DESCRIPTIVE INFORMATION

FCC FILING FOR SC4812-MF 1X @ 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 2.1033 through 2.1055 are addressed.

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

Section 2. 1033 (b) **Identification of Equipment:** IHET5BP1

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 22(H). 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 1M30F9W (per FCC Part 2.201, subpart C).

(2) **Frequency Range**

This transmitter operates within the 869.70 to 893.31 MHz Band for 1X operation (per FCC Part 22). This base station will support CDMA operations on channel numbers 1013 through 1023 and 1 through 777 inclusive for 1X operation.

(3) **Range of Operating Power**

The rated maximum average power out of the SC4812-MF 1X @ 800 MHz CDMA BTS is .063mW (-12 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

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

channels are present. For a typical system setup, the theoretical difference between minimum power and maximum power is about 8 dB. The output power is variable in 0.25 dB steps. 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 500 Watts as defined in Part 22.913(a).

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

The applied voltages and currents into each of the Linear Power Amplifier's final transistor elements are as follows:

Drain	27.0 VDC
Drain Current	1.0 AMPS
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 the Test Report Exhibit.

The Clock Synchronization Module (CSM/CSM2) provides clock and time signals for an SC4812-MF 1X @ 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 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.

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

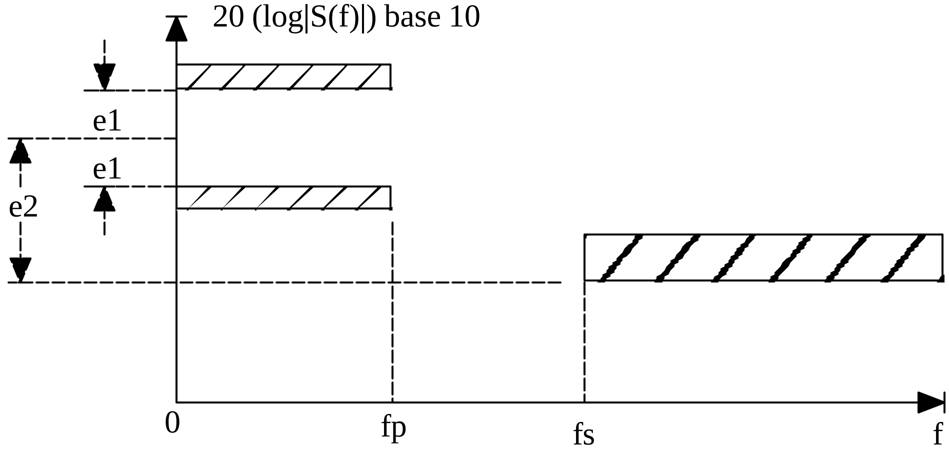
Refer to the Test Report Exhibit.

In a CDMA system, the input signal (voice for example) is sampled and coded in a vocoder. This signal is then spread to approximately 1.28 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 channel), then the two signals are simply layered one atop the other within the 1.3 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 Finite Impulse Response (FIR) filters in the BBX1X. There are two such filters, the short filter (33 tap) and the long filter (43 tap), both of which operate at 2x the CDMA chip rate. Following the FIR filters are two half band filters which each double the sample rate to procuce an 8x output rate. The digital filtering exceeds the requirements of the 48 tap CDMA specification. Output I and Q data streams from the filters are guaranteed to be 45 dBc below the carrier at 750 kHz offset. After conversion to analog, further filtering of the signal in order to prevent aliasing and further reduce emissions is accomplished with 5-pole analog filters.

A more detailed description of the typical 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.



BASEBAND FILTERS FREQUENCY RESPONSE LIMITS

The normalized frequency response of either 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:
Short filter, e1=1.5dB, e2=-8dB, fp=590kHz, and fs=740kHz
Long filter, e1=1.5dB, e2=55dB from 705kHz to 740kHz and 60dB at 740kHz.

Means for Limiting Power

The power output will be controlled by the 1X Multi-Channel CDMA (MCC) cards and the Base Band Transceiver (BBX-1X). The Base Band Transceiver card (BBX-1X) has an automatic gain control around the transmitter lineup to maintain an output power that is within ±1dB of the input power plus required gain on the BBX-1X.

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

Refer to 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 or the data rate requested by the AT. Regardless of vocoder rate and system type, 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 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 1.2888 MHz. This spreads the signal over a 1.28 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. For 1X, 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 2.925 (f) **Equipment Identification**

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

Section 2.1033 **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 BTS Configurations**

The BTS contains one Combined CDMA Channel Processing (C-CCP) shelf, capable of supporting up to 12 MCC1X cards. The MCC provides signal processing functions necessary to implement various channel functions specified in the CDMA Common Air Interface specification.

For 1X, Channel types include sync channels, paging channels, access channels, and traffic channels. The MCC converts between CDMA STRAU traffic and control format and CDMA baseband format.

Section 2.925 **Description of Various BTS Configurations (cont.)**

RX inputs from the BBX1X to the MCC consist of I and Q signals from the main & diversity receive antennas. Each of the 13 BBX1X cards has its own common connection to all MCC cards. A single TX output per MCC per sector is routed to the proper BBX1X. 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 BTS 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 BTS is configurable in an omni, three-sector, or six-sector arrangement.

Section 2.983 **Use with Various Power Supplies**

The BTS can accommodate a DC input voltage of 27V or –48VDC. During –48V operation, up to 5 power converters convert the incoming voltage to a regulated +27V buss, and share the load current equally. Circuit breakers are provided for each feed to the C-CCP shelf in the BTS. Additionally, circuit breakers are provided for fans and other components requiring direct feed from the 27V buss..

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 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 2.1049 Measurement Required: **Occupied Bandwidth**

Refer to 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 BTS 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) for 1X.

Channel Power Bandwidth:	1.30 MHz
Resolution Bandwidth:	30 KHz

2. Channel Power Measurement of the CDMA Carrier Centered at 893.31 (Ch. 777) for 1X.

Channel Power Bandwidth:	1.30 MHz
Resolution Bandwidth:	30 KHz

Record the Channel Power Measurements.

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

Refer to 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 22 the minimum standards for Transmit Port Conducted Spurious Emissions are as follows:

Section 22.917 (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 BTS 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 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 5555 N. Beach Street, Fort Worth, Texas 76137 or at the radiation test facility located at 1605 Liberty School Rd., Azle, TX 76020.

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 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 22.355)

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.