DESCRIPTIVE INFORMATION

FCC FILING FOR SC4812T @1.9 GHz CDMA BTS

The Information in this exhibit is in accordance with the FCC Rules and Regulations, Vol. II, Part 2, Subpart J. Sections 2.1033 through 2.1055 are addressed.

Section 2.1033 (a) **Name of Applicant and Manufacturer:** MOTOROLA

Section 2. 1033 (b) **Identification of Equipment:** IHET6BN1

Section 2. 1033 (c) **Quantity Production:** Quantity Production is planned.

Section 2. 1033 (d) **Technical Description**

This Transmitter is intended for use in the Public Cellular Radio Telecommunications Service and is designed in compliance with the FCC Rules and Regulations Title 47, Part 24(E). This transmitter is capable of spread spectrum (CDMA) operation, and allows up to 128 Walsh codes to support Pilot, Sync, Paging, Supplemental, and Traffic channels.

(1) **Types of Emissions**

This equipment will be capable of operation using wide band spread spectrum techniques employing Direct Sequence Code Division Multiple Access (DS-CDMA) digital communication techniques.

For this transmitter, the emission designator is 1M25F9W (per FCC Part 2.201, subpart C).

(2) **Frequency Range**

This transmitter operates within the 1930 to 1990 MHz Band (per FCC Part 24). This base station will support CDMA operations on channel numbers 25 through 1175 (1931.25 MHz - 1988.75 MHz).

(3) **Range of Operating Power**

The rated maximum average power out of the SC4812T @1.9 GHz CDMA BTS is 40 W (46.0 dBm) per RF carrier. However, in CDMA the actual power output is based on the number of traffic channels in operation. The minimum power occurs when only a pilot signal is present. The maximum power occurs when a pilot along with synchronization, paging, and traffic channels are present. For a typical system setup, the theoretical difference between minimum power and maximum power is about 20 dB. The output power is variable in 0.25 dB steps.

(3) **Range of Operating Power (cont.)**

In addition, the dynamics of a CDMA system allow for what is called "cell breathing". This allows an operator to vary the range of a cell by controlling the power of the pilot signal.

(4) **Maximum Power Limits**

The peak output power of a base station transmitter may not exceed 100 Watts as defined in Part 24.232.

(5) **Applied voltages and currents into the final transistor elements of the transmitter output:**

In the CDMA system, the applied voltages and currents into the final transistor elements SRF7042X4 for 40 W output:

Drain	27.7 VDC
Drain Current	1.0 AMPS x 3
Gate Voltage	4 VDC

(6) **Function of Each Active Device**

Refer to the Operational Description Exhibit.

(7) **Complete Circuit Diagrams**

Refer to the Schematics Exhibit.

(8) **Instruction/Installation Manual**

Refer to the Installation Manual Exhibit.

(9) **Tune-Up/Optimization Procedure**

Refer to the Users Manual Exhibit.

(10) Means for Frequency Stabilization

Refer to Section F of the Test Report Exhibit.

The Clock Synchronization Module (CSM/CSM2) provides clock and time signals for an SC4812T @1.9 GHz CDMA BTS. In addition, it provides the primary source, a 3 MHz clock, for the transmit synthesizer in the Broadband Transceiver. The CSM/CSM2 relies on a GPS receiver, either riding piggyback onto the CSM/CSM2 card or remotely located in an integrated package with the GPS antenna as the primary time reference for the ovenized oscillator. Two types of redundancy are provided:

1) Dual CSM/CSM2 cards provide redundancy in case of primary CSM/CSM2 failure.

2) Redundancy is also provided by either a High Stability Oscillator (HSO) or a Low Frequency Reference (LFR), such as a Loran C receiver, residing in a separate slot. The HSO is provided in case of GPS system failure.

The CSM/CSM2 uses the received signals as a reference to provide the required clock for the site. The CSM/CSM2 distributes CDMA time, a 19.6608 MHz clock, and a two second synchronization pulse every even second of universal time to the CDMA Clock Distribution (CCD) Cards .

The CSM/CSM2 is also responsible for configuration and management of the GPS and LFR systems. CSM/CSM2 software determines on a site basis what the GPS and LFR configurations should be. For future Commercial CDMA systems, GPS and LFR configuration information could optionally be downloaded to the CSM/CSM2 from the GLI2. The CSM/CSM2 is managed by the GLI2.

The High Stability Oscillator (HSO) or Low Frequency Time Reference (LFR) is used to provide a stable time reference in case of a GPS system failure or shutdown. The output of the LFR card is routed to the CSM/CSM2 cards, which derive the appropriate time references for the RF section. The current LFR is a LoranC receiver. In areas where LoranC is unavailable, the HSO may be used.

(11) **Means for Attenuation of Spurious Emissions**

Refer to Section C of the Test Report Exhibit.

Band pass filters are employed in the transmit RF circuit to attenuate far out spurious emissions. The filter used here is of an air dielectric cavity resonator type.

In addition to the digital filters described below, the baseband also employs a discrete anti-alias filter that attenuates signals greater than 2MHz. Out of band emissions are also attenuated by ceramic filters in the transmit RF lineup.

In addition, suppression of spurious radiation is obtained by proper shielding techniques.

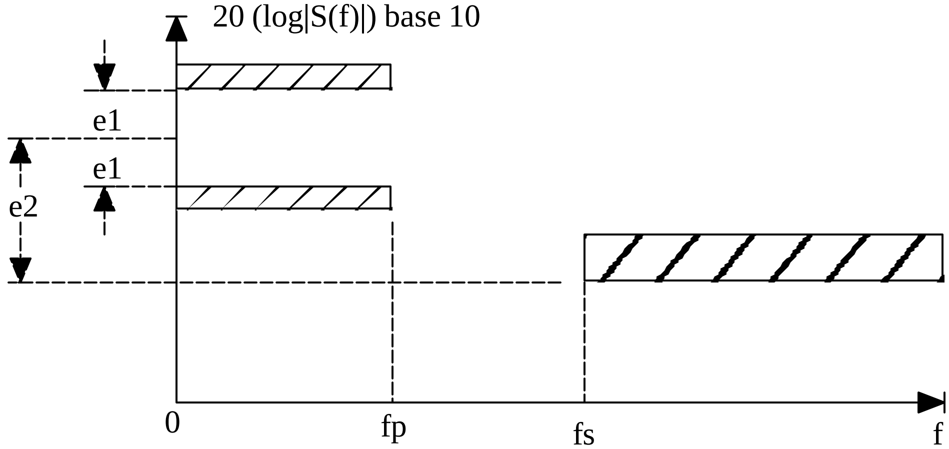
Means for Limiting Modulation

Refer to Sections B and F of the Test Report Exhibit.

In a CDMA system, the input signal (voice for example) is sampled and coded in a vocoder. This signal is then spread to 1.23 MHz by a pseudo-random spreading code. This spreading code sets the bandwidth of the spread-spectrum signal. If more than one signal is in operation (i.e. more than one voice channel), then the two signals are simply layered one atop the other within the 1.23 MHz band. So, to some extent, the bandwidth of the transmitted signal is limited by the chip rate of the PN spreading code.

Primary limiting of the CDMA signal bandwidth is accomplished by the use of baseband digital filtering. This consists of Finite Impulse Response (FIR) filters in the BBX . The FIR filtering conforms to the IS95A/B and IS2000 spectral shape is limited in conformance to the spectral mask shown below. Output I and Q data streams from the filters are guaranteed to be 54 dBc below the carrier at 885 kHz offset. Higher order images of the digital output are removed with the analog anti-alias filters post the analog-to-digital converters (DACs).

The baseband filters have a linear phase. In addition, they have a frequency response S(f) that satisfies the limits shown in the figure below. The normalized frequency response of the filter shall be contained within plus or minus error (e1) in the passband and shall be less than or equal to error (e2) in the stop band (f>fs). The numerical values for the parameters are e1=1.5dB, e2=-40dB, fp=590kHz, and fs=740kHz.



BASEBAND FILTERS FREQUENCY RESPONSE LIMITS

The peak-to-average ratio, and to some extent the overall power, is also limited with a programmable digital limiter. The digital limiter prevents occasional large peaks and thus avoids amplifier operation in a non-linear region that could produce spectral re-growth.

Means for Limiting Power

The power output will be controlled by the Multi-Channel CDMA (MCC) card and the Base Band Transceiver (BBX). The Base Band Transceiver card (BBX) has an automatic gain control around the transmitter lineup to maintain an output power that is within $\pm$1dB of the input power plus required gain on the BBX . In addition, the baseband filtering system is implemented in a manner that precludes digital wrap around. That is, the filters and other compensation blocks saturate rather than roll over. Thus, large power swings are not presented to the DACs or, subsequently, to the power amplifiers. Naturally occurring peaks are also limited with the digital limiter as described above.

(12) **Description of Digital Modulation Techniques**

This system supports and conforms to the modulation characteristics for voice and data as defined by IS95 A and B. It also supports and conforms to the modulation characteristics of IS2000 for spreading rate 1, rate sets 3 and 4 and user data rates up to 153.6 kbps. For clarity, the following table shows all supported data rates and modulation characteristics supported by the system.

Forward Radio Configuration	Rates	
RC1	1200, 2400, 4800 and 9600 bps data; R=1/2; BPSK modulation	Rate Set 1
RC2	1800, 3600, 7200 and 14400 bps data; R=1/2; BPSK modulation	Rate Set 2
RC3	1500, 2700, 4800, 9600, 19200, 38400, 76800 and 153600 bps data; R=1/4; QPSK modulation	Supported in 1X mode only

Forward Radio Configurations

Modulation of individual channels is performed digitally, at baseband and in conformance with the modulation characteristics defined by the standards. Once modulated, the amplitude of each channel is set and Walsh code spreading is applied. At this point, all channels assigned to a particular carrier are summed together with the pilot, sync and paging channels, limited to reduce the peak to average power, and then quadrature spread. The spread, baseband carrier is then digitally filtered and applied to an RF carrier. Each RF carrier is then amplified, combined with other carriers and then transmit out the base station antenna.

Section 2.925 (f) **Equipment Identification**

A drawing of the equipment identification nameplate appears in the ID Label/Location Info Exhibit.

Section 2.925 **Photographs**

The photographs showing external construction are in the External Photos Exhibit. The photographs showing internal construction are in the Internal Photos Exhibit.

Section 2.925 **Description of Various Cabinet Configurations**

The Frame contains one Combined CDMA Channel Processing (C-CCP) shelf, capable of supporting up to 12 MCC cards. The MCC provides signal processing functions necessary to implement various channel functions specified in the CDMA Common Air Interface specification. Channel types include sync channels, paging channels, access channels, and traffic channels. The pilot Channel is implemented on the BBX. The MCC converts between CDMA STRAU traffic and control format and CDMA baseband format. RX inputs from the BBX to the MCC consist of I and Q signals from the main & diversity receive antennas. Each of the 13 BBX cards has its own common connection to all MCC cards. A single TX output per MCC per sector is routed to the proper BBX. The C-CCP shelf supports up to 4 dedicated CDMA carriers at 1 to 3 sectors or up to 2 dedicated CDMA carriers at 6 sectors The C-CCP also contains control, clock, and alarm functions as required.

A fully loaded Frame supports one complete C-CCP shelf. Up to four (4) CDMA Carriers for 3 sectors and up to two carriers for 6 sectors will provide transmission. Again, the frame is configurable in an omni, three-sector, or six-sector arrangement.

Section 2.925 **Use with Various Power Supplies**

The Frame can accommodate a DC input voltage of +27VDC. Polarity changes are accommodated in the power distribution area by feeding straight through or crossing over the primary input voltage. Circuit breakers are provided for each feed to the C-CCP shelf in the Frame. Additionally, circuit breakers are provided for fans and other components requiring direct primary input voltage.

Three Power Supply Cards installed in the C-CCP Shelf convert the input DC voltage to the necessary voltages required to power the cards in the shelf.

The power supply cards are in a N+1 redundant, load sharing configuration. This means all supplies are on line at all times. Two supplies have the capacity to power an entire shelf. With this scheme, one supply is not designated as primary or redundant, all are on line and circuitry between the supplies assures load sharing equality to within approximately 15%. Each supply has an LED to alarm a detected failure.

Section 2.1047(d) Measurements Required: **Modulation Characteristics**

Refer to Section B of the Test Report Exhibit. Waveform Quality (ρ)

<u>DEFINITION</u>

Transmit waveform quality is the normalized correlated power between the actual waveform and the ideal waveform. The range of values for the transmit waveform quality is from 1.0, a perfect CDMA waveform, to 0.0, a non-CDMA signal. As an example, a base station with a 0.4 dB degradation in its transmit waveform would have a quality (ρ) of 10^(-0.4/10) = 0.912.

<u>MINIMUM STANDARD</u>

The minimum waveform quality figure for a spread-spectrum CDMA signal is -0.4 dB or 0.912 as measured with a Rho meter.

METHOD OF MEASUREMENT

Set the pilot level to 20% of the CDMA Avg. power, and transmit the pilot signal only. Connect the Rho meter directly to the transmit port. On the CDMA Rho Meter, disable the RF generator and set the tuning mode to manual. Enter the base station's RF transmit frequency and set the input attenuation to hold. Set the input attenuation to 20 dB. Now, set the DSP Analyzer test mode to continuous and chose the Rho measurement as the measurement type. Set the channel to forward and choose amplitude middle as the trigger qualifier. Set the gain to 0 dB. Set the reference frequency to 19.6608 MHz. Select internal to lock-on to the CDMA time base reference. Read the measured value for Rho on the Rho meter.

Section 2.1049(c) Measurement Required: **Occupied Bandwidth**

Refer to Section E of the Test Report Exhibit.

DEFINITION

The measured spectral width of an emission. The measurement determines occupied bandwidth as the difference between upper and lower frequencies where 0.5% of the emission power is above the upper frequency and 0.5% of the emission power is below the lower frequency at rated power, with Pilot, Page, Sync, and Traffic Channel modulation.

Data to show the bandwidth occupied by this transmitter and output power is presented in the form of Channel Power Measurement plots from a spectrum analyzer. The Channel Power Measurement divides the Channel Power Bandwidth into increments (defined by the Resolution Bandwidth Setting selected), then sums the energy contained in each of those increments to provide an integrated measurement of the power in the Channel Power Bandwidth.

METHOD OF MEASUREMENT

Connect a spectrum analyzer to the cabinet RF Transmit Port. Set the CDMA signal power to maximum. Setup the spectrum analyzer to make the following integrated Channel Power Measurements:

1. Channel Power Measurement of the CDMA Carrier Centered at 1931.25 (Ch. 25)

Channel Power Bandwidth: 1.25 MHz

Resolution Bandwidth: 30 KHz

2. Channel Power Measurement of the CDMA Carrier Centered at 1988.75 (Ch. 1175).

Channel Power Bandwidth: 1.25 MHz

Resolution Bandwidth: 30 KHz

Record the Channel Power Measurements.

Repeat the procedure with the CDMA signal power set to Minimum level.

Section 2.1051 Measurement Required: **Spurious & Harmonic Emissions at the Antenna Terminals**

Refer to Section D of the Test Report Exhibit.

DEFINITION

Conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies that are outside the authorized bandwidth of the transmitter at rated power, with Pilot, Page, Sync, and Traffic Channel modulation. Reduction in the level of these spurious emissions will not affect the quality of the information being transmitted.

MINIMUM STANDARD

Per CFR 47 Part 24.238 the minimum standards for Transmit Port Conducted Spurious Emissions are as follows:

Section 24.238 (a) Emission Limits

On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43+10 log (P) dB.

METHOD OF MEASUREMENT

Connect a spectrum analyzer to the cabinet RF Transmit Port. Measure the power level at the carrier frequency. Now, sweep the spectrum analyzer over a frequency range from 1MHz to tenth harmonic of the carrier frequency, recording all spurious emissions.

Section 2.1053 Measurement Required: **Field Strength of Spurious & Harmonic Radiation**

Refer to Section C of the Test Report Exhibit.

DEFINITION

Radiated spurious and harmonic emissions are emissions from the equipment when loaded into a non-radiating load on a frequency or frequencies that are outside an occupied band sufficient to assure transmission of information with required quality for the class of communications desired at rated power, with Pilot, Page, Sync, and Traffic Channel modulation. The reduction in the level of these spurious emissions will not affect the quality of the information being transmitted.

MINIMUM STANDARD

The magnitude of each spurious and harmonic emission that can be detected when the equipment is operated under the conditions specified in the alignment procedure, shall not be less than 43 + 10*log(mean output power in Watts) dB below the mean power output. Necessary measurements were made at Motorola Inc., located at 1475 W Shure Dr, Arlington Heights, IL 60004 or at the radiation UL International Lab test facility located at 333 Pfingsten Road., Northbrook, IL 60062-2096

INSTALLATION OF EQUIPMENT

The equipment under test is placed on a turntable, connected to a dummy RF load, and placed in normal operation. A receiving antenna located 3 meters from the turntable picks up any signal radiated from the transmitter and its operating accessories. The antenna is adjustable in height from 1 to 4 meters and can be horizontally or vertically polarized.

METHOD OF MEASUREMENT

The equipment is adjusted to obtain peak readings of received signals wherever they occur in the spectrum by:

1. Rotating the transmitter under test.

2. Adjusting the antenna height.

The testing procedure is repeated for both horizontal and vertical polarization of the receiving antenna. Relative signal strength is indicated on meters built into the receiver. To obtain an actual radiated signal strength, the meter reading is adjusted to correct for all affecting factors, such as antenna gain, RF gain, and cable loss. A table of correction factors vs. frequency is then used to convert a signal level measured at the receiver to the value that would be measured at the device (assuming an isotropic radiator).

Section 2.1055 Measurement Required: **Frequency Stability**

Refer to Section F of the Test Report Exhibit.

DEFINITION

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

MINIMUM STANDARD

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block (per CFR47 Part 24.235).

METHOD OF MEASUREMENT

Frequency measurements shall be made at the extremes of the temperature range -30 to 50 degrees Celsius and at intervals of not more than 10 degrees throughout the range. A period of time sufficient to stabilize all of the components in the equipment shall be allowed prior to each frequency measurement. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need to be subjected to the temperature variation test.