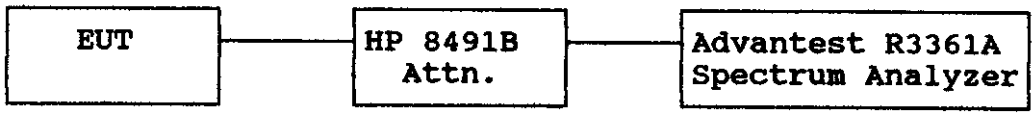
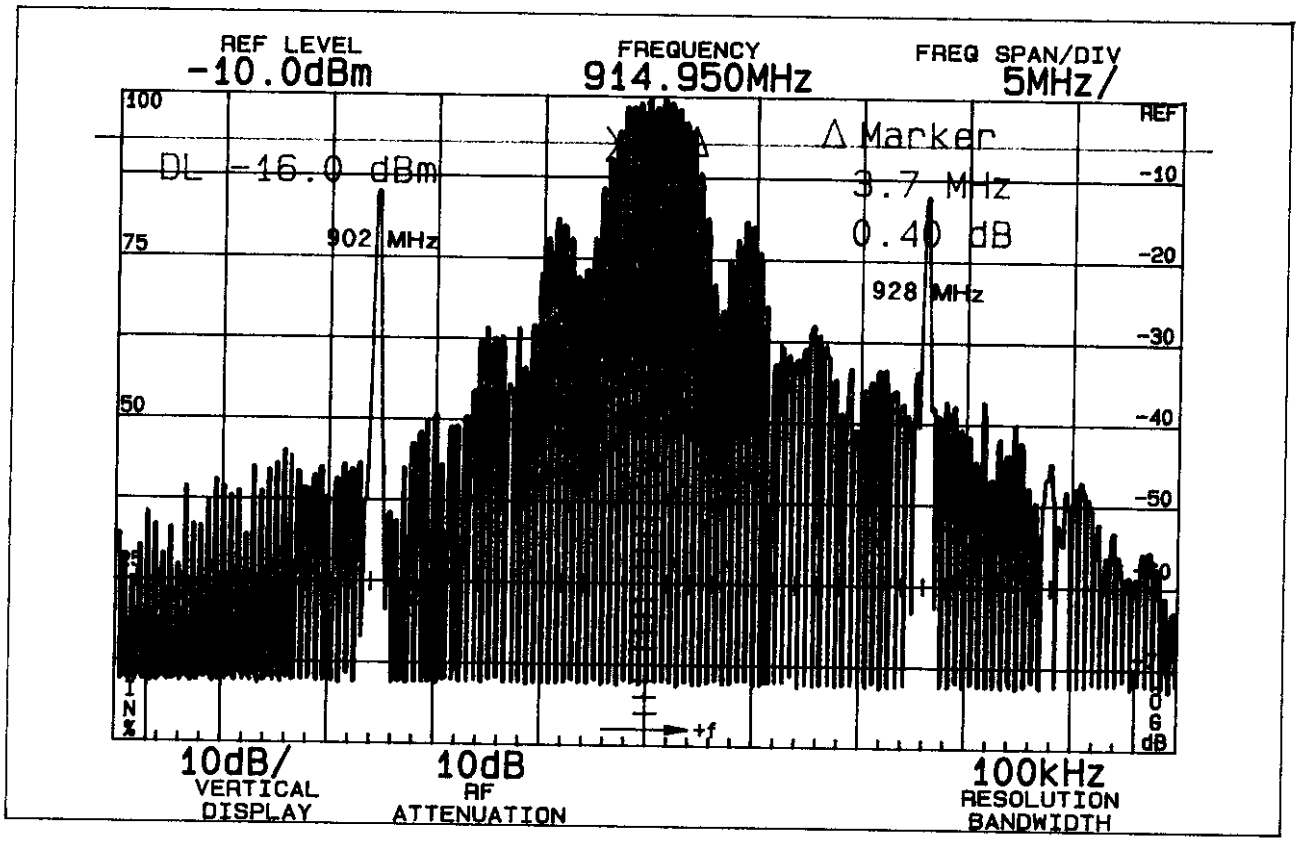
NAME OF TEST:	6.0 dB BANDWIDTH
RULES:	Para. 15.247(a)(2)
REQUIREMENT:	The 6.0 dB bandwidth must be greater than 500 kHz.
MEASUREMENT:	The 6.0 dB bandwidth was 3.7 MHz @ 915 MHz
MEASUREMENT DATA:	See plot, Figure 1



A: \RAMAGDB2.DBW

FIGURE 1

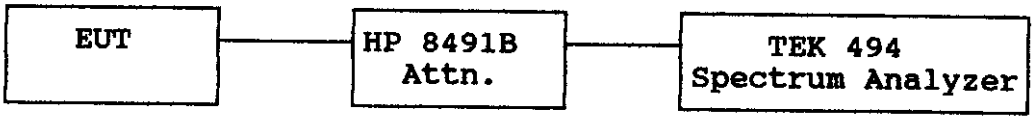


6 dB Bandwidth
RBW: 100 kHz
Markers: 902 and 928 MHz

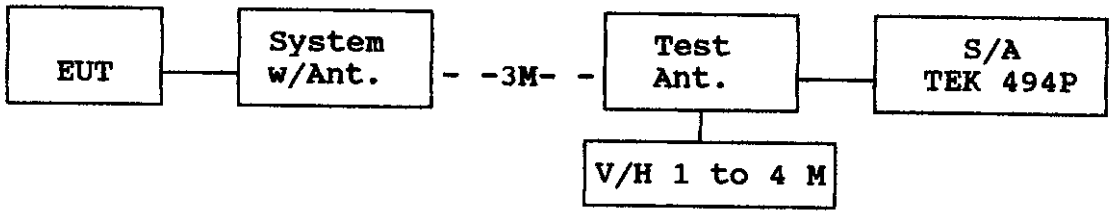
NAME OF TEST:	PEAK POWER
RULES:	Para. 15.247(b)
REQUIREMENT:	Maximum peak power shall not exceed 1 watt. (Antenna gain is less than 6 dBi.)
MEASUREMENT:	+28.1 dBm or 640 mW

NAME OF TEST:	Out-of-Band Emissions
RULES:	Para. 15.247(2)(c), 15.209(a)
REQUIREMENT:	Emissions must be at least 20 dB below the highest emission within the authorized band as measured with a 100 kHz RBW; or shall not exceed the general levels of 15.209(a) whichever is the lesser attenuation.
MEASUREMENT DATA:	Figure 2 Table 1 (Conducted) Table 2 (Radiated)

(Conducted)

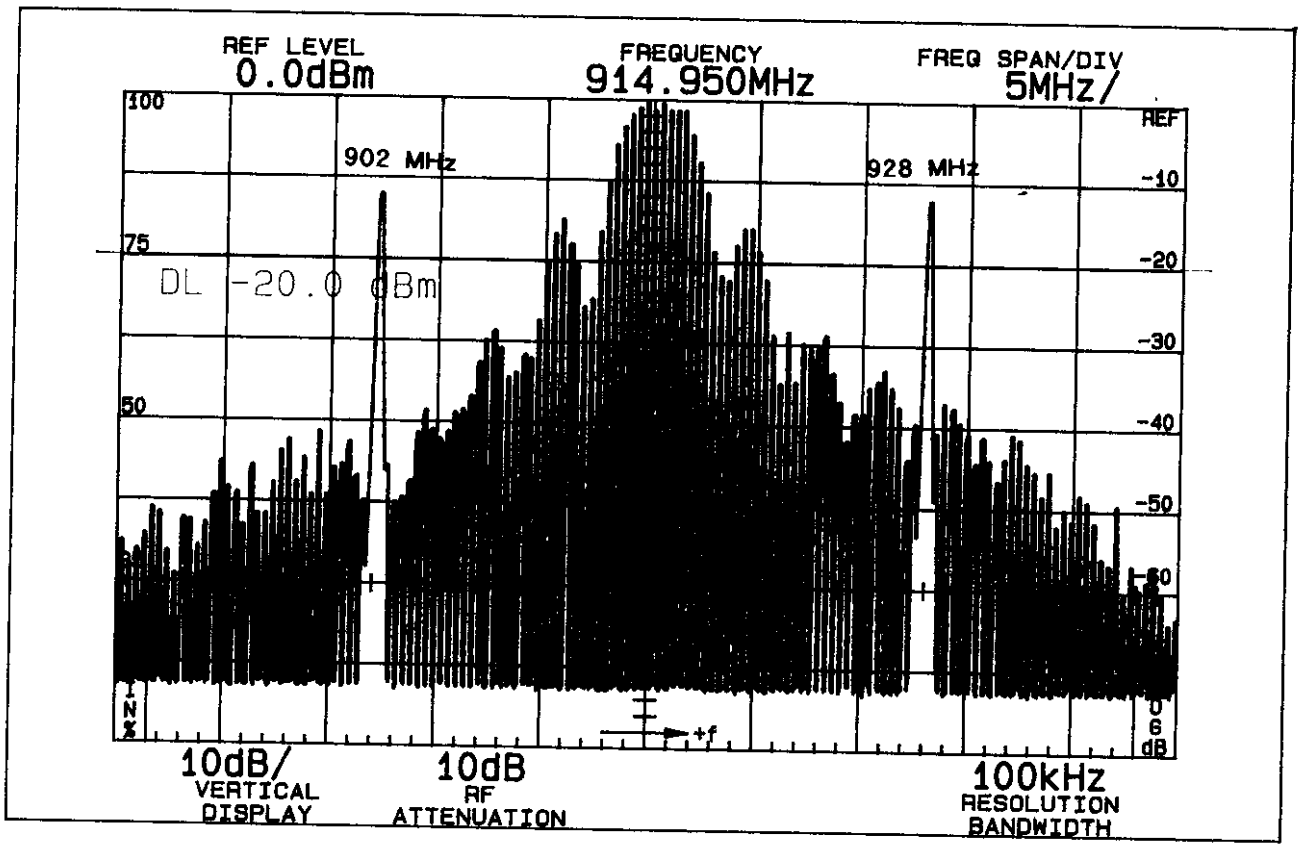


(Radiated)



A: \RAHAR3KB.OBW

FIGURE 2



Out-of-Band Emissions
RBW: 100 kHz
VBW: >100 kHz
Markers: 902 and 928 MHz

TABLE 1

CONDUCTED EMISSIONS

915 MHz, 0.640 W, 117 Vac

Spurious Frequency (MHz)	dB Below Carrier
1830.000	67
2745.000	61
3660.000	70
4575.000	71
5490.000	69
6405.000	70
7320.000	70
8235.000	70
9150.000	69
Limit:	20 dBc

TABLE 2

RADIATED EMISSIONS

915 MHz, 0.640 W, 117 Vac

Emission Frequency (MHz)	Meter Reading (dBm)	Antenna Factor (dB)	Field Intensity uV/m @ 3m	dB Below Carrier
915.000	- 6.0	23.2	1621810.1	0
1830.000	-72.8	27.4	380.2	72.6
2745.000	-75.6	30.2	380.2	72.6
3660.000	-81.2	32.8	269.2	75.6
4575.000	-80.8	33.1	291.7	74.9
5490.000	-77.6	35.0	524.8	69.8
6405.000	-80.4	35.7	412.1	71.9
7320.000	-63.2	37.2	1122.0	63.2
8235.000	-65.6	38.2	955.0	64.6
9150.000	-64.8	38.5	1083.9	63.5

NAME OF TEST:	Power Spectral Density
RULES:	15.247(d)
REQUIREMENT:	The peak level measured must be no greater than +8.0 dBm, in any 3 kHz band.
MEASUREMENT DATA:	See Figure 3

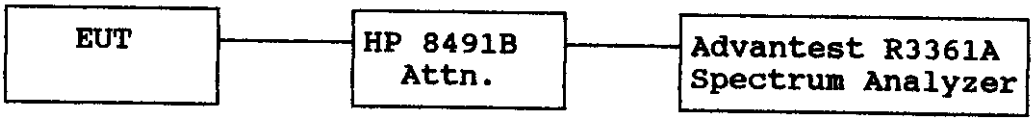
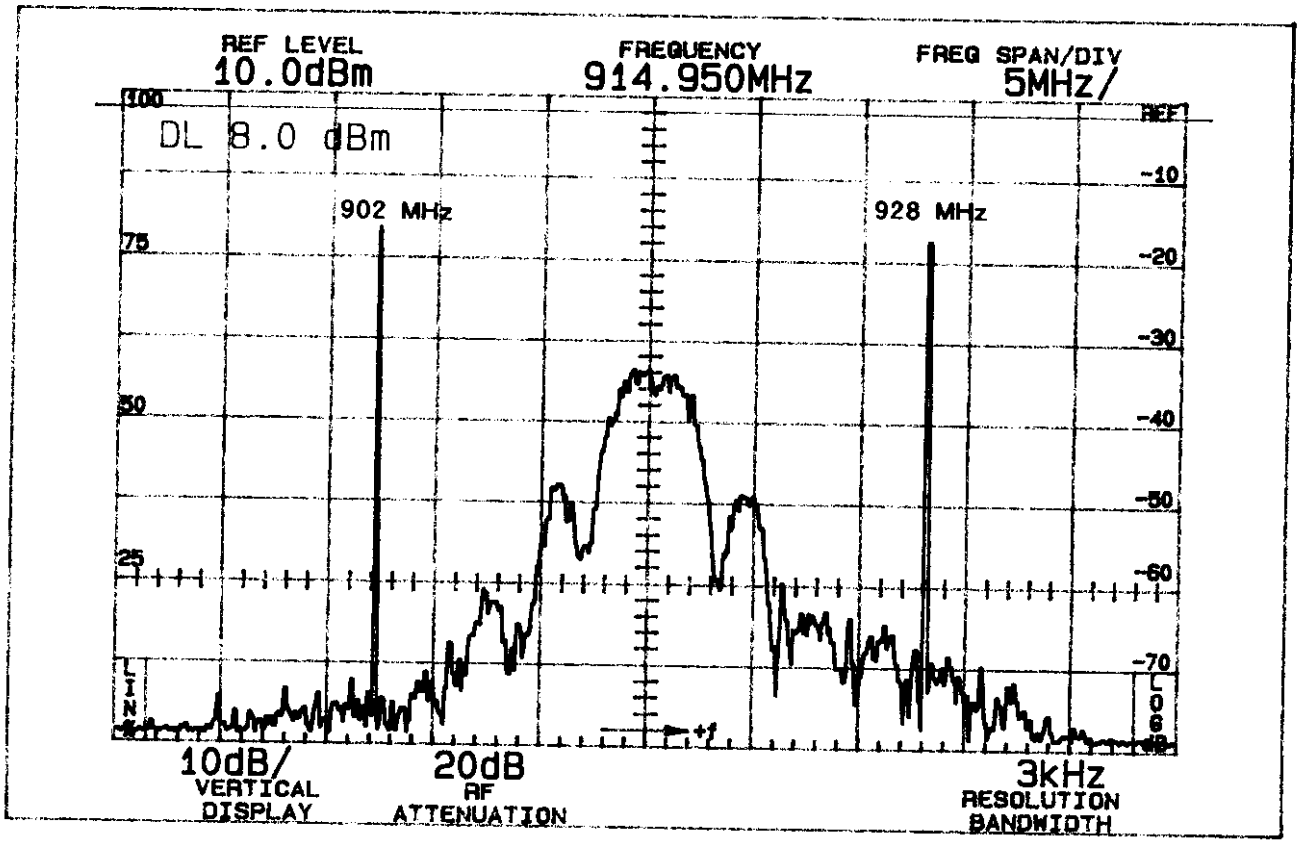


FIGURE 3



RBW: 3 kHz
Markers: 902 and 928 MHz
Scan Time: 1 Sec/Div
Peak Detector

Power Density
FCC ID: MS8-CellTrackIT-1
FIGURE 3

NAME OF TEST: Processing Gain

RULES: Para. 15.247(e)

REQUIREMENT: Processing gain shall be at least 10 dB

MEASUREMENT DATA: Processing gain, (measured by manufacturer) is >10 dB.

@ 915 MHz: (F_C)

$$G_p = (S/N)_o + M_j + L_{sys} \quad (1)$$

S/N @ BER = 7.663 dB

M_j = 11.8 @ 915 MHz

L_{sys} = 1 dB

G_p = 20.5 dB

Worst Case:

@ 914.1 MHz

S/N = 7.663 dB

M_j = 4 dB @ 9141

L_{sys} = 1 dB

G_p = 12.7 dB

(1) Dixon, R. Spread Spectrum Systems

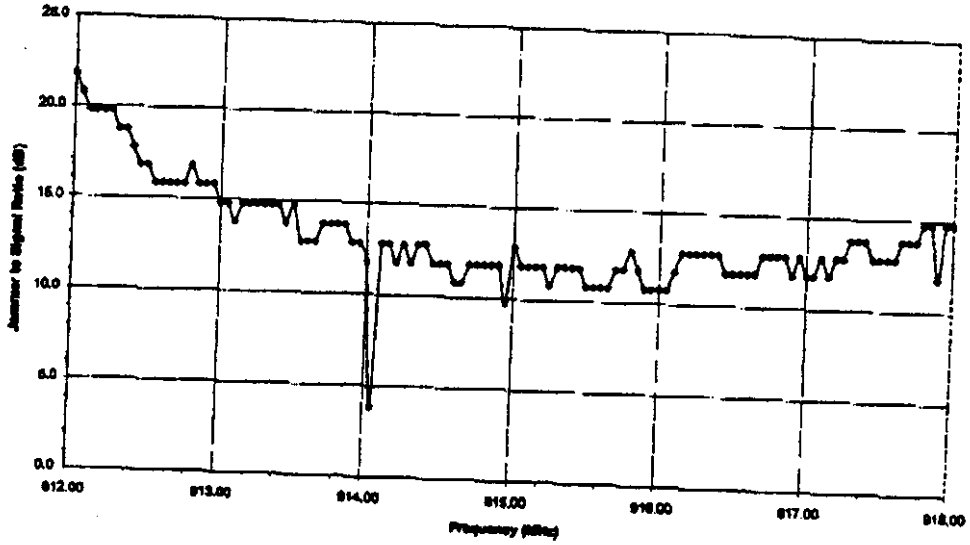
CellTrackIT processing gain measurement.
23/7/99

Result required to demonstrate compliance with Part 15 of FCC rules section 15.247(e)
Measurement performed using CW Jamming margin method detailed in appendix C

System passband is 6 MHz. CW jammer swept from 912000 kHz to 918000 kHz in 50 kHz steps. Transmitter generating packets at approx 28 Hz. Fail threshold reached when >20 % of transmitted packets are not received. The receiver only indicates a received packet if the packet header is found and the 24 bit CRC is validated.

Measurements of jamming margin wrt. frequency are given in chart below.

CellTrackIT Mode Jamming Margin



$Pass_p := 0.8$ Packet pass rate for measurement and analysis

$Plen := 153$ Bits per packet

$dB := 1$

$Err_b := 1 - Pass_p^{\frac{1}{Plen}}$

$Err_b = 1.457 \cdot 10^{-3}$ Effective BER for given packet length

$Err_{demod}(SNR) := \frac{1}{2} \cdot \exp(-SNR)$ Optimal DPSK demodulator bit error rate

$SNR := -\ln(2 \cdot Err_b)$

$SNR = 5.838$

$SNR_{dem} := 10 \cdot \log(SNR)$

$SNR_{dem} = 7.663 \cdot dB$ SNR for given bit error rate

$JM := 11.8 \cdot dB$ Measured jamming margin (See chart above)

$Loss := 1 \cdot dB$ Processing loss

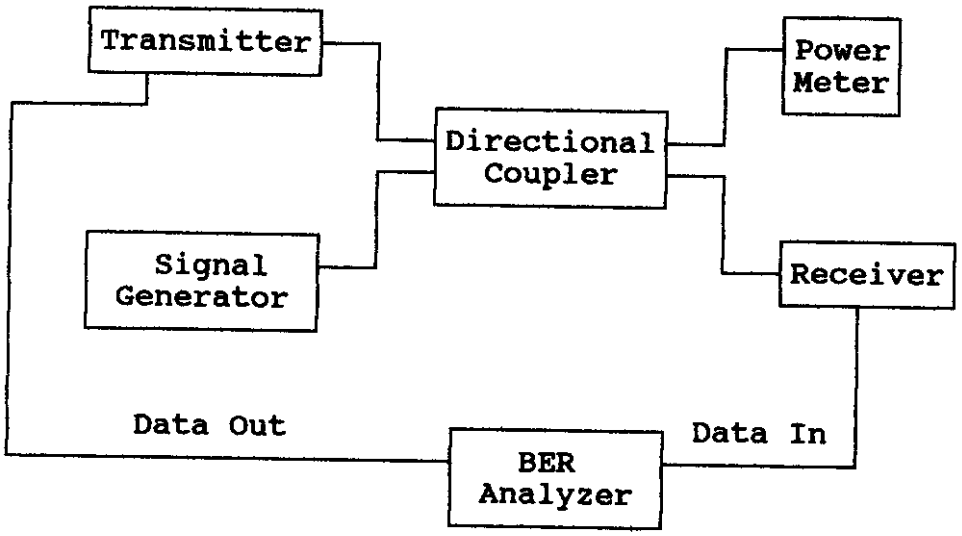
$ProcGain := JM + Loss + SNR_{dem}$ Process gain

$ProcGain = 20.5 \cdot dB$

MFG G_p DATA
FCC ID: MS8-CellTrackIT-1

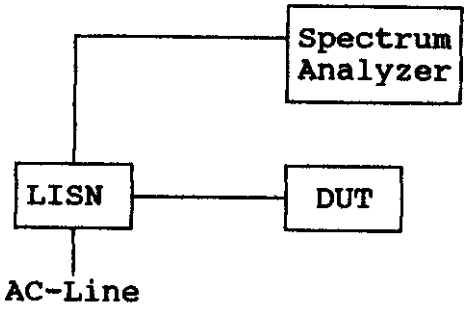
FIGURE 4

FIGURE 5



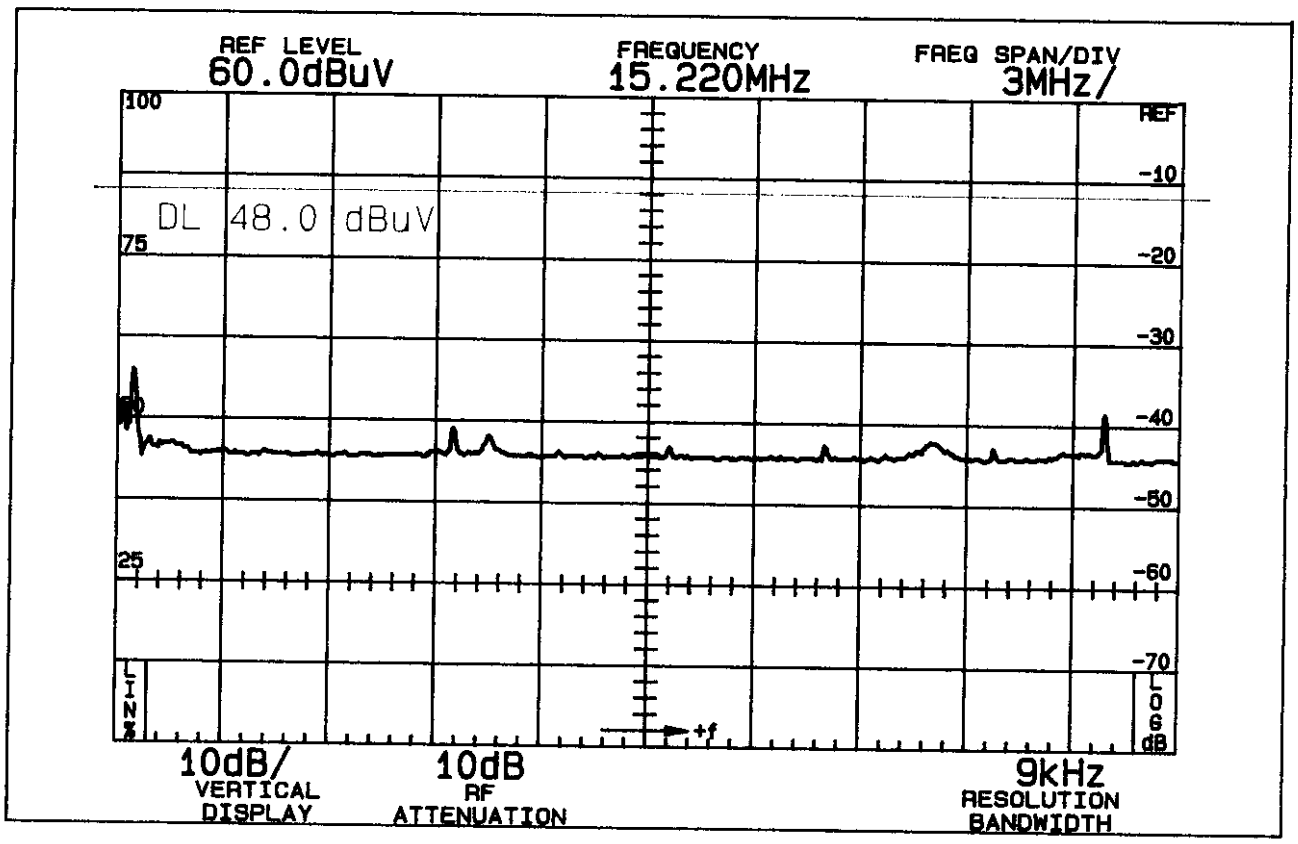
G_p BLOCK DIAGRAM
FCC ID: MS8-CellTrackIT-1
FIGURE 5

NAME OF TEST:	AC-Line Conducted Emissions
RULES:	Para. 15.207
REQUIREMENT:	Radio frequency voltage conducted back onto the AC power line shall not exceed 250 micro-volts from 0.45 to 30 MHz.
MEASUREMENT DATA:	See Figures 6 and 7.



A: \RAMARR.OBH

FIGURE 2

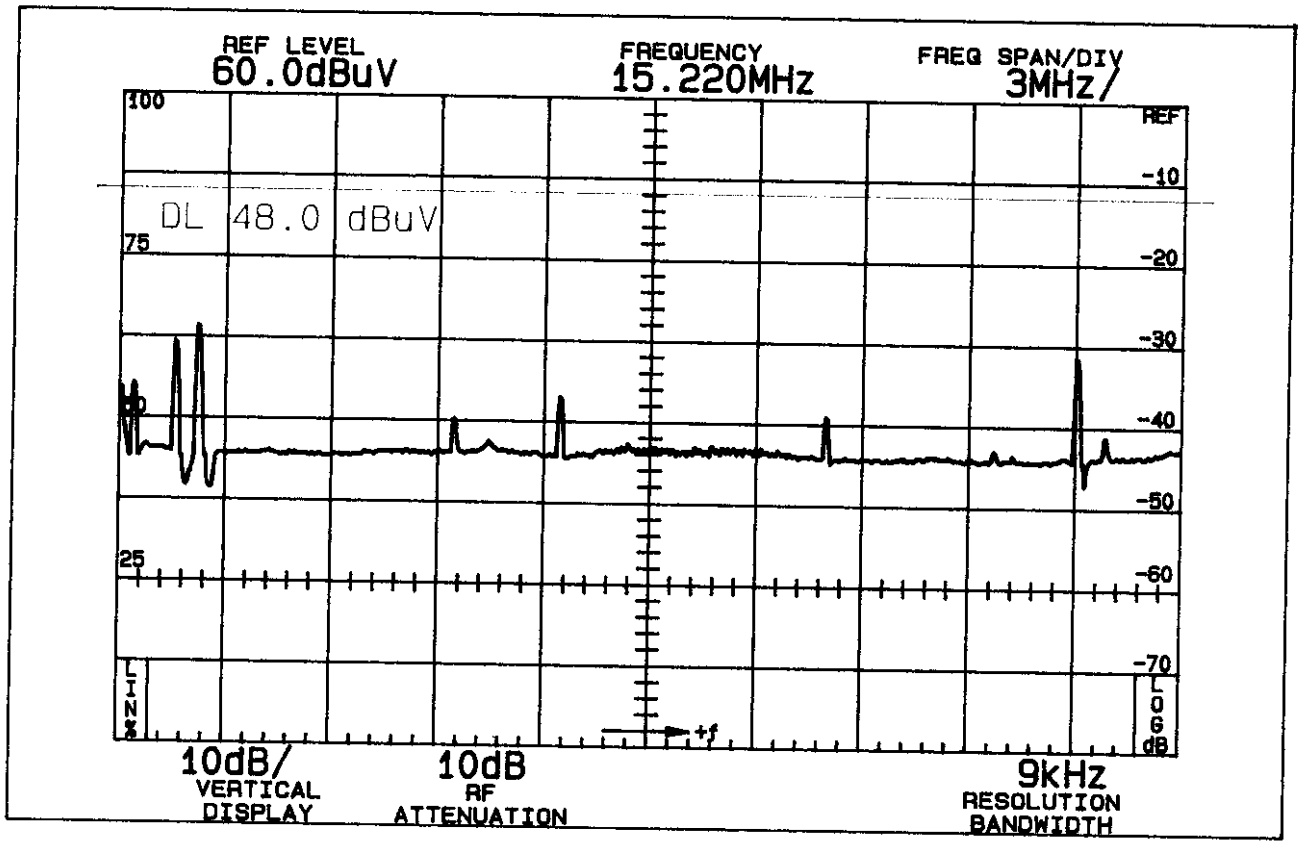


LINE CONDUCTED EMISSIONS
FCC ID: MS8-CellTrackIT-1

FIGURE 6 (Left LISN)

A: \RANAPL.GBN

FIGURE 3



LINE CONDUCTED EMISSIONS
FCC ID: MS8-CellTrackIT-1

FIGURE 7 (Right LISN)

TEST PROCEDURES

6.0 dB BANDWIDTH: The measurements were made with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz and the video bandwidth (VBW) = 300 kHz and the span set as shown on plot.

POWER OUTPUT: The RF power output was measured at the antenna connector using a peak power meter.

ANTENNA PORT CONDUCTED EMISSIONS: The RBS = 100 kHz, VBW = 300 kHz; the spectrum was scanned from 30 MHz to the 10th harmonic of the fundamental.

PROCEDURES: Radiated Spurious Emissions

Procedures of ANSI 63.4 - 1992 were followed.

The field strength of the radiated emissions from the device was measured at a distance of 3 meters. The spectrum was scanned from 30 MHz to the tenth harmonic using a HP 8596E or TEK 494P spectrum analyzer and HP 8447D low-noise preamplifier.

Measurement procedure included recording the worst-case field strength for receiving test antenna polarization, test antenna height variation from 1 meter to 3 meters and test sample rotation, and test sample antenna in both vertical and horizontal plane.

RBW: 100 kHz to 1 GHz; then 1 MHz.

The test sample was placed on a rotatable 80 cm high wooden stand. The receiving antenna, placed 3 meters from the test sample, was a Eaton/Singer DM-105 calibrated dipole set or EMCO 3115 horn. Power supply was 117 Vac.

Tabulation of the measurements are shown in Table 2.

PROCEDURES: AC Line Conducted Spurious

Power line conducted spurious were measured from .45 to 30 MHz using a 50 uH impedance stabilization network, (LISN).

The device under test was placed on a ground plane on a 80 cm high wooden stand centered on the ground plane. The LISN network was placed in contact with the conductive floor at the base of the test stand.

PROCEDURES: AC Line Conducted Spurious (Cont'd)

Coaxial cables to the left and right LISN output ports were connected by RG 55/U coaxial cable to a shielded high-isolation SPDT coaxial relay and then to the spectrum analyzer 50 ohm input port. When measurements were made, the unused LISN port was terminated in 50 ohms.

The device under test was operated in modes which maximized observed spurious.

An Advantest R3361A spectrum analyzer was the detector, using a 9 kHz resolution bandwidth. The spectrum analyzer was in the CISPR quasi-peak detector mode, with a 120 second scan.

Plots are shown in Figures 6 and 7. The 250 microvolt limit (48 dBu) is shown as a green line.

TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	CALIBRATION DUE
Spectrum Analyzer	Tektroniz	494P	07-28-00
Spectrum Analyzer	Hewlett Packard	8596E	04-15-00
Spread Analyzer	Advantest	R3361A	08-03-00
Dipole Antennas	EMCO	3121	03-06-00
Horn antenna	EMCO	3115	07-14-00
LISN	Compliance Engr	ISN-2	12-31-99