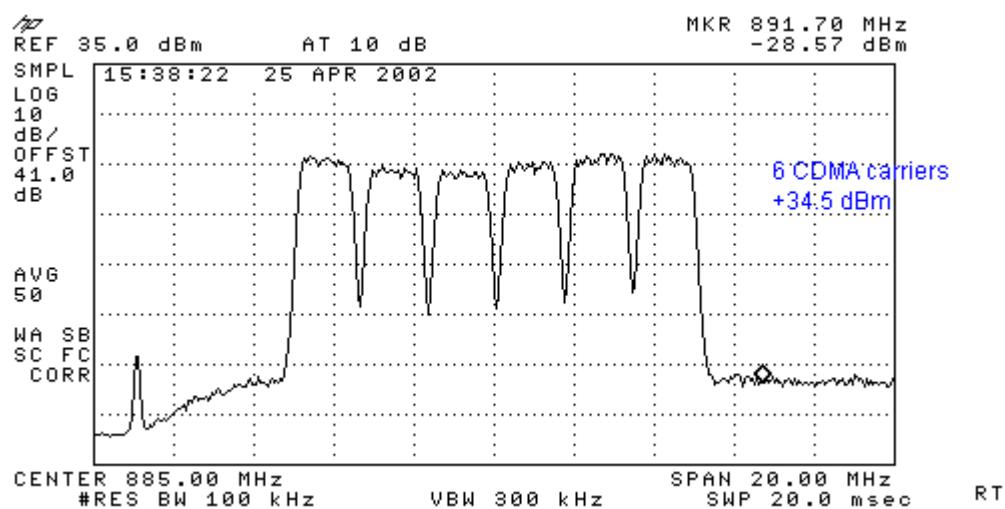


Figure 7-28 Six CDMA carriers, cellular B block, +34.5 dBm

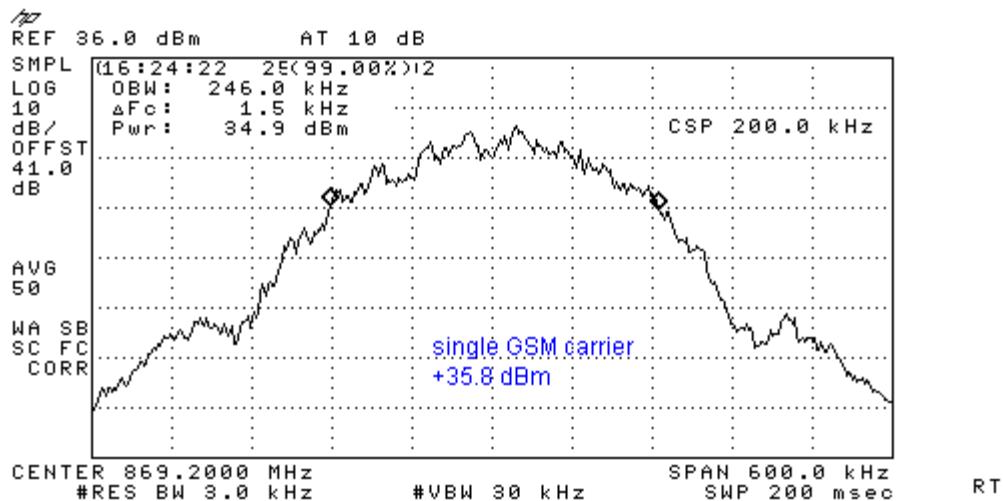
Cellular GSM


Figure 7-29 Single GSM carrier, cellular A block, +35.8 dBm, occupied bandwidth

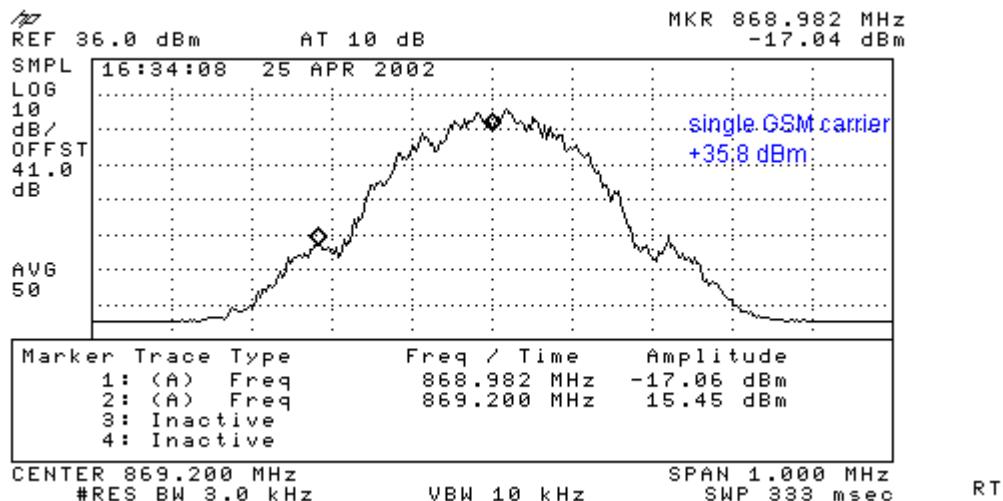


Figure 7-30 Single GSM carrier, cellular A block, +35.8 dBm, block edge

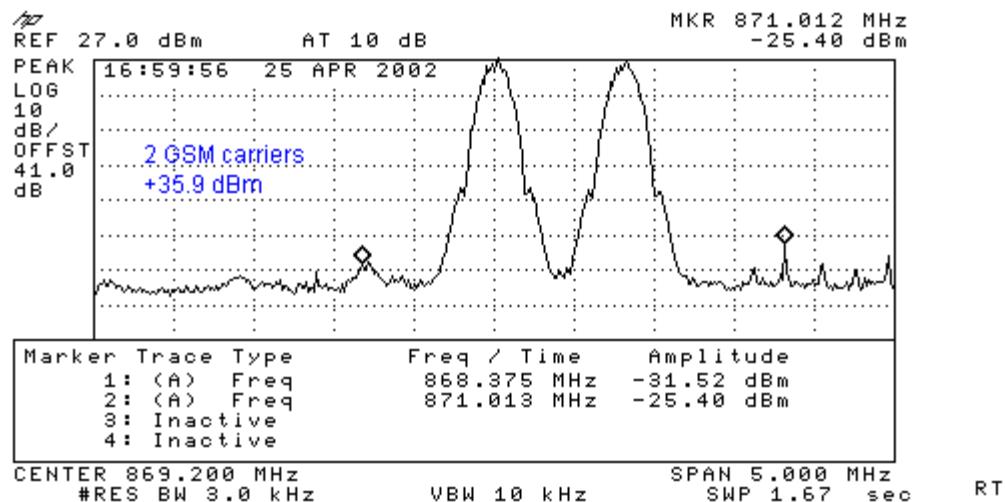


Figure 7-31 Two GSM carriers, cellular A block, +35.9 dBm

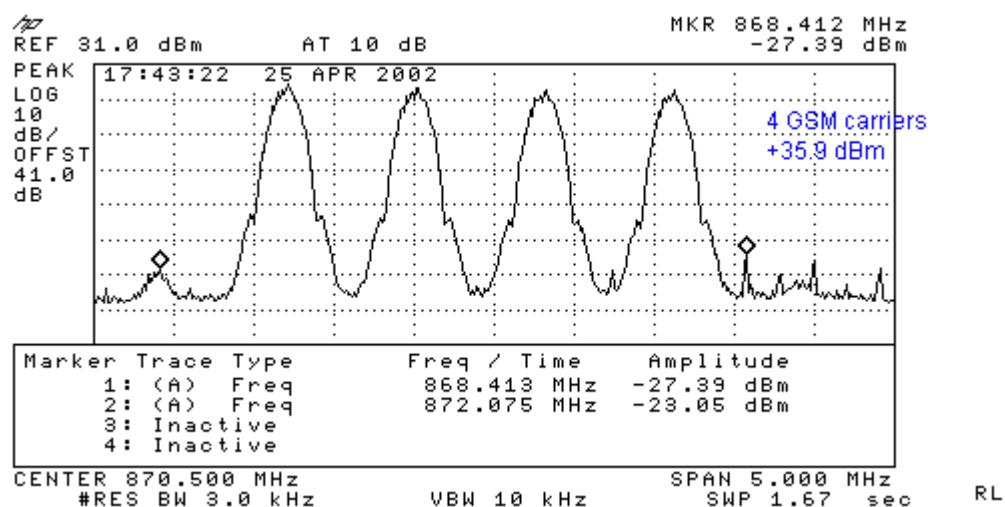


Figure 7-32 Four GSM carriers, cellular A block, +35.9 dBm

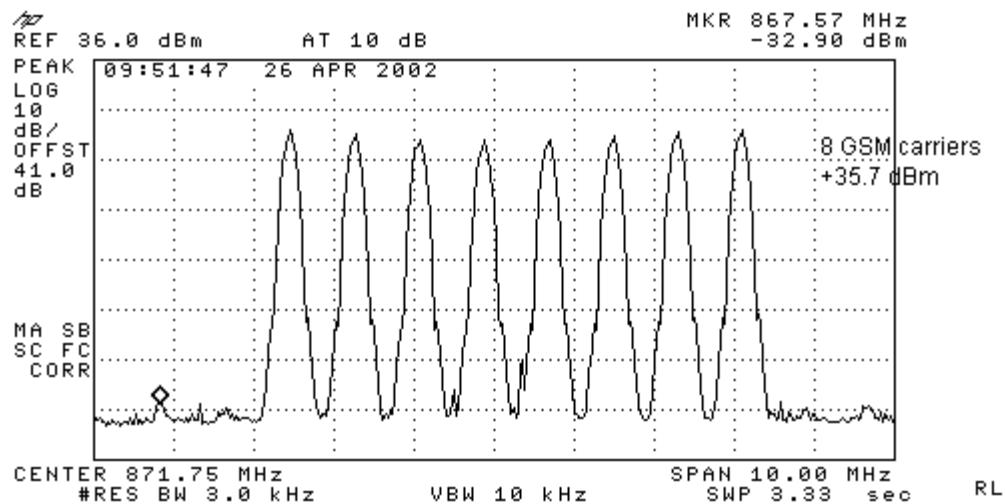


Figure 7-33 Eight GSM carriers, cellular A block, +35.7 dBm

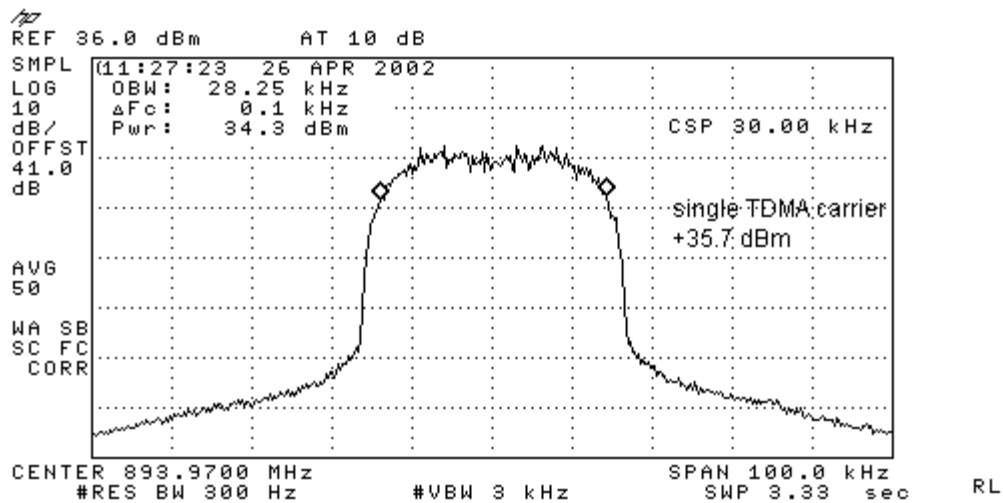
Cellular TDMA


Figure 7-34 Single TDMA carrier, cellular B block, +35.7 dBm, occupied bandwidth

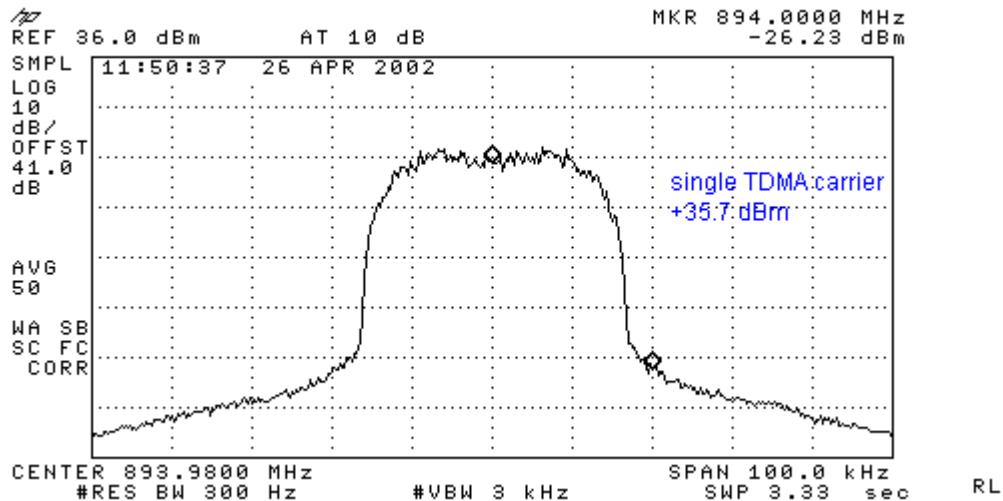


Figure 7-35 Single TDMA carrier, cellular B block, +35.7 dBm, block edge

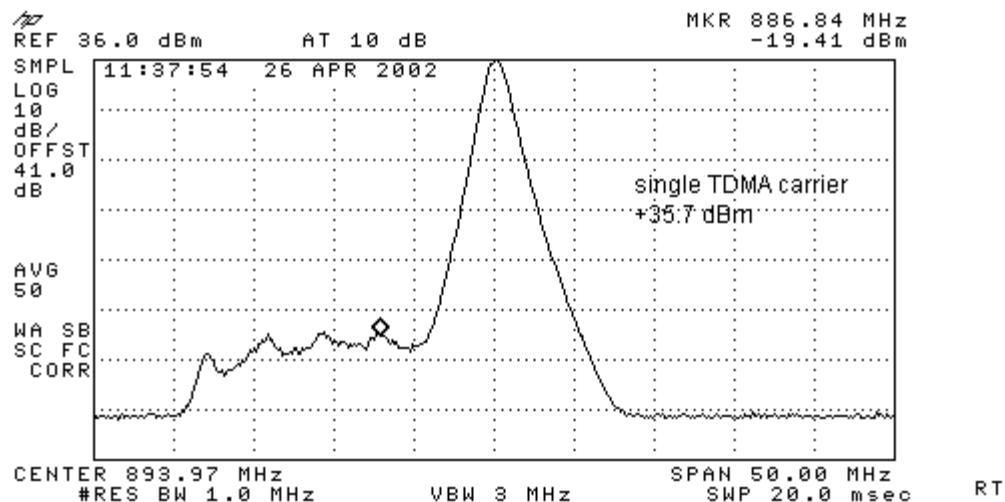


Figure 7-36 Single TDMA carrier, cellular B block, +35.7 dBm

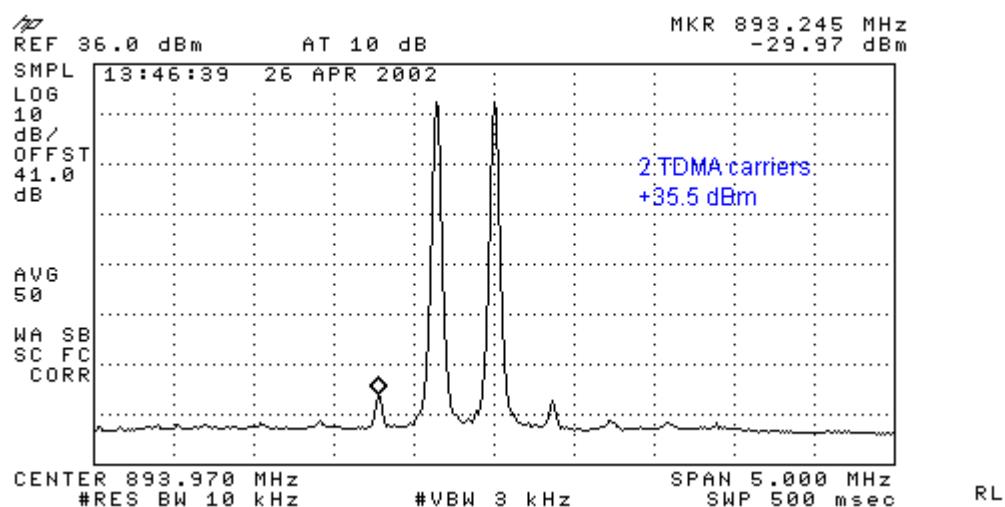


Figure 7-37 Two TDMA carriers, cellular B block, +35.5 dBm

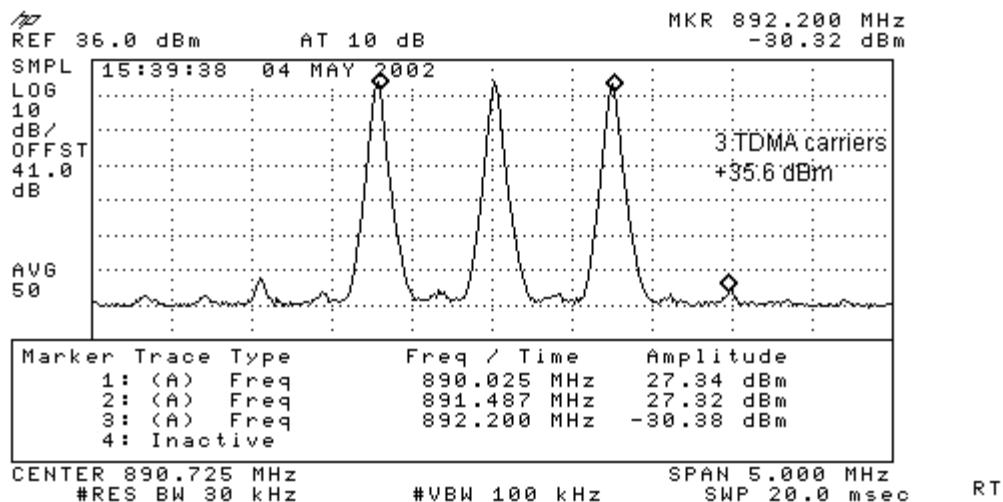


Figure 7-38 Three TDMA carriers, cellular A block, +35.6 dBm

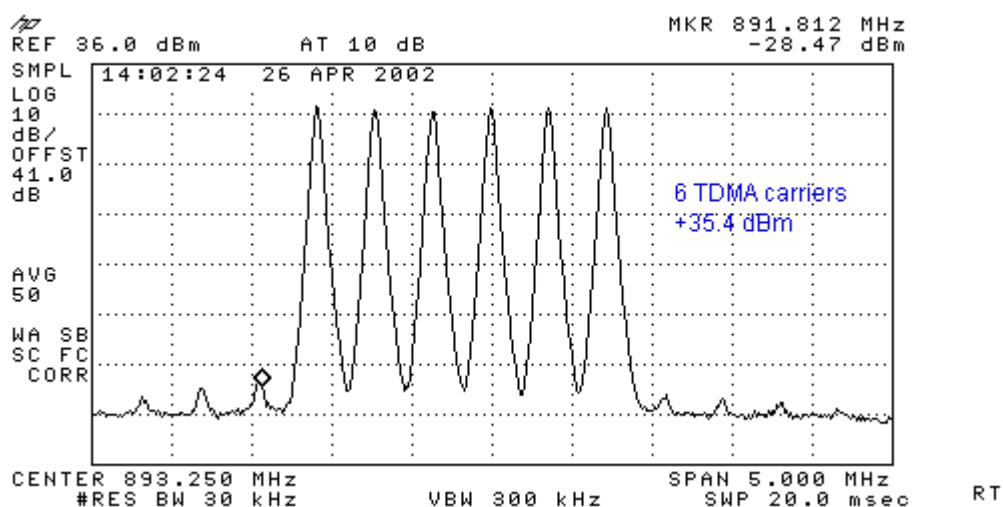


Figure 7-39 Six TDMA carriers, cellular B block, +35.4 dBm

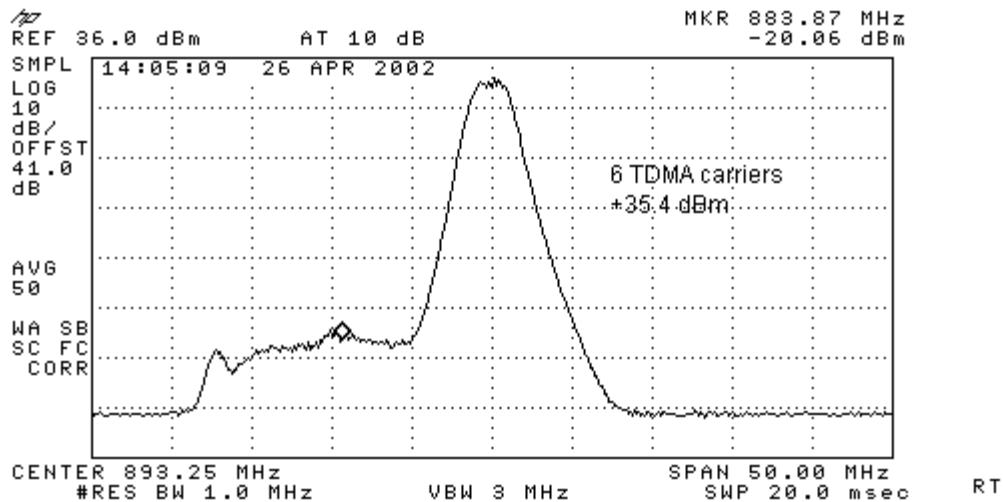


Figure 7-40 Six TDMA carriers, cellular B block, +35.4 dBm, spurious emission

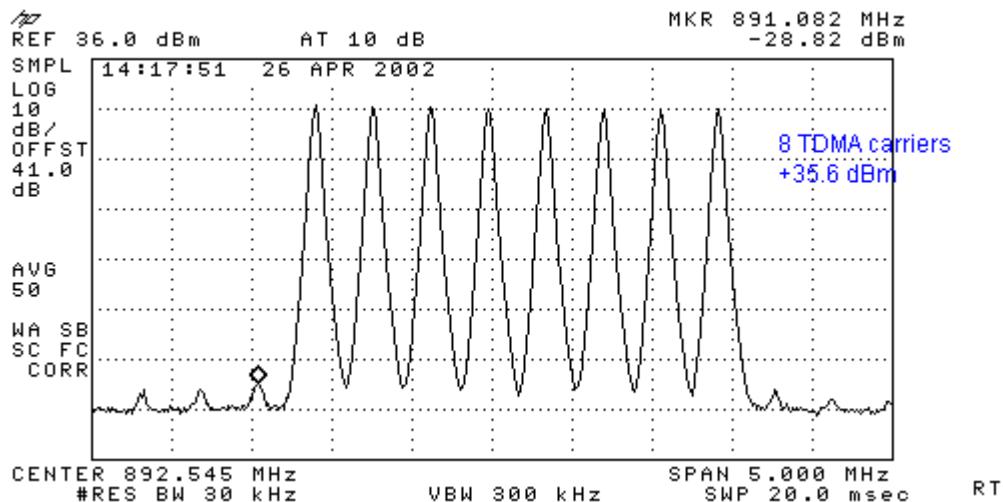


Figure 7-41 Eight TDMA carriers, cellular B block, +35.6 dBm

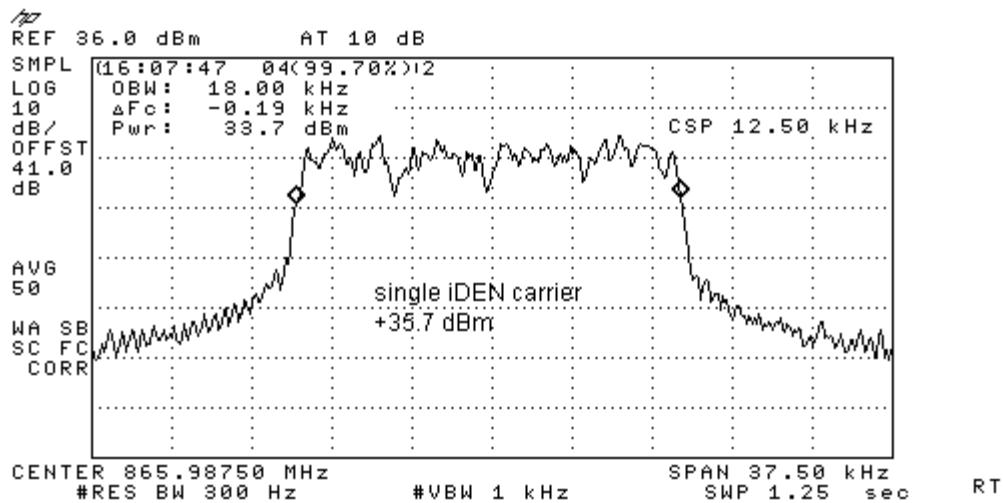
SMR iDEN

Figure 7-42 Single iDEN carrier, SMR block C, +35.7 dBm, occupied bandwidth

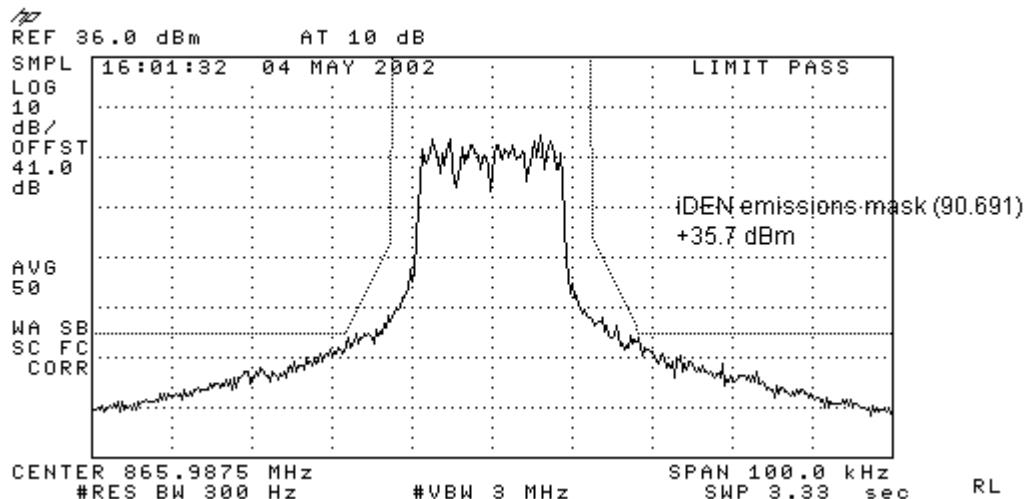


Figure 7-43 Single iDEN carrier, SMR block C, +35.7 dBm, emissions mask of 47CFR 90.691

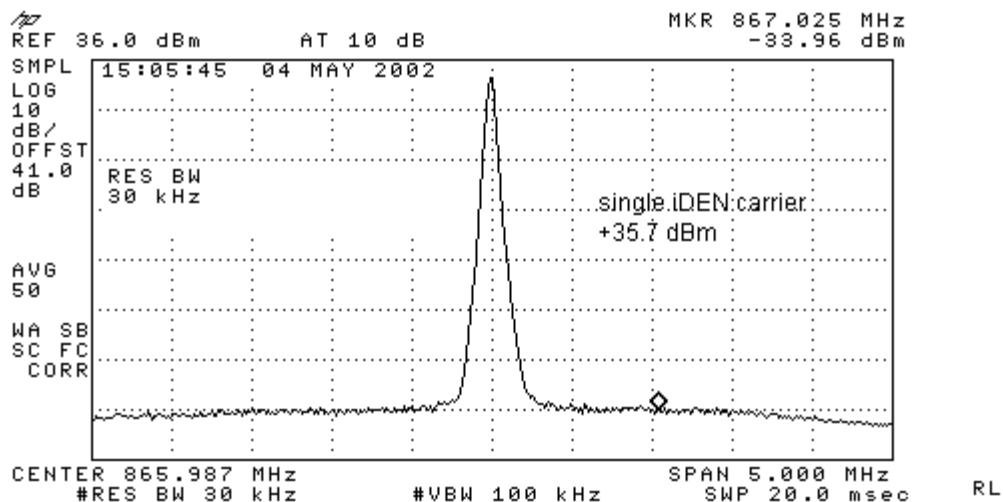


Figure 7-44 Single iDEN carrier, SMR block C, +35.7 dBm

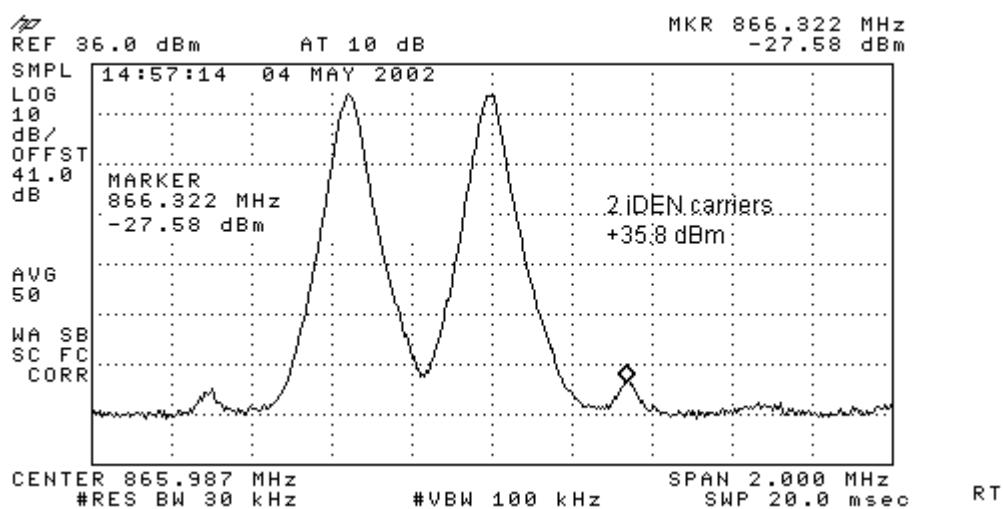


Figure 7-45 Two iDEN carriers, SMR block C, +35.8 dBm

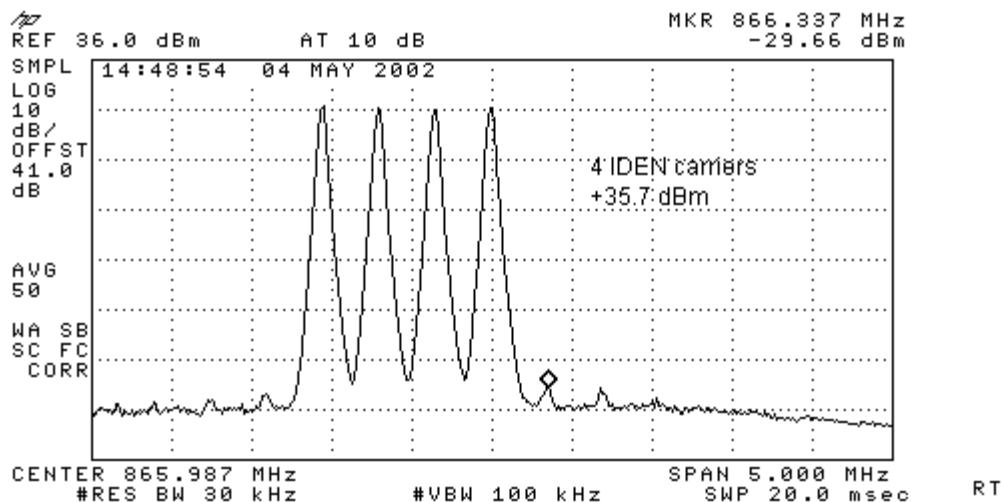


Figure 7-46 Four iDEN carriers, SMR block C, +35.7 dBm

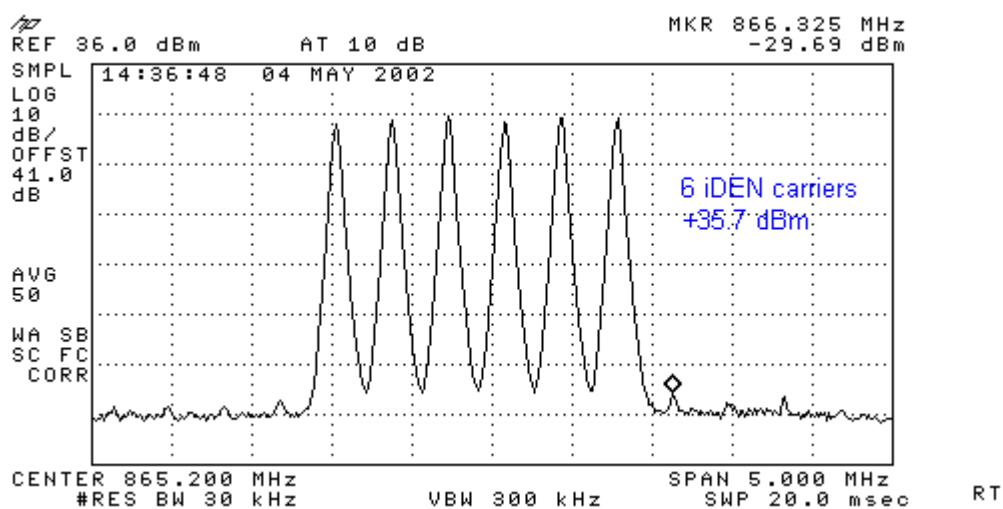


Figure 7-47 Six iDEN carriers, SMR block C, +35.7 dBm

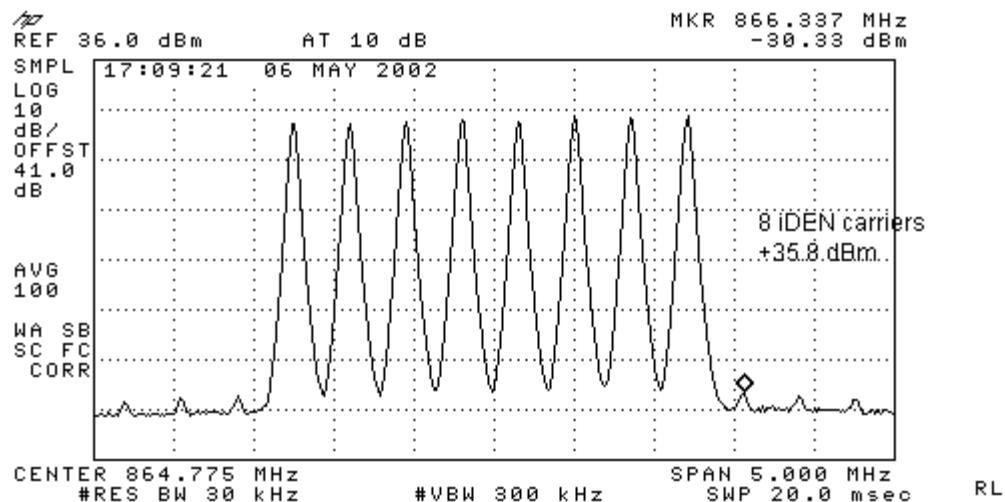


Figure 7-48 Eight iDEN carriers, SMR block C, +35.8 dBm

Multiple tenants

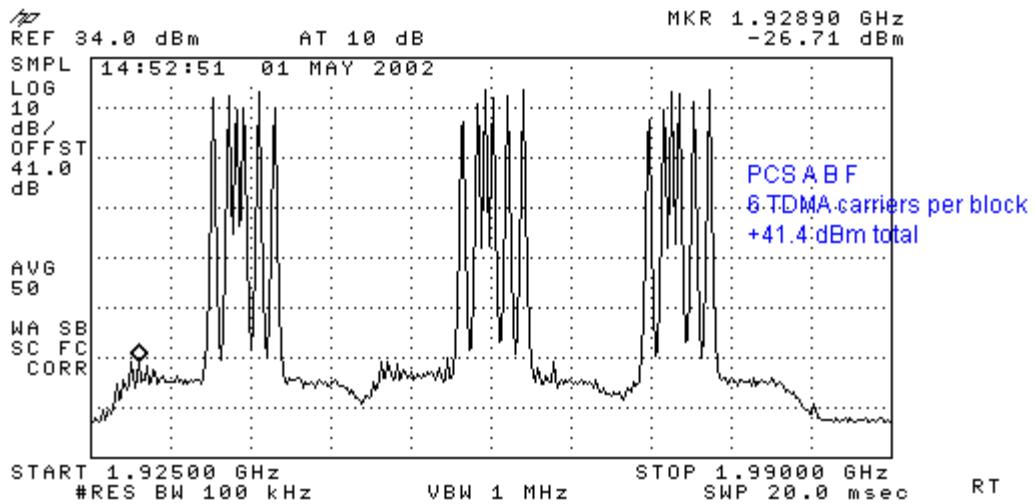


Figure 7-49 PCS Blocks A/B/F, six TDMA carriers per block, +41.4 dBm total

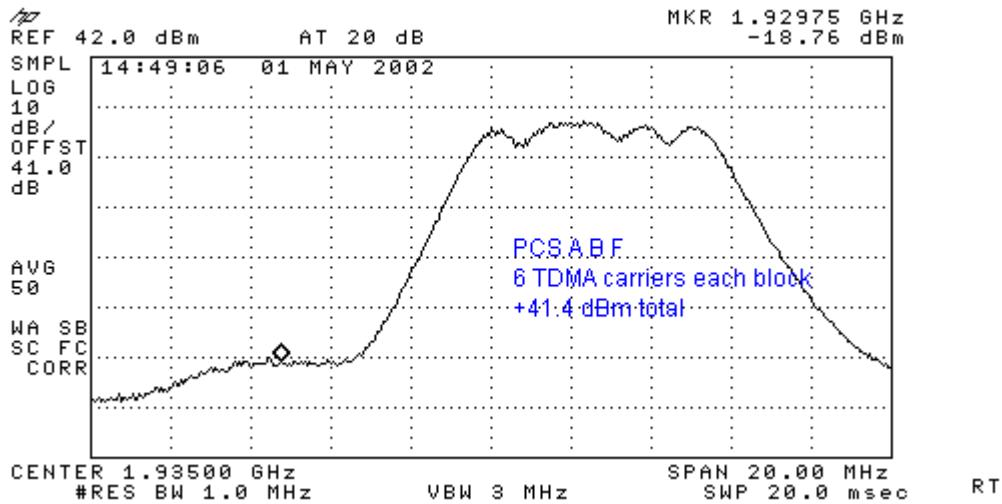


Figure 7-50 PCS Blocks A/B/F, six TDMA carriers per block, +41.4 dBm total, close-up of block A

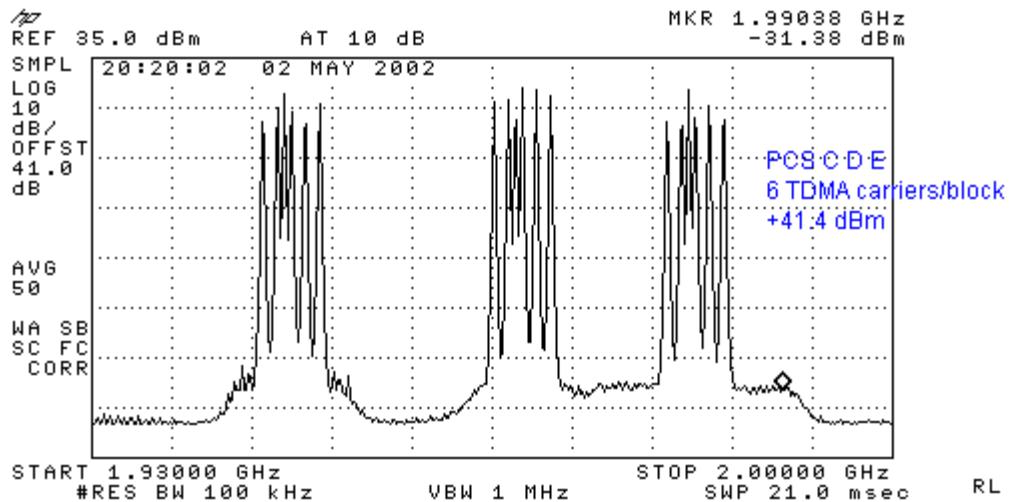


Figure 7-51 PCS blocks D/E/C, six TDMA carriers per block, +41.4 dBm total

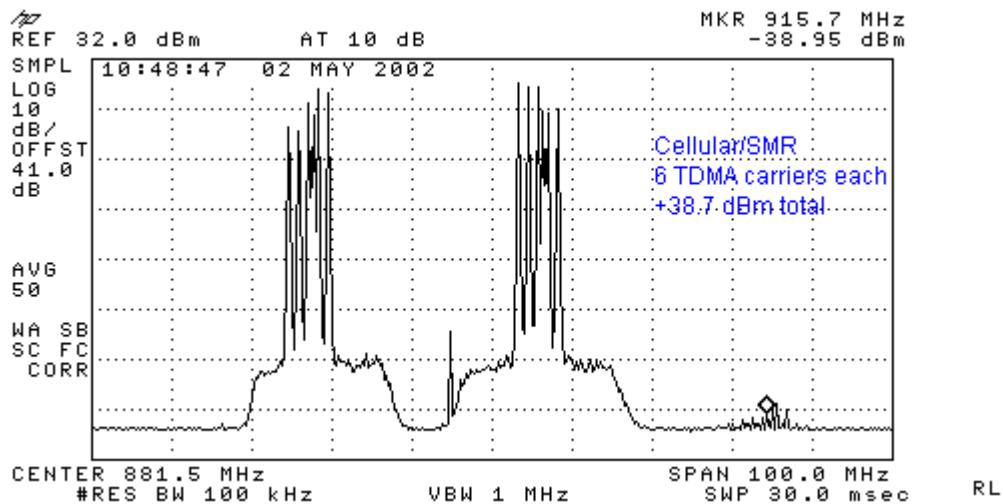


Figure 7-52 Cellular block B and SMR, six TDMA carriers per block, +38.7 dBm total

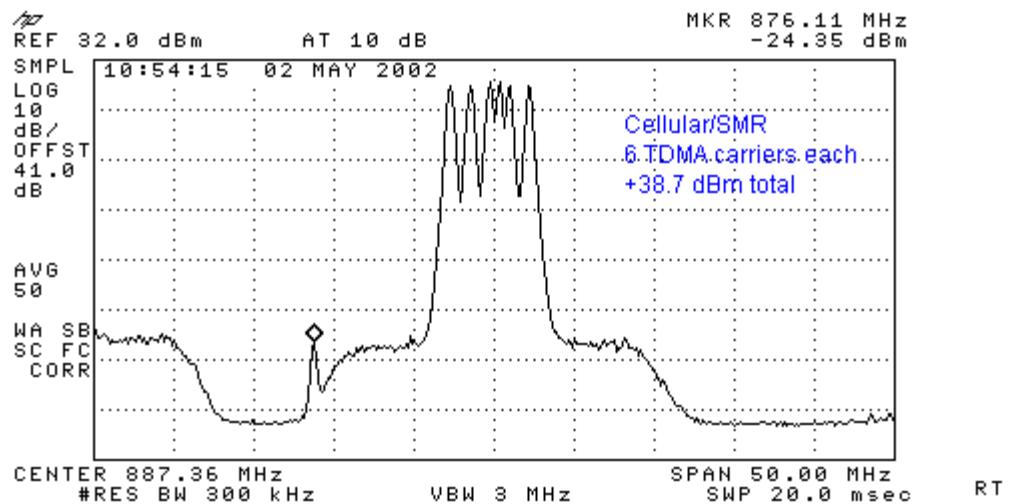


Figure 7-53 Cellular block B and SMR, six TDMA carriers per block, +38.7 dBm total, spurious emission