Application Note

Anritsu

Practical Tips on cdma2000 1xEV-DO Forward-Link Movement

MT8212B

Cell Master™

This is a practical cdma2000 1x EVolution-Data Optimized (1xEV-DO) measurement procedures note. The objective of this note is to present measurement tips and procedures which will help a field-based network technician or RF engineer conduct base transceiver station (BTS) forward-link measurements on 1xEV-DO access networks.

Evolution to cdma2000 1xEV-DO

CDMA2000 is a family of third-generation (3G) technologies that has enabled a seamless evolution from the cdmaOne second-generation (2G) digital air interface standard to CDMA2000 1xRTT. Now it is enabling the evolution to cdma2000 1xEV-DO – a 3G standard that is optimized for packet data services. Migration to the 1xEV-DO standard offers new and existing applications for customers and for operators a means of achieving higher system capacity, while easing system operation and maintenance.

Understanding cdma2000 1xEV-DO

cdma2000 1xEV-DO is a 3G standard that was standardized by the Telecommunication Industry Association (TIA) as the TIA-856-A cdma2000 high-rate packet data air interface specification. It supports data packet services of up to 3.072 Mbps in the forward link and 460.8 Kbps in the reverse link - using just 1.23 MHz of spectrum - and has a typical cell radius of 5 to 15 km. The cdma2000 1xEV-DO is fully mobile with no line-of-sight required.

1xEV-DO is suitable for high-bandwidth download applications such as enterprise VPN computing, MP3 transfers, video streaming and high-speed web or mail downloading. Operators can use it to deploy a low-cost data-only broadband system or to add or increase the data capacity of their existing CDMA IS-95 or 1xRTT.

1xEV-DO networks offer a number of significant benefits which include:

- Superior user experience which increases data revenue and improves customer satisfaction.
- Support for a wide array of applications ranging from business email, residential broadband and mobile video on demand.
- Seamless integration with IS-95 and 1xRTT networks which allows operators to offer voice and data services.
- Wide-area coverage, with no requirement for line-of-sight or directed antenna, which reduces the number of cell sites required.
- Cell-site capacity of up to 2000 mobile subscribers per cell site which reduces cap-ex per subscriber.

Networks based on cdma2000 1xEV-DO now provide commercial service to subscribers in South Korea, Japan and the United States - serving more subscribers than any other 3G technology.

cdma2000 1xEV-DO Basics

The cdma2000 1xEV-DO specification uses the same frequency band, channel bandwidth (1.23 MHz) and chip rate (1.2288 Mcps) as cdmaOne and CDMA2000 1xRTT (Figure 1). Each chip lasts for a duration of 0.8138 microseconds. It also flaunts a number of key differences. For the purpose of this application note, only the characteristics and measurements of the 1xEV-DO forward link will be addressed.

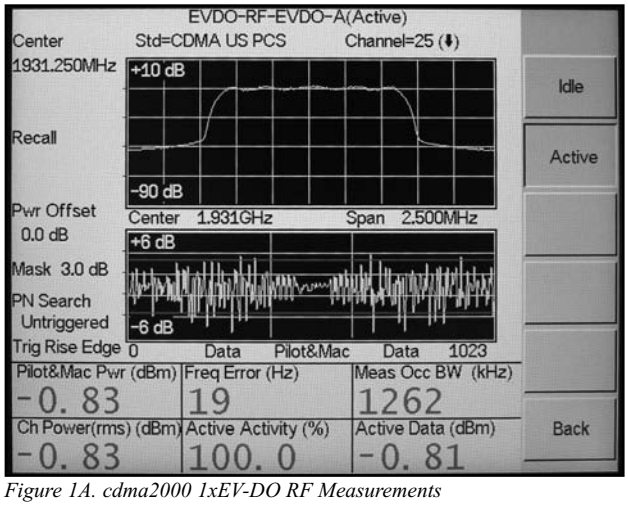

Figure 1A. cdma2000 1xEV-DO RF Measurements

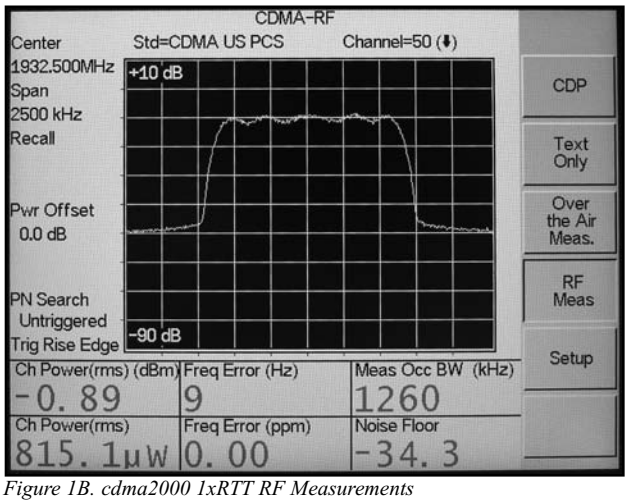

Figure 1B. cdma2000 1xRTT RF Measurements

In the forward link, the mobile terminal continually updates the base station with the data rate it can receive. This information allows the system to service a single user at any given instant. In contrast to earlier CDMA systems, 1xEV-DO is able to support multiple users utilizing time division multiplexing (TDM) to search for the mobile terminal that requests the highest data rate (Figure 2). The basic TDM forward link slot structure is shown in Figure 3. Here, time slots for data transmissions are dynamically assigned, as opposed to being pre-assigned. This data-rate control feature enables the base station to efficiently transmit at full power, thereby achieving very high-peak data rates for users in good coverage areas.

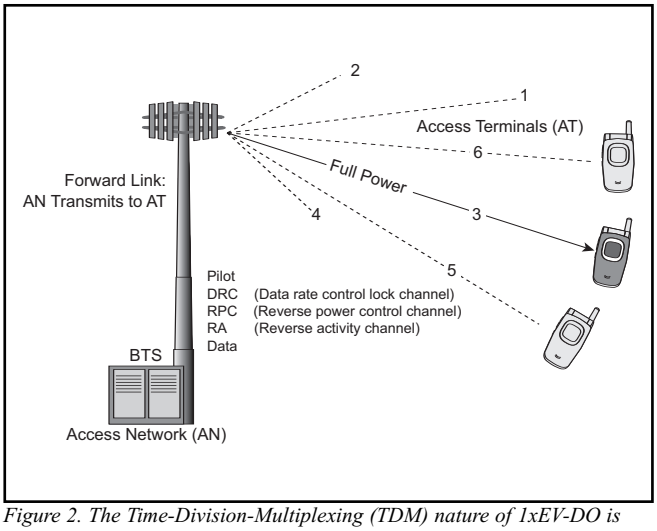

Figure 2. The Time-Division-Multiplexing (TDM) nature of 1xEV-DO is illustrated by this graphic.

The forward link frame of cdma2000 1xEV-DO networks is 26.666 msec and consists of 16 slots. In downlink, each 1.666-msec slot is time-divided into two half slots of 1024 chips, for a total of 2048 chips. The 1024 chips in a half-slot can be further time-divided into: 800 Data chips, 128 Media Access Control (MAC) chips and 96 Pilot chips.

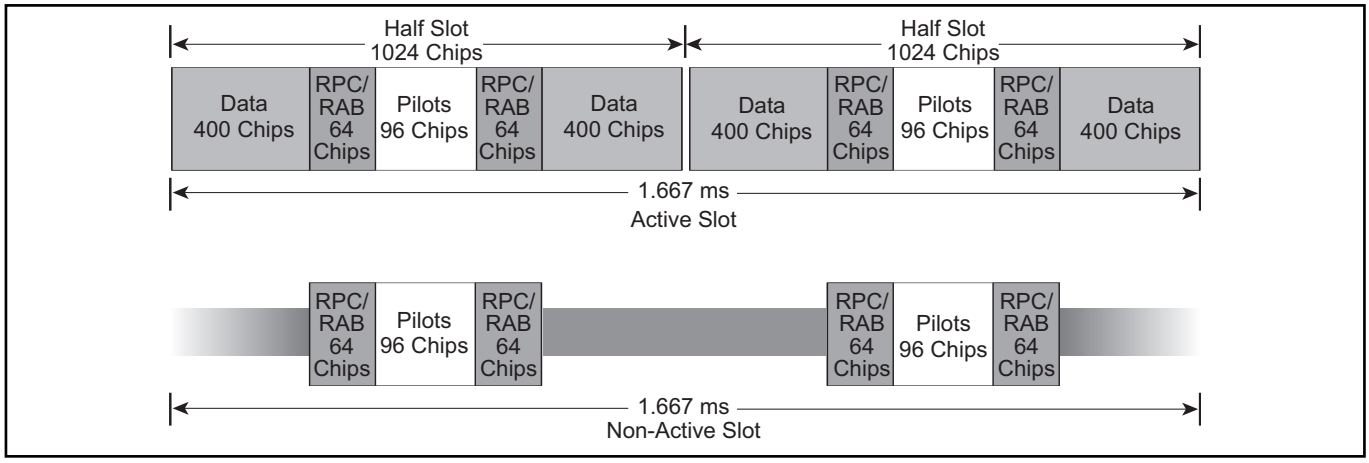

Figure 3. Shown here are both the active and idle slots of a 1xEV-DO system.

The Data Channel transmits the Forward Traffic Channel, which carries user data packets, and the Forward Control Channel, which carries control messages and may also carry user traffic. The MAC Channel controls the overall 1xEV-DO traffic. The Pilot Channel provides synchronization for the 1xEV-DO Access Terminals (ATs). While the Pilot and MAC Channels are always active in a 1xEV-DO signal, the Data Channel may sometimes transmit no data. When no data is transmitted, the half-slot is considered idle. Otherwise, it is called an active slot.

Within each slot, the Pilot, MAC, and Traffic or Control Channels are time division multiplexed. The traffic/control channel has Preamble chips which can range from 64 to 1024 chips in length, depending on its data rate. Note that the modulation scheme is also dependent on the data rate. Each channel can then be demodulated into code-division-multiplexed quadrature Walsh channels.

The MAC channel can be demodulated into 64 or 128 Walsh channels depending on the physical layer “Subtype”. In Subtype 0 and Subtype 1, the MAC Channel uses a Walsh cover of length 64, with code numbers or “MAC Index” ranging from 5 to 63. In physical layer Subtype 2, the MAC Channel uses a Walsh cover of length 128 and the MAC index can go up to 127.

The Walsh channels consist of up to 4 types of sub-channels: Reverse Power Control (RPC), Data Rate Control Lock (DRCLock), Reverse Activity (RA) and ARQ channel (only in Subtype 2). They can be used to control multiple user activities.

Testing of cdma2000 1xEV-DO base stations requires specific measurement tools such as a spectrum analyzer, power meter, cable and antenna analyzer, and waveform-quality/code-domain power (CDP) measurement device. While these tools can each be utilized as separate instruments, test equipment like the Cell Master MT8212B combines many of these functions into a single package, providing the field-based network technician or RF engineer an easy to use, cost-effective solution.

cdma2000 1xEV-DO Versus 1xRTT

Single carrier (1x) radio transmission technology (1xRTT) is often referred to as CDMA2000 1x. Like 1xEV-DO, 1xRTT is a 3G technology based on CDMA. The two standards have the following main differences (see Table 1):

- 1xRTT increases voice service capacity and improves data transmission rates. 1xEV-DO does not provide voice service, but further increases data transmission rates.
- 1xRTT has the capability to provide ISDN-like speeds of up to 144 kbps. cdma2000 1xEV-DO, on the other hand, features a peak network downlink speed of 3.072 Mbps and 300 to 500-kbps average user throughputs for file downloads.
- 1xEV-DO’s use of time-division-multiplexing (TDM) differs from that of 1xRTT. Unlike traditional TDM systems where each user is assigned a particular timeslot, 1xEV-DO assigns timeslots dynamically depending on the needs and reception conditions of each user. The use of TDM also allows all available power to be dedicated to one user. The result is better signal quality and higher data rates. By contrast, 1xRTT differentiates transmissions to users by Walsh code and occurs in parallel. The achievable data rate is determined by the number of simultaneous transmissions in 1xRTT, transmit power levels, and various other factors.

Differences between 1xEV-DO and 1xRTT

	1xEV-DO	1xRTT
Bandwidth	1.23~1.25 MHz	1.23~1.25 MHz
Chip Rate	1.2288 Mcps	1.2288 Mcps
Power Control Frequency	No DL PC	800 Hz up/down
Base-Station Synchronization	Yes, via GPS	Yes, via GPS
Cell Search	Sync through time-shifted short code correlation	Sync through time-shifted short code correlation
Downlink Pilot	TDM common	CDM common
User Separation	TDM (scheduler)	CDM
2G Interoperability	Not backward compatible	Backward compatible

Table 1. Comparison of cdma2000 1xEV-DO and 1xRTT

Understanding CDMA2000 1xEV-DO Measurements

In general, CDMA signals are far more complex than those found in analog systems. Sophisticated code domain modulation and spread-spectrum schemes, hand-off control and power management functions are just a few of the new technology challenges. Overall power level and frequency versus time measurements alone cannot verify performance or isolate problems in these new systems. Consequently, properly characterizing complex CDMA signals, such as those associated with cdma2000 1xEV-DO networks, now requires field technicians to measure many different types of parameters. The cdma2000 1xEV-DO measurements that can be made with Cell Master include:

Pilot & MAC Power

The Pilot & MAC Power shows the average power of the Pilot and MAC Channels. This is an absolute value and is expressed in either dBm or Watts. For Over-the-Air (OTA) measurements, the Pilot&MAC Powers will fluctuate more because of noise, interference and signal path variations.

Data Power

Data Power is the average power of the Data Channel. When the slot is active, the Data Power should be very similar to the MAC & Pilot Power. When the slot is idle, the Data Power has to be at least 7 dB below the MAC & Pilot Power – assuming that Cell Master is connected directly to the base station.

Channel Power

During an active slot, Channel Power is similar to MAC & Pilot Power, as well as to the Data Power. During an idle slot, the measured Channel Power value falls between the measured Pilot&MAC Power and Data Power, since it is a weighted average of the two. In the case when both active and idle slots are present, the channel power will depend on the ratio of the two types of slots present, and it will fluctuate as the percentage of each type of slot changes.

Data Modulation

In cdma2000 1xEV-DO networks, modulation varies depending on the data rate. QPSK (lower data rates), 8-PSK (medium data rates) and 16-QAM (higher data rates) modulation types are supported. If the modulation type is known, it may be input into Cell Master via the Set-Up menu. Alternatively, Cell Master can automatically determine the modulation type. When the slot is idle, Cell Master displays "Idle" in the modulation type box.

Note that the type of modulation used in 1xEV-DO is only related to the signal's nominal data rate and does not affect the signal quality. However, when the input signal quality is very poor, Cell Master may report a wrong modulation type. This, in turn, may affect the Rho (waveform quality) measurement. It is recommended therefore, that when measuring very noisy signals, if the modulation type is known, the automatic modulation detection be turned off to get a more accurate Rho value.

PN Offset

All chips in a 1xEv-DO forward signal are complex multiplied by a PN short code. The PN Offset identifies one of the 512 short code sequences used to differentiate sectors on base stations for communication with mobile units.

Note that PN Offset requires the trigger to be selected. Also, the PN number can be set manually or automatically.

Tau (τ)

Tau measures the time delay from the input trigger to the “start of a slot,” The measurement is expressed in microseconds. The CDMA standard specifies a maximum offset of 10 µs. Generally, 5 µs is the recommended maximum. This only applies when the Cell Master is connected directly to a base station through a cable. In OTA measurements, Tau will increase as the distance to the base station increases and can easily go beyond 10 µs if the base station is far away. (Each microsecond represents approximately 300 meters in distance.)

Timing error can occur when the propagation delay is too long. In this case, the received PN Offset may be different from the value designated on the Sync channel causing the handoff to fail. Another cause of timing error is a bad Global Positioning System (GPS) receiver or timing distribution network within the base station. To test a base station’s GPS and timing distribution system, use Cell Master’s internal GPS receiver as an accurate timing reference while performing base station tests.

Note that CDMA's PN measurement relies solely on the external trigger or GPS signal for reference. However, being TDM in nature, 1xEV-DO's PN must be aligned with the start of a 1xEV-DO slot, in addition to referencing the external trigger or GPS signal. Therefore, when the user connects an external trigger that is poorly aligned with the 1xEV-DO signal slots, Cell Master may report a Tau value that is very large in magnitude in order to give the best possible PN Offset estimation.

Waveform Quality (Rho)
Rho (ρ) is a measure of the modulation quality of the transmitted cdma2000 1xEV-DO signal. It measures the amount of power correctly transmitted. When connected to a good 1xEV-DO source, all Rho values will be 0.97 or above. They will decrease when the channel power is too weak. When noise or distortion is present, for example in an Over The Air (OTA) measurement, the Rho value may drop dramatically. Any Rho value below 0.9 should only be used as a qualitative reference, as opposed to a quantitative measure.

ρ Pilot
Rho (ρ) Pilot is a measure of the quality of the Pilot Channel.

ρ Overall 1 and 2
Rho (ρ) Overall 1 and 2 are measures of the overall 1xEV-DO signal quality during an active slot. Rho Overall 1 measures from the beginning to the end of a half slot, while Rho Overall 2 measures from the middle of one half slot to the middle of another half slot. In general, both measurements will present similar values. When the input signal has a high percentage of idle slots, Cell Master may not be able to capture enough active slots to calculate a valid Rho Overall 1 or Rho Overall 2 value. In this case, "Idle" will be displayed.

Overall Error Vector Magnitude (EVM)
While the Overall EVM measurement is not part of the 1xEV-DO test specification (Rho serves the same purpose), it is included in Cell Master and can be utilized depending on the users personal preference. With overall EVM, the smaller the number measured, the better the signal quality. When connected directly to Cell Master, a good signal will have an EVM below 10%. Note that overall EVM will increase as signal power becomes too weak.

Data Code Power
The Data Channel in 1xEV-DO consists of 16 "I" sub-channels and 16 "Q" sub-channels. Each of these channels has a measured Data Code Power of around –15.05 dB, relative to the total Data Channel Power. When connected to a good signal source, the data code minimum will be typically larger than –15.5 dB, while the data code maximum will be typically less than –14.6 dB. The smaller the difference between the two measured values the better the signal quality.

MAC Code Power
MAC channels of cdma2000 1xEV-DO networks are Walsh de-spreaded into 64 or 128 sub-channels depending on the physical layer Subtype.

The MAC channel in Subtype 0 and Subtype 1 physical layer has a Walsh length of 64. Channels 0 to 3 are reserved. Channel 4 is the reverse activity (RA) channel and channels 5 to 63 control individual access terminals such as cell phones or laptops. The more active channels there are the more 1xEV-DO users are communicating with the base station.

The MAC channel in Subtype 2 physical layer has a Walsh length of 128. Subtype 2 is a newly established standard and its signal has to be demodulated differently. The user should not change the Cell Master setup to 128 MAC codes unless they are certain that they are measuring a Subtype 2 signal.

Noise Floor
Noise Floor is the average power in the unused Walsh codes or inactive MAC channels, relative to the total MAC Channel Power. It is expressed in units of dB and displayed in both the Code Domain Power, Text and OTA measurement displays. When connected to a good 1xE-VDO source, the Noise Floor measured by Cell Master should be –31.5 dB or below. When noise or distortion is present, such as in an OTA measurement, the Noise Floor may be considerably higher.

Frequency Error
Frequency Error is the difference between the received center frequency and the specified center frequency. This measured value is only as accurate as the frequency reference used and is typically only useful with a good external frequency reference. CDMA2000 requires the frequency error to be less than 0.05 ppm of the carrier frequency.

Measured Occupied Bandwidth
The Measured Occupied Bandwidth is calculated as the bandwidth containing 99% of the transmitted power.

Idle Data Power
Idle Data Power is defined as the average power of the data channel portion of the idle 1xEV-DO slot that is captured. If no idle slots are captured, then Cell Master will display "Idle."

Making CDMA2000 1xEV-DO Measurements

Anritsu's Cell Master MT8212B can measure cdma2000 1xEV-DO performance in one of two ways, either:

- Via Direct Connection of Cell Master to the base station
- Over The Air (OTA) with an antenna

Set-Up

Making cdma2000 1xEV-DO measurements with Cell Master requires some initial set-up, regardless of whether the measurement will be taken Over The Air or via a Direct Connection. This set-up involves configuring Cell Master to the base station frequency (Figure 4).

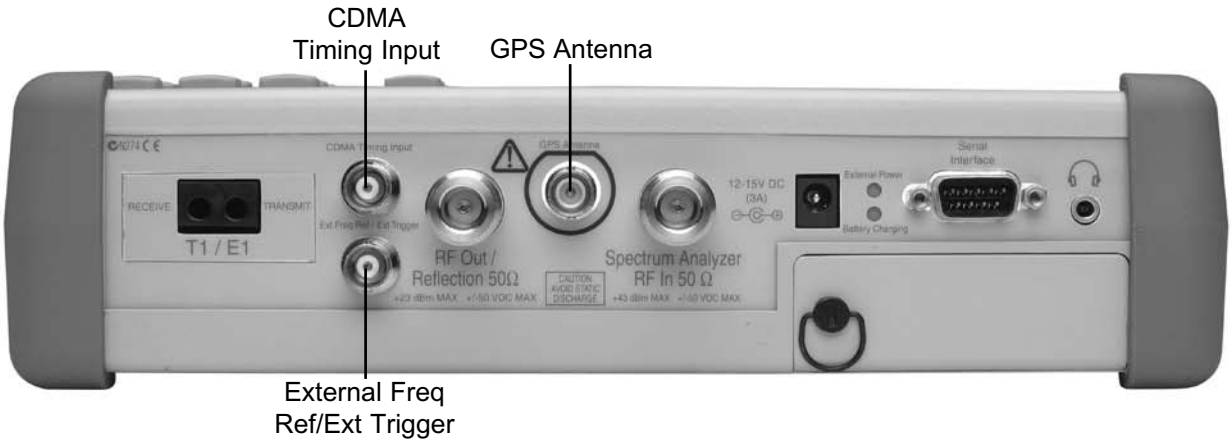

Figure 4. Shown here is a top view of Cell Master MT8212B

To set Frequency press the FREQ/DIST key to set and change frequencies for the cdma2000 1xEV-DO measurements. Cell Master must be configured to tune to the frequency being output by the base station. To choose the specific standard for your application:

1. Press the FREQ/DIST key.
2. Press the Signal Standard and Select Standard soft keys. A table of currently selected, common signal standards will be displayed. To view all the signal standards in the instrument, press the Show All soft key.
3. Use the keypad or Up/Down arrow keys to highlight the standard and press ENTER.
4. To deselect a signal standard, press the Select/Deselect soft key.
5. To view only the selected signal standards, press the Show Selected soft key. The list will show only the selected standards.
6. Press the Select Channel soft key to choose the appropriate channel for the selected standard. Cell Master will automatically adjust the span for the CDMA signal.

Note: In Cell Master 1xEV-DO signal standards are same as CDMA signal standards.

Now, set the amplitude. To change the amplitude configurations, press the AMPLITUDE key. Select the dBm/Watts soft key to choose to display the measurement results in either dBm or Watts. Next, press the Power Offset soft key and enter a power offset to have Cell Master automatically adjust for the loss through any external cables, attenuators and couplers. If the loss is not known, Cell Master's Transmission Measurement option can be used to measure the loss of the system.

Cell Master will automatically change attenuation, preamplifier and digital gain settings to make the best 1xEV-DO measurements. With the initial set-up complete, you are now ready to begin making cdma2000 1xEV-DO measurements.

Making Direct Connect Measurements

To connect the base station to Cell Master, connect the power amplifier of the base station to Cell Master's RF In port using a coupler or attenuator. To measure a cdma2000 1xEV-DO signal over the air, connect the appropriate frequency band antenna to the Cell Master RF Input and an Anritsu GPS antenna to the Cell Master GPS connector.

Note that the maximum input power (without damage) is +43 dBm on the RF In port, and +23 dBm on the RF Out port. To prevent damage, always use a coupler or high power attenuator.

Cell Master can demodulate the 1xEV-DO signal by connecting to the base station as shown in Figure 5.

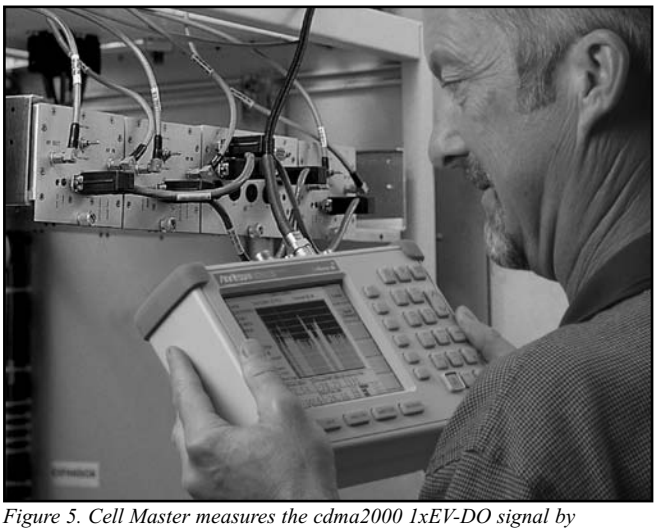

Figure 5. Cell Master measures the cdma2000 1xEV-DO signal by connecting to the base station.

If you choose to measure CDMA performance by connecting the base station directly to the Cell Master MT8212B, additional set-up for frequency reference and timing is required to make accurate results.

In order to get accurate frequency measurements, an external referencefrequency must be attached to the Cell Master Ext Ref Freq input. Most base stations have a reference frequency available on a BNC connector. Cell Master is able to lock to different frequencies. To configure Cell Master to use an external reference frequency:

1. Press FREQ/DIST and External Ref Freq soft key and use the keypad or Up/Down arrow keys to enter the frequency.
2.Press ENTER to select. As Cell Master locks to the source, the message "Ext Ref Unlocked" may briefly flash on the display. If this message stays on, check that Cell Master is set to the correct external frequency. If the message "External reference unavailable. Using internal reference" is displayed then there is no reference frequency present on the Ext Ref Freq input.

Cell Master needs a timing reference to determine PN Offset and timing errors. This reference comes from the base station when it is connected to Cell Master or it can be recovered from GPS when a GPS antenna is connected to Cell Master. The setup menu for this function is available through the MEAS/DISP key, setup and PN Search. The Direct Connect timing reference options include:

GPS (Auto or Manual) – Cell Master uses GPS as the timing reference. In Auto mode Cell Master automatically detects the strongest pilot, while in Manual mode it searches only for the specified PN. Either way, the Anritsu GPS antenna must be connected to the Cell Master GPS antenna connector. GPS must be turned on under "Sys|Options|GPS|GPS On/Off". Note that the GPS must be locked to the satellites before GPS Auto or GPS Ma nual can be used. (Depending on the quality of the GPS signal at the location of the test, it may take anywhere between 1 to 3 minutes for the GPS antenna to receive the full timing info. The user can look at the progress of the GPS synchronization by pressing the Quality soft key under GPS setup menu.)

External (Auto or Manual) – Cell Master uses an external even second time mark as the timing reference. The time mark is usually available at the base station on a BNC connector labeled "ESTM" or "PP2S". ESTM must be connected to the CDMA Timing Input connector on Cell Master. In Auto mode, Cell Master will automatically detect the strongest pilot. In Manual mode, Cell Master searches only for the specified PN.

No Trigger – If both GPS and external timing are unavailable, you may choose No Trigger for the PN search.

Making Over The Air Measurements

The OTA method is considered the most preferable means of measuring cdma2000 1xEV-DO BTS performance as it offers a more cost-effective, time-efficient approach to testing. Its proactive nature reduces the amount of time that performance degradations exist within a base station and minimizes the likelihood of a catastrophic failure. When a problem is detected, the OTA test provides insight into the cause, enabling the technician to ensure that the right tools and parts are available when the time comes to fix the problem on site. Using the OTA test, technicians can execute a diagnostic test in less than five minutes without even getting out of their vehicles, although the vehicle should be parked close to the site (Figure 6).

The OTA test enables field technicians to examine real-time traffic loading and power distribution. Monitoring traffic and power on a specific sector provides insight into its capacity utilization. This can be particularly important in high use areas where a decision needs to be made with regard to adding additional capacity. OTA test enables technicians to quickly see if the capacity already in place at the site is being utilized efficiently.

OTA test also provides field technicians with the ability to monitor hard to reach pole-top base stations. Traditionally, the repair process for pole-tops entailed pulling down the failed base station, then installing a new one. The failed base station was then returned to the manufacturer or repair depot for service. If a base station was determined to be healthy – no trouble found (NTF) - the cost of the process was incurred unnecessarily. OTA testing provides information about the health of the base station, thereby improving the likelihood that a correct decision will be made with regard to the base station. The result is fewer NTFs and elimination of its associated costs.

To get accurate results, the pilot dominance reading should be more than 9 dB and multipath power less than 0.4 dB.

Measurement Quality	Pilot Dominance	Multipath Power
Very good	>12 dB	<0.1 dB
Fair	>9 dB	<0.4 dB
Marginal	>6 dB	<0.7 dB

If you choose to measure cdma2000 1xEV-DO performance over the air with an antenna then additional set-up is required, as Cell Master needs a timing reference to determine PN Offset and timing errors. This reference comes from the base station when it is connected to Cell Master or it can be recovered from GPS when a GPS antenna is connected to Cell Master. The set-up menu for this function is available through the MEAS/DISP key. For OTA measurement GPS antenna connection is more convenient.

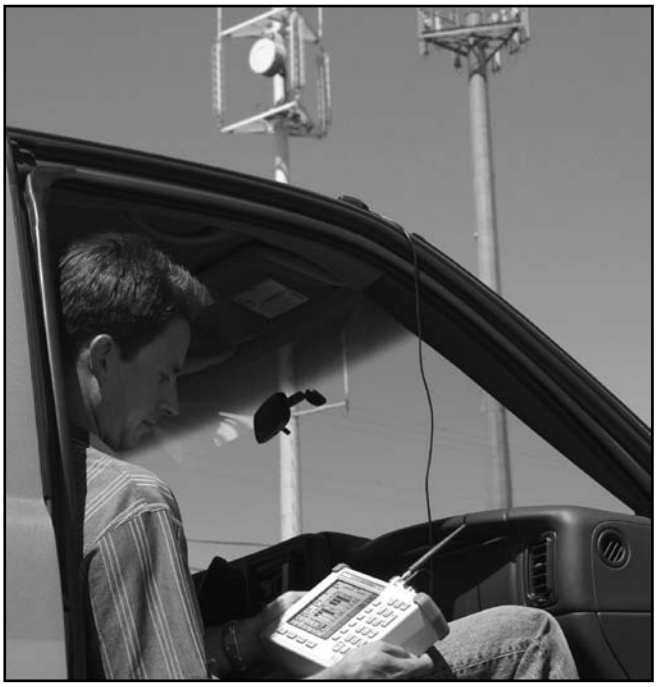

Figure 6. Cell Master can also demodulate the1xEV-DO signal using an over the air antenna. A built-in GPS feature provides users with UTC time and location information.

The OTA timing reference options include:

GPS (Auto or Manual) – Cell Master uses GPS as the timing reference. In Auto mode Cell Master automatically detects the strongest pilot, while in Manual mode it searches only for the specified PN. Either way, the Anritsu GPS antenna must be connected to the Cell Master GPS antenna connector. GPS must be turned on under "Sys|Options|GPS|GPS On/Off". Note that the GPS must be locked to the satellites before GPS Auto or GPS Manual can be used. (Depending on the quality of the GPS signal at the location of the test, it may take anywhere between 1 to 3 minutes for the GPS antenna to receive the full timing info. The user can look at the progress of the GPS synchronization by pressing the Quality soft key under GPS setup menu.)

No Trigger – If GPS is unavailable, you may choose No Trigger for the PN search.

cmda2000 1xEV-DO RF Measurements

To make 1xEV-DO measurements using Cell Master, connect it to the base station following these steps:

1. Press Cell Master's MODE key, use the Up/Down arrow key to select the EVDO mode and press ENTER.
2. Select and press the Signal Standard soft key. Use the soft keys or the Up/Down arrow key to highlight the appropriate standard, such as CDMA US PCS, and press ENTER.
3. Press the Select Channel soft key and use the Up/Down arrow key or the numeric keypad to enter the appropriate channel, such as 50, and press ENTER.
4. Press the MEAS/DISP key and select the RF Meas soft key to display the RF Measurements screen (Figure 7).

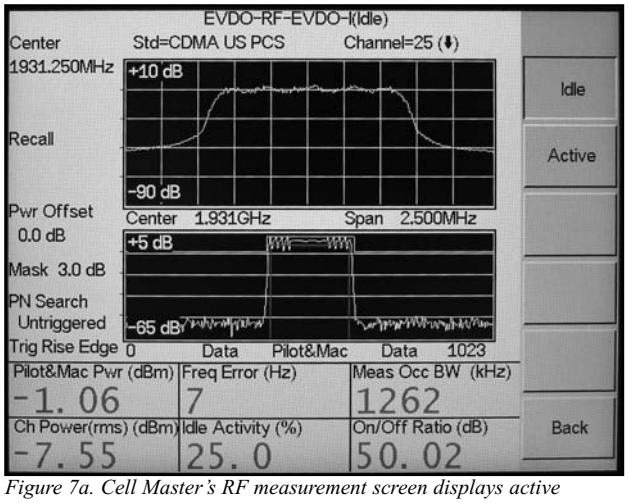

Figure 7a. Cell Master's RF measurement screen displays active cdma2000 1xEV-DO activity.

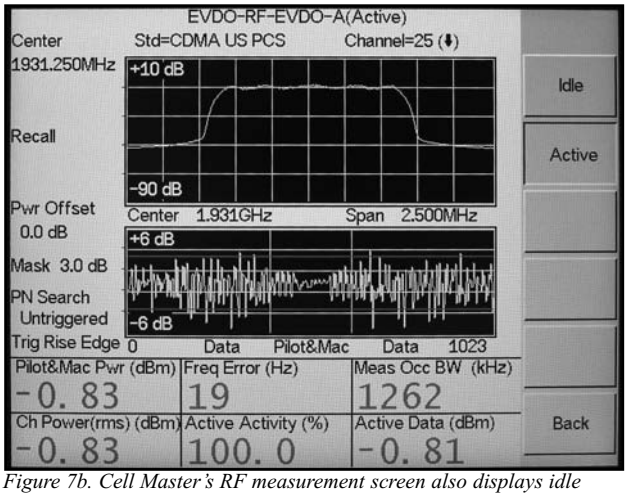

Figure 7b. Cell Master's RF measurement screen also displays idle cdma2000 1xEV-DO activity.

Demodulating cdma2000 1xEV-DO Signals

Demodulation is the process whereby the changes imposed on the carrier at the receiver are removed to reveal the message at the receiver. Cell Master demodulates cdma2000 1xEV-DO signals either by connecting directly to the base station or over the air with an antenna.

To demodulate cdma2000 1xEV-DO signals, connect Cell Master to the base station according to the following the steps:

1. Press the Cell Master MODE key, use the Up/Down arrow key to select the EVDO mode and press ENTER.
2. Select and press the Signal Standard soft key. Use the soft keys or the Up/Down arrow key to highlight the appropriate standard, such as CDMA US PCS, and press ENTER.
3. Press the Select Channel soft key and use the Up/Down arrow key or the numeric keypad to enter the appropriate channel, such as 50, and press ENTER.
4. Press the MEAS/DISP key and select the Setup soft key to open the Setup menu.
5. Press the PN Search soft key and choose External Auto when Cell Master is connected to the base station following the setup instructions. Note that with GPS OTA measurements, you must select the GPS Auto soft key after the GPS is synchronized.
6. Press Back to return to the previous menu.
7. Press the Data Modulation Type soft key and select Auto or, to select a particular modulation type, select the appropriate soft key.
8. Press Back twice to return to the measurements menu.

Power or Data Code Power screens (Figure 8).

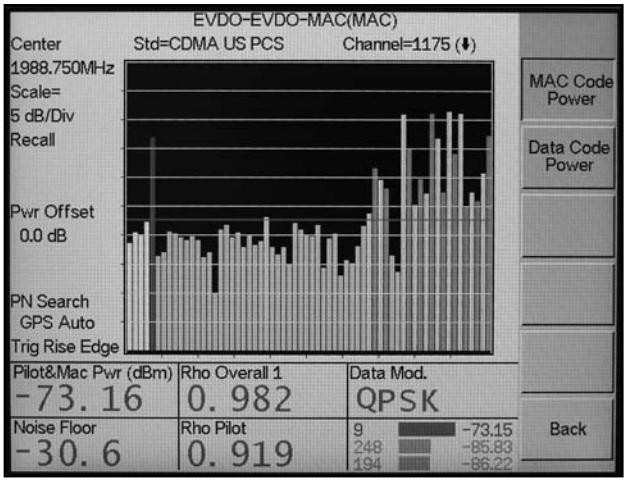

Figure 8A. MAC Code Power screen shot.

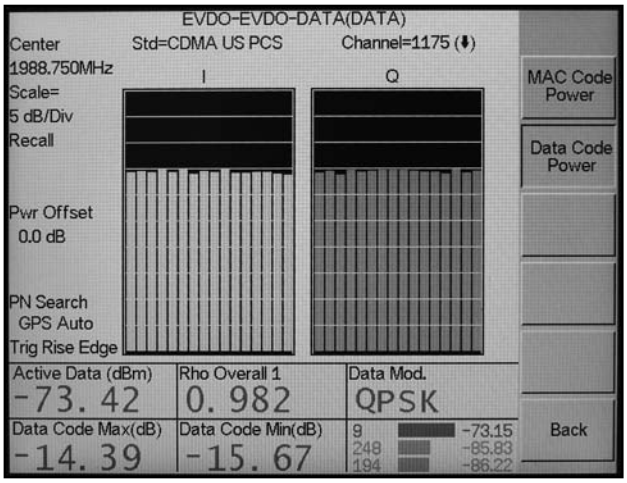

Figure 8B. Data Code Power screen shot.

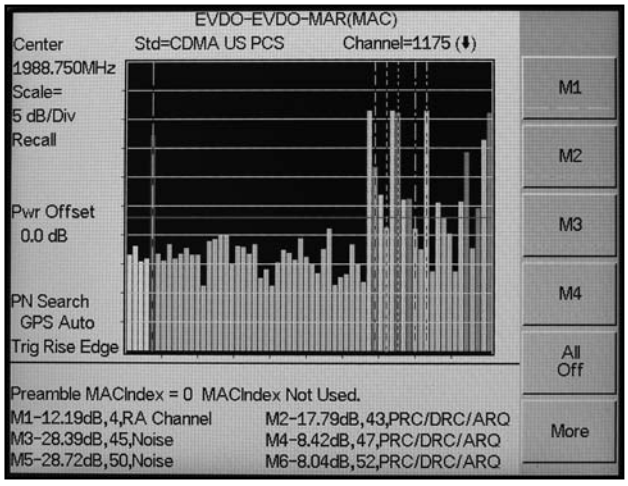

Figure 9. 1xEV-DO measurement with markers

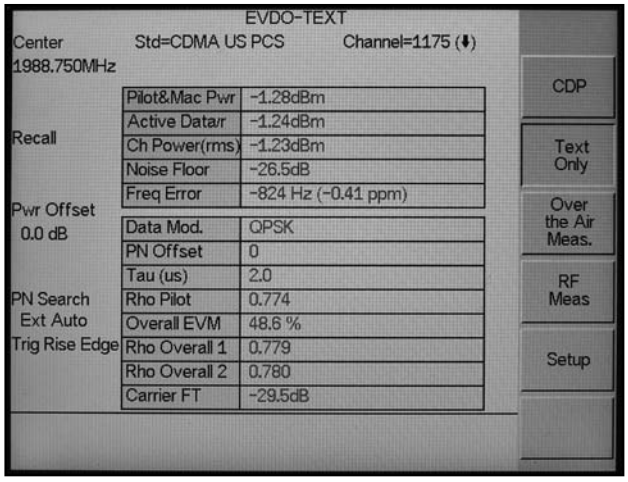

Figure 10. Cell Master provides users with a text-only screen view of the 1xEV-DO OTA measurement.

As shown in Figure 9, Markers can be used to read the individual code power and type of code like traffic, pilot, paging or sync.

CellMaster provides the user with a text summary of all the available data (Figure 10).

Over The Air Test

To make 1xEV-DO over the air measurements, follow these steps:

1. Press Cell Master's MODE key, use the Up/Down arrow key to select the EVDO mode and press ENTER.
2. Select and press the Signal Standard soft key and press the Select Standard soft key. Use the soft keys or the Up/Down arrow key to highlight the appropriate standard, such as CDMA US PCS, and press ENTER.
3. Press the Select Channel soft key and use the Up/Down arrow key or the numeric keypad to enter the appropriate channel, such as 50, and press ENTER.

Cell Master features a built-in GPS receiver that increases technician productivity by providing coordinated universal time (UTC) time and location (latitude, longitude and altitude) information. Timing information is crucial for Cell Master to accurately determine PN Offset and timing errors. In CDMA mode, the GPS clock can be used to make OTA measurements. Cell Master's GPS option is offered with a magnet mount antenna with a 15 foot (~5m) cable to mount on the car or other useful surface.

To activate the GPS feature:

1. Connect an Anritsu GPS antenna to the GPS antenna connection on Cell Master's connector panel. Note that Cell Master's GPS antenna connection is fitted with a reverse BNC connector to help prevent damage to the GPS circuitry. There is a DC voltage present on this connector. Only the Anritsu GPS antenna should be connected to this port.
2. Press the SYS key to open the system menu.
3. Select the GPS soft key to open the GPS menu.
4. Press the GPS On/Off soft key to turn the GPS feature on or off. When GPS is turned on, the GPS icon below will be displayed in red:

5. When the GPS receiver has tracked at least three satellites, the GPS icon will change to:

6. Press the Location soft key to view the latitude, longitude and altitude information and UTC timing.
7. Press the Quality soft key to display the number of tracked satellites and the GPS quality. When at least three satellites are being tracked, the GPS icon will change. Note that the Reset soft key must be pressed when activating the GPS for the first time.
8. Press the MEAS/DISP key and select the Setup soft key.
9. Select PN Search and press the GPS Auto soft key. If the GPS satellites are not being tracked, then GPS cannot be activated in 1xEV-DO mode.
10. Press Back to return to the previous menu.
11. Press the Data Modulation Type soft key and select Auto.
12. Press Back to return to the measurement menu.
13. Press the Over The Air Meas soft key and the Pilot Scan soft keys to display the readings (Figure 11).
14. Press Multipath soft key to display Multipath readings (Figure 12).

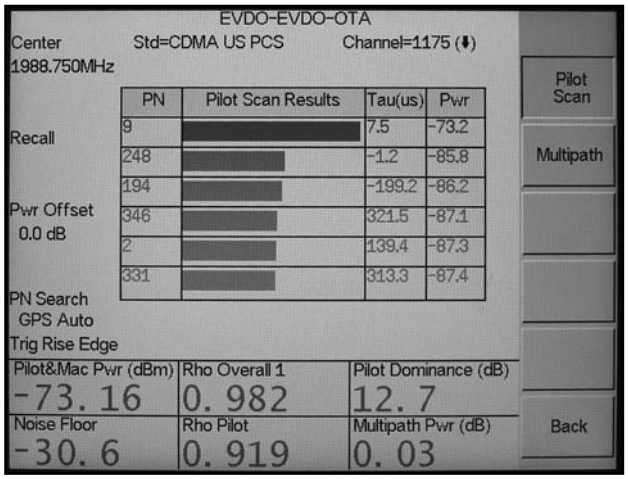

Figure 11. This graphic depicts the cdma2000 1xEV-DO OTA measurement screen.

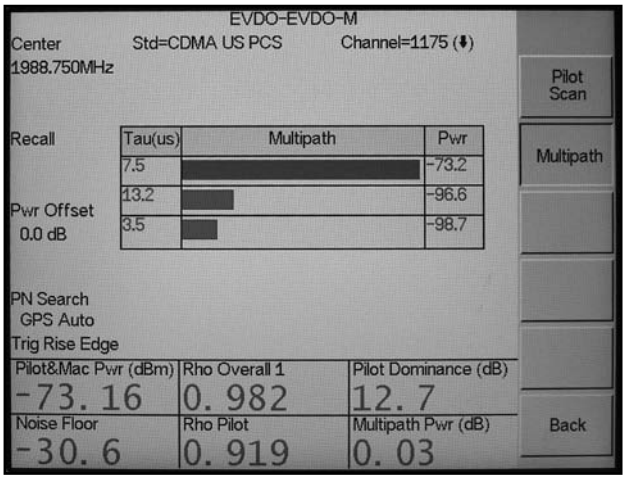

Figure 12. This graphic deplays the Multipath readings.

Conclusion

Anritsu's Cell Master MT8212B provides cdma2000 1xEV-DO measurement capabilities which enable field-based network technicians and RF engineers with a quick, efficient and cost-effective means of maintaining and troubleshooting BTS performance. Cell Master's support for RF measurements, demodulation and OTA measurements in cdma2000 1xEV-DO wireless networks is essential to those wanting to zero in on problems, while minimizing service disruptions and time spent off line.

Anritsu

ANRITSU Corporation
5-1-1 Onna, Atsugi-shi, Kanagawa, 243-8555 Japan
Phone: +81-46-223-1111
Fax: +81-46-296-1264

- U.S.A.
ANRITSU Company
1155 East Collins Boulevard, Suite 100,
Richardson, Texas 75081
Toll Free: 1-800-ANRITSU (267-4878)
Phone: +1-972-644-1777
Fax: +1-972-671-1877

- Canada
ANRITSU Electronics Ltd.
700 Silver Seven Road, Suite 120, Kanata,
Ontario K2V 1C3, Canada
Phone: +1-613-591-2003
Fax: +1-613-591-1006

- Brazil
ANRITSU Electrônica Ltda.
Praca Amadeu Amaral, 27-1 andar
01327-010 - Paraiso, São Paulo, Brazil
Phone: +55-11-3283-2511
Fax: +55-11-3886940

- U.K.
ANRITSU EMEA Ltd.
200 Capability Green, Luton, Bedfordshire LU1 3LU, U.K.
Phone: +44-1582-433280
Fax: +44-1582-731303

- France
ANRITSU S.A.
9, Avenue du Québec Z.A. de Courtaboeuf
91951 Les Ulis Cedex, France
Phone: +33-1-60-92-15-50
Fax: +33-1-64-46-10-65

- Germany
ANRITSU GmbH
Nemetschek Haus, Konrad-Zuse-Platz 1
81829 München, Germany
Phone: +49 (0) 89 442308-0
Fax: +49 (0) 89 442308-55

- Italy
ANRITSU S.p.A.
Via Elio Vittorini, 129, 00144 Roma, Italy
Phone: +39-06-509-9711
Fax: +39-06-502-2425

- Sweden
ANRITSU AB
Borgafjordsgatan 13, 164 40 Kista, Sweden
Phone: +46-8-534-707-00
Fax: +46-8-534-707-30

- Finland
ANRITSU AB
Teknobulevardi 3-5, FI-01530 Vantaa, Finland
Phone: +358-20-741-8100
Fax: +358-20-741-8111

- Denmark
ANRITSU A/S
Kirkebjerg Allé 90 DK-2605 Brondby, Denmark
Phone: +45-72112200
Fax: +45-72112210

- Spain
Anritsu EMEA Ltd.
Oficina de Representación en España
Edificio Veganova
Avda de la Vega, nº 1 (edf 8, pl1, of 8)
28108 ALCOBENDAS - Madrid, Spain
Phone: +34-914905761
Fax: +34-914905762

- United Arab Emirates
ANRITSU EMEA Ltd.
Dubai Liaison Office
P O Box 500413 - Dubai Internet City
Al Thuraya Building, Tower 1, Suite 701, 7th Floor
Dubai, United Arab Emirates
Phone: +971-4-3670352
Fax: +971-4-3688460

- Singapore
ANRITSU Pte. Ltd.
10, Hoe Chiang Road #07-01/02, Keppel Towers,
Singapore 089315
Phone: +65-6282-2400
Fax: +65-6282-2533

- P. R. China (Hong Kong)
ANRITSU Company Ltd.
Suite 923, 9/F., Chinachem Golden Plaza, 77 Mody Road,
Tsimshatsui East, Kowloon, Hong Kong, P.R. China
Phone: +852-2301-4980
Fax: +852-2301-3545

- P. R. China (Beijing)
ANRITSU Company Ltd.
Beijing Representative Office
Room 1515, Beijing Fortune Building,
No. 5 , Dong-San-Huan Bei Road,
Chao-Yang District, Beijing 100004, P.R. China
Phone: +86-10-6590-9230
Fax: +82-10-6590-9235

- Korea
ANRITSU Corporation, Ltd.
8F Hyunjuk Bldg. 832-41, Yeoksam-Dong,
Kangnam-ku, Seoul, 135-080, Korea
Phone: +82-2-553-6603
Fax: +82-2-553-6604

- Australia
ANRITSU Pty Ltd.
Unit 21/270 Ferntree Gully Road, Notting Hill
Victoria, 3168, Australia
Phone: +61-3-9558-8177
Fax: +61-3-9558-8255

- Taiwan
ANRITSU Company Inc.
7F, No. 316, Sec. 1, Neihu Rd., Taipei 114, Taiwan
Phone: +886-2-8751-1816
Fax: +886-2-8751-1817

- India
ANRITSU Pte. Ltd.
India Liaison Office
Unit No.S-3, Second Floor, Esteem Red Cross Bhavan,
No.26, Race Course Road, Bangalore 560 001 India
Phone: +91-80-32944707
Fax: +91-80-22356648

Application Note No. 11410-00379, Rev. A Printed in United States 2007-03