DESCRIPTIVE INFORMATION

FCC FILING FOR SC4812ETL @ 800 MHz CDMA BTS

The Information in this exhibit is in accordance with the FCC Rules and Regulations, Vol. II, Part 2, Subpart J. Sections 2.983 through 2.999 are addressed.

Section 2.983 (a) **Name of Applicant and Manufacturer:** MOTOROLA

Section 2.983 (b) **Identification of Equipment:** IHET5AP2

Section 2.983 (c) **Quantity Production:** Quantity Production is Planned.

Section 2.983 (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 22(E).This transmitter is capable of spread spectrum (CDMA) operation, and allows up to 64 Walsh codes to support Pilot, Sync, Paging 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 869.70 to 893.31 MHz Band (per FCC Part 22). This base station will support CDMA operations on channel numbers 1013 through 1023 and 1 through 777 inclusive.

(3) **Range of Operating Power**

The rated maximum average power out of the SC4812ETL @ 800 MHz CDMA BTS is 40 W (46.0 dBm). 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 8dB. The output power is variable in 0.25 dB steps. The range is 12 dB.

(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 22.232

(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 SC4812ETL @ 800 MHz 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.

Bandpass 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.

The baseband employs a discrete L-C 7-pole elliptic filter. This filter is used to attenuate sideband noise and close in spurious emissions.

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

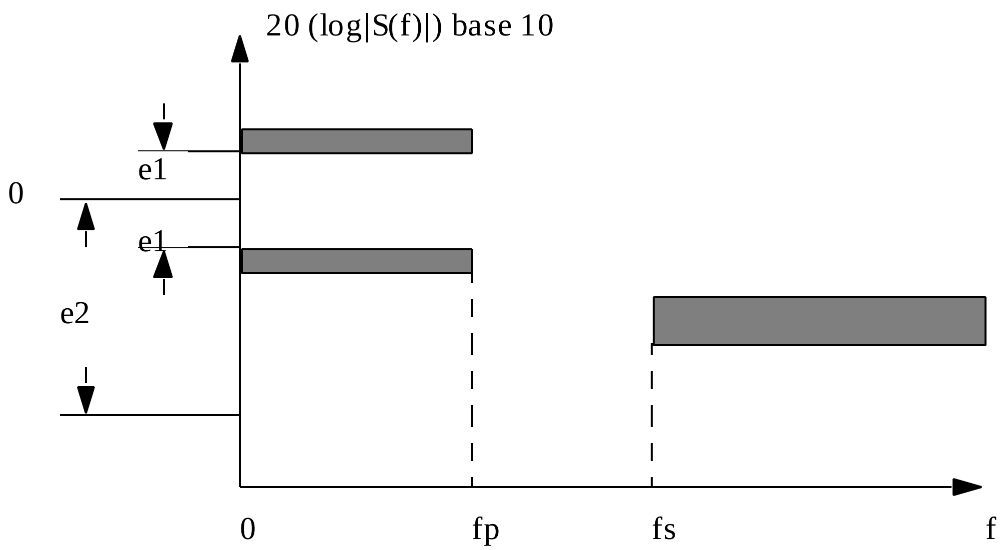
Means for Limiting Modulation

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 a programmable digital limiter and Finite Impulse Response (FIR) filters in the BBX2. The digital limiter prevents occasional large peaks and thus avoids wrap-around error that would occur. The FIR filters are 13 Tap and run with four sets of coefficients at a 4X rate, thus being equivalent to a 48-tap linear FIR filter. Output I and Q data streams from the filters are guaranteed to be 45 dBc below the carrier at 885 kHz offset. Further filtering of the analog wave is accomplished through the use of a 7-pole elliptic filter in the BBX2. A more detailed description of the FIR filter response is given in the following graph.

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

Means for Limiting Power

The power output will be controlled by the Multi-Channel CDMA (MCC) card and the Base Band Transceiver II (BBX2). The Base Band Transceiver card (BBX2) 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 BBX2.

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

Refer to Section B of the Test Report Exhibit.

The Code Division Multiple Access (CDMA) system uses only a digital transmission mode for both the voice and data transmission. The voice vocoder rate is variable and ranges from 0.8 to 8.6 KBPS in a Rate Set 1 system, and from 1.05 to 13.35 KBPS in a Rate Set 2 system. The exact data rate chosen is based on the voice activity factor. Regardless of vocoder rate and system type, Rate Set 1 or 2, the modulation symbol rate is always 19.2 KBPS into the block interleaver and Walsh function modulator on all paging and traffic channels. Encoding at 9600 bps results in a set forward traffic channel power, and at a sub-rate of 4800 bps approximately half of the forward power is effectively reduced.

The CDMA waveform is a combination of frequency division, code division, and orthogonal signal multiple access techniques. Frequency division is employed by dividing the available spectrum into nominal 1.25 MHz bandwidth channels. Code division is employed by "mixing" the data with a pseudorandom noise binary code at a rate of 1.2288 MHz. This spreads the signal over a 1.23 MHz bandwidth.

The spread signal is then encoded into two parallel bit streams referred to as I(t) and Q(t). At any time t, the vector form of I(t) and Q(t) forms a vector which can be plotted as a constellation on a graph whose abscissa and ordinate axes are scaled in terms of the magnitude of I(t) and Q(t) respectively.
Only four differential changes between any two sequential vectors are permitted. The digitally encoded I and Q waveforms from the pilot, paging, synchronizing, and traffic signals are then digitally combined and digitally filtered. These signals are then passed through a Digital to Analog converter and filtered using a 7-pole Elliptic filter with a 3 dB cutoff frequency of 630 kHz. This encoding scheme is referred to as Binary Phase Shift Keying (BPSK). These I(t) and Q(t) signals are then applied to the modulator.

Section 2.983 (e) **Standard Test Conditions**

The following conditions and procedures were followed during testing of this transmitter:

Room Temperature	+ 25 °C
Room Humidity	50%
AC Supply Voltage	220 VAC (nominal), 47-63 Hz

Prior to testing, the unit was tuned up according to the Manufacturer's Alignment Procedure. All data presented represents the worst case parameter being measured. All test data required by sections 2.985 through 2.997 can be found in Section A through F of the Test Report Exhibit.

Section 2.983 (f) **Equipment Identification**

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

Section 2.983 (g) **Photographs**

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

Section 2.983 **Description of Various Cabinet Configurations**

The 800 MHz SC4812ETL BTS is a smaller version of the SC4812ET with the power section integrated into the same cabinet with the RF circuitry. The cabinet may be powered up with 240 VAC. Battery backup consists of up to 12 optional batteries that fit inside the cabinet. Up to two carriers are supported in a 3 sector configuration. (Six sector configurations are not available.) A future feature will add the capability of transmit diversity. In such a configuration, the cabinet will be able to support one carrier only (3 sector configuration). An air to air heat exchanger is used for cooling each cabinet, except in the LPA area, which uses blower fans.

The cabinet contains one Small CDMA Channel Processing (SCCP) shelf, capable of supporting up to 4 MCCx24 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 BBX2. The MCC converts between CDMA STRAU traffic and control format and CDMA baseband format. RX inputs from the BBX2 to the MCC consist of I and Q signals from the main & diversity receive antennas. Each of the 7 BBX2 cards has its own common connection to all MCC cards. A single TX output per MCC per sector is routed to the proper BBX2. The SCCP shelf supports up to 2 dedicated CDMA carriers at 1 or 3 sectors. The SCCP also contains control, clock, and alarm functions as required.

A fully loaded cabinet supports one complete SCCP shelf. Up to two (2) CDMA Carriers for 3 sectors will provide transmission. Again, the cabinet is configurable in an omni or three-sector arrangement, with a transmit diversity (one carrier only) option being available in future.

Section 2.983 **Use with Various Power Supplies**

The cabinet is run using AC power. A single-phase 240 VAC power source (208-240 VAC is acceptable) may be connected via the Hubbel connector. The AC power is then rectified and sent to the Power Distribution Assembly (PDA). There, relays are used to select an AC or DC input source for system power. The breakers are also located in the PDA. The rectifiers may supply a fully loaded and configured system. Three rectifiers are required to run the cabinet. The fourth rectifier provides redundancy and sharing.

Circuit breakers are provided for each feed to the SCCP shelf. Additionally, circuit breakers are provided for fans and other components requiring direct primary input voltage.

Two Power Supply Cards installed in the SCCP 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 2.987(d) Measurements Required: **Modulation Characteristics**

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

DEFINITION

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.

MINIMUM STANDARD

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 2.989(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.

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 RF 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 869.70 (Ch. 1013).

Channel Power Bandwidth: 1.25 MHz

Resolution Bandwidth: 30 KHz

2. Channel Power Measurement of the CDMA Carrier Centered at 893.31 (Ch. 777).

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 2.991 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. Reduction in the level of these spurious emissions will not affect the quality of the information being transmitted.

MINIMUM STANDARD

Per CFR 47 Parts 22.901(d) (2) and 22.917(e), 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 RF 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 2.993 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. 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 2.995 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 carrier frequency of each transmitter must be maintained within 1.5 ppm. (per CFR 47 Part 22)

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.