**Report on Test Measurements**

**Statement of Certification**

The technical data supplied with this application, having been taken under my supervision is hereby duly certified. The following is a statement of my qualifications:

College Degree: **BSEE, Valparaiso University, Valparaiso, Indiana, USA**
**MSEE, Illinois Institute of Technology, Chicago, Illinois, USA**

**__24___ years of Design and Development experience in the field of two-way radio communication.**

NAME: **Ken Weiss**

SIGNATURE: _____

DATE: **December 7, 2006**

POSITION: **Senior Staff Engineer**

I hereby certify that the above application was prepared under my direction and that to the best of my knowledge and belief, the facts set forth in the application and accompanying technical data are true and correct:

NAME: **Ali Sajanlal**

SIGNATURE: _____

DATE: **December 7, 2006**

POSITION: **Engineering Section Manager**

## Report on Test Measurements

*Submitted Measured Data – Index*

## Report on Test Measurements

*RF Power Output Data*

The RF power output was measured with the indicated voltage applied to and current into the final RF amplifying device. The DC current indicated is the total for the final RF amplifier stage, consisting of six parallel modules, or twelve parallel power transistors.

Quad Carrier Mode:

| | | |
|---|---|---|
| Measured RF output | **42** | Watts, Average |
| DC Voltage | **28.3** | Volts |
| DC Current | **14.3** | Amperes |
| Input power for final RF amplifying device(s) | **303** | Watts |
| Primary Supply Voltage | **48** | Volts DC |
| | | |
| Minimum Measured RF output | **5** | Watts, Average |
| Normal DC Voltage | **28.3** | Volts |
| Normal DC Current | **4.9** | Amperes |
| Input power for final RF amplifying device(s) | **139** | Watts |
| Primary Supply Voltage | **48** | Volts DC |

Single Carrier Mode:

| | | |
|---|---|---|
| Measured RF output | **52** | Watts, Average |
| Normal DC Voltage | **28.3** | Volts |
| Normal DC Current | **14.3** | Amperes |
| Input power for final RF amplifying device(s) | **340** | Watts |
| Primary Supply Voltage | **48** | Volts DC |
| | | |
| Minimum Measured RF output | **5** | Watts, Average |
| Normal DC Voltage | **28.3** | Volts |
| Normal DC Current | **4.9** | Amperes |
| Input power for final RF amplifying device(s) | **139** | Watts |
| Primary Supply Voltage | **48** | Volts DC |

**Report on Test Measurements**

*Occupied Bandwidth*

**Occupied Bandwidth – Multi-Carrier Base Radio, 25 kHz Channel Spacing – 940 - 941 MHz Operation**
There are four exhibits shown for 940-941 MHz operation. All can be used in a system configuration based upon channel usage as described in Exhibit B. All of the following charts reference the following setup and specification requirements.

| | |
|---|---|
| Modulation Type: | Quad-QAM, 64 kbps Random Data Per Channel |
| Emission Designator: | (See Exhibit Table Below) |
| Channelization: | 25 kHz per channel |
| Power Setting: | (See Exhibit Table Below) |

§ 24.133 Emission Limits:
(1) For transmitters authorized for a bandwidth greater than 10 kHz

(a) The power of any emission shall be attenuated below the transmitter power (P), as measured in accordance with § 24.132(f), in accordance with the following schedule:

(i) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of up to and including 40 kHz:

*at least 116 Log10 ((fd+10)/6.1) decibels;*
*or 50 plus 10 Log10 (P) decibels;*
*or 70 decibels;*
*(whichever is the lesser attenuation)*

(ii) On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 40 kHz:

*at least 43 plus 10 Log10 (P) decibels;*
*or 80 decibels;*
*(whichever is the lesser attenuation)*

(b) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

(c) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

(d) The following minimum spectrum analyzer resolution bandwidth settings will be used: 300 Hz when showing compliance with paragraphs (a)(1)(i) and (a)(2)(i) of this section; and 30 kHz when showing compliance with paragraphs (a)(1)(ii) and (a)(2)(ii) of this section.

§ 24.132(f) All power levels specified in this section are expressed in terms of the maximum power, averaged over a 100 millisecond interval, when measured with instrumentation calibrated in terms of an rms-equivalent voltage with a resolution bandwidth equal to or greater than the authorized bandwidth.

Necessary Bandwidth Calculation:
The necessary bandwidth of the modulation signal is not calculable per the formulas defined in 47 CFR 2.202 (b). Specifically, although the modulation for this emission is a composite modulation, the equations given in the composite tables in 2.202 are not applicable since none of them adequately approximate the form of digital modulation used. The necessary bandwidth of 17.7 kHz per carrier is based upon a 99% power measurement of the transmitter spectrum, per 2.202 (a). For the composite two carrier signal (1 additional channel), the resulting necessary bandwidth is 17.7 kHz + 1*25 kHz = 42.7 kHz. For the composite signal of n additional carriers, the resulting necessary bandwidth is 17.7 kHz + n*25 kHz.

**Report on Test Measurements**

*Occupied Bandwidth*

**Occupied Bandwidth – Multi-Carrier Base Radio, 25 kHz Channel Spacing – 940 - 941 MHz Operation (Continued)**

*Measurement Procedure and Instrument Settings*

Reference Calibration Analyzer Settings:

| | | | |
|---|---|---|---|
| Horizontal: | 12.5 kHz per Division | Resolution Bandwidth: | 300 kHz |
| Vertical: | 10 dB per Division | Video Bandwidth: | 500 kHz |
| Sweep Time: | as needed (<2000 Hz / Second) | Span: | as needed per # carriers |
| Detector Mode: | Peak | | |

Emission Measurement Analyzer Settings:

| | | | |
|---|---|---|---|
| Horizontal: | 12.5 kHz per Division | Resolution Bandwidth: | 300 Hz |
| Vertical: | 10 dB per Division | Video Bandwidth: | 3 kHz |
| Sweep Time: | as needed (<2000 Hz / Second) | Span: | as needed per # carriers |
| Detector Mode: | Peak | | |

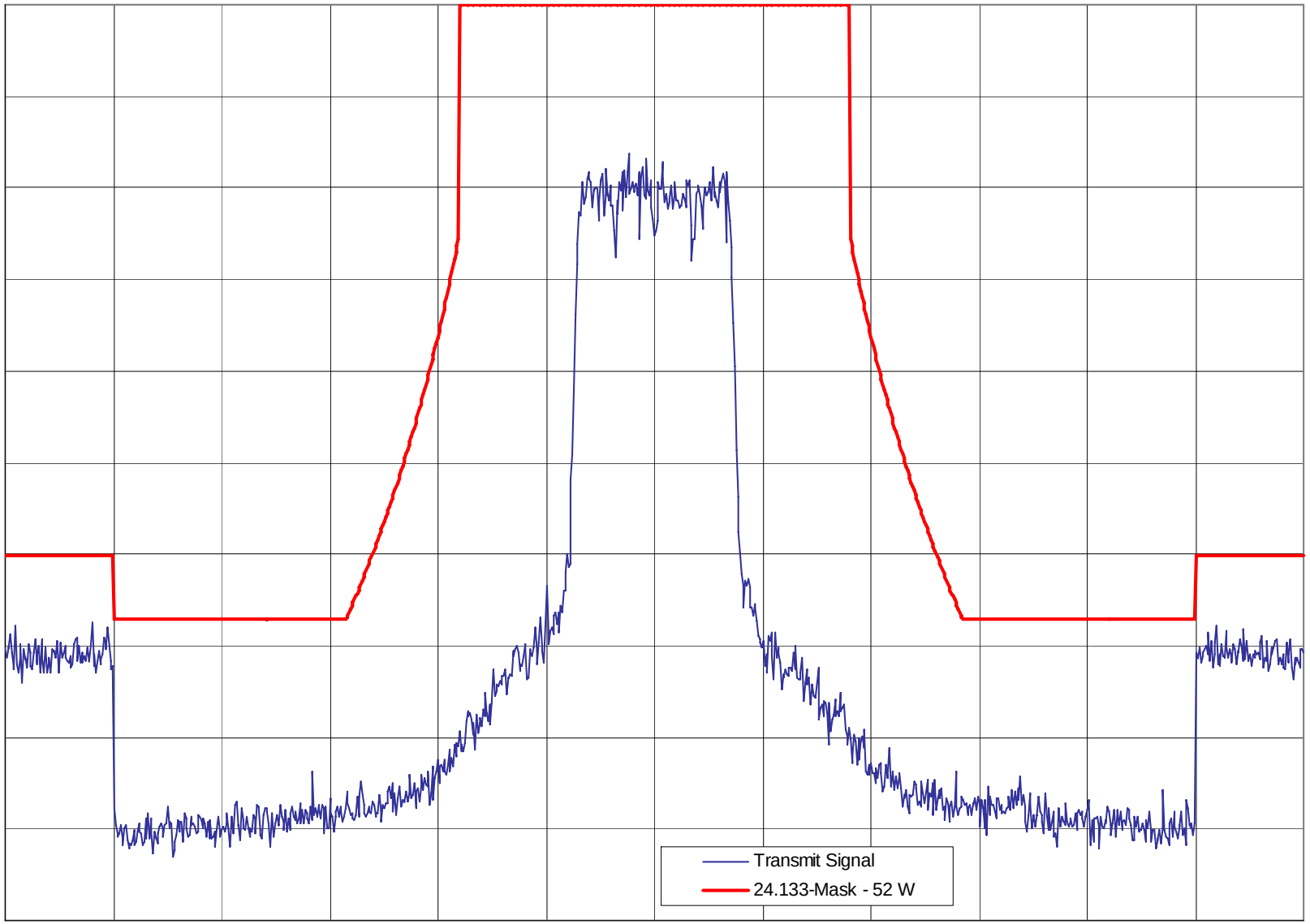
Test Procedure:

1) Adjust the spectrum analyzer per the values specified in the Reference Calibration Analyzer Settings section above.
2) Modulate the transmitter with the appropriate signaling pattern, (mixed QAM, pseudorandom data) and key the transmitter at the full power rating for the number of carriers to be measured. Use the analyzer controls to set this signal to the full-scale reference line. Allow the analyzer to sweep fully, store the sweep, and record the peak value.
3) Adjust the analyzer per the values specified in the Emission Measurement Analyzer Settings section above.
4) Allow the analyzer to sweep, and record the resultant emission levels.
5) Plot the resulting analyzer trace and the emission mask limit, add annotation text and labeling as appropriate. For frequencies 40 kHz or more outside of the edge of authorized bandwidth, the data is adjusted using the factor 10*log(30kHz/300Hz) or 20 dB.

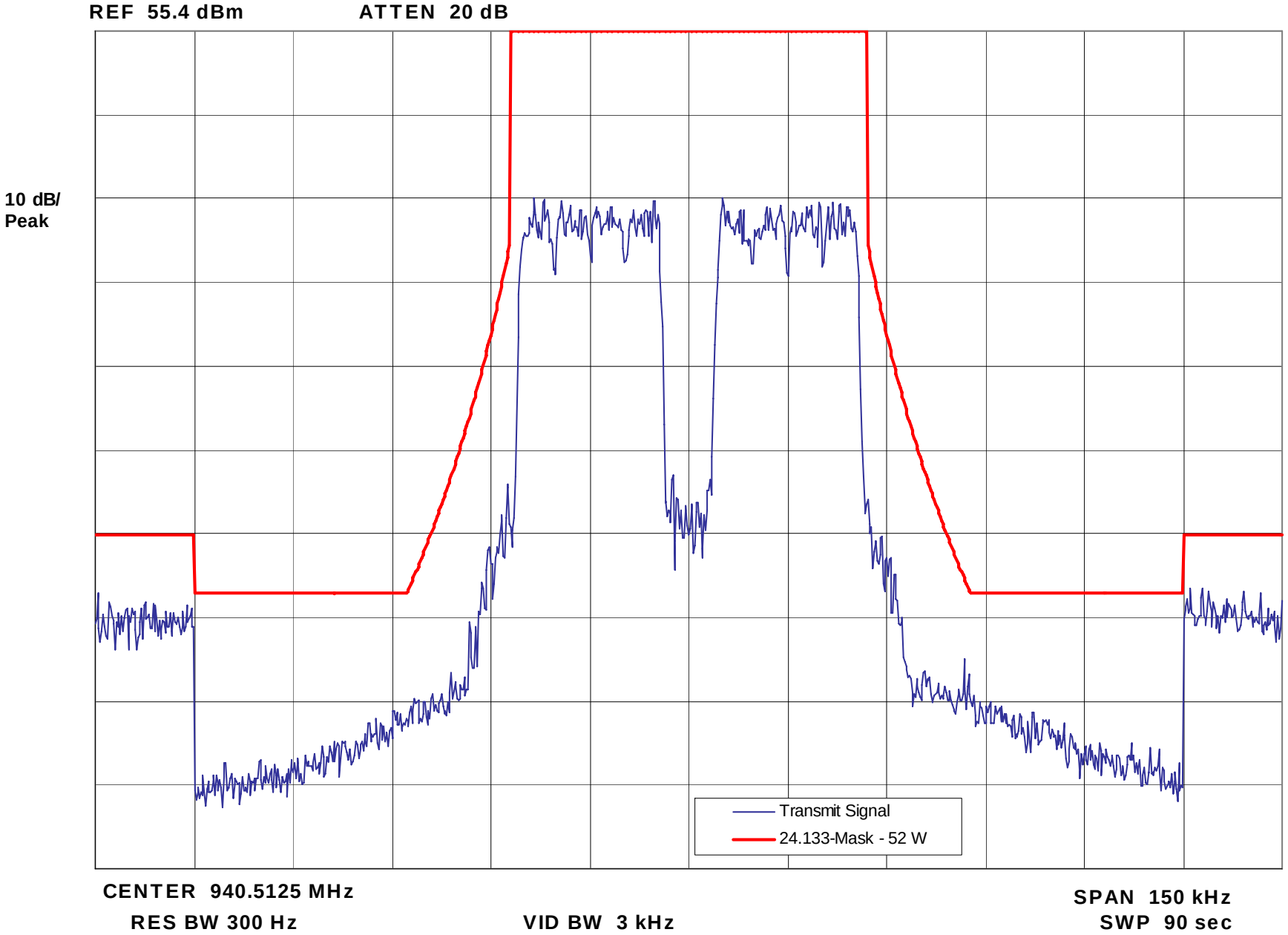
| EXHIBIT | DESCRIPTION | Power (Watts, Avg) | Emission Designator |
|---|---|---|---|
| 11B-11 | 940.5000 MHz – One Carrier | 52 Watts | 17K7D7W |
| 11B-12 | 940.5000 MHz – Two Carriers | 52 Watts | 42K7D7W |
| 11B-13 | 940.5000 MHz – Three Carriers | 48 Watts | 67K7D7W |
| 11B-14 | 940.5000 MHz – Four Carriers | 42 Watts | 92K7D7W |

## Occupied Bandwidth -- One Carrier - 16-QAM - 17K7D7W - 52 Watts

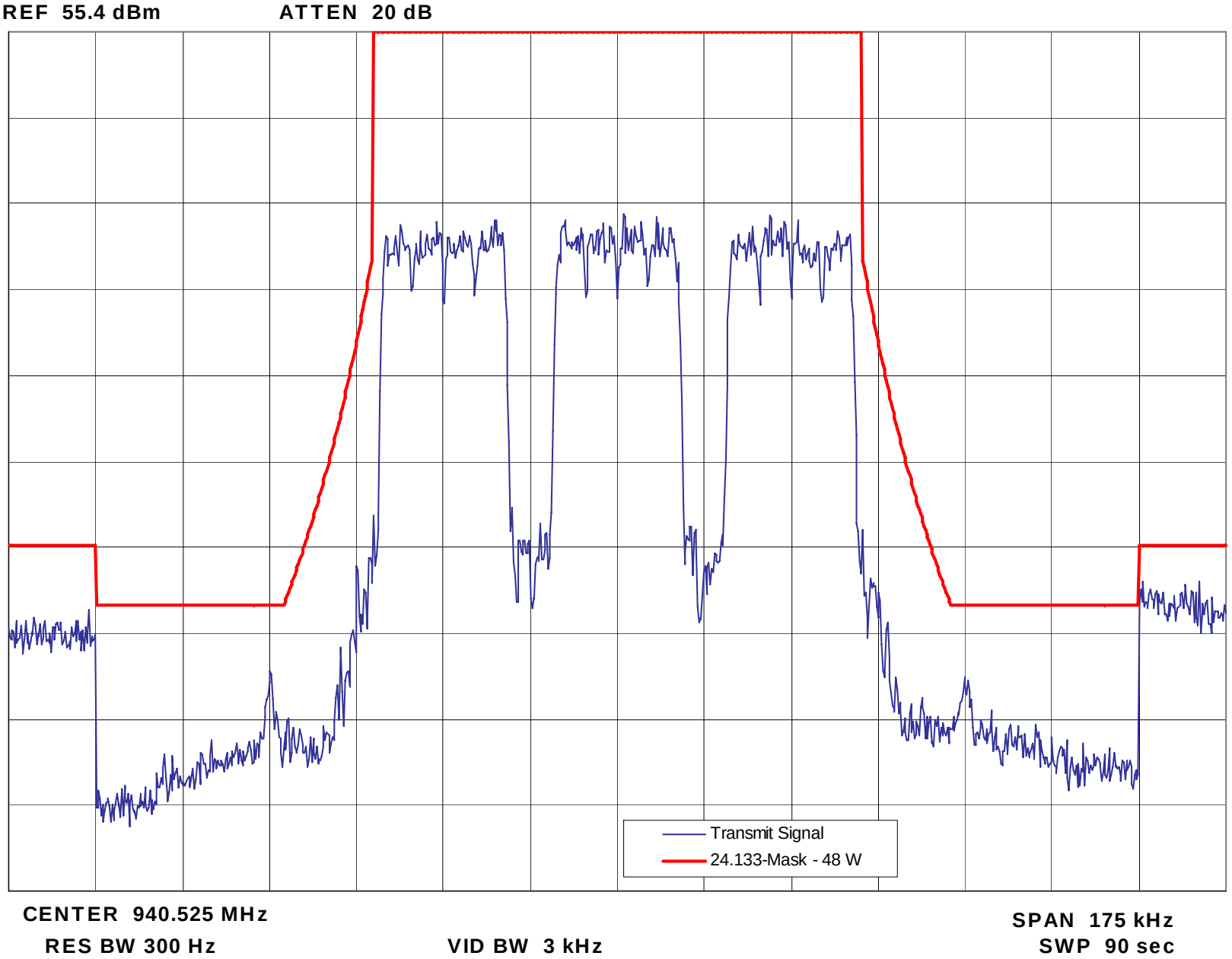
REF 55.4 dBm ATTEN 20 dB



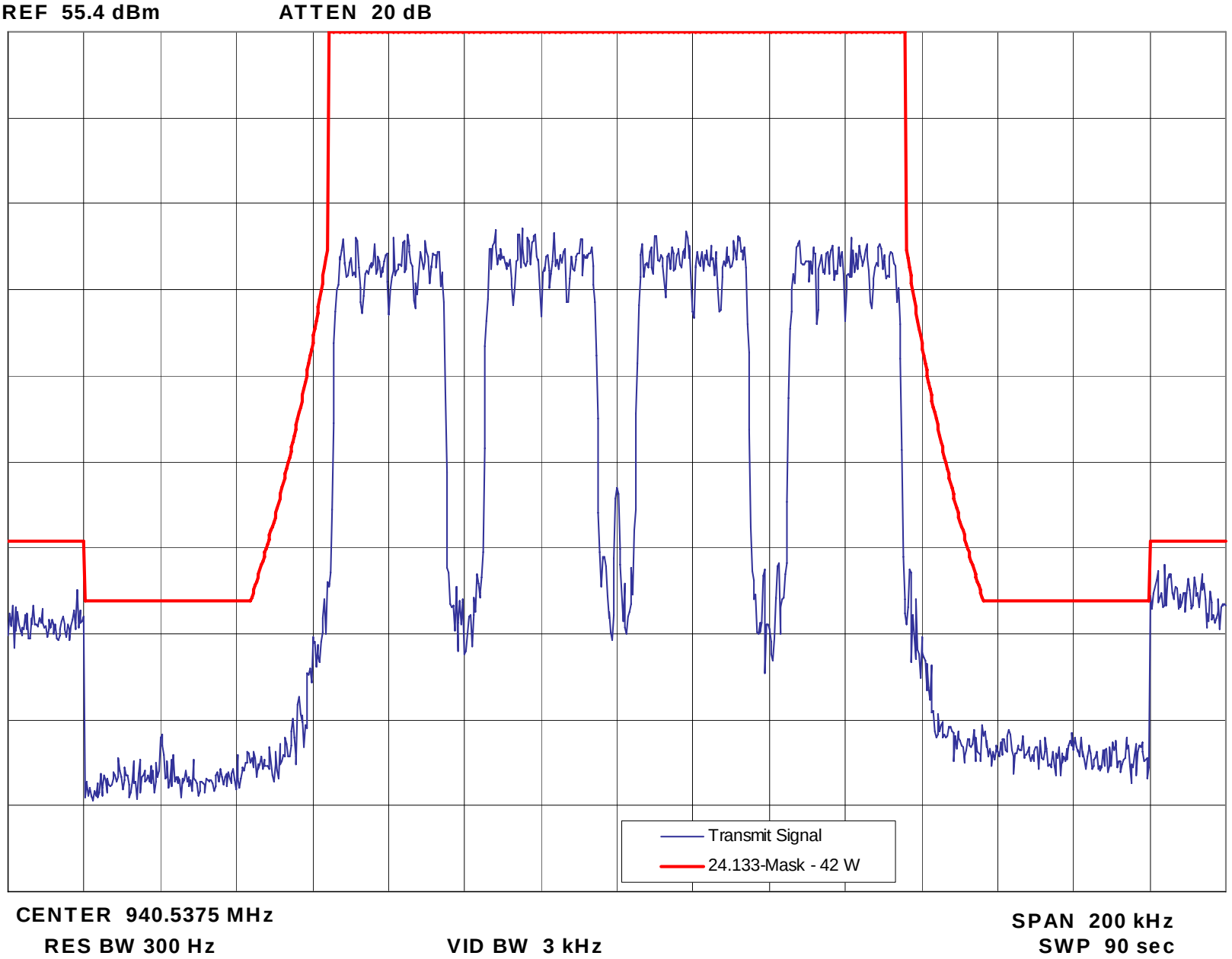
## Occupied Bandwidth -- Two Carriers - 16-QAM - 42K7D7W - 52 Watts



## Occupied Bandwidth -- Three Carriers - 16-QAM - 67K7D7W - 48 Watts



**Occupied Bandwidth -- Four Carriers - 16-QAM - 92K7D7W - 42 Watts**



**Report on Test Measurements**

*Conducted Spurious Emissions*

**SPECIFICATION REQUIREMENT:**

Reference: Part 24.133 Emission Limits
On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 40 kHz, the power of any emission shall be attenuated below the transmitter power (P), in Watts, by at least 43 plus 10 Log10 (P) decibels, or 80 decibels (whichever is the lesser attenuation).

Modulation: Pseudorandom data

Carrier Frequency: A Quad carrier centered at 940.9500 MHz, or one single carrier frequency at 940.9500 MHz, was measured. This frequency is near the top edge of the operating band 940-941 MHz.

**SPURIOUS EMISSION PLOTS:**

| **EXHIBIT** | **DESCRIPTION** |
|---|---|
| 11C-1 | Quad Carrier - Conducted Spurious Emissions, Harmonics, Power Output at 42 Watts<br>The specification limit is -59.2 dBc |
| 11C-2 | Quad Carrier - Conducted Spurious Emissions, Harmonics, Power Output at 5 Watts<br>The specification limit is -50.0 dBc |
| 11C-3 | Single Carrier - Conducted Spurious Emissions, Harmonics, Power Output at 52 Watts<br>The specification limit is -60.2 dBc |
| 11C-4 | Single Carrier - Conducted Spurious Emissions, Harmonics, Power Output at 5 Watts<br>The specification limit is -50.0 dBc |

APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC5798-P

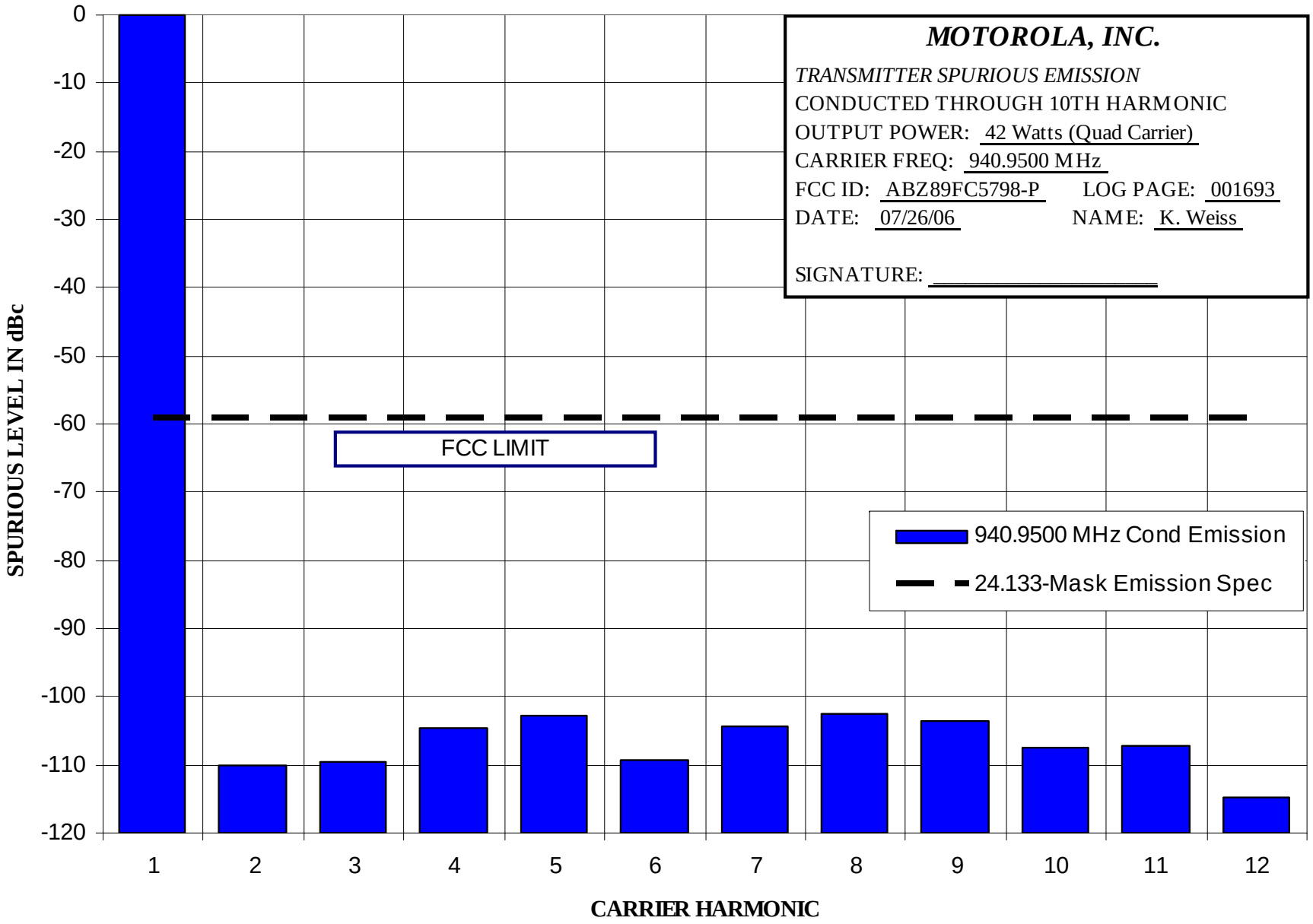



EXHIBIT 11C-1

APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC5798-P

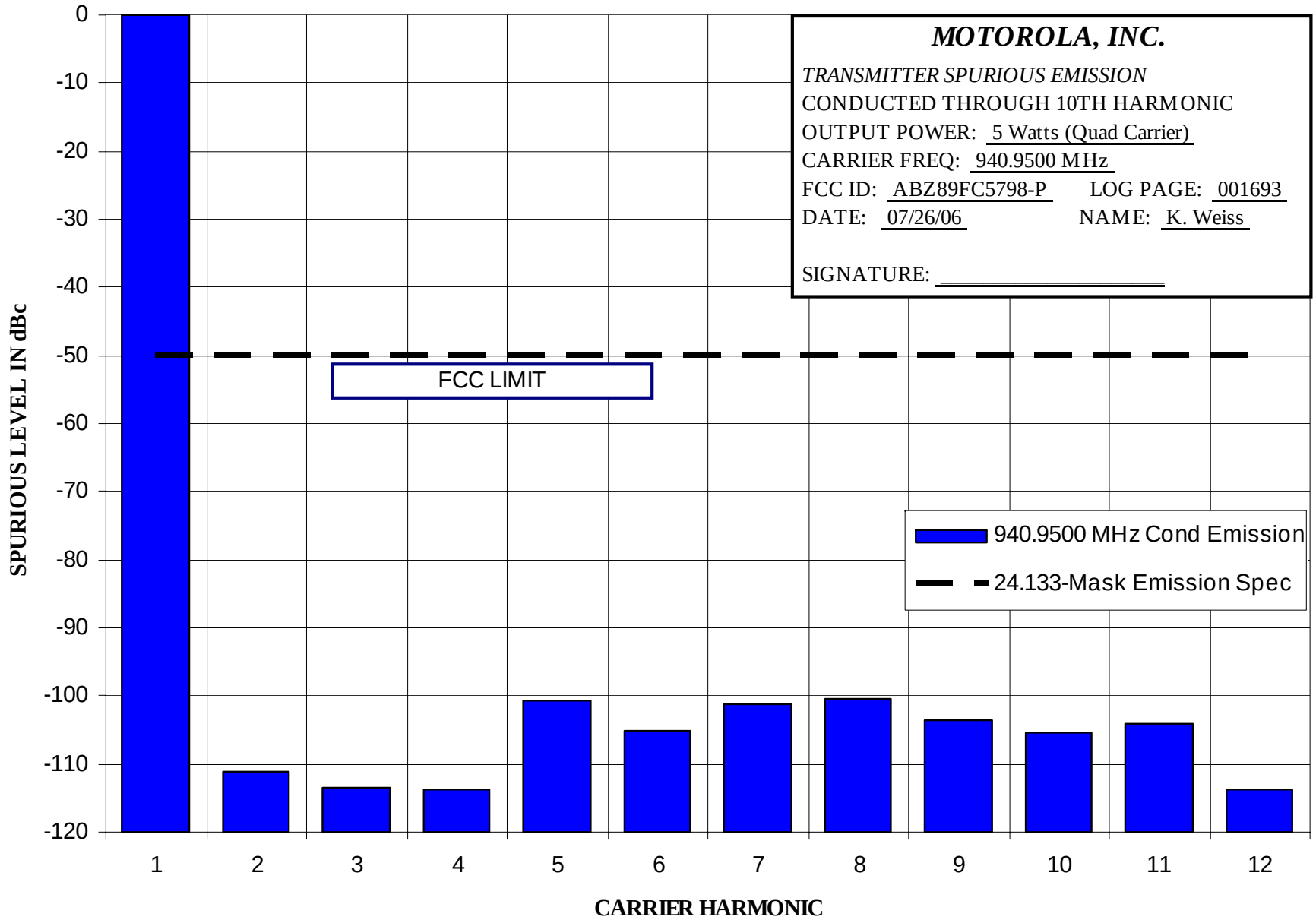



EXHIBIT 11C-2

APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC5798-P

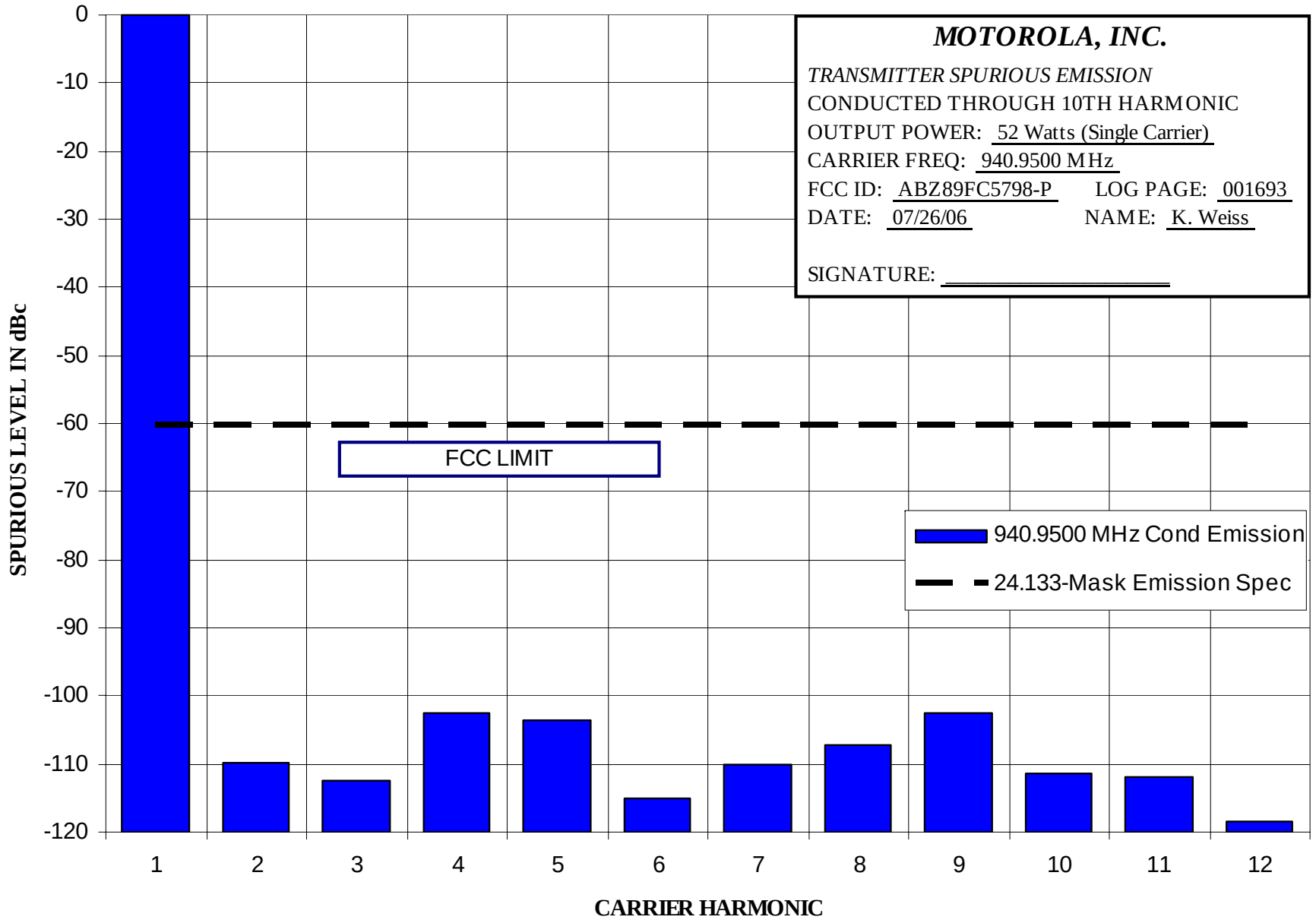



EXHIBIT 11C-3

APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC5798-P

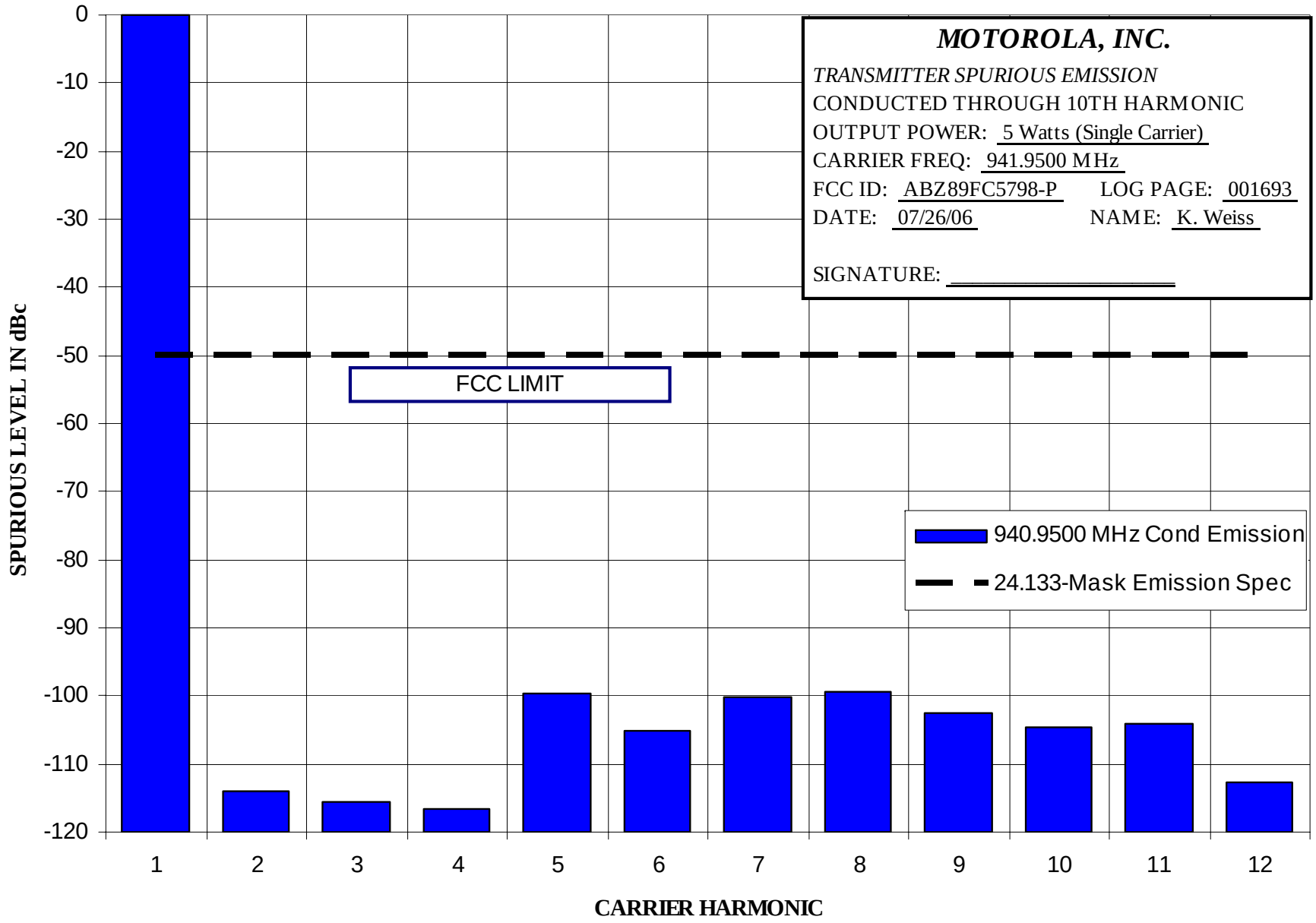



EXHIBIT 11C-4

**Report on Test Measurements**

*Radiated Spurious Emissions*

**SPECIFICATION REQUIREMENT:**

**Reference: Part 24.133 Emission Limits**

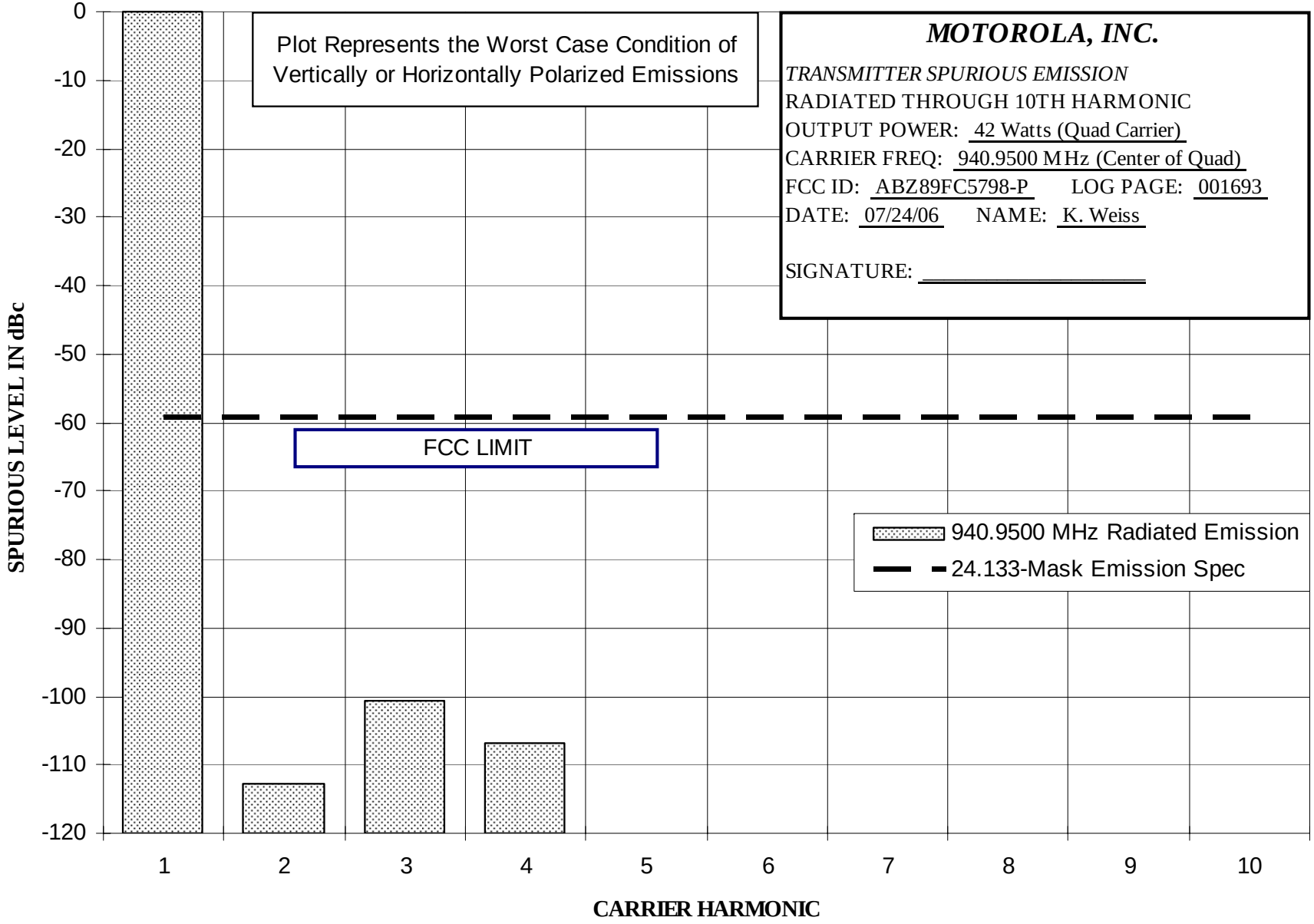
On any frequency outside the authorized bandwidth and removed from the edge of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 40 kHz, the power of any emission shall be attenuated below the transmitter power (P), in Watts, by at least 43 plus 10 Log10 (P) decibels, or 80 decibels (whichever is the lesser attenuation).

Modulation: Pseudorandom data

Carrier Frequency: A Quad carrier centered at 940.9500 MHz, or one single carrier frequency at 940.9500 MHz, was measured. This frequency is near the top edge of the operating band 940-941 MHz.

**SPURIOUS EMISSION PLOTS:**

| EXHIBIT | DESCRIPTION |
|---|---|
| 11D-1 | Quad Carrier - Radiated Spurious Emissions, Power Output at 42 Watts<br>The specification limit is -59.2 dBc |
| 11D-2 | Quad Carrier - Radiated Spurious Emissions, Power Output at 5 Watts<br>The specification limit is -50.0 dBc |
| 11D-3 | Single Carrier - Radiated Spurious Emissions, Power Output at 52 Watts<br>The specification limit is -60.2 dBc |
| 11D-4 | Single Carrier - Radiated Spurious Emissions, Power Output at 5 Watts<br>The specification limit is -50.0 dBc |


Plot Represents the Worst Case Condition of Vertically or Horizontally Polarized Emissions
MOTOROLA, INC.
TRANSMITTER SPURIOUS EMISSION
RADIATED THROUGH 10TH HARMONIC
OUTPUT POWER: 42 Watts (Quad Carrier)
CARRIER FREQ: 940.9500 MHz (Center of Quad)
FCC ID: ABZ89FC5798-P LOG PAGE: 001693
DATE: 07/24/06 NAME: K. Weiss
SIGNATURE:
FCC LIMIT
940.9500 MHz Radiated Emission
24.133-Mask Emission Spec
SPURIOUS LEVEL IN dBc
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
1
2
3
4
5
6
7
8
9
10
CARRIER HARMONIC

APPLICANT: MOTOROLA

EQUIPMENT TYPE: ABZ89FC5798-P

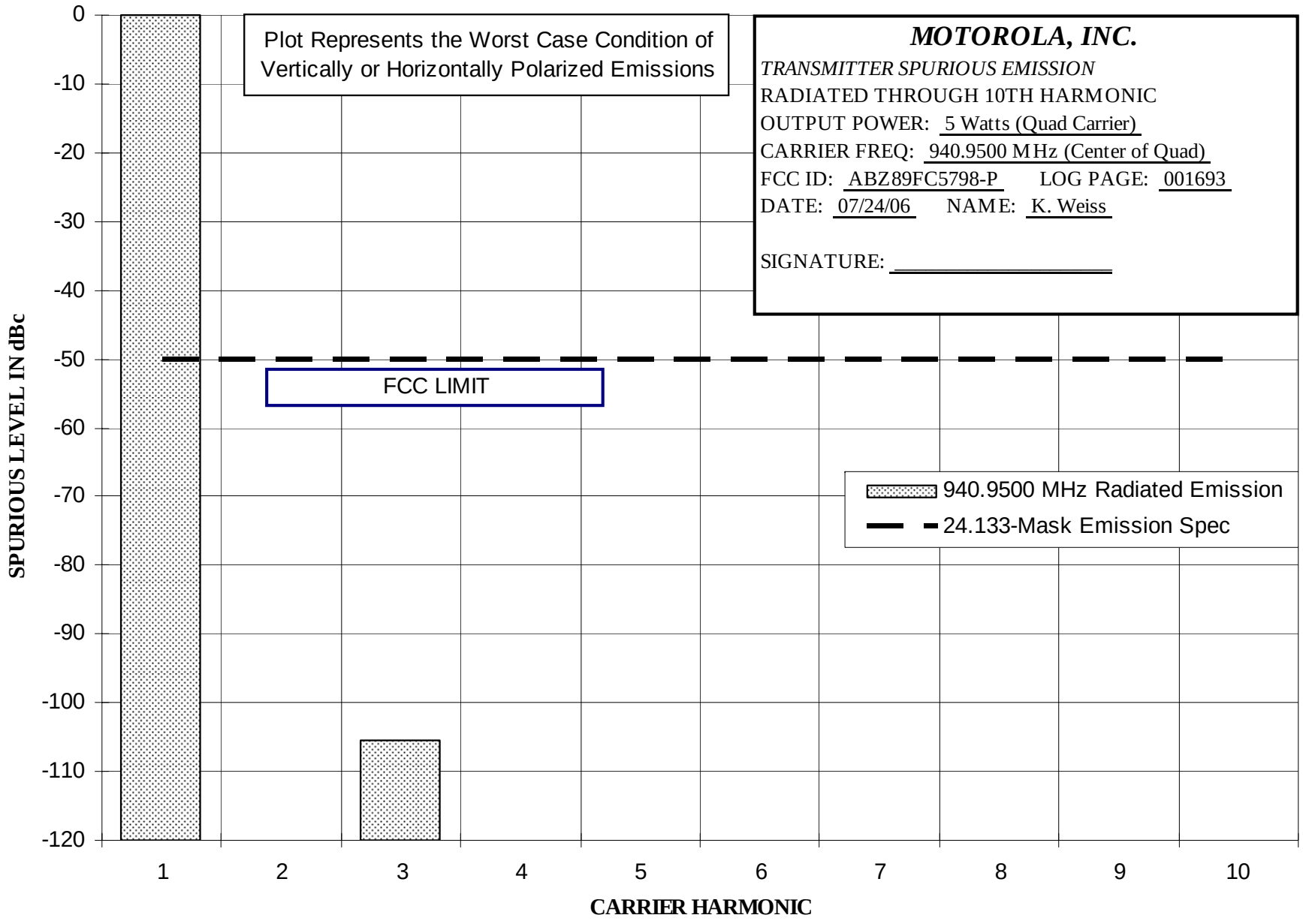
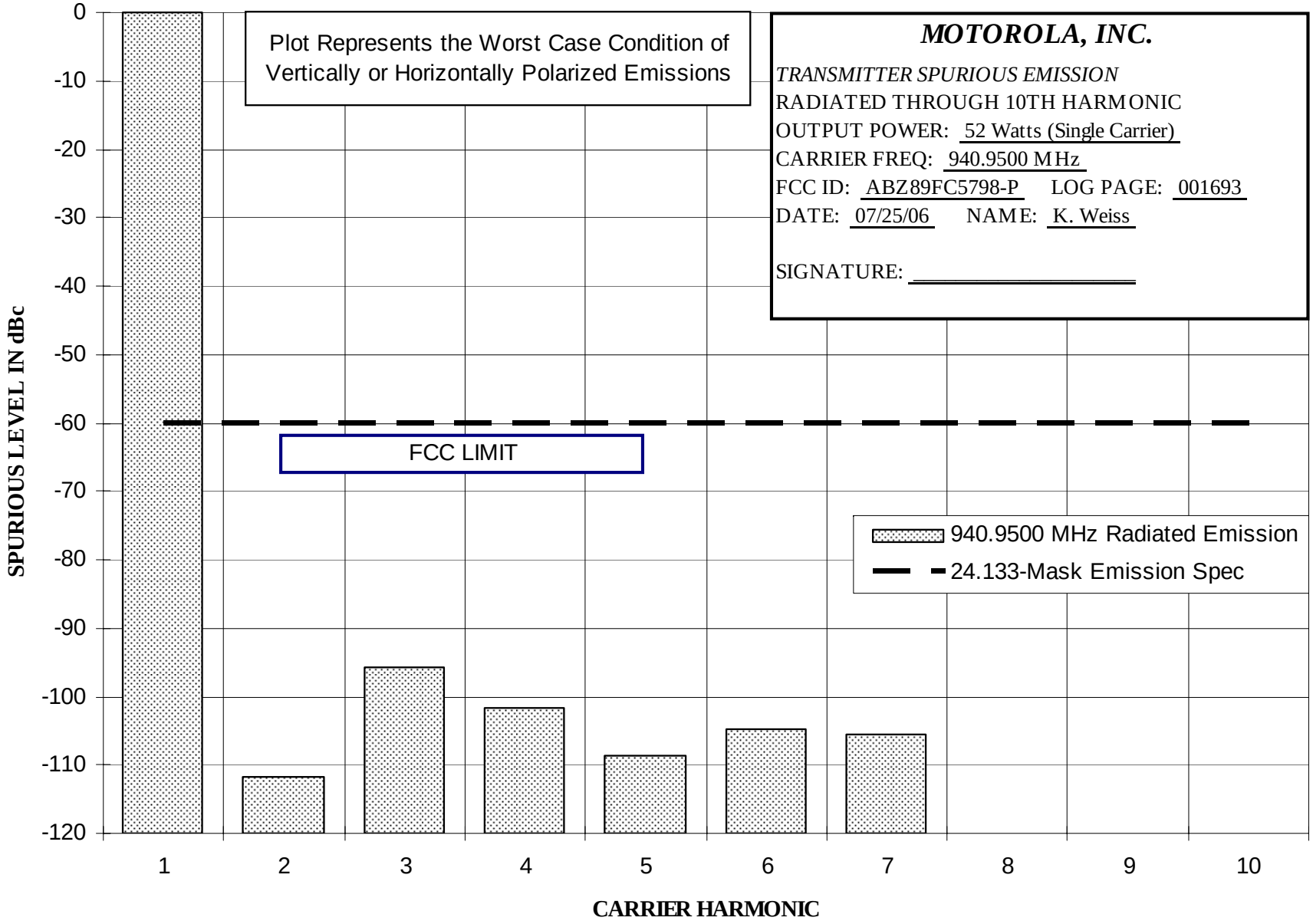
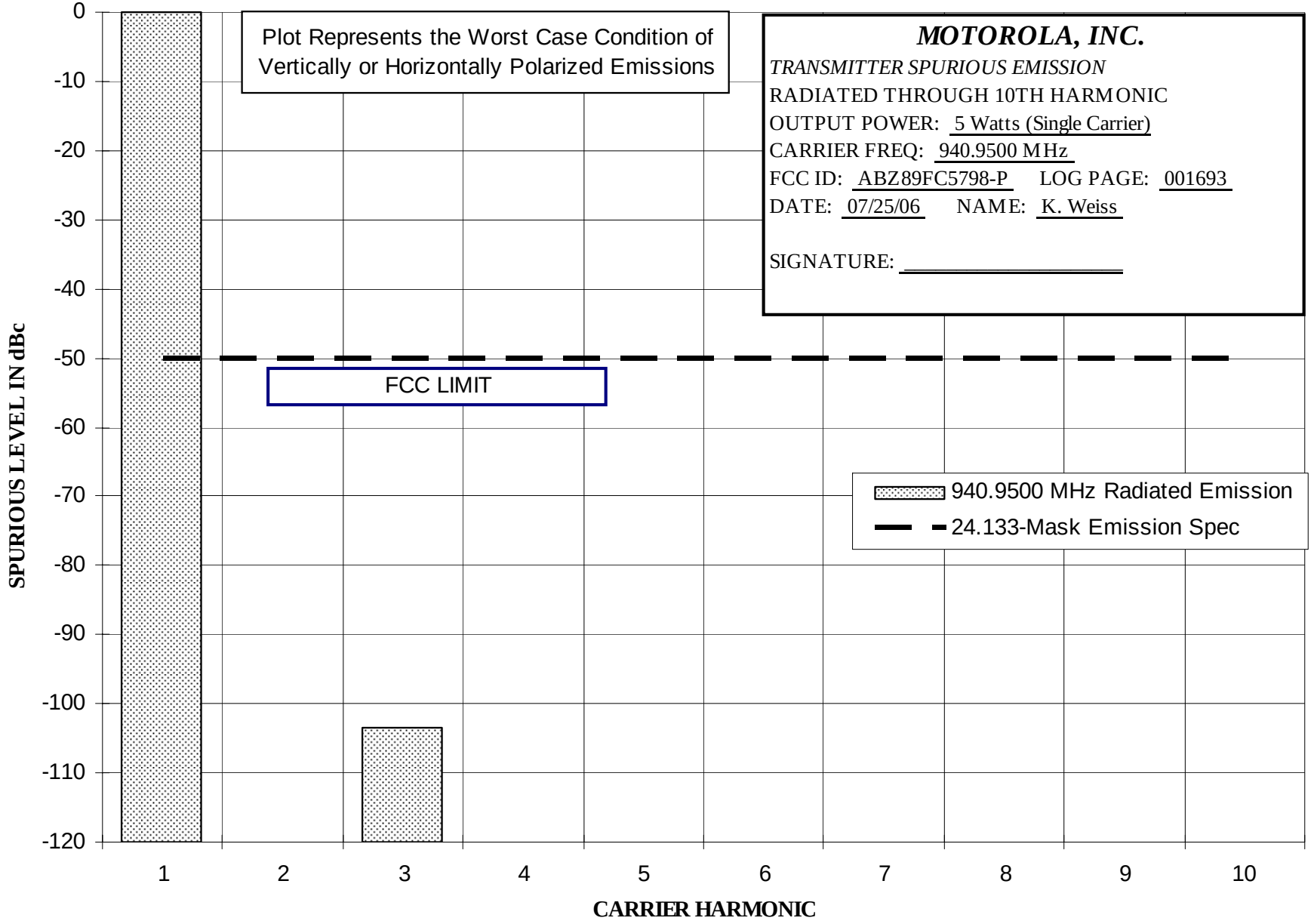



EXHIBIT 11D-2


Plot Represents the Worst Case Condition of
Vertically or Horizontally Polarized Emissions
MOTOROLA, INC.
TRANSMITTER SPURIOUS EMISSION
RADIATED THROUGH 10TH HARMONIC
OUTPUT POWER: 52 Watts (Single Carrier)
CARRIER FREQ: 940.9500 MHz
FCC ID: ABZ89FC5798-P LOG PAGE: 001693
DATE: 07/25/06 NAME: K. Weiss
SIGNATURE:
FCC LIMIT
940.9500 MHz Radiated Emission
24.133-Mask Emission Spec
SPURIOUS LEVEL IN dBc
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
1
2
3
4
5
6
7
8
9
10
CARRIER HARMONIC


Plot Represents the Worst Case Condition of Vertically or Horizontally Polarized Emissions
MOTOROLA, INC.
TRANSMITTER SPURIOUS EMISSION
RADIATED THROUGH 10TH HARMONIC
OUTPUT POWER: 5 Watts (Single Carrier)
CARRIER FREQ: 940.9500 MHz
FCC ID: ABZ89FC5798-P LOG PAGE: 001693
DATE: 07/25/06 NAME: K. Weiss
SIGNATURE:
FCC LIMIT
940.9500 MHz Radiated Emission
24.133-Mask Emission Spec
SPURIOUS LEVEL IN dBc
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
1
2
3
4
5
6
7
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9
10
CARRIER HARMONIC

**Report on Test Measurements**

*Oscillator Frequency Stability*

**SPECIFICATION REQUIREMENT:**

**Reference: Part 24.135**

Fixed and Base stations, operating at 940-941 MHz, must have a frequency stability of better than +/- 1 PPM.

Manufacturer data for the system site frequency standard was used in generation of the following frequency stability exhibits.

**FREQUENCY STABILITY PLOTS:**

| EXHIBIT | DESCRIPTION |
|---|---|
| 11E-1 | Frequency Stability Vs Temperature |
| 11E-2 | Frequency Stability Vs Voltage |

APPLICANT: MOTOROLA, INC.

EQUIPMENT TYPE: ABZ89FC5798-P

**MOTOROLA, INC.**

*OSCILLATOR FREQUENCY STABILITY CHARACTERISTIC Vs. TEMPERATURE*

OSCILLATOR FREQUENCY: 5 MHz
FCC ID: ABZ89FC5798-P LOG PAGE: 885767
DATE: 6/28/00 NAME: Ken Weiss

SIGNATURE: _____

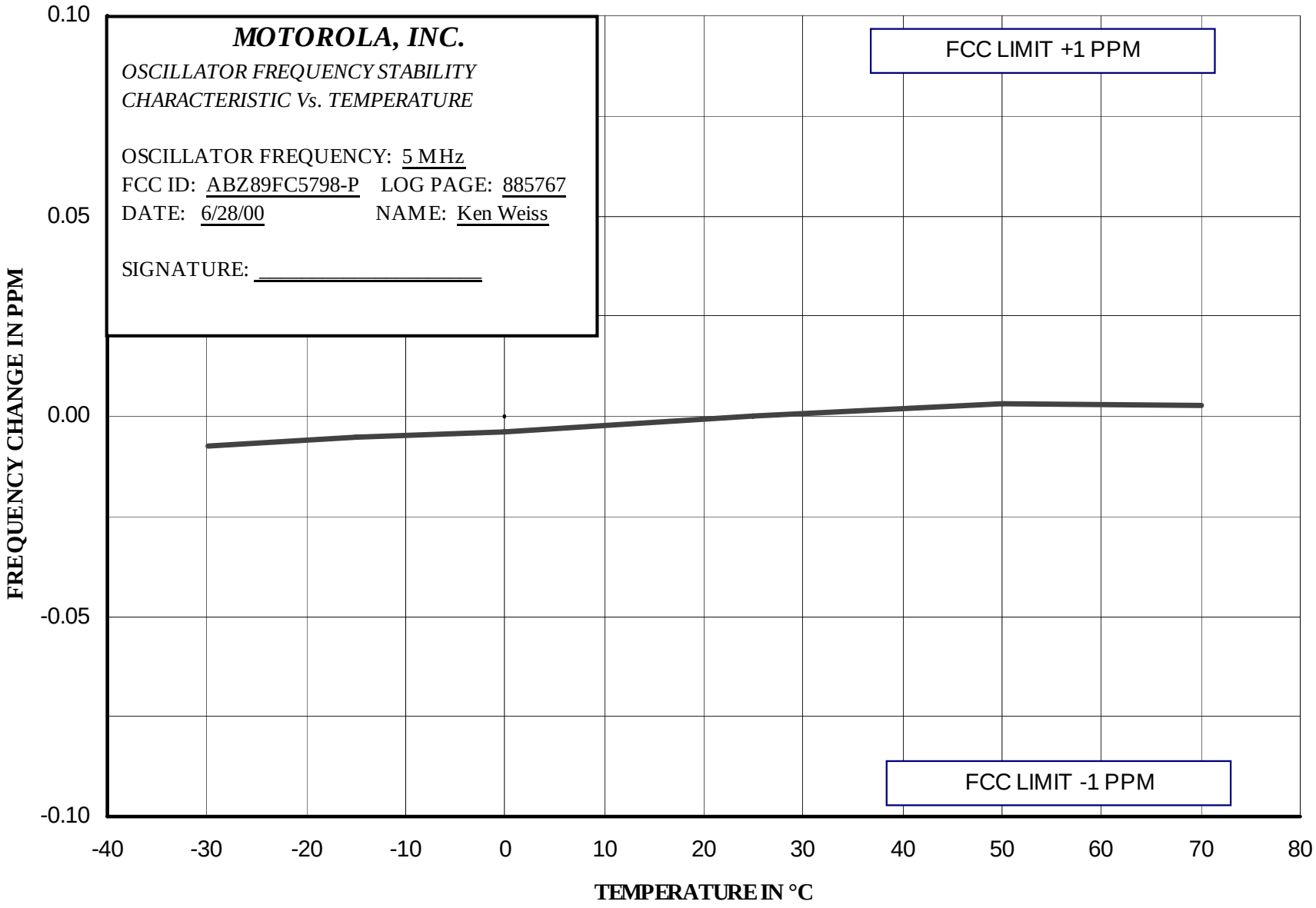
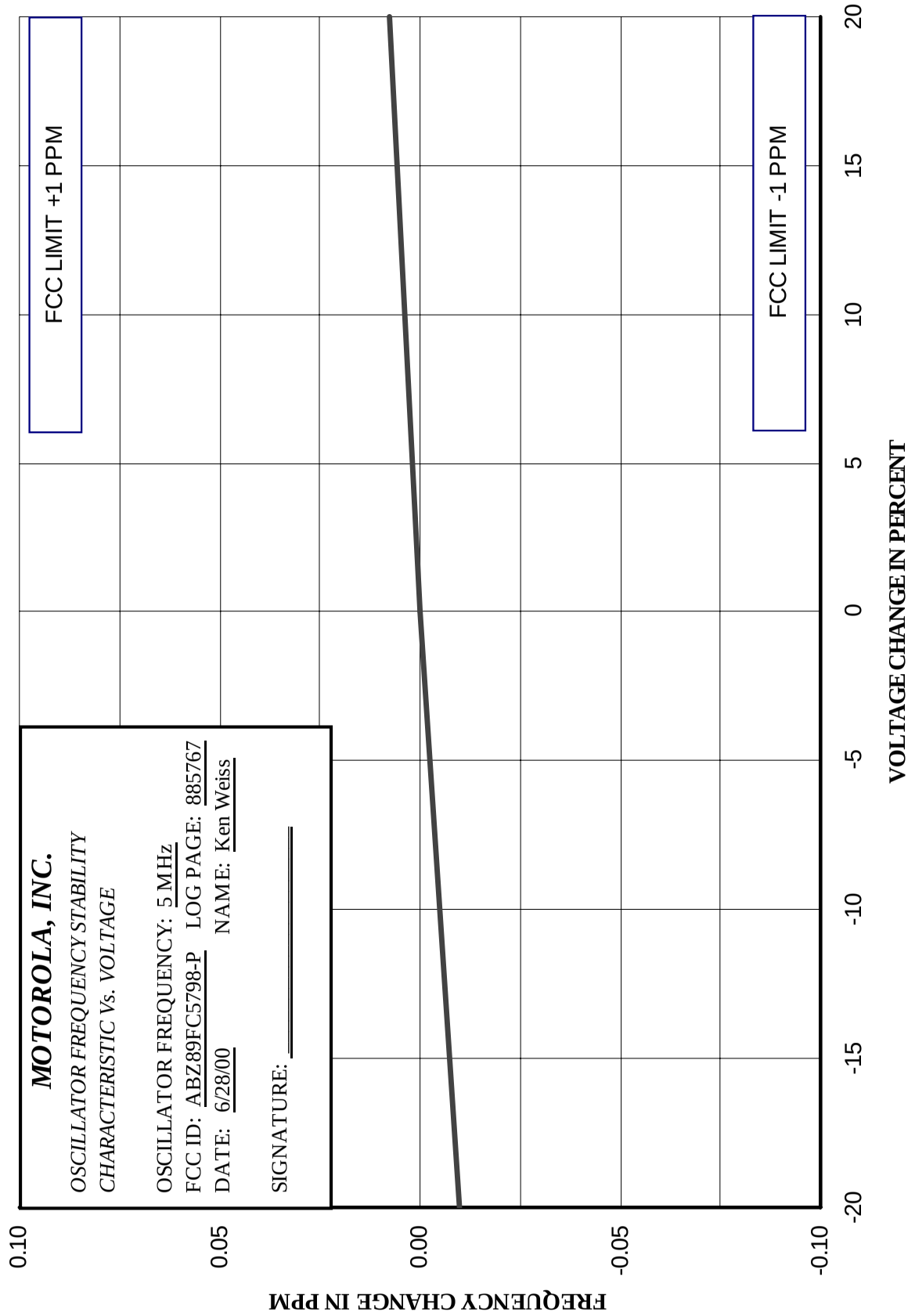



EXHIBIT 11E-1


MOTOROLA, INC.
OSCILLATOR FREQUENCY STABILITY
CHARACTERISTIC Vs. VOLTAGE
OSCILLATOR FREQUENCY: 5 MHz
FCC ID: ABZ89FC5798-P LOG PAGE: 885767
DATE: 6/28/00 NAME: Ken Weiss
SIGNATURE:
FCC LIMIT +1 PPM
FCC LIMIT -1 PPM
FREQUENCY CHANGE IN PPM
0.10
0.05
0.00
-0.05
-0.10
-20
-15
-10
-5
0
5
10
15
20
VOLTAGE CHANGE IN PERCENT

**Report on Test Measurements**

*Human Exposure Compliance Statement*

**SPECIFICATION REQUIREMENT:**

§ 24.52 (RF Hazards)

Motorola certifies that it has determined that the equipment for which authorization is being sought complies with IEEE C95.1-1991, "IEEE Standards for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz" as measured using methods specified in IEEE C95.3-1991, "Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields -- RF and Microwave." This certification is based upon the installations being made in accordance with the instructions supplied with the equipment and in recognition that because of the characteristics of a particular site, a determination of compliance with respect to any particular site can be made only upon an analysis of the installation.

*Human Exposure Manual Section*

**SPECIFICATION REQUIREMENT:**

§ 24.52 (RF Hazards)

This equipment is designed to generate and radiate radio frequency (RF) energy. It should be installed and maintained only by trained technicians. Licensees of the Federal Communications Commission (FCC) using this equipment are responsible for ensuring that its installation and operation comply with FCC regulations designed to limit human exposure to RF radiation in accordance with the American National Standards Institute IEEE Standard C95.1-1991, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.*

This standard establishes two sets of "maximum permitted exposure" limits, one for "controlled" environments and another that allows less exposure, for "uncontrolled" environments. These terms are defined by the standard:

> **Uncontrolled environment:** Uncontrolled environments are locations where there is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or workplaces where there are no expectations that the exposure levels may exceed those shown [in a table of exposure limits].
>
> **Controlled environment:** Controlled environments are locations where there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment, by other cognizant persons, or as the incidental result of transient passage through areas where analysis shows the exposure levels may be above those shown in [the table of limit exposures for uncontrolled environments] but do not exceed the values in [the table of higher limit values for controlled environments].

The maximum permitted exposures prescribed by the standard are set in terms of different parameters of effects, depending on the frequency generated by the equipment in question. At the frequency range of this Personal Communication System equipment, 940-941 MHz, the maximum permitted exposure levels are set in terms of "power density", whose definition and relationship to electric field and magnetic field strengths are described by the standard as follows:

> **Power density (S):** Power per unit area normal to the direction of propagation, usually expressed in units of watts per square meter ($W/m^2$) or, for convenience, units such as milliWatts per square centimeter ($mW/cm^2$). For plane waves, power density, electric field strength (E) and

magnetic field strength (H) are related by the impedance of free space, i.e., 377 ohms. In particular,

$$S = \frac{E^2}{377} = 377 \quad H^2$$

where E and H are expressed in units of V/m and A/m, respectively, and S in units of W/m$^2$. Although many survey instruments indicate power density units, the actual quantities measured are E or E$^2$ or H or H$^2$.

Within this frequency range, the maximum permitted exposure limit for uncontrolled environments is a power density (mW/cm$^2$) that equals f/1500, where "f" is the frequency expressed in MHz, and measurements are averaged over a period of 30 minutes. The maximum permitted exposure limit for controlled environments, also expressed in mW/cm$^2$, is f/300 where measurements are averaged over 6 minutes. Applying these principles to the minimum and maximum frequencies for which this equipment is intended to be used yields the following maximum permitted exposure levels:

| | Uncontrolled Environment | Controlled Environment |
|---|---|---|
| | 941 MHz | 941 MHz |
| Limit | 0.627 mW/cm$^2$ | 3.14 mW/cm$^2$ |

If it is intended that the equipment will operate at more than one frequency, compliance should be assured at the frequency which produces the lowest exposure limit (among the frequencies at which operation will occur).

Licensees must be able to certify to the FCC that their facilities meet the limits shown above. Some lower power PCS devices, 100 milliWatts or less, are excluded from demonstrating compliance, but this equipment operates at power levels orders of magnitude higher, and the exclusion is not applicable.

Whether a given installation meets the maximum permitted exposure limits depends, in part, upon antenna type, antenna placement and the output power to which this equipment is adjusted. The following example sets forth the distances from the antenna to which access should be prevented in order to comply with the "uncontrolled" and "controlled" environment exposure limits as set forth in the ANSI IEEE standards and computed above.

*Human Exposure Manual Section*

**Example Calculations for iDEN 900 MHz Quad Transmitter:**

Calculating the minimum distance from the antenna necessary to meet the requirements of an uncontrolled environment, we assume the following:

Transmit frequency = 941 MHz
Base station cabinet output power, *P* = +47.16 dBm (52 Watts)
Antenna feeder cable loss, *CL* = 1.0 dB
Antenna input power *Pin* = *P* - *CL* = +47.16 - 1.0 = +46.16 dBm (41.3 Watts)
Antenna gain, *G* = 14.9 dBd, 17 dBi, sector antenna
Antenna height, *h* = 2.44 m

Using the following relationship (cylindrical model used for near field calculation)[1]:

$$S = \frac{Pnet}{2\pi Rh}$$ Omni-directional antenna

Or

$$S = \left(\frac{180}{\theta}\right)\frac{Pnet}{\pi Rh}$$ Sectorized antenna

where *S* is the maximum permissible power density in W/m$^2$ and *R* is the safe distance from the sectorized antenna in meters, the minimum distance is calculated as follows:

$$R = \left(\frac{180}{\theta}\right)\frac{Pnet}{2\pi hS} = \frac{41.3}{\pi \times 2.44 \times 6.27} = 1.5$$ Meters (uncontrolled environment)

$$R = \left(\frac{180}{\theta}\right)\frac{Pnet}{2\pi hS} = \frac{41.3}{\pi \times 2.44 \times 31.4} = 0.3$$ Meters (controlled environment)

where *S* = 6.27 W/m$^2$ and *S* = 31.4 W/m$^2$ are obtained from table listed above by converting from mW/cm$^2$ to W/m$^2$.

**Note:** The above result applies only in the direction of maximum radiation of the antenna. Actual installations may employ antennas that have defined radiation patterns and gains that differ

[1] Federal Communications Commission Office of Engineering & Technology, OET Bulletin 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 97-01, page 32.

from the example set forth above. The distances calculated can vary depending on the actual antenna pattern and gain.

While installation calculations such as the above are useful and essential in planning and design, validation that the operating facility using this equipment actually complies will require making power density measurements. For information on measuring RF fields for determining compliance with ANSI IEEE C95.1-1991, see *IEEE Recommended Practice for the Measure of Potentially Hazardous Electromagnetic Fields - RF and Microwave,* IEEE Std C95.3-1991. Copies of IEEE C95.1-1991 and IEEE C95.3-1991 may be purchased from The Institute of Electrical and Electronics Engineers, Inc., Attn: Publication Sales, 445 Hoes Lane, P.O Box 1331, Piscataway, NJ 08855-1331, (800) 678-IEEE or from ANSI, (212) 642-4900. Persons responsible for installation of this equipment are urged to consult these standards in determining whether a given installation complies with the applicable limits.

Whether a given installation meets ANSI standards for human exposure to radio frequency radiation may depend not only on this equipment but also on whether the "environments" being assessed are being affected by radio frequency fields from other equipment, the effects of which may add to the level of exposure. Accordingly, the overall exposure may be affected by radio frequency generating facilities that exist at the time the licensee's equipment is being installed or even by equipment installed later. Therefore, the effects of any such facilities must be considered in site selection and in determining whether a particular installation meets the FCC requirements.

## Report on Test Measurements

*Test Equipment List*

| MODEL | MANUFACTURER | DESCRIPTION | Serial No. | Last Cal | Next Cal |
|---|---|---|---|---|---|
| 438A | Hewlett Packard | RF Power Meter | 3513U06093 | 10/24/05 | 10/23/08 |
| 8481A | Hewlett Packard | RF Power Sensor | 3318A90348 | 11/19/04 | 11/19/07 |
| E4443A | Agilent | Spectrum Analyzer | MY43360090 | 12/27/03 | 12/27/06 |
| 83712A | Hewlett Packard | Signal Generator | 3429A00455 | no calibration required | |
| 85460A | Hewlett Packard | EMI Analyzer, Filter | 3704A00467 | 11/17/03 | 11/17/06 |
| 85462A | Hewlett Packard | EMI Analyzer, RF/Display | 3906A00500 | 11/17/03 | 11/17/06 |
| 8593E | Hewlett Packard | EMI Receiver | 3513A01649 | 05/19/04 | 05/19/07 |
| (Various) | Weinschel, Kathrein, Bird | RF Loads, Couplers, Filters | Various | no calibration required | |
| 3020A, etc. | Narda | Directional Coupler | Various | no calibration required | |
| 8593A | Hewlett Packard | Spectrum Analyzer | 3513A01649 | 05/19/04 | 05/19/07 |
| 438A | Hewlett Packard | RF Power Meter | 2743A04603 | 10/28/05 | 10/28/06 |
| 8482A | Hewlett Packard | RF Power Sensor | 2652A13844 | 10/31/05 | 10/31/06 |