Roaming List Editor

This application displays a phone's roaming protocol information.

CAIT (not included with the MDK)

The QUALCOMM QCTest™ CDMA Air Interface Tester (CAIT) is the enhanced Windows version of QUALCOMM's Mobile Diagnostic Monitor (MDM), which has been used extensively worldwide to analyze over-the-air CDMA system performance.

CAIT characterizes over-the-air CDMA cellular or PCS system performance by measuring real-time, mobile-based CDMA RF performance as well as messaging and protocols specified by IS-95, J-STD-008, CDMA2000, 1xEV-DO, and WCDMA standards. CAIT displays subscriber station characteristics and can manipulate QUALCOMM subscriber station data and functions. CAIT is designed to operate using most handsets that contain QUALCOMM ASICs as well as all of QUALCOMM's test/trial phones. Whether conducting tests in the lab or in the field, CAIT is a powerful tool to evaluate handset and network performance.

An alternative product is the Spirent Universal Diagnostic Monitor (UDM), designed to monitor and analyze the performance of CDMA mobile devices and networks.

Note Kyocera Wireless Corp. does not distribute or resell this software. Please contact QUALCOMM Incorporated directly to obtain CAIT (http://www.qualcomm.com/qctest), or Spirent Communications to obtain their UDM (http://www.spirentcom.com).

9 Digital and Audio Signal System Specifications

CDMA transceiver signal definitions

The signals fall into the following classifications.

- Power
- Serial port 1
- Serial port 2
- Analog audio and audio control

Circuitry description

Power requirements

Power (+3.6 V to +4.2 VDC) is fed to the CDMA transceiver via the VPH_PWR signal. This signal is fed from an external DC source.

Power consumption, analog	
	Voice, while transmitting
Peak	1.1 A
Average	1.1 A

Power consumption, digital						
	Power up* **	**Registration****	**Voice***	**CS Data***	**Packet Data*+**	**GPS*+**
Peak	1300 mA	320 mA (duration 150 mS)	820 mA	410 mA	1150 mA (duration 45 mS)	1220 mA (duration 45 mS)
Average	130 mA	6 mA/9 mA**	288 mA	296 mA	705 mA	320-400 mA

* In CDMA, power consumption increases with distance from the base station. See "CDMA reverse link power control" on page 8. Max power = 25 dBm.

** The Module needs to register only once. Standby (SCI=0) wakes up every 1.2 sec for 120 mS - 140 mA.

*** Duration 3.5 mS for capacitor charging

+ Reading at beginning of session

Note There is no significant change in power consumption over the range of the supplied voltages with the spec (+3.6 V - +4.2 VDC).

There is no more than a 6% fluctuation on current consumption over the specified temperature range (-30 to +60C).

The above numbers are worst-case. We tested based on maximum current, max/min temperature, and max/min voltage conditions, so the designer can expect to encounter these values only the the worst environments (margin +/- 3%).

The *Kyocera 200 Module User's Guide*, 82-B7908-1, describes the method for bringing the CDMA transceiver to the full power-up mode. MDK users can also power up by placing a jumper across pins 2 and 3 of J5 (XCVR_EN#).

Transceiver enable and external power

There are two ways to enable the module, transceiver enable (XCVR_EN#), and external power detection (VEXT#). To use external power detection, the VEXT# signal is pulled low. In this mode, the Module will power on whenever VPH_PWR is applied. There is a pull-down resistor on VEXT#, so external power is the default setting. To use XCVR_EN#, the VEXT# signal must be pulled up to VPH_PWR. The use of these signals is described in the *Kyocera 200 Module User's Guide*, 82-B7908-1.

To use the Module as a full CDMA transceiver, a jumper should be placed over pins 2 and 3 of J5. (Note that the small white dot indicates pin 1.) To program the Module using the MDK and appropriate service programming tools, the jumper must be removed.

Transceiver detection

The signal XCVR_DET is used to detect that the Module is powered on. This is a digital signal wth a maximum current (source or sink) of 1 mA. This signal has a maximum output voltage of 2.85 V. See the *Kyocera 200 Module User's Guide*, 82-B8908-1, for more detail on the use of this signal.

LED

The Module contains circuitry to drive an external LED. A separate enable signal (LED_EN#) is used to enable the drive circuit. The output signal (LED_DRV) should be connected to the cathode of the LED. The drive current is set at 10 mA and can be used to drive multiple LEDs. Since LED_EN# is pulled up to VPH_PWR on the Module, an open collector enable circuit is recommended. If this circuit is not used, both pins should not be connected.

Serial port signals

The CDMA transceiver digital circuitry is powered from a 2.85 V supply. A series resistor or other latchup control mechanism placed at the receiver inputs of the CDMA transceiver prevents CMOS latchup due to differing supply voltages and ground bounce.

A CMOS logic high level corresponds to a data link mark or one level. A CMOS logic low level corresponds to a data link space or zero level. The data rate of this

serial interface is up to 230.4 Kbps. There shall be eight data bits, no parity, and at least one stop bit.

The maximum digital signal voltage levels for both serial ports are shown in Notes 1 and 2 in the Signal Definition Table in Chapter 15.

Serial port 1

These data signals between the CDMA transceiver and the MDK form a full duplex asynchronous serial port with CMOS levels. The port is used to pass data for standard modem functions. These signals are present on the MDK and are referred to as UART1.

The signals are standard RS-232 signals as listed below.

- MSM_DP_TXD
- MSM_DP_RXD
- MSM_DP_CTS#
- MSM_DP_RTS#
- MSM_DP_DTR#
- MSM_DP_RI#
- MSM_DP_DCD#

Serial port 2

These data signals between the CDMA transceiver and the MDK form a full duplex asynchronous serial port with CMOS levels. These signals are present on the MDK and are referred to as UART2

The signals are a subset of the standard RS-232 signals as listed below.

- MSM_DP_TXD2
- MSM_DP_RXD2
- MSM_DP_CTS2#
- MSM_DP_RTS2#

Audio circuitry description

The Module contains complete audio circuitry to allow you to complete the cellular telephone circuits in analog form. The analog form uses the traditional microphone input and speaker output.

The analog circuits are intended for a very simple, non-echo-canceling environment. The analog audio portion of the board has been carefully designed so that you can interface with the module and maintain the very highest audio quality. It is strongly recommended that the user device carefully isolate the audio circuits and grounds from all other sources of noise in the system.

On the speaker side, the output is driven directly from the codec differential outputs and can drive a 1500 ohm circuit. It is suggested that you buffer this signal with an external amplifier for driving lower impedance devices. If the external circuits are differential, then you should connect to both SPKR+ and SPKR-. If the external circuits are single-ended, then you should connect to SPKR+ and leave SPKR- floating.

The microphone inputs, MIC+ and MIC-, are differential inputs intended for use with a standard condensing microphone. If the user device has a single-ended output from microphone circuits, then MIC+ should be used for the input signal to the module and MIC- should be connected to AUDIO_GND.

Audio circuits

The Module provides raw low-level audio signals to the 50-pin module connector (see Chapter 14). These signals are amplified on the MDK board. End users needing audio should use audio circuits similar to those shown in Chapter 14.

Analog audio and audio control

On the CDMA transceiver, the audio signals connect directly to the differential audio signals on the MSM5100. The signals are:

- EAR_SPKR+, EAR_SPKR- (Connect 32 ohm or greater earpiece receiver across these lines.)
- MAIN_MIC+, MAIN_MIC- (Mic 1)
- HS_SPEAKER
- HS_MIC+ (Mic 2)

An additional signal called LSPKR_ON is present on the board-to-board connector and could be used to enable an audio amplifier on the MDK board if that is needed in the future. Another signal, HS_PRES#, is used to indicate to the CDMA transceiver that a headset has been connected to the MDK. The MDK currently has an open drain output that is pulled up through a resistor on the CDMA transceiver. When this signal goes low, it means a headset has been connected to the headset jack on the MDK.

The MDK audio circuits are optimized for the devices specified below.

Microphone

Sensitivity: -45 +/-3 dB @ 1 kHz (0 dB = 1 V/Pa) RL = 2 kohms Vcc = 2 V

Ear speaker

Impedance: 32 ohms @ 1 kHz

Sensitivity (at 1 mW/1 kHz): 105 +/-3 dB

10 Radio Frequency System Specifications

Module antenna specifications

Two 50 ohm coaxial RF connectors are provided for Module testing and integration into an end user device. One connector is for GPS RF only; the other is for the Module's tri-mode (PCS/cellular CDMA/AMPS) RF. The OEM developer must provide a suitable antenna that works in the desired frequency band of operation. The table below provides the Module's conducted receive and transmit capabilities measured at the RF connectors The antenna gain should be designed using the conducted performance as a guideline toward meeting the radiated system requirements. (See Chapter 14, "Mechanical Specifications," on page 75 for RF connector detail.)

Kyocera 200 Module conducted requirements and typical performance

Parameter	Minimum Module Requirement	Typical Module performance at 25C
GPS receiver sensitivity	-147 dBm	< -149 dBm*
PCS receiver sensitivity	-104 dBm	< -106.5 dBm
Cell CDMA receiver sensitivity	-104 dBm	< -107 dBm
AMPS receiver sensitivity	-116 dBm	< -118.5 dBm
PCS max transmit power	22.5 dBm	23 dBm
Cell CDMA max transmit power	23.5 dBm	24 dBm
AMPS max transmit power	26 dBm	26.5 dBm

* With assistance

Standards

The Kyocera 200 Module meets or exceeds the following air interface standards and minimum performance standards except as noted in the applicable "Specification exceptions" section in this chapter.

Standards specific to 800 MHz

- TIA/EIA IS-95-A

  Mobile Station – Base Station Compatibility Requirements for Dual-Mode Wideband Spread Spectrum Cellular System

- TIA/EIA TSB-74

  Support for 14.4 Kbps Data Rate and PCS Interaction for Wideband Spread Spectrum Cellular System

Standards specific to 1900 MHz

- ANSI J-STD-008

  Personal Station – Base Station Compatibility Requirements for 1.8 to 2.0 GHz CDMA PCS

- ANSI J-STD-018

  Recommended Minimum Performance Requirements for 1.8 to 2.0 GHz CDMA Personal Stations

Standards applicable to both 800 MHz and 1900 MHz

- CDG Ref. Document 27

  High Rate Speech Service Option for Wideband Spread Spectrum Communication Systems

- TIA/EIA IS-96-A

  Speech Service Option 1 Standard for Dual-Mode Wideband Spread Spectrum Cellular Systems

- TIA/EIA IS-125

  Recommended Minimum Performance Standards for Digital Cellular Wideband Spread Spectrum Speech Service Option 1

- TIA/EIA IS-126-A

  Mobile Station Loopback Service Option Standard

- QUALCOMM Document: 80-12918-1, Rev. X3

  Markov Service Options for Wideband Spread Spectrum Communications Systems

- TIA/EIA IS-637-A

  Short Message Service (partial support)

- TIA/EIA IS-707A

  Packet data, circuit-switched data and digital fax capabilities as described in this document

- TIA/EIA IS-98-D

  Recommended Minimum Performance Requirements for Dual-Mode Wideband Spread Spectrum Cellular Mobile Stations

- TIA-916

  Recommended Minimum Performance Specification for TIA/EIA/IS-801-1 Spread Spectrum Mobile Stations

- TIA/EIA IS-2000, release 0

  Introduction to cdma2000 Standards for Spread Spectrum Systems

Specification exceptions

The Kyocera 200 Module performs to the specifications except as noted in this section.

Interoperability limitation

All components of the features listed in the previous section are not capable of being tested for interoperability with current infrastructure equipment until such time as commercially deployed infrastructure equipment supports all feature components. Prior to such interoperability testing occurring, all CDMA modules delivered by KWC may have the following exceptions.

- Authentication
- Reduced rate vocoder operation

IS-637 specification implementation

The CDMA Module supports the following IS-637 features (mobile-terminated).

Cellular Paging Teleservice (CPT)

Cellular Messaging Teleservice (CMT)

Voice Mail Notification (VMN)

RF system specifications

The Kyocera 200 Module meets the IS-98 specification at 800 MHz, the ANSI J-STD-0018 specification at 1900 MHz, and the TIA-916 GPS specification.

CDMA reference material and training

The Telecommunication Industry Association (TIA) oversees the CDMA standards. These documents are published and obtainable from:

Global Engineering
15 Inverness Way East
Inglewood, CO 80112
USA

800-854-7179
fax - 303-397-2740

Global Engineering
Europe: Rapidoc (UK)

+44 1344 861 6666 rapidoc@techindex.co.uk

All CDMA devices that are activated on a service provider's network are expected to comply with these various standards.

For information on CDMA worldwide, please visit the Web site for the CDMA Development Group at http://www.cdg.org. The CDMA Development Group (CDG) is a consortium of companies who have joined together to lead the adoption and evolution of CDMA wireless systems around the world.

11 Module Testing and Integration

This chapter outlines the testing performed at KWC and the suggested testing required by the customer. This test flow is part of the warranty/product support plan that KWC uses for returned Modules.

KWC Module production testing

The Module is assembled by using standard Surface Mount Technology (SMT) and tested to verify functional performance.

It is anticipated that once the Module has been designed into the customer's units, the incoming QA test at the customer site should be able to determine that the Module is meeting specifications.

Customer Module/device testing

Customer testing of the Module is recommended to be done in two parts. The customer is responsible for developing the test software and test flow at their incoming QA receiving. KWC provides a basic specification, which describes a set of tests to be performed, and suggests equipment and equipment settings to test the Module to the pertinent specifications.

First, the customer tests RF specification-compliant Modules in developing the incoming test software. This incoming testing can be reduced to a sample test as required by the customer.

After this incoming test, the customer then assembles the Module into the OEM device. During final testing, another final test station is used to test the Module inside the device.

The test uses the 50 ohm connector and the same scripts used in the incoming test station to see if the Module still performs to specification while in the OEM's device.

If this final test fails, it is the customer's responsibility to use the incoming QA test station to verify that the Module is either performing or not performing to specification. If the Module fails this test, then it is returned to KWC as a non-compliant device.

CDMA test equipment and products

- Lease or purchase of test equipment is available from vendors who provide this equipment for CDMA over-the-air simulation. Some suggested products include:
  - Hewlett Packard® HP-8924 CDMA Mobile Station Tester
  - Rohde & Schwarz CMU200 Radio Communication Tester
  - Tektronix® CMD-80 CDMA Mobile Station Tester
  - Agilent 8960 Series 10 E5515C CDMA Mobile Station Tester
- Spectrum analyzer, RF power meter
- CDMA Air Interface Tester (CAIT), available from QUALCOMM Incorporated
  - Windows-based program that generates real-time graphical displays that illustrate radio frequency (RF) energy, multipath, transmit/receive power, vocoder rate, frame error rate information, and system status.

    This product requires the execution of the Test and Deployment Supply Agreement with QUALCOMM.
- Universal Diagnostic Monitor (UDM), available from Spirent plc

Product integration

The Module is intended to be integrated into a customer device for provision of voice and data capabilities as outlined in chapter "RF System Specifications." The Module is designed to be integrated by using a simple serial port for control and call processing and a single RF connection using the 50 ohm connector. A second 50 ohm connector is used for GPS. All testing costs will be incurred by the customer.

Note The Module may require further shielding to pass FCC Part 15 in the device being built. The customer is responsible for any further shielding.

The Module has been tested by integrating it into user equipment. The tests indicated that the shielding provided on the Module is adequate to ensure that the KWC Module does not prevent the customer from passing the FCC Part 15 testing if they shield their own device properly.

The customer's final device needs to maintain the standards that the Module has already passed in CDG Stage 1 and CDG Stage 2 certification tests. This device also needs to pass CDG 3 certification with the carrier/service provider(s) that the customer expects will provide service for the device once on the market. These test costs are the responsibility of the customer.

Overview of test and integration flow

This section outlines hardware integration and test steps an OEM of a Module needs to address in order to verify performance of a KWC Module in an end application.

Integration tests

The Module has been tested for compliance to TIA/EIA IS-98-D or ANSI J-STD-0018 (SP-3385) as a stand-alone device. Integration testing is required to assert that these specifications are still met when the Module is operating in the end application. Formal compliance to IS-98-D or J-STD-0018 is proven by doing regression testing in the application device. The customer is ultimately responsible for compliance of the application device.

Antenna matching

The Module has two 50 ohm coaxial RF connectors that can be mated with suitable 50 ohm antennas that work in the desired frequency band of operation. Antenna systems should be designed to ensure compliance with IS-98 and J-STD-0018.

Audio integration

Performance of microphone and speaker transducers must be verified in the end application. Module analog audio circuits have been verified in a typical portable phone application.

The serial data, power supply/battery and the digital codec interfaces should be integrated and verified for proper electrical performance.

Mechanical and environmental tests

Modules are tested for compliance to environmental requirements typical for cellular phones. Similar tests appropriate for use in the end application device should be performed and would be the responsibility of the customer.

CDG-1, CDG-2, CDG-3

Modules are certified CDG-1 and certified with Lucent, Nortel, Motorola, and Samsung infrastructure equipment to CDG-2 testing requirements agreed to by the CDMA Development Group. Users may wish or be required to perform all or a regression suite of these tests depending on the carrier network they use. Standards also vary in some international markets. (Information on the CDMA Development Group (CDG) is available at www.cdg.org.)

- CDG-1 tests are performed in formal test labs of various members of the CDG. CDG-1 tests verify compliance to either IS-98-D or J-STD-0018.

CDG-2 tests are performed on site at infrastructure equipment manufacturers (arranged by the OEM developer). These tests verify interoperability with infrastructure equipment. Tests are run using the RF test connector (not antenna system).

- CDG-2 tests verify compliance to CDG57 and IS-898.
- CDG-3 tests are an end application test. These are over-the-air tests to verify performance within a particular carrier's network. The Module is not formally tested in this manner. The OEM needs to perform this testing in coordination with the carrier(s) they plan to utilize.

FCC compliance

The equipment certifications appropriate to your device are marked on the device and the accompanying product specification. Where appropriate, use of the equipment is subject to the following conditions.

Caution The Kyocera 200 Module has been certified by the Federal Communications Commission ("FCC"). Unauthorized modifications or changes not expressly approved by Kyocera Wireless Corp. ("Kyocera") could void compliance with regulatory rules, and thereby your authority to use this equipment.

Caution Electromagnetic Interference (EMI): To avoid any harmful interference to radio communication or any electronic equipment, it is a user's responsibility to test the final product at a system level and to ensure the final product is in compliance with Part 15 of the FCC rules. This test can be performed by any FCC-certified test lab.

WARNING: To reduce any possible hazard due to exposure of the human body to electromagnetic radiation, per FCC OET Bulletin 65, this device is approved for operation using the antennas as described below. The antenna installation must provide a separation distance of 20 cm or more between the antenna and all persons to satisfy Maximum Permissible Exposure (MPE) compliance. This installation limitation must be included in the integrator/Original Equipment Manufacturer ("OEM") user guide to alert users on FCC RF exposure compliance. In order to fulfill the FCC certification requirements, the following requirements must be complied with.

Labeling:

An FCC ID label is on the Module itself. The FCC label must be visible through a window on the final device or it must be visible when an access panel, door, or cover is easily removed. If not, a second label must be placed on the outside of the final device containing the following text:

Contains "FCC ID: OVFKWC-M200"

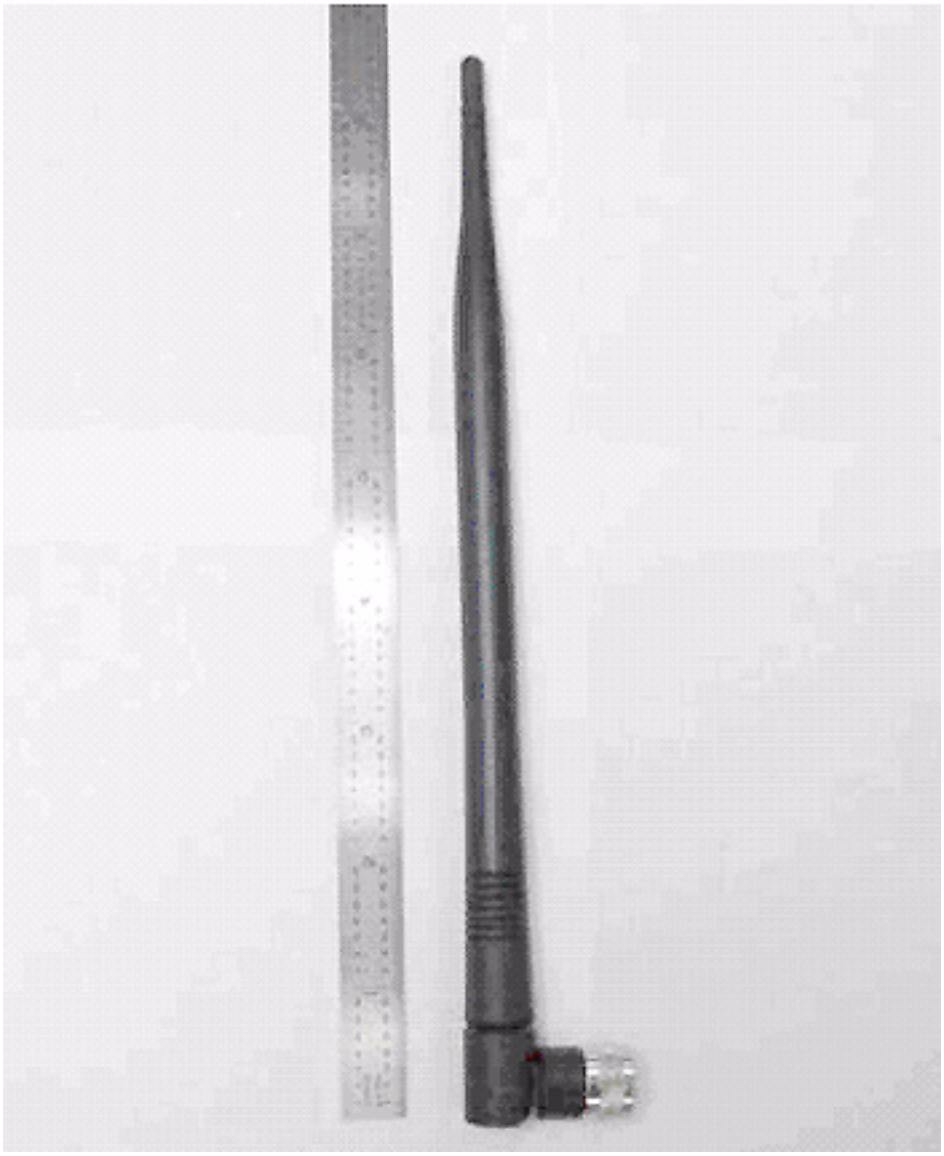
Antenna:

For FCC compliance, the Kyocera 200 Module has been tested with the approved antennas listed below. At an OEM's request and agreement to pay Kyocera for all related costs, including but not limited to engineering costs, outside lab costs, and FCC charges, Kyocera will consider adding new antennas to the current FCC ID.

If Kyocera, in its discretion, agrees to test the Kyocera 200 Module with an alternative antenna and the test is successful, Kyocera will then apply to the FCC for a Class II Permissive Change.

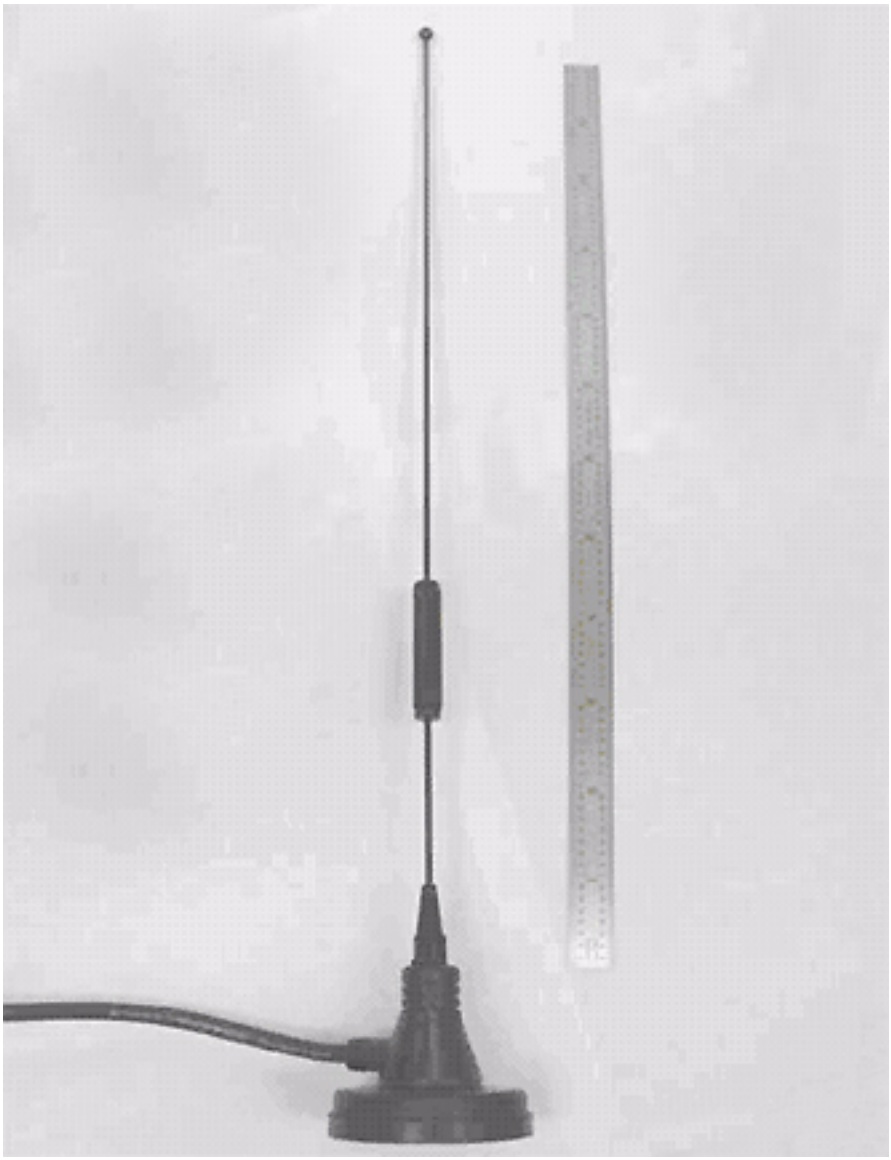
If an OEM does not use a Kyocera pre-certified antenna configuration or work with Kyocera to add its antenna to the Kyocera FCC ID, the OEM may not use Kyocera's FCC ID grant number and must apply to the FCC for a new certification and new FCC ID for their final product.

1. Swivel dipole
   - Manufacturer: Galtronics Inc.
   - Model number: 020806075-2397
   - Measured maximum gain (including RF cable loss): 2.2 dBi in cell band and 5.4 dBi in PCS band



2. Mono pole dual band magnetic mount

- Manufacturer: MAXRAD, Inc.
- Model number: MDBM800/1900TNC
- Rated gain: 2 dBi at 824-896 MHz, 2 dBi at 1850-1990 MHz



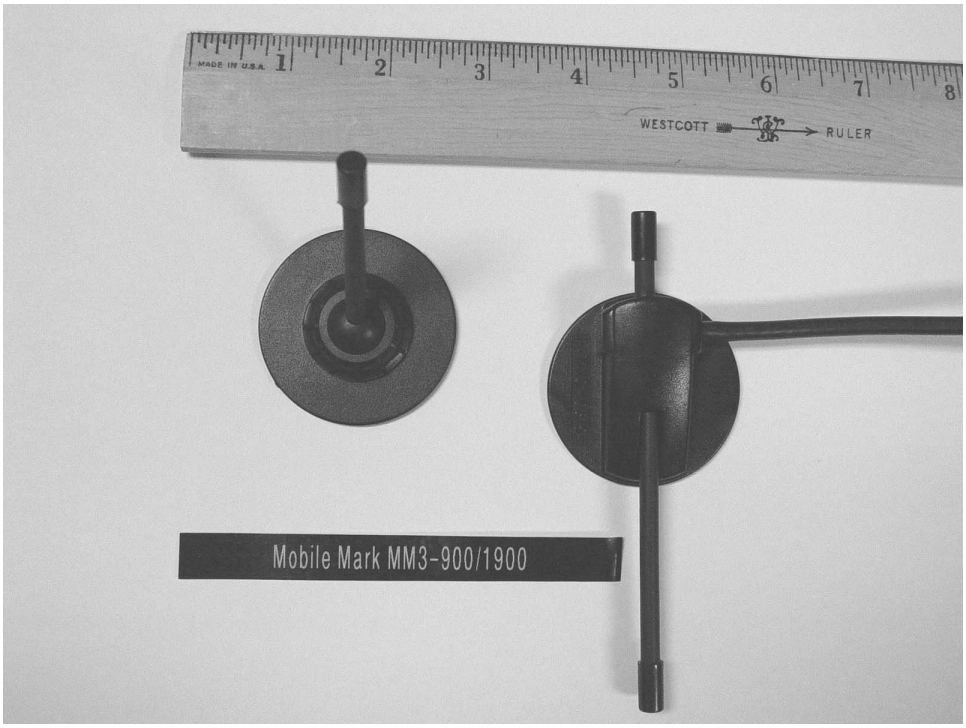
3. Mono pole and patch for GPS
   - Manufacturer: Mobile Mark, Inc.
   - Model number: SMV-UCE-1C2C
   - Rated gain: 2 dBi on Cellular, Unity on PCS

4. Printed dipole
   - Manufacturer: Comverge Technologies, Inc.
   - Model number: UNIVERSAL MAINGATE C&I - CDMA ASSY 473609
   - Rated gain: Unity on Cellular, not designed for PCS

5. Quarter wave sleeve dipole for Cellular, half wave sleeve dipole for PCS
   - Manufacturer: Klong Electronics Co. Ltd.
   - Model number: EX-203
   - Rated gain: Cellular: 1.61 dBi, PCS: 2.77 dBi

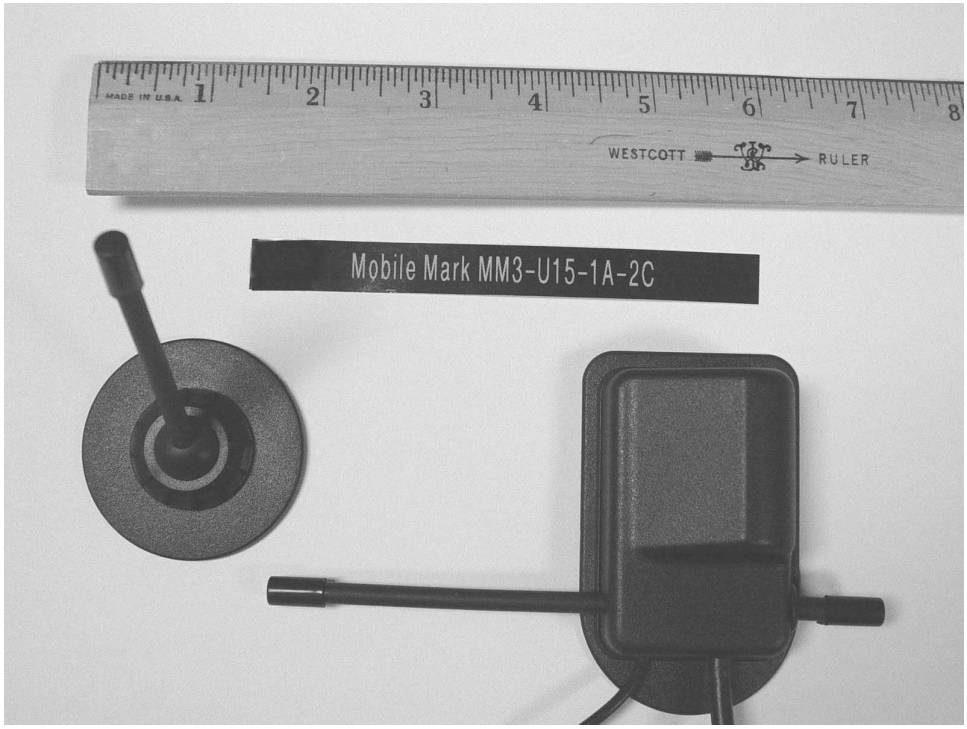
6. Dual Band AMPS/PCS Dipole Omnidirectional Antenna
   - Manufacturer: Radiall/Larsen Antenna Technologies
   - Model number: R380.900.318
   - Rated gain (including the cable losses): -1 dBi Max for 806-890 MHz, -1 dBi Max for 1.85-1.99 GHz

7. Dual Cellular/PCS On-Window whip
   - Manufacturer: Mobile Mark, Inc.
   - Model number: MM3-900/1900
   - Rated gain
     Cellular Band: 3 dB maximum,
     PCS: Unity Gain



8. Surface Mount Quad Band for 800 - 2500 MHz & GPS

- Manufacturer: Mobile Mark, Inc.
- Model number: MM3-U15-1A-2C
- Rated gain
  800-GHz 2 dBi
  1 GHz - 2.4 GHz Unity



9. Glass Mount Tri-Band for Cellular, PCS & GPS

- Manufacturer: Mobile Mark, Inc.
- Model number: SMM-UCE-3A2C
- Rated gain
  Cellular Band: 3 dB maximum
  PCS: Unity Gain

10. Dual Band Collinear

- Manufacture: MAXRAD, Inc.
- Model Number: BMAX824/1850
- Rated Gain: 2.2 dBi at 824-296 Mhz /4 dBi at 1850-1990 Mhz