411-2051-500

Wireless Solutions

DualMode 800 Enclosure

Maintenance Manual

MTX08 Draft 00.01 November 1999

NORTEL NETWORKS

Wireless Solutions

DualMode 800 Enclosure

Maintenance Manual

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About this document

This publication is one of a set of documents that provide Nortel Networks customers with information and suggestions on the planning, operations and maintenance of their TDMA 800 MHz Universal Enclosure system. This set of documents includes the following manuals:

Manual title	Manual number
DualMode 800 Enclosure Functional Description	411-2051-100
DualMode 800 Enclosure Pre-Installation Guidelines	411-2051-200
DualMode 800 Enclosure RF Deployment Guide	411-2051-300
DualMode 800 Enclosure Installation Manual	—
DualMode 800 Enclosure Maintenance Manual	411-2051-500
DualMode 800 Enclosure Troubleshooting Guide	411-2051-900

Audience for this document

The intended audience for this set of manuals includes cell site technicians and planning engineers who require detailed information on the planning, operation and maintenance of a TDMA 800 MHz Universal Enclosure cell site.

The *Functional Description* is a technical reference foundation for the other documents in the documentation suite and is written for all.

The *Pre-Installation Guidelines* provides information on site selection, concrete pad preparation and specifications and installation guidelines.

The *RF Deployment Guide* is written for system planning personnel planning to implement new cells or expand existing cell sites.

The *Maintenance Manual* and the *Troubleshooting Guidelines* provide information on problem recognition and preventive maintenance are written

for the cell site technician to assist in troubleshooting and performing routine work.

The document suite assumes that the reader has a basic knowledge of cellular systems and radio propagation and is familiar with measurement units and terms associated with these concepts. This document does not provide detailed information on the theory of switching and radio propagation.

Organization of this document

This publication is organized to present the following information:

- overview of the TDMA 800 MHz Universal Enclosure, highlighting the components
- layout of the equipment bays, interface module and battery pedestal
- detailed descriptions of the TDMA 800 MHz equipment, both standard components and thoses specific to the enclosure. RF paths, channel expansion, and field-replaceable units are also included.
- discussion of the environmental control systems (heating/cooling)
- the power systems of the enclosure, as well as grounding requirements
- technical specifications of the enclosure
- list of terms (acronyms and abbreviations)

Related documents

Equipment operation

In a DualMode 800 Enclosure, you can communicate with the Alarm Control Unit (ACU), the Transmit Receive Unit (TRU) and the Multi-Channel Power Amplifier (MCPA) by the use of an interface terminal or a computer. You can use the handset on the DualMode Cell Site Monitor (DCSM) to program the mobile unit and perform call through test.

This chapter describes the interface commands for configuring and programming these units in the DualMode 800 Enclosure.

Alarm Control Unit

The MAINTENANCE (Local Terminal) port located on the front of the ACU gives direct access to the ACU MPU board. You can use this interface to configure and monitor the alarm input points and the control output contacts.

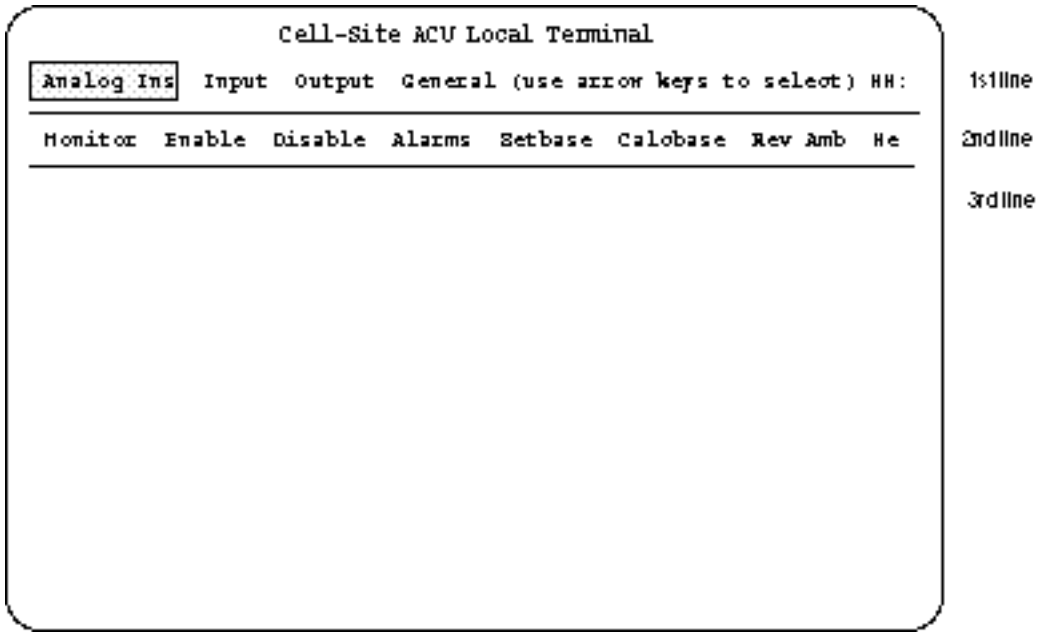
To access the ACU for local maintenance and monitoring, you need a VT100 (or equivalent) terminal with the following settings:

Stop bit control	1 bit
Word length	8 bits
Parity	none
BAUD rate	9600
Interface	RS-232C

If you cannot set the terminal to the settings listed, change the ACU configuration by setting the local terminal switch (SW3) on the MPU board to match your terminal settings. Refer to Table 5-4 for the settings of SW3 in the *DualMode 800 Enclosure Functional Description*, 411-2051-100.

When the terminal and ACU are set correctly, connect the terminal to the MAINTENANCE port with a null modem cable. Power up the terminal, hold the CONTROL key and press the Z key. A menu of options will appear on the screen as shown in Figure 1-1.

Figure 1-1
ACU Initial screen display

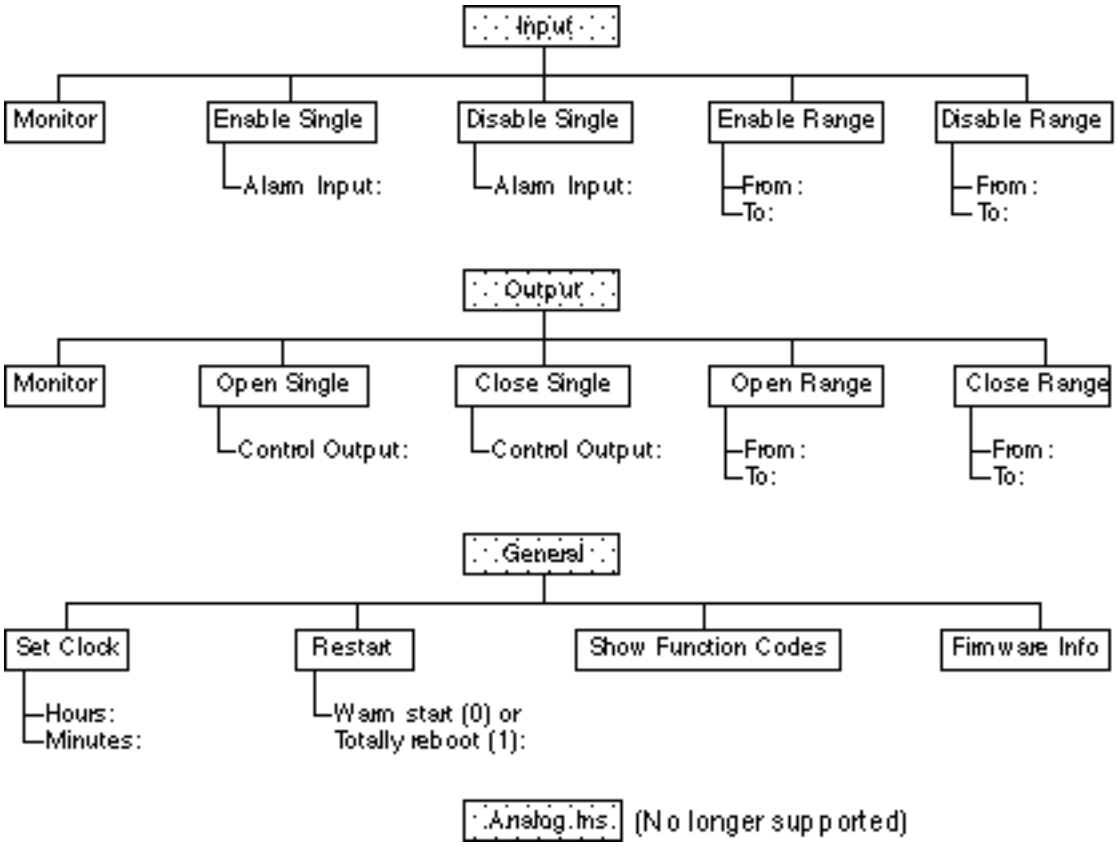


You can choose one of the four primary options at the first level:

- Input
- Output
- General
- Analog Ins (not used)

Each option consists of up to three lines on the screen. Figure 1-2 shows the structure of these options.

Figure 1-2
ACU menu structure



Selecting an option

This document describes the procedure for selecting and setting the parameters for ‘Enable Single’ in the Input option. You can use the same procedure as an example to select the other options.

> ***Note:*** The left and right arrow keys move the cursor to options on the same line. The up arrow key moves the cursor back to the previous line and the down arrow key moves the cursor to the next line.

1. On the first line, press the right arrow key to move the cursor to the Input option. The options on the second line will change accordingly as the cursor moves.
2. Press the down arrow key to move the cursor to the second line. The cursor will highlight the first option on the second line.

3. On the second line, press the right arrow key to move the cursor to the Enable Single option. The options on the third line will change accordingly as the cursor moves.
4. Press the down arrow key to move the cursor to the third line. The cursor will highlight the first option on the third line.
5. On the third line, type in the number of the alarm input point that needs to be enabled. Press the Return key.

   Note: For options that have more than one parameter on the third line, use the left and right arrow keys to move the cursor from one parameter to another parameter.

6. Press the Return key a second time to execute the selected parameter of the option. The display will show:

   ```
   Command Sent...Acknowledge Received
   ```

7. Press the up arrow key to move the cursor back to the previous line.

   Note: The 'Monitor', 'Show Function Codes' and 'Firmware Info' options do not have a third line on the menu. When selecting these options, press the Return key after they are selected. The information for these options will appear on the display.

Input option

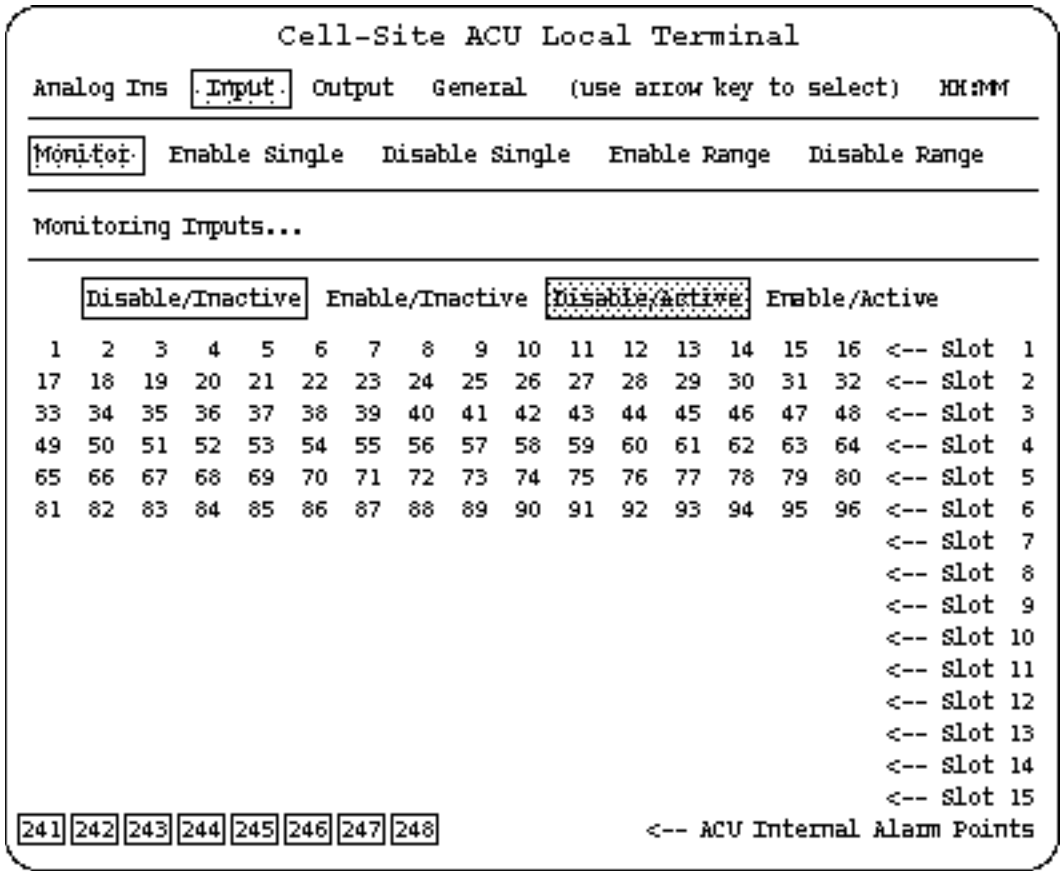
You can select the following five functions under the Input option:

- Monitor
- Enable Single
- Disable Single
- Enable Range
- Disable Range

Monitor

This function monitors the status of each alarm input point. Figure 1-3 shows a typical screen display of the Input Monitor option.

Figure 1-3
Typical Input Monitor screen display



- Alarm point 241—ROM check
- Alarm point 242—RAM check
- Alarm point 243—Non-volatile RAM check
- Alarm points 244 to 248—Reserved

For the assignment of the external input alarm points, refer to Table 3-7 in the *DualMode 800 Enclosure Functional Description*, 411-2051-100.

The status of each point is displayed as follows (see Figure 1-3 for the screen display):

- Disable/Inactive — The alarm input point has been disabled either from the MTX or the terminal and is currently not detecting an alarm.
- Enable/Inactive — The alarm input point has been enabled and is currently not detecting an alarm.

- Disable/Active — The alarm input point has been disabled. It is currently detecting an alarm which, because it is disabled, will not be reported to the MTX.
- Enable/Active — The alarm input point has been enabled. It is currently detecting an alarm that has been reported to the MTX.

You can monitor the status of the alarms continuously because the terminal automatically updates the display every second while in the Monitor mode.

After you leave the Monitor function, the data will still be displayed until you press the RETURN key.

Enable Single

The Enable Single function enables input alarm points one at a time. You must enable an input alarm point before it will report alarm conditions to the MTX.

Disable Single

The Disable Single function disables input alarm points one at a time. A disabled input alarm point will not report alarm conditions to the MTX.

Enable Range

The Enable Range function enables a group of input alarm point at a time.

Disable Range

The Disable Range function disables a group of input alarm point at a time.

Output option

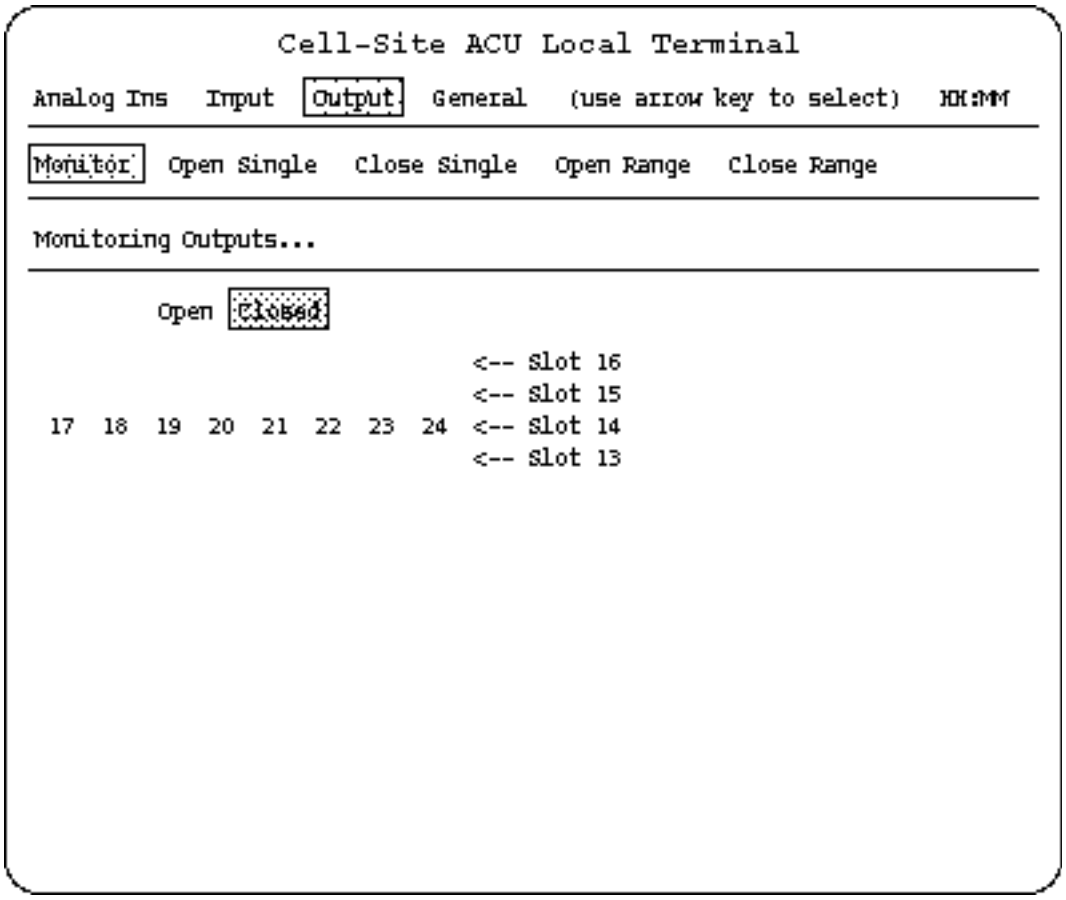
You can select the following five functions under the Output option:

- Monitor
- Open Single
- Close Single
- Open Range
- Close Range

Monitor

This function monitors the status of each output contact point. Figure 1-4 shows a typical screen display of the Output Monitor option.

Figure 1-4
Typical Output Monitor screen display



Note: An Urban cell site does not have specific assignment for output contact points.

HH:MM is the ACU clock display. The display updates the time once every minute.

The status of each point is displayed as follows (see Figure 1-4 for the screen display):

- Open The output contact is open.
- Closed The output contact is closed.

You can monitor the status of the output contacts continuously because the terminal updates the display with an opened or closed output contact.

After you leave the Monitor function, the data will still be displayed until you press the RETURN key.

Open Single
The Open Single function opens output contact points one at a time. Setting an output contact point to Open disables that output point.

Close Single
The Close Single function closes output contact points one at a time. Setting an output contact point to Closed enables that contact point.

Open Range
The Open Range function opens a group of output contact points at a time.

Close Range
The Close Range function closes a group of output contact points at a time.

General option
You can select the following four functions under the General option.

- Set Clock
- Restart
- Show Function Codes
- Firmware Info

Set Clock
The ACU clock determines the time alarms are generated. This option allows you to set the time on a 24-hour basis.

Restart
This function restores the alarm input points and output contacts of the ACU to the default states.

Show Function Codes
This function displays the function codes the system uses on messages between the MTX and the ACU.

Firmware Info
You can display information about the existing firmware load in the ACU.

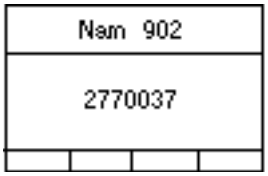
DualMode Cell Site Monitor (DCSM)

The DualMode Cell Site Monitor (DCSM) can operate in two modes, stand-alone and directed. In stand-alone mode, the DCSM functions like a normal mobile telephone. In directed mode, the DCSM performs test functions under the control of the MTX.

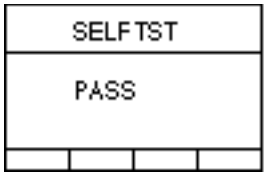
When you power up or reset a DCSM, the DCSM performs a self-test.

> ***Note:*** During power up, it may take as long as four minutes for the DCSM to startup.

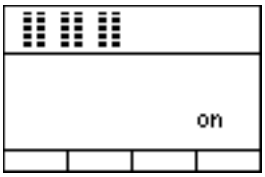
The display on the handset first shows the phone number of the mobile unit.



On a successful self-test, the display shows the SELFTST PASS message.



The DCSM is in stand-alone mode after the self-test. The display shows that the mobile unit is on and is ready for originating and answering calls.



Stand-alone mode operation

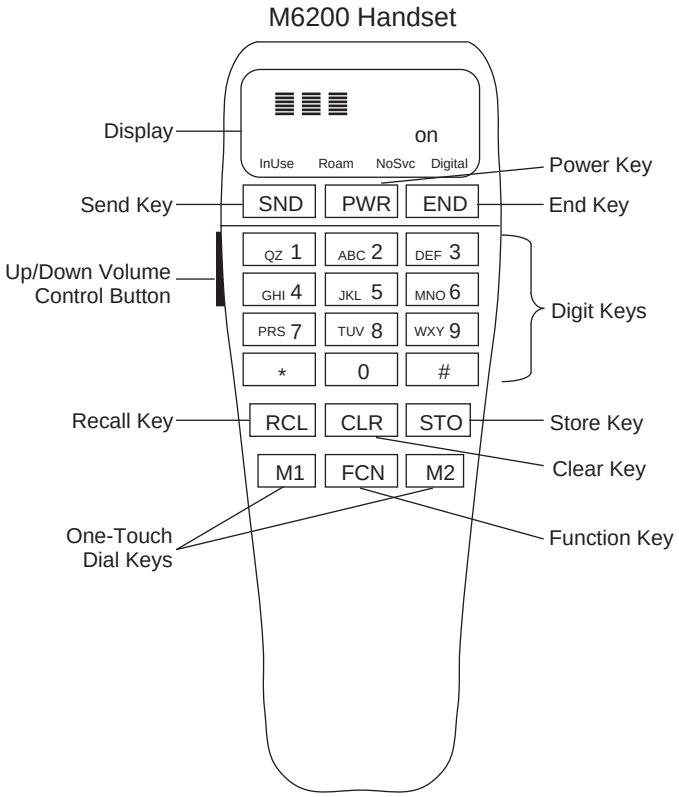
In stand-alone mode you can use the handset on the front panel of the DCSM to originate and answer calls.

The mobile unit functions in the same way as a subscriber mobile telephone in the cellular system. For this reason, the mobile unit in the DCSM has to be activated in the same way as a subscriber mobile telephone. The cellular system will not recognize the mobile unit or allow it to function unless the programming on the Numerical Assignment Modules (NAM) is completed.

The Hughes M6200 handset (NT3P75AB)

The Hughes M6200 cellular telephone is used as the mobile unit in the DCSM. Figure 1-5 shows the location of controls and keypad on the Hughes M6200 handset.

Figure 1-5
Controls and keypad on Hughes M6200 handset



Controls and keypad description

Display	Provides the following information: Signal Strength—bars on the upper left of the display indicate the signal strength of your phone when it is on. Three full bars signifies highest strength. InUse—indicates a call is in progress. Roam—when on or flashing, indicates that the phone is outside the home service area as determined by Sys ID. NoSvc—indicates that the signal strength is not strong enough to allow a call to be initiated or received. Digital— indicates that the current call is in digital mode.
Up/Down Volume Control keys	Adjusts the keypad, speaker and earpiece sound level. This key is also used to scroll through the parameters of the NAMs and other menus.
0-9 Digit keys	Used for entering telephone numbers.
SND (Send) key	Originate/answer calls.
PWR (Power) key	The function of this key has been disabled. The mobile/DCSM cannot be turned off by this key.
END key	Ends calls.
RCL (Recall) key	Recalls numbers stored in memory.
CLR (Clear) key	Clears the display or allows you to exit from any menu.
STO (Store) key	Stores information in memory and confirms your selections.
One-Touch Dial keys (M1 and M2)	Numbers stored in either of these keys can be dialed by simply pressing the appropriate key.
FCN (Function) key	When used with other keys, personalizes your phone.

Programming the mobile

To activate the Hughes M6200 mobile, you need to program:

- the four Numerical Assignment Modules (NAMs)
- Due to NAM4's scanning control of paging channels, it must be programmed when the M6200 mobile is used in the DCSM.
- System selection

CAUTION
Failure to program the DCSM mobile unit as described, or attempting to program the DCSM mobile unit as a regular M6200 mobile will result in the malfunction of the DCSM.

Programming the NAM parameters

For the M6200 cellular telephone, the NAMs are stored in the mobile and need to be programmed when the DCSM is installed in the cell site.

The NAM parameters that can be programmed are:

- Area Code
- Phone Number
- Access Overload Class (ACCOLC)
- Primary 1st Paging Channel (1STCHP1)
- Secondary 1st Paging Channel (1STCHP2)
- System ID (SID)
- Extended System ID (Ex SID1-8)
- Unlock
- Security Code (Secure)
- Digital Indicator (Dig Ind)
- Sticky Analog (StickyA)
- BillBoard1 (NAMs 1 to 3 only)
- BillBoard2 (NAMs 1 to 3 only)

  Note: NAM 4 includes five additional programming fields:

  — Scn DCCH

  — # DCSS

  — 1STCHA1

— 1STCHA2

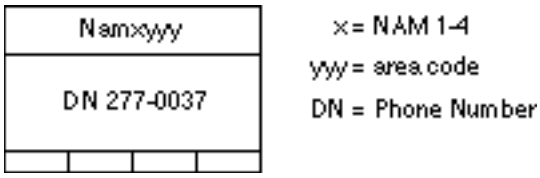
— 1STCHB1

— 1STCHB2

— #DCCHS

— 1STDCCH

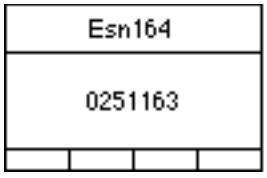
Press the FCN key and then the 0 (zero) key to select a NAM. The display shows the letters “NAM” and the phone number for NAM1. The “Volume” arrow keys on the side of the handset can be used to select the other three NAMs.



To read the ESN (Electronic Serial Number) and to access the contents of NAM1, enter a six digit security code. The factory default security code is 000000.

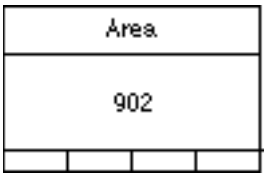
When the correct security code is entered, the display shows the (ESN) of the mobile telephone. Record the ESN number as it is required for datafilling the CSMINV table.

Note: The numbers shown in the following screen displays are examples only.

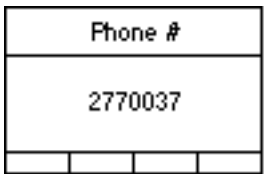


At this point, you have accessed NAM1 and may press the “Volume” arrow keys to scroll through all of the NAM parameters. Use the CLR key and the number keys to set the parameters of the NAM that you have selected. After changing one parameter, you may edit another one by pressing an arrow key to scroll to the parameter. Press the STO key when you are done with the selected NAM.

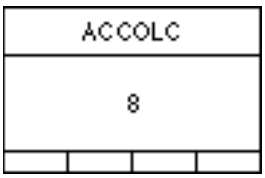
Use the arrow key to scroll to the Area Code display. Enter your three digit area code.



Use the arrow key to scroll to the Phone Number display. Enter your seven digit phone number.



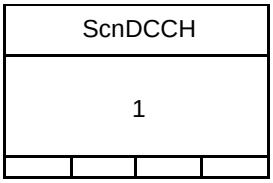
Use the arrow key to scroll to the Access Overload Class (ACCOLC) display. Enter the ACCOLC. The default setting is 10 for the DCSM.



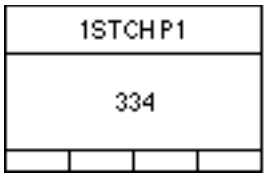
For NAM4 only:

Use the arrow key to scroll to the field ScnDCCH

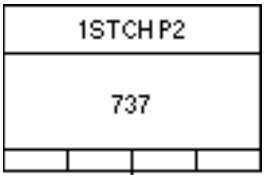
- Set ScnDCCH to 1 if you want the mobile to scan using the IS-136.1 scanning algorithm (that is, scan for DCCHs) or
- Set ScnDCCH to 0 if you want the mobile to scan using the IS-136.2 scanning algorithm (that is, scan ACCHs only)



Use the arrow key to scroll to the Primary First Paging Channel (1STCHP1) display. Enter the Control Channel (CCH) number for your cellular band, Channel 333 for A system or channel 334 for B system. The CCH must be a standard CCH although NAM4 can be programmed to use a non-standard CCH. A non-standard CCH is generally for bench-testing to prevent interference with local cel1site CCHs. (333 for A, or 334 for B system)

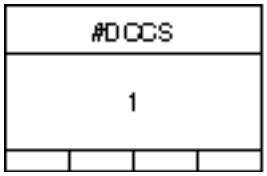


Use the arrow key to scroll to the Secondary First Paging Channel (1STCHP2) display. Enter the three digit second control channel number of the cell site, if any. (708 for A, or 737 for B system)



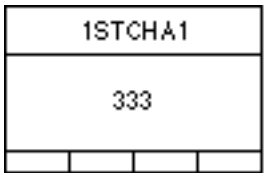
Programming control channels to scan: *NAM4 only*

Use the arrow key to scroll to the #DCCS (number of dedicated control channels) display. Enter the total number of control channels that the DCSM is assigned to scan (1 to 21 channels).



For NAM4 only:

Use the arrow key to scroll to 1STCHA1 display. Enter the A side primary control channel (IS-54B and IS-136.2 default 333).



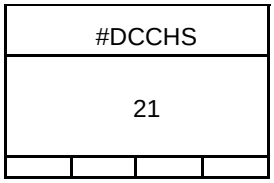
Repeat this step for: 1STCHA2 *A side secondary control channel (708*)*
1STCHB1 *B side primary control channel (334 *)*
1STCHB2 *B side secondary control channel (737*)*

** IS54B and IS-136.2 defaults*

Note: These fields define the control channels the DCSM is to use.
For example: range of control channels = STCHAx + (#DCCS + 1)
and/or = 1STCHBx - (#DCCS - 1)

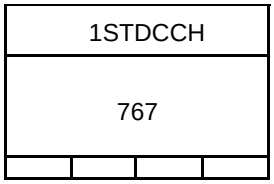
For NAM4 only:

Use the arrow key to scroll to the #DCCHS (number of Digital Control Channels) display. Enter the total number of control channels that the DCSM is assigned to scan (1 to 21 channels).

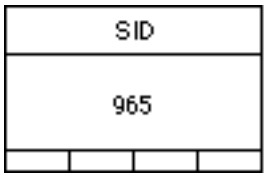


For NAM4 only:

Use the arrow key to scroll to the 1st Digital Control Channel (1STDCCH) display. Enter your 1st DCCH.



Use the arrow key to scroll to the System ID (SID) display. Enter your System ID.



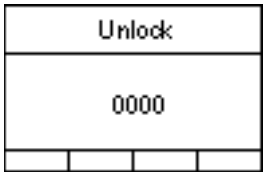
Use the arrow key to scroll to the Extended System ID 1 display (Ex SID1). If the factory default does not read zero then enter zero in this field.

Repeat this step for the other Extended System IDs (Ex SID2-Ex SID8).

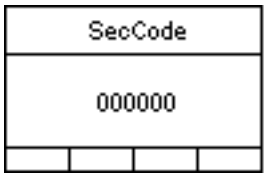
Use the arrow key to scroll to the Unlock Code display. Enter your four digit Unlock Code. The factory default is 0000.

CAUTION
Whenever you enter a new Unlock Code or Security Code, make sure that you have recorded the new code. There is no way you can unlock the mobile or enter the NAM again without entering the correct Unlock Code or Security Code.

Note: Nortel Networks recommends that unless under management directive, the Unlock and Security codes not be changed from their defaults.

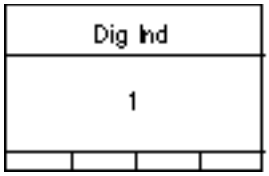


Use the arrow key to scroll to the Security Code (SecCode) display. Enter your six digit Security Code. The factory default is 000000.



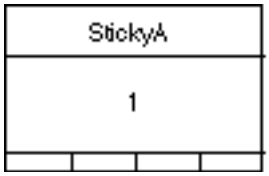
Use the arrow key to scroll to the Digital Indicator display (Dig Ind).

Note: In the DCSM applications, always enter a 1 to allow the mobile to indicate if it is in Digital mode.



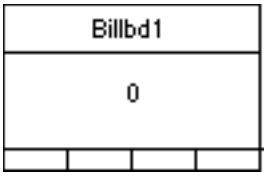
Use the arrow key to scroll to the Sticky Analog display (StickyA).

Note: In the DCSM application, always enter a 0 to keep the mobile in analog mode and preventing it from entering the digital mode state.



For NAM1 only:

Use the arrow key to scroll to Billboard 1 (Billbd 1). Enter a zero in this field.



Repeat this step for the BillBd 2 field.

Use the arrow key to scroll through the NAM and verify that all the values have been entered correctly. Press STO key to store all the values into volatile memory that you have entered.

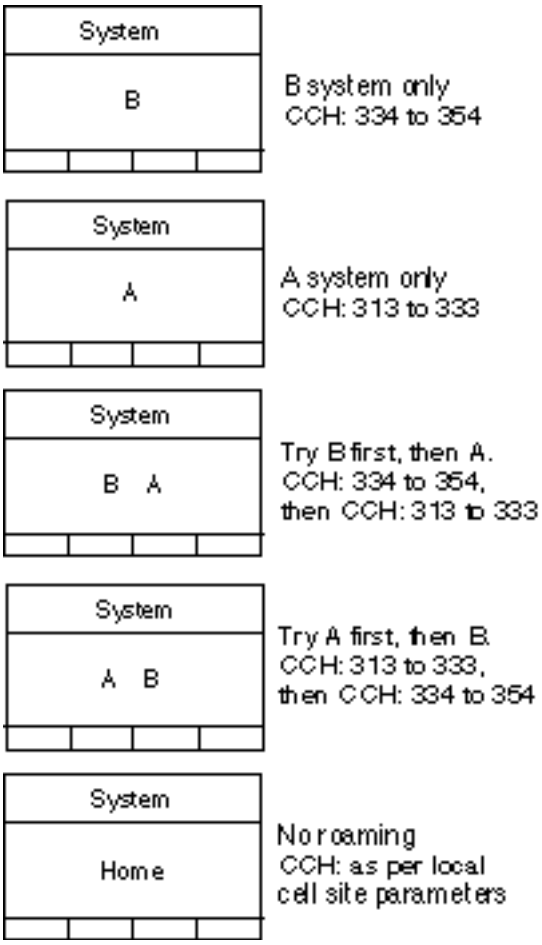
Press the reset button on the rear panel of the DCSM to reset the unit. You can also perform a BSY and RTS to reset the DCSM. You have programmed NAM's non-volatile memory when the self-test is completed.

NAM 4 must be programmed as well if only one telephone number is assigned to the DCSM. Nortel Networks recommends that you also load the three remaining NAMs (NAMs 2,3 and 4) with the same information to prevent from inadvertently selecting a vacant NAM.

Repeat the same programming procedure by using the FCN key and the 0 (zero) key to get the NAM display. Use the arrow key to select one of the three remaining NAMs. Program each NAM.

Programming the system selection

When all the NAMs have been programmed, enter the system selection for the DCSM in your service area. Press the FCN key and then the 1 key. Use the arrow key to scroll through the system selection options. When the system of your service area appears (consistent with your Primary First Paging Channel, 1STCHP1, in NAM4), stop scrolling. Press the STO key to confirm your selection and place it into memory.



Note: Making a system selection inconsistent with your 1STCHP1 could prevent calls from being made and cause the “Roam” indicator on the display to blink.

Configuration of the mobile cellular telephone is now complete and the phone can now be used to originate and answer calls.

Operating the mobile

When all the NAMs have been programmed and the system selection has been selected, the Mobile Unit is ready for operation.

Receiving a call

When the phone rings, lift the handset from the hang up cradle and press the SND key to answer the call.

> ***Note:*** If the phone is locked, or you are accessing functions or storing/ recalling a number when the phone rings, you can still answer the call by pressing the SND key.

Placing a call

Enter the telephone number you want to call and press the SND key.

Ending a call

Press the END key to end a call.

> ***Note:*** Returning the handset to the hang up cradle without pressing the END key will not end a call.

Transmit Receive Unit (TRU)

The Transmit Receive Unit (TRU) provides two methods for accessing the Operation, Administration, and Maintenance (OA&M) functionality, the front panel display interface and the AMPS/TDMA Terminal Interface. The front panel display provides operating parameters and status information; the Terminal Interface acts as a user-friendly interface to TRU command, control, and monitoring functions.

The operating parameters and status information on the front panel display are also available through the terminal interface by using the QUERY FAULT command in the command line mode. This contains all of the necessary information for proper OA&M functions of the TRU.

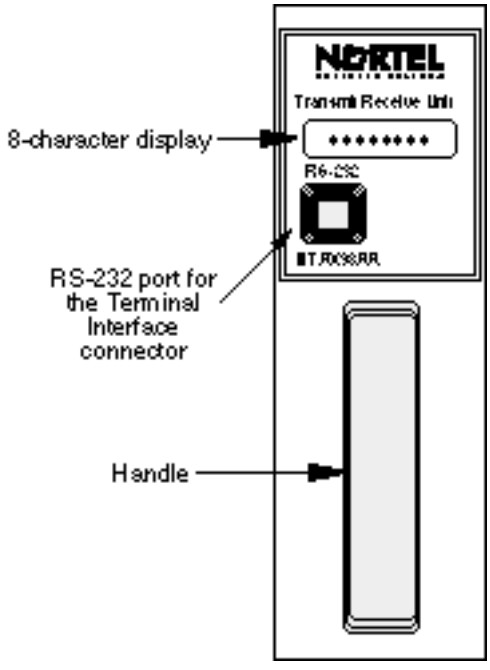
The front panel display interface

The front panel display on the TRU provides operating parameter information for the technician to properly administer the TRU.

TRU2 (NTAX98AA) front panel display interface

The front panel display interface for the TRU2 (NTAX98AA), as shown in Figure 1-6, consists of an eight-character LED display of current status information.

Figure 1-6
Front panel layout of the TRU2 (NTAX98AA)



- The first three characters on the display show the current personality of the TRU:

Display	Personality
AVC	Analog Voice Channel
ACC	Analog Control Channel
ALR	Analog Locate Receiver
DCC	Digital Control Channel
MDS	Mobile Data Base Station
TTC	TDMA (digital) Traffic Channel
TLR	TDMA (digital) Locate Receiver

- The next character on shows an asterisk (*) if the TRU is currently transmitting. Otherwise, it is left blank.
- The last four characters show the current channel number or, if the TRU is not selected, ROMIDLE is displayed.

TRU3 (NTAW99AA) front panel display interface

The front panel display interface for the TRU3 (NTAW99AA), as shown in Figure 1-7, consists of six LEDs. The top three LEDs show the operational status of the TRU. The bottom three LEDs show the personality status of the TRU.

Figure 1-7
Front panel layout of the TRU3

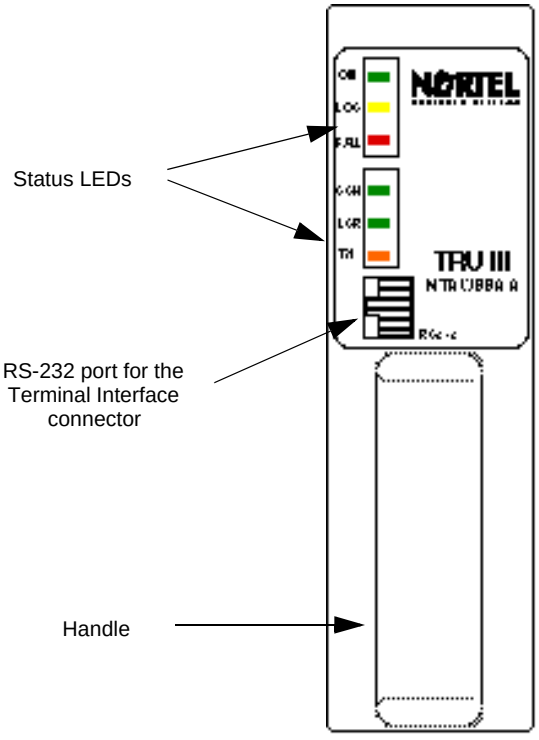


Table 1-1 shows the various transitions in LED state that may be observed during operation.

Table 1-1
Transitions in the TRU3 LED state

State	Status	LED						Description/Action
		ON	LOS	FAIL	CCH	LCR	TX	
1	Power-up (LED check)	*Flash*	*Flash*	*Flash*	*Flash*	*Flash*	*Flash*	LEDs flash on and off for approximately 1 second, then radio goes to state 2.
2	Diagnostics	Off	Last state	Last state	**On**	**On**	Off	Radio is not in service. It performs a series of hardware diagnostic tests that run for approximately 12 seconds. If all tests pass, radio goes to state 3; otherwise, it goes to state 5.
3	ROM-idle	**On**	Last state	Last state	**On**	**On**	Off	If the radio in this state is not put into service in one minute, it resets itself and returns to state 2. The radio transitions between states 2 and 3 until it is put into service (state 6), loading begins (state 4), or a Hard Reset command is received from the MTX (state 2).
4	Loading	**On**	Off	Off	*Flash*	*Flash*	Off	The ON LED is on and the CCH and LCR LEDs flash during the loading period. When loading is complete, radio returns to state 2.
5	Idle fault	Off	Off	**On**	Off	Off	Off	The radio is in this state when a hardware diagnostic test fails before the radio is put into service. When the radio is in this state, perform the following: (a) Re-seat the radio into its slot again (or to another slot) to identify if the fail was caused by a power supply glitch or some other transient event. (b) If the fault is cleared, the FAIL LED turns off, the ON, CCH and LCR LEDs turn on and the radio proceeds to state 2. (c) If the FAULT LED remains on, replace the radio and return it to your Customer Service Office (CSO) for repair.

- continued -

Table 1-1
Transitions in the TRU3 LED state (continued)

State	Status	LED						Description/Action
		ON	LOS	FAIL	CCH	LCR	TX	
6	In-service —DCCH or 2T+C	**On**	Off	Off	**On**	Off	**On**	During normal operation, the TX LED turns on whenever the radio's transmitter is active. Radio remains in this state until one of the followings happens: —external failure detected, radio goes to state 7 —internal hardware failure detected, radio goes to state 8 —radio taken out of service by the MTX (SYBSY) or by an operator (MANB), radio goes to state 2
	In-service —TTC (transmitter active)	**On**	Off	Off	Off	Off	**On**	
	In-service —TTC (transmitter inactive)	**On**	Off	Off	Off	Off	Off	
7	LOS	**On**	**On** (Note 1)	Off	Last state	Last state	Last state (Note 2)	This state indicates that a failure outside the radio has occurred. Typical loss of service conditions include: PA fault, Link Access Protocol-D (LAPD) link disconnection, or a loss of connection to the Digital Signal Processing Module (DSPM). The MTX will take the radio out of service (state 2) once the LOS condition is reported with the exception of loss connection to DSPM. The radio is reported as in-service trouble state. Service is restored when the connection to the DSPM is re-established.
8	Fault	Off	Off	**On** (Note 3)	Off	Off	Off	This state indicates that an internal hardware fault is detected. The MTX will take the radio out of service (state 2) once the fault is reported. The fault is reported to the MTX as an MTX105 log. Refer to the *DualMode Radio Unit Troubleshooting Guide*, 411-2131-166, for more information.
- End -								

Note 1: Loss-of-service conditions which are not detected by the radio, such as excessive SWERRs, do not cause the yellow LED to turn on directly. However, if the ICP chooses to close the signalling connection to the radio, the yellow LED will be activated indirectly and further

troubleshooting will be required to isolate the exact cause of the loss of service.

Note 2: In general, the TX LED is off (radio taken off-the-air) when the radio is in the loss-of-service or radio-failure states. The only exception is when the radio is operating in the fractional DCCH (2T+C) state and there is a loss of connection to the DSPM. In this case, the loss-of-service condition applies because the traffic channels within the radio are unusable. However, the TX LED is on because the DCCH within the radio is still active.

Note 3: When a fault is detected, the radio is taken SYSBSY and any attempt to return the radio into service is expected to fail. It may be necessary to replace the radio before proper operation can be achieved.

The Terminal Interface

The terminal interface, connected to the TRU is for the purposes of installation, maintenance, tests, and status query, is an ASCII terminal. The Operation, Administration and Maintenance (OA&M) commands are entered by way of a VT100 (or compatible) terminal connected to the RS-232 interface on the front panel of the TRU. This allows maintenance, test, query, and measurement functions to be performed without requiring the TRU to be connected to the rest of the DMS-MTX* system.

CAUTION
Service interruption
Never put a TRU into the terminal interface mode when the TRU is in an active call processing state. The call in progress will be dropped.

Commands are typed into the terminal to set operating parameters and perform control, maintenance, and status query functions. It is typically used to bring the unit on air during installation and commissioning. There are no switches, jumpers, or adjustable hardware elements within the TRU that need to be accessed by the user.

All TRU operating parameters are controlled either from the ASCII terminal or from a Maintenance and Administration Position (MAP*) terminal at the MTX switch as part of call processing. The control from the MAP terminal is called the Remote Radio Interface (RRIF) feature. Refer to the *Remote Radio InterFace Reference*, 411-2131-115, for the RRIF commands.

Note: Not all OA&M commands are available for the TRU3 through RRIF. The TRU3 does not support RRIF Layer 2, VBER, or RF measurements in MTX08.

The terminal interface can be operated in command line mode or in the more convenient fullscreen monitor mode. The basic commands, with the same functionality, are available in the command line mode as well as in the fullscreen mode.

The AMPS/TDMA Fullscreen Monitor

The AMPS/TDMA Fullscreen Monitor is the primary user interface to the DRU's OA&M capabilities. Two modes of operation are available; analog (AMPS) mode and digital (TDMA) mode. The primary purpose of the Fullscreen Monitor is to provide a mean for quickly commissioning a DRU in a cell site. Additionally, it provides user-friendly access to the DRU's OA&M test and maintenance functions so that problems in the DRU or the mobile can be detected, diagnosed, and remedied. The Fullscreen Monitor is intended for use on a DRU not in an active call processing state.

> ***Note:*** The TRU3 does not support AMPS mode. However, the commands for AMPS operation can still be entered in both the command line mode or the fullscreen mode.

Fullscreen monitor setup

The terminal interface can be operated in command line mode or in the more convenient fullscreen monitor mode. The basic commands, with the same functionality, are available in the command line mode as well as in the fullscreen mode.

The fullscreen monitor is the primary user interface to the OA&M capabilities of the DRU. Two modes of operation are available; analog (AMPS) mode and digital (TDMA) mode.

Connect a VT100 (or equivalent) terminal to the RS-232 port on the front panel of the Transmit Receive Unit (TRU). By pressing the “Break” key on the terminal keyboard, you can access the command line mode. The terminal will display the following:

For the TRU 2:

```
TRU Terminal Interface
(C) Copyright 1990-1996 Bell Northern Research, Inc.
>
```

For the TRU3:

```
TRU-III Terminal Interface
(C) Copyright 1996-97 Nortel
>
```

To enter the fullscreen mode, at the command line prompt (>), type in the commands:

```
>SET LT OFF
>SET FS ON
```

The SET LT OFF command disables the LAPD timeout. If the TRU detects loss of the LAPD link, it resets itself after 10-12 seconds. With the LAPD timeout set off, the TRU does not reset, which is necessary for stand alone testing.

The SET FS ON command clears the existing display and invokes the fullscreen display in the AMPS mode. In the fullscreen monitor, the OA&M commands are displayed and selected by their alphabetic code. The results of each OA&M command are displayed at specific screen locations.

Figure 1-8 shows the fullscreen displays for the TRU2 and Figure 1-9 shows the fullscreen for the TRU3. Table 1-2 shows a summary of the fullscreen commands and these commands are explained in Table 1-3. Table 1-4 to Table 1-6 show and explain the command line mode commands.

The terminal screen is divided horizontally into a status area and a command area. The bottom line of the terminal display is used as the command area; you may enter the appropriate letter representing the command. Directly above the command area is the output message line where status and output messages, such as selection parameters and error messages, are displayed.

On-line help

Interfacing with the Fullscreen Monitor is simplified by the availability of on-line help. The user may type “HELP” or “?” in response to any prompt. A brief paragraph describing the function of the DRU terminal interface is displayed. Several on-line help categories are available. Each help category contains a brief, one-line description of each command in that category. The following categories of help commands are available:

- HELP HELP Lists help categories
- HELP MTCE Lists maintenance commands
- HELP TESTS Lists test commands
- HELP MSR List measurement and query commands
- HELP MONITOR List commands within the monitor subsystem

Figure 1-8
Fullscreen display for the TRU2

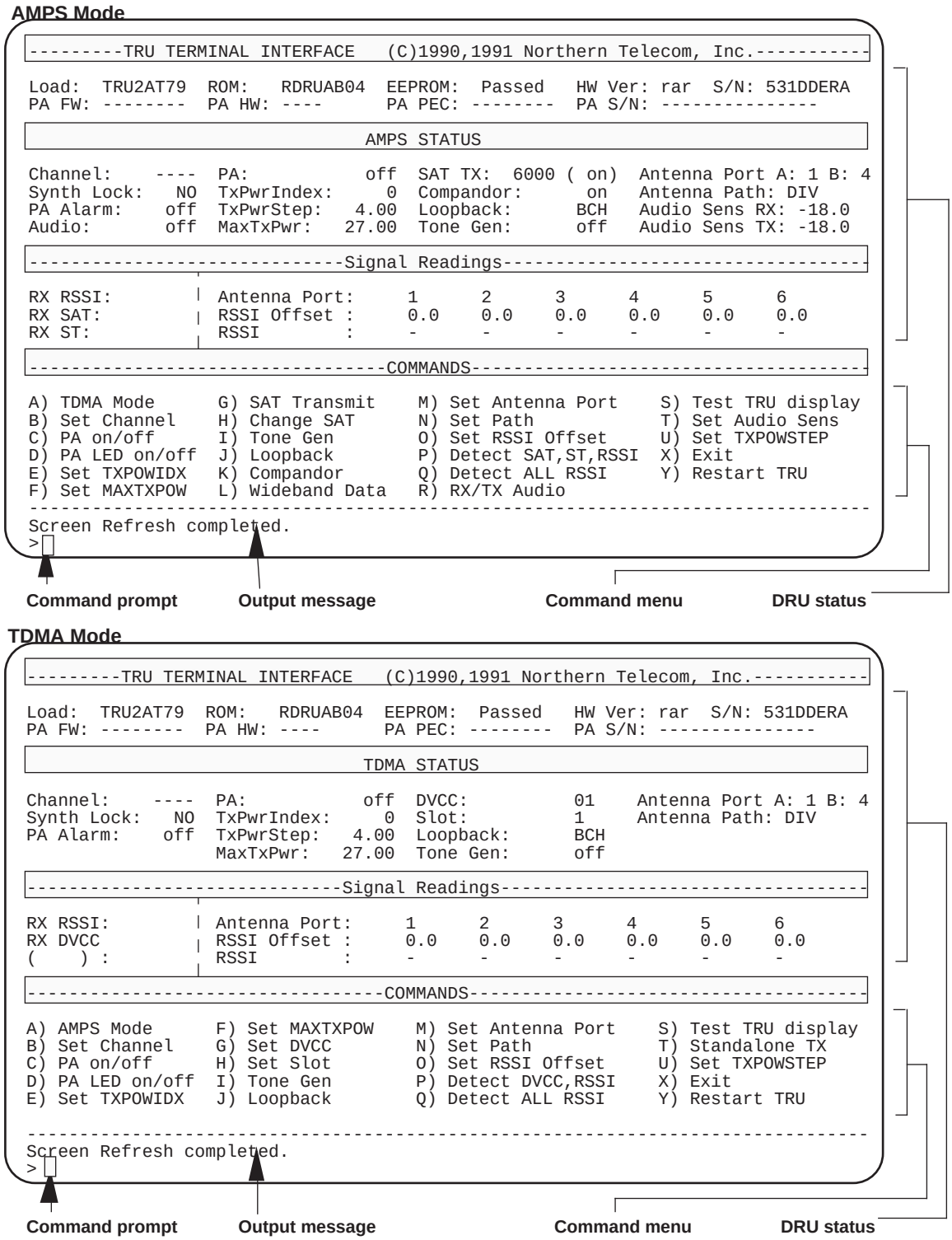
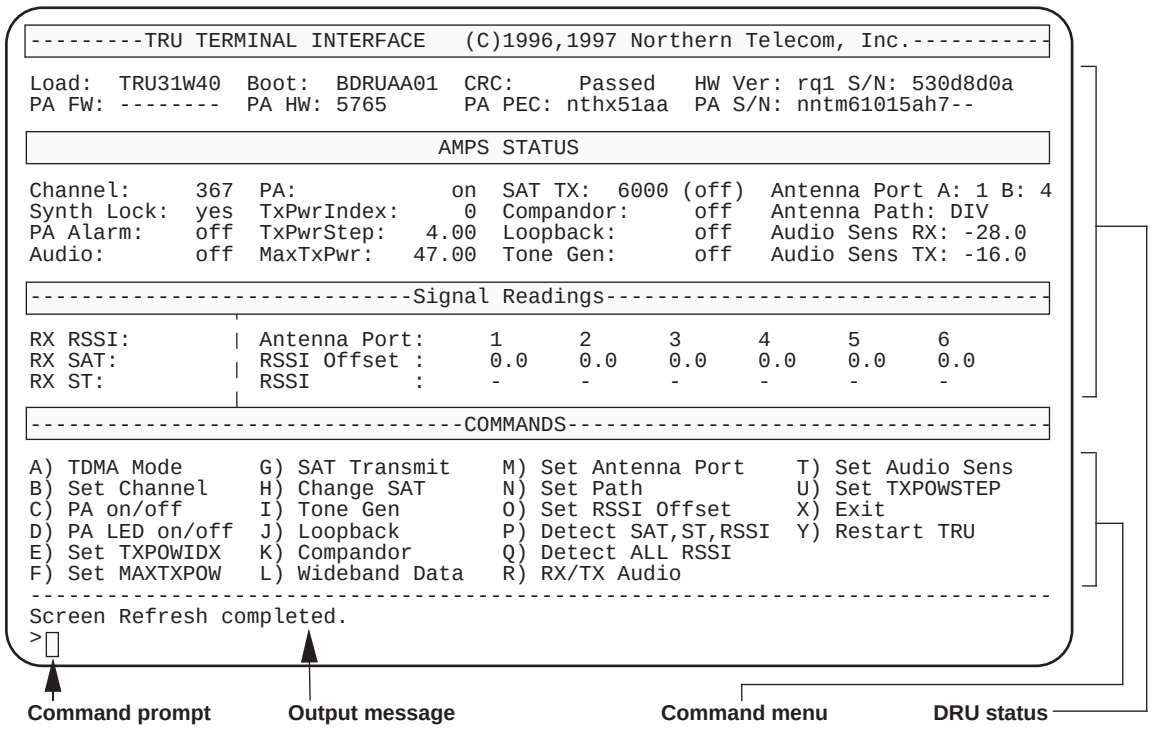


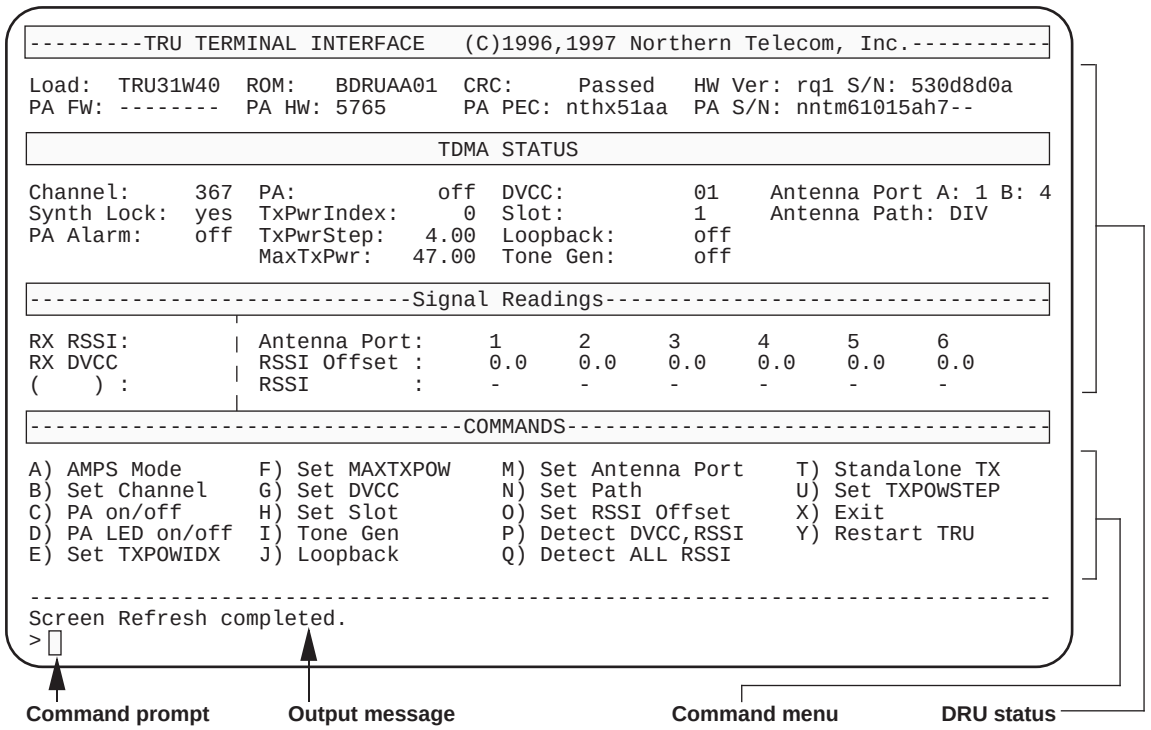
Figure 1-9
Fullscreen display for the TRU3

AMPS Mode



Command prompt **Output message** **Command menu** **DRU status**

TDMA Mode



Command prompt **Output message** **Command menu** **DRU status**

Fullscreen commands

Table 1-2 lists a set of the fullscreen commands. Some commands are only applicable to the TRU in either the analog or digital mode; others are applicable only when the TRU is in a particular state. Using such a command when the TRU is not configured correctly results in the error message below:

```
That function is not available in the DRU's current state.
```

A command is entered on the command line at the > prompt. You must press the “Return” key to execute the command. For some commands, additional parameters need to be entered and a prompt will appear on the message line. Enter the appropriate parameter and press the “Return” key to execute the command. Only one command may be executed at a time.

Table 1-2
TRU Fullscreen command summary

Code	AMPS Mode	TDMA Mode
A	Change screen to TDMA mode display	Change screen to AMPS mode display
B	Set Channel	Set Channel
C	Set PA on/off	Set PA on/off
D	Set PA LED on/off	Set PA LED on/off
E	Set TXPOWIDX	Set TXPOWIDX
F	Set MAXTXPOW	Set MAXTXPOW
G	SAT Transmit	Set DVCC
H	Change SAT	Set SLOT
I	Set Tone Gen	Set Tone Gen
J	Set Loopback	Set Loopback
K	Set Compandor	—
L	Set Wideband Data	—
M	Set Antenna Port	Set Antenna Port
N	Set Path	Set Path
O	Set RSSI Offset	Set RSSI Offset
P	Detect SAT/ST/RSSI	Detect DVCC/RSSI
Q	Detect ALL RSSI	Detect ALL RSSI
R	Set Rx/Tx Audio	—
S	Test TRU Display	Test TRU Display
T	Set Audio Sens	Standalone TX
U	Set TXPOWSTEP	Set TXPOWSTEP
X	Exit	Exit
Y	Restart TRU	Restart TRU

A complete description of the fullscreen commands is given in Table 1-3. This table is broken into five groups according to the functions of the commands:

- Configuration functions for TRU operating parameters
- Transmit functions for TRU transmit status
- Receive functions for TRU receive status
- AMPS mode functions for functions available in AMPS mode only
- TDMA mode functions for functions available in TDMA mode only

Table 1-3
TRU Fullscreen commands

Configuration functions (available to both the AMPS and the TDMA modes)**:**			
Code	**Command**	**Status**	**Action/Initial Value**
A	Set Mode	AMPS TDMA	Toggles between the AMPS mode display and the TDMA mode display.
B	Set Channel	0000	Sets the current channel and updates the Channel field on the display. If the TRU Synthesizer was able to lock to the specified channel, the Synth Lock field displays "YES"; otherwise, the Channel field displays "----" and the Synth Lock field displays "NO".
D	Set PA LED	on/off	Turns the alarm LED on the front panel of the MCPA on or off. The status is shown in the PA Alarm field.
I	Set Tone Gen	BCH RF Off	Turns on either the tone generation (1004 Hz) on the B-channel to the MTX, the RF tone generation (1 kHz) on air, or turns off the tone generation. The status is shown in the Tone Gen field.
J	Set Loopback	BCH RF Off	Sets either the B-Channel Audio Loopback (to MTX), the RF Loopback (to mobile), or Off (no Loopback). The status is shown in the Loopback field.
S	Test Display (not available for TRU3)	—	Verifies the TRU's 8-character LED display by alternately showing the following three patterns on the LED display until the “Return” key is pressed: 00000000 ******** .....
X	Exit	—	Leaves fullscreen monitor mode, clearing the screen and returning to command line mode.
Y	Restart TRU	W C	Executes either a ROM level reset (C = COLD) or a FLASH level restart (W = WARM). You are prompted for the type of restart to be performed. ***Note:*** This will restart the DRU and force an exit from the fullscreen monitor mode.
C	Set PA on/off	on/off	Turns the TRU transmitter on or off. The status is shown in the PA field.
- continued -			

Table 1-3
TRU Fullscreen commands (continued)

Transmit functions (available to both the AMPS and the TDMA modes)**:**			
Code	**Command**	**Status**	**Action/Initial Value**
E	Set TXPOWIDX	0..7	Sets the current TRU power level attenuation number. The TRU has maximum output power when power level is set at “0” (no attenuation). The status is shown in the Power Level or TxPwrIndex field. ***Note:*** Nortel Networks recommends that you set the power level at “0” unless otherwise specified as a site requirement.
F	Set MAXTXPOW	-1.0 dBm to 27.0 dBm ***Note:*** These values are for NO PATYPE used in Urban.	Defines the maximum power level (dBm) which maps to an Attenuation Level number of “0” and updates the TRU Power or MaxTxPwr field. Due to the nature of this command, it is not available if you have not previously set the TRU power level. ***Note:*** If the TRU transmitter is on (C command) and the power level is set (E command), the TRU output power changes immediately when this command is entered.
U	Set TXPOWSTEP	1..4	Sets the current MCPA power step size number (1.00 dB to 4.00 dB in 0.25 dB steps). The status is shown in the Power Step or TxPwrStep field. ***Note:*** Nortel Networks recommends that you set the power step size at “4” unless otherwise specified as a site requirement.
- continued -			

Use the three TRU Power commands according to the following relationship when adjusting the TRU output power:

TRU Output Power = MAXTXPOW - (TXPOWIDX x TXPOWSTEP)

Example: If you require an output power of 15.75 dBm at the TRU output, you can use either one of the following TRU power settings to obtain that output power.

	TRU Power Settings			**TRU Output Power (in dBm)**
	Max Power/ MAXTXPOW	**Power Level/ TXPOWIDX**	**Power Step size/ TXPOWSTEP**	
1	15.75	0 (no attenuation)	4.00 (default)	15.75 - (0 x 4.00) = 15.75
2	27.00 (default)	3	3.75	27.00 - (3 x 3.75) = 15.75
3	27.00 (default)	5	2.25	27.00 - (5 x 2.25) = 15.75

Table 1-3
TRU Fullscreen commands (continued)

Receive functions (available to both the AMPS and the TDMA modes)**:**			
Code	**Command**	**Status**	**Action/Initial Value**

M	Set Antenna Port	(1 or 2 or 3)
		(4 or 5 or 6)
			Selects antenna ports to use on path A and B. The Antenna Port field will show:
			`Port A: 1, 2 or 3`
			`Port B: 4, 5 or 6`
			Note: Only 1 and 4 can be selected in Omni cell sites.

N	Set Path	A B DIV	Selects the antenna path. The status is shown in the Antenna Path field. DIV indicates diversity switching between paths A and B.
O	Set RSSI Offset	xx.x Parameters for detector, ant1, ant2 and ant3 must be entered.	Sets the 3 RSSI Offsets (MCGAIN) for the ports on the specified antenna path. Input values are limited to the range -100 to +100; however, the offsets should be kept to ± 5 dB to keep RSSI values between -130 dBm and -30 dBm. (See the RSSI Offset tests in Chapter 11.)
Q	Detect All RSSI	— Signal reading area displays: -000.0	Constantly measures RSSI detected on all the six antenna ports until the “Return” key is pressed. Updates the six RSSI fields on the right hand side of the Signal Readings area on the display. ***Note:*** The current path and port settings cannot be determined after this command is executed. The corresponding status fields will be cleared.
- continued -			

Table 1-3
TRU Fullscreen commands (continued)

AMPS mode functions (available to the AMPS mode only)**:**			
Code	**Command**	**Status**	**Action/Initial Value**
G	Set SAT Transmit	on/off	Turns on/off generation of SAT. The status is shown in the SAT TX field.
H	Change SAT	5970 6000 6030	Sets the transmit SAT frequency. The selected SAT frequency is shown in the SAT TX field.
K	Set Compandor	on/off	Sets TX compression and RX expansion on or off. The status is shown in the `Compandor` field.
L	Transmit Wideband Data	—	Enables wideband data transmission. The TRU will begin to transmit wideband data at the currently selected TRU power level. The wideband data transmission is disabled by pressing the “Return” key.
- continued -			

AMPS mode functions (available to the AMPS mode only)**:**			
Code	**Command**	**Status**	**Action/Initial Value**
P	Detect SAT,ST,RSSI	SAT, ST, RSSI, A (all) Signal reading area displays: -000.0	Constantly measures SAT, ST, and RSSI detected on the assigned port of the current path (set by the M and N commands) until the “Return” key is pressed. Updates the RX SAT, RX ST, and RSSI fields on the left hand side of the Signal Readings area on the display. ***Note:*** The M and N commands must be set prior to this command.
R	Set RX/TX Audio	TX RX BOTH OFF	TX—unmutes the TX audio; mutes the RX audio. RX—mutes the TX audio; unmutes the RX audio. BOTH (TX RX)—unmutes both TX and RX audio. OFF—mutes both TX and RX audio. The status is shown in the Audio field.
T	Set TX/RX Audio Sens	TX -xx.x RX -xx.x	Sets the audio sensitivity for the entered TX or RX path. The selected audio sensitivity levels are shown in the Audio Sens fields. The limits for the TX and RX audio sensitivity are: TX Sens: -28.0 dBm ≤ -xx.x ≤ -10.0 dBm RX Sens: -28.0 dBm ≤ -xx.x ≤ -16.0 dBm ***Note:*** Set both TX and RX Sens to -18.0 in the tests described in this manual.
- continued -			

Table 1-3
TRU Fullscreen commands (continued)

TDMA mode functions (available to the TDMA mode only)**:**			
Code	**Command**	**Status**	**Action/Initial Value**
G	Set DVCC	01..FF (hexadecimal)	Sets the Digital Verification Color Code (DVCC) transmitted by the TRU when the TRU transmitter is enabled. DVCC is an 8-bit verification code transmitted between the mobile and the base station. It is used in TDMA cellular to differentiate between mobiles on the same frequency.
H	Set Slot	1..3	The TRU currently supports Full Rate (3 slots) coding, that is, three mobiles sharing one frequency. This command sets the current TDMA slot used by the TRU for DVCC transmission and signal measurements.
P	Detect DVCC, RSSI	-000.0 Y/N	Displays if current DVCC setting is detected and/or the RSSI measurement on the current slot of the antenna setup. The status will be displayed in the RX RSSI and RX DVCC fields.
T	Standalone TX	on/off	Allows the TRU2 and TRU3 to transmit without using a single-channel PA (see PA type in Table 1-4). This is used for either low power testing or on low power cell sites.
- End -			

Command line mode commands

The Command line mode consists of three different sets of commands:

- maintenance commands
- measurement commands
- test commands

Command line mode maintenance commands

Each function in the maintenance command suite may be used by an operator to aid in the diagnosis and repair of faults in the TRU. There are a large number of functions to set up loopbacks and set calibration parameters. In addition, there are some periodic maintenance functions that must be performed at regular intervals.

> ***Note:*** The Command line mode and the Fullscreen mode are intended for testing purposes only. Do not place the TRU into either one of these modes during call processing. The call in progress will be dropped.

Table 1-4 gives the name, command, state, and action for the command line mode maintenance commands. These commands apply to both the TRU2 and TRU3 unless stated otherwise.

Table 1-4
Command line mode maintenance commands

Name	Terminal Command	Personality Allowed	Description
Antenna Switch Mode	Set ASWMODE A|B Fixed	VCH	Sets the antenna switch mode for the given path. The path can be A(0) or B(1). The mode is fixed.
Blinking Display (TRU2 only)	Set BLINKING on|off	Any	Causes the front panel display of the TRU2 to blink on and off if set ON.
Clear SWERR Table	Set RSETSWERR	Any	Clears the SWERR table and resets the current SWERR count to zero.
Compandor Control	Set COMPRESSION| EXPANSION on|off	VCH	Controls the dynamic range compression and expansion of the TRU compandor.
Digital Verification Color Code	Set DVCC dvcc_value slot_number	TTC	Sets the DVCC value for the slot specified or all slots if ”ALL” is entered as the slot number.
Display Message (TRU2 only)	Set DISPLAY string	Any	Sets the front panel display on the TRU2 to the specified string.
- continued -			

Table 1-4
Command line mode maintenance commands (continued)

Name	Terminal Command	Personality Allowed	Description
DRU Reset	Execute RESET	Any	Causes the DRU to completely reset all of its systems and restart processing at the ROM level.
DRU Restart	Execute RESTARTFLASH	Any	Causes the DRU to restart processing within the flash load.
Enable Fullscreen Mode	Set FS on	VCH, CCH, ALR, or Maint.	Enables the Fullscreen mode of the terminal interface.
Fault Simulation	Run FAULTSIM fault	Any	Simulates the specified fault by sending the fault up to the ICP.
Installation Calibration	Set INSTCAL dB_level	VCH, CCH, or TTC	Provides the capability to correct the power reading (range: ± 100dB; 0.01 dB resolution).
LAPD Timeout Control	Set LT| LAPDTIMEOUT on|off	Any	Enables/disables the LAPD timeout. If the TRU detects loss of the LAPD link, it resets itself after 10-12 seconds. With the LAPD timeout set off, the TRU does not reset, which is necessary for stand alone testing.
Message Injection	Run INJECT from|to ICP|MPA|DSP bytes ***Note:*** MPA not supported by Urban	Any	Injects the specified message trace (bytes) at the specified interface point in the specified direction.
Message Trace Control	Set TRACE from|to ICP|MPA|DSP on|off ***Note:*** MPA not supported by Urban	Any	Enables/disables message trace at the specified interface point in the specified direction.
MPA LED On/Off (Not used in Urban)	Set MPALED on/off	Any	Turns the fault indicator LED on MPA module on or off.
Nominal Application Gain	Set NOMGAIN dB_level	VCH, CCH, or TTC	Provides a method of compensating for nominal losses or gains as a result of cell site hardware used with the TRU (range: ± 100dB; 0.01 dB resolution).
OM Simulation	Run OMSIM omtype	Any	Pegs the occurrence of the specified OM.
- continued -			

Table 1-4
Command line mode maintenance commands (continued)

Name	Terminal Command	Personality Allowed	Description
PA On/Off	Set PA on|off	VCH, CCH, or TTC	Turns the power amplifier (transmitter) on/off.
PA LED On/Off	Set PALED on/off	Any	Turns the fault indicator LED on MCPA module on or off.
PA Type	Set PATYPE type ***Note:*** DualMode 800 Enclosure supports only the NONE mode.	VCH, CCH, or TTC	Allows for the setting of the type of PA being used: MPA indicates that a MPA is being used; SCLPA indicates that a SCLPA is being used; NONE indicates that no PA is used - the TRU is using its own internal PA to output a modulated signal.
Path Antenna Select	Set DIVPORT path_A_port:1|2|3 path_B_port:4|5|6	VCH	Establishes a ”nailed” connection for the given antenna.
Receive Path Selection	Set PATH A|B|CURRENT|DIV	VCH	Set the diversity receiver to be either the A(0) or B(1) path, or enable diversity switching (2).
Receive SAT Color Code	Set RXSATCC detector cc	VCH	Configures the SAT detector to look for specified color code.
Rx Audio On/Off	Set RXAUDIO on|off	VCH	Turns on (unmute) or off (mute) the transceiver audio output upstream (to the ICRM).
SAT Frequency Select	Set TXSATCC cc	VCH	Selects frequency to be used for SAT generation.
SAT Generation On/Off	Set SATGEN on|off	VCH	Turns on/off generation of supervisory audio tone.
Set Audio Sensitivity	Set AUDSENS TX|RX dBm_value	VCH	Sets the audio sensitivity for the transmit or receive paths.
Set C-Side Loopback	Set BCHLOOP on|off	All but maint.	Enables/disables TCM loopback to the ICRM.
Set C-Side Tone Generation	Set BCHTONE on|off	VCH	Enables/disables tone generation to the ICRM.
Set Channel	Set CHANNEL chan	All but maint.	Sets the receive and transmit channel to the given value.
- continued -			

Table 1-4
Command line mode maintenance commands (continued)

Name	Terminal Command	Personality Allowed	Description
Set Mobile Loopback	Set RFLOOP on|off	VCH, CCH	Enables/disables the RF loopback capability of the TRU.
Set Multicoupler Gain	Set MCGAIN A|B dB_loss1 dB_loss2 dB_loss3	Any	Sets the compensation for the gain through the antenna and multicoupler system for the antennas connected to the specified path.
Set PA Maximum Power Level	Set MAXTXPOW dBm_level	VCH, CCH, or TTC	Sets the output power of the MCPA to the specified dBm value with a resolution of 0.01 dB.
Set PA Power index	Set TXPOWIDX index	VCH, CCH, or TTC	Sets the MCPA power to the specified dpc index. The index is an integer (from 0 to 7) that corresponds to a dBm power level.
Set PA Power Step	Set TXPOWSTEP dB_adjustment	VCH, CCH, or TTC	Adjusts the output power DPC stepsize of the MCPA by the amount specified. The power step value can be 0 to 100 dB in steps of 0.01 dB.
Set Personality	Set PERS ACC|ALR|AVC|TLR|TTC ***Note:*** The TRU3 supports DCCH and TTC only	Any	The TRU is reset and set to the given personality. The personality may be IS-54 CCH, AMPS LCR, AMPS VCH, TDMA LCR, or TDMA TTC.
Set Transmission	Set TRANSMIT on|off	VCH, CCH, or TTC	Enables/disables the transmitter in the TRU. This command functions the same as the ”Set PA on|off” command.
SWERR Simulation	Run SWERRSIM class code	Any	Logs an artificial software error.
Transmitter Tone Generation Control	Set RFGEN on|off	VCH	Turns on/off generation of transmitter test tone.
Tx Audio On/Off	Set TXAUDIO on|off	VCH	Turns on (unmute) or off (mute) the transceiver audio output downstream (to the mobile).
- End -			

Command line mode measurement commands

Measurements of operational parameters are taken periodically and on demand from the ICP or the terminal interface. If a measurement exceeds a threshold value, the ICP receives an alarm message. Table 1-5 gives the name, command, state, and action for the Command line mode measurement commands.

Table 1-5
Command line mode measurement commands

Name	Terminal Command	Personality Allowed	Description
Audio Sensitivity Settings	Query AUDSENS	VCH	The audio sensitivity settings in dBm for the transmit and receive paths.
Continuous Status Display	Query STATUS on|off DIV|ALL|CURR|ST|SAT|A	VCH	Enables/disables a continuous display of channel number, RSSI, SAT, and ST of the diversity port or the channel number and RSSI readings from each port.
Digital Verification Color Code	Query DVCC	TTC	The DVCC status for each slot. In TRU3, the status indicates the actual SAT value.
Display SWERR Table	Query SWERR	Any	The SWERR Class, SWERR Code, and associated information words.
Hardware Version Number	Query HWVERS	Any	The hardware release number of the TRU being queried.
MPA or PA Firmware Version Number	Query MPAFW or PAFW	Any	The MPA/SCLPA firmware version number of the DRU being queried. ***Note:*** DualMode 800 Enclosure does not support MPA or SCLPA.
Multicoupler Gain Settings	Query MCGAIN	Any	The multicoupler gain compensation in dBm for each antenna on both receive paths.
PA Maximum Power Setting	Query MAXTXPOW	VCH, CCH, or TTC	The adjusted maximum TX power setting in dBm, stored in the TRU and the delta adjust from the MCPA.
PA Power Step Size	Query TXPOWSTEP	VCH, CCH, or TTC	The adjusted TX power step size setting in dB, stored in the TRU and the delta adjust from the MCPA.
- continued -			

Table 1-5
Command line mode measurement commands (continued)

Name	Terminal Command	Personality Allowed	Description
PA status	Query PASTATUS	Any	The TX information (PA type, current power, power reference, step size, DPC index, and alarm status) being queried.
Previous Uptime Counter	Query PREVUPTIME	Any	The time that the DRU had operated before the last reset in days, hours, minutes.
Radio Load status	Query LOAD	Any	For obtaining load name of the TRU.
Radio status	Query RADIO (TRU3 only)	Any	For obtaining information on the status of the TRU3. This information is provided through an alphanumeric display on the TRU2.
Reset reason	Query RESETREASON	Any	When the DRU is reset, a reason code is stored in a reserved area of memory and can be read when the DRU is active again to give the reason for the last reset. If no reason is stored, then the reset was caused by some unsolicited event.
RSSI Measurement	Query RSSI	Any	In the TTC state, indicates RSSI readings for each slot. In other states, indicates current RSSI reading at the diversity switch.
SAT Status	Query SAT detector	VCH	Indicates that SAT status on the receive path for the current SAT color code. In TRU3, the status indicates the actual SAT value.
ST Status	Query ST	VCH	Indicates the ST status on the receive path.
Uptime Counter	Query UPTIME	Any	The time that the DRU has been operating since the last reset in days, hours, minutes.
- End -			

Command line mode test commands

Testing ensures the proper working order of the DRU's components. Each test result is sent to the ICP by request or regular audit. Testing can be initiated by entering the appropriate command from the ASCII terminal, by a message sent from the ICP, or by regular audits on the DRU. An audit test failure initiates an alarm unless the alarms are disabled. Table 1-6 gives the name, command, state, and action for the Command line mode test commands.

Table 1-6
Command line mode test commands

Name	Terminal Command	Personality Allowed	Action/Initial value
Calibration Table Sanity Tests (For TRU2 only)	TEST EEPROM	Any	Calibration information is stored in EEPROM along with an associated CRC. This test calculates each table's CRC and compares to the stored CRC. If a table has not been written, the result is "n/a".
DSP Sanity Test	TEST DSP ALL	Maint.	This test checks the basic sanity of the DSPs by checking for basic messaging ability in each one.
Flash Load CRC Test	TEST FLASH	Any	This test reads all data stored in flash EEPROM, calculates the CRC, and compares this value against the CRC stored in the flash EEPROM.
Individual DSP Sanity Test	TEST DSP dspid#	Maint.	This test is similar to the previous one except that the sanity test is only run on a particular DSP chip.
RAM Read/Write Test (For TRU2 only)	TEST RAM	Any	The read/write memory is checked to ensure that all locations can be written to and read, and that each address accesses a unique memory location.
- End -			

Multi-Channel Power Amplifier (MCPA)

During installation or expansion of a DualMode 800 Enclosure, you need to set the output power of the Multi-Channel Power Amplifier (MCPA) to the desired level of the cell/sector. You can use the MCPA software program (PEC NTFC07BC), provided with the MCPA, to set the output power. This software program comes in two floppy disks and it works with a computer (a PC or a laptop) using Windows 95. To use the software for setting the MCPA output, you need to:

1. install the software program on to your computer
2. run the program on the computer
3. if required, download the firmware for the MCPA shelf from the computer to the shelf

   Note: For new cell sites/MCPA shelves, the firmware is downloaded at the factory. This step is required only if you are upgrading the firmware to a newer version.

4. enter the per channel output power and the number of channels for the MCPA shelf
5. initialize the power setting

Installing the MCPA software program

Use the following procedure to install the MCPA software program on to your computer:

1. Place disk 1 of the software program into your computer.
2. Run the setup program and follow the on-screen prompts. The setup program automatically sets up the ‘Nortel gain’ program in the Start menu.

Running the MCPA software on the computer

To run the ‘Nortel gain’ program on the computer, use the following procedure:

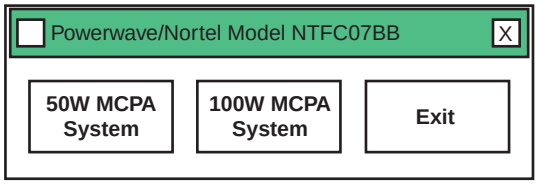
1. Turn off the power to the computer and the MCPA shelf.
2. Connect from an available serial communications port on the computer, using a null modem cable, to the RS232 connector (J6) on the backplane of the MCPA shelf. Make sure that the connection is secure. The following lists the pin-outs of the connectors:

9-pin male connector			9-pin female connector	
	Pin 2	to		Pin 3
	Pin 3			Pin 2
	Pin 5			Pin 5
	Pin 8			Pin 8

Note: Do NOT make any connections to the other pins.

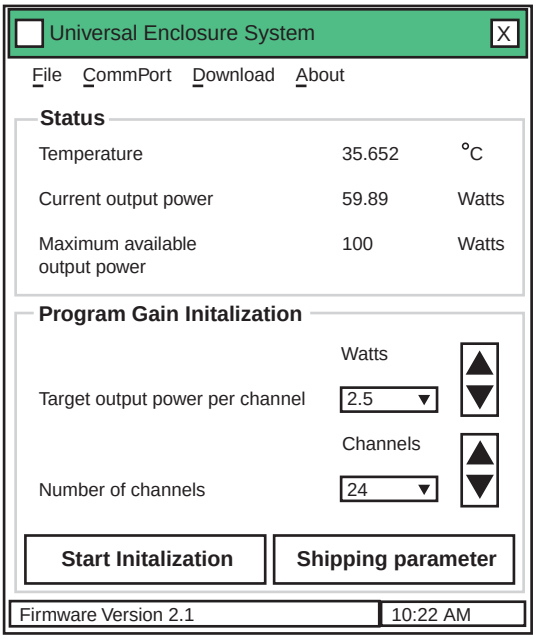
3. Turn on the power to the computer and the MCPA shelf.
4. Start the ‘Nortel gain’ program from the Start menu on the computer. The selection menu for the MCPA will pop out (see Figure 1-10). Select the 100W MCPA system.

Figure 1-10
Selection menu for the MCPA



5. The power setting menu for the MCPA will pop out (see Figure 1-11).

Figure 1-11
Power setting menu for the MCPA



6. Click on the Comm Port parameter on the menu. Set the Comm Port (COMM1, 2, 3, or 4) parameter to match the physically-connected serial communications port on the computer.

   Note: To verify communications between the computer and the MCPA shelf, check for a temperature reading on the menu. If there is no temperature reading, the Comm Port parameter may not match the

communications port on the computer. Select the right port on the menu.

You can also check for communications by turning on or off the power of an MCPA module using the RF ON switch on the front panel of the module. The maximum available power reading on the menu should change according to the number of powered-on MCPA modules (120W for three modules, 80W for two modules, and 40W for one module).

If necessary, restart the software program to re-establish communications.

Fixing the 'Run-time error' problem

The reason you will get a 'Run-time error' is when choosing a comm port that is not available. Verify that no other program is open and using the comm port that the MCPA software is trying to use. If a 'Run-time error' message appears every time you try to run the software, use the following procedure to fix the problem:

1. Use the Windows Explorer to view the Windows directory.
2. Double-click on the 'REGEDIT.EXE' file. A Registry Editor will open.
3. Double-click on the directory 'HKEY_CURRENT_USER'.
4. Double-click on the directory 'SOFTWARE'.
5. Double-click on the directory 'VB and VBA Program Settings'.
6. Double-click on the directory 'Powerwave RD Testing'.
7. Double-click on the directory 'System'.
8. Double-click on the 'CommAlarmBoard' file in the file panel.
9. A dialog box will open and a '1' should be typed in the 'value data' entry box. This refers to Comm Port 1. If a '1' is already in the entry box, you might want to try 2, 3 or 4.
10. Choose 'OK'. The number '1' or the number you entered should be displayed on the data column next to the CommAlarmBoard.
11. Close the Registry Editor.
12. Run the MCPA software again.

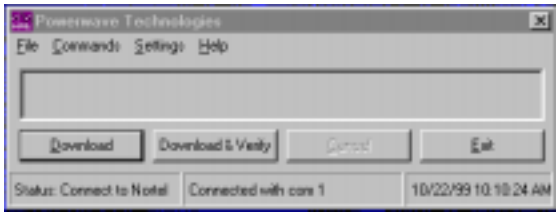
Downloading the MCPA firmware to the MCPA shelf (if required)

Note: This procedure is required only if you need to upgrade the MCPA firmware from version 2.1 to a newer version.

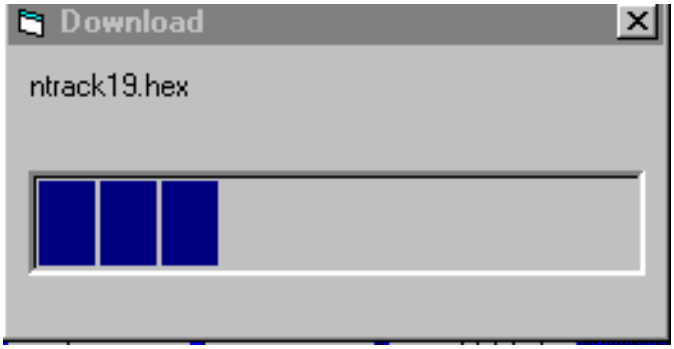
IMPORTANT
Power to the MCPA shelf must remain on during the downloading period.

Use the following procedure if you need to download the firmware to the MCPA shelf:

1. Run the 'Nortel gain' program by performing Steps 1 to 5 of the procedure listed in the *Running the MCPA software on the computer* section. The power setting menu will pop out (see Figure 1-11).
2. At the menu, click on the Download parameter and then select the software version, for example, NTRACK2_2.HEX.
3. At the **'Powerwave Technologies'** menu, select 'Download'.
4. At the **'Warning'** menu, select 'OK'. The screen will show the following:



5. Midway through the download process, the secreen will turn to the following:



6. When download is complete, the software will display **'Download is complete'** on the screen. Click 'OK'. The shelf is ready for operation.

Setting the MCPA output power

After installing the software on the computer or downloading the firmware to the MCPA shelf, you can begin to set the output power for the MCPA shelf. The MCPA output power setting determines the per carrier power as well as the maximum power to be transmitted by the MCPA modules. Here are some examples of how to calculate and set the MCPA output power.

IMPORTANT
The calculation refers to output at the MCPA shelf. If you need the output power at the antenna port of the duplexer, you must add the insertion loss into your calculation.

- If your cell/sector has 16 channels and you want to transmit an output power of 2.5 watts per channel, enter:
  2.5 in the "Target output power per channel" box, and
  16 in the "Number of channels" box

  This sets the per channel output power to 2.5 watts and the total MCPA output power of the 16 channels is 40 watts (16 channels x 2.5 watts).

- If the capacity of the cell/sector is reduced to 12 channels, the per channel output power remains at 2.5 watts while the total MCPA output power is reduced to 30 watts (12 channels x 2.5 watts).

  In this case, you do not need to set the power level again if the per channel output power is at the desired level. However, if you need a new per channel power level, you have to set the output power level again.

- If the capacity of the cell/sector is increased to 24 channels, the per channel output power decreases to 1.67 watts while the total MCPA output power remains at 40 watts (24 channels x 1.67 watts).

  In this case, if you want to maintain the per channel output power at 2.5 watts, you need to enter the requirements again. So, enter:
  2.5 in the "Target output power per channel" box, and
  24 in the "Number of channels" box

  This sets the per channel output power to 2.5 watts and the total MCPA output power of the 24 channels is 60 watts (24 channels x 2.5 watts).

  Note: You must use two MCPA modules to obtain a total output power of higher than 100 watts.

Power setup procedure

IMPORTANT
Nortel Networks recommends that ALL channels (with at least eight channels) be turned on at the time of initial power setting. Otherwise, accuracy of the output power may be affected.

To set the MCPA output power, use the following procedure:

1. Run the 'Nortel gain' program by performing Steps 1 to 5 of the procedure listed in the *Running the MCPA software on the computer* section. The power setting menu will pop out (see Figure 1-11).
2. Enter the target output power and the number of channels supported by the MCPA shelf in their respective areas on the menu.
3. Initialize the setting by clicking the Start Initialization menu bar. If the Start Initialization bar is not active (grayed out) on the menu, re-entering the output power level will bring it on (active) again.
4. A prompt requiring that all carriers are on will appear. Make sure that the number of turned-on carriers (TRUs) matches the number of channels entered. Click 'OK'.

IMPORTANT
Suppose that your cell/sector is using 16 channels at the time of the power set up and you plan to expand it to 24 channels in the future. You can enter 24 as your number of channels for the cell/sector. However, for output accuracy, you should have all 24 channels turned on at the time of initialization. If you do not have the eight expansion channels ready, it is best to keep the number of channels to 16 at this time and perform initialization again at the time when the cell/sector expands to 24 channels.

5. At the **'Initialization Done'** prompt, click 'OK'. Power set up is complete.

Periodic maintenance

This section briefly discusses all aspects of cell site maintenance, and when necessary, refers you to detailed testing procedures in other operational tests in this manual.

Periodic maintenance records

Periodic maintenance helps you in two ways:

- it allows you to detect and replace degraded equipment before it affects service
- it allows you to take steps to protect equipment from damage or degradation

To support these functions, you must keep records. Records allow you to:

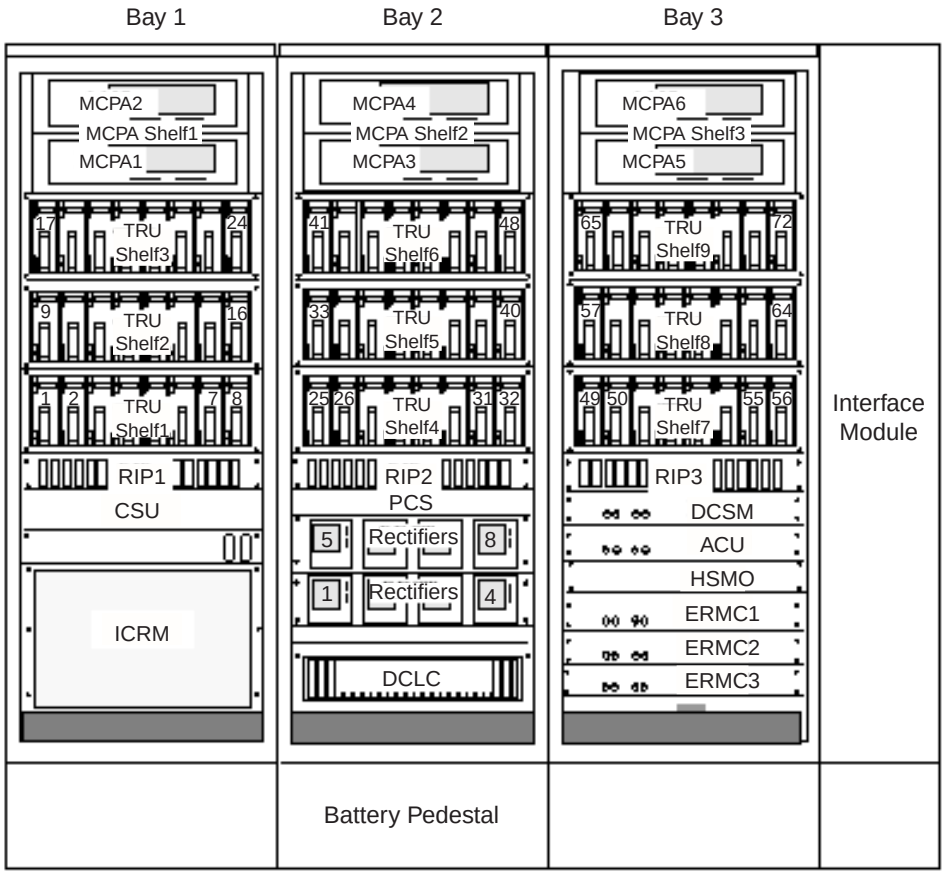
- recognize deteriorating performance by comparing current and past test results
- ensure that all steps required to protect equipment have been taken
- create a maintenance history of a cell site; thereby allowing you to plan for the future and predict future maintenance needs
- provide information to decide sparing levels and ‘out of expectation’ failure level for specific equipment

For maximum benefit, maintenance records should be kept on site and should be well organized so that call-out staff have access to and can determine the maintenance history of a particular site. Referenced documents such as this manual will contain blank forms for recording specific test results. These forms should be copied as required and included with your records.

Equipment in a DualMode 800 Enclosure

Figure 2-1 shows the location of equipment in a DualMode 800 Enclosure.

Figure 2-1
Equipment layout of a DualMode 800 Enclosure



Legends:

ACU	Alarm Control Unit	HSMO	High Stability Master Oscillator
CSU	Channel Service Unit	MCPA	Multi-Channel Power Amplifier
DCLC	DC Load Center	PCS	Power Control Shelf
DCSM	DualMode Cell Site Monitor	RIP	Rack Interface Panel
ERMC	Enhanced Receive MultiCoupler	TRU	Transmit Receive Unit
ICRM	Integrated Cellular Remote Module		

Transmit Receive Unit (TRU) and Multi-Channel Power Amplifier (MCPA)

The Transmit Receive Unit (TRU) needs no periodic testing in either the analog or the digital mode — only do testing if you suspect a fault or want to verify correct operation. The bit error rate (BER) test is typically used for troubleshooting. BER is defined as the ratio of erroneous bits to the total number of received bits in a transmission system. Another troubleshooting test is the TDMA Modulation Accuracy Test which measures the Error Vector Magnitude(EVM). The Multi-Channel Power Amplifier (MCPA) should be tested for power output once a year. For these tests, refer to Chapter 11, *DualMode Radio Unit Testing*, in this manual.

High Stability Master Oscillator (HSMO)

In dual-mode (mixed analog and digital) or digital sites, the HSMO frequency should be checked once a year. In analog cell sites, the frequency is not as critical and the HSMO need not be tested at all. Any problems with the HSMO in an all analog cell site will show up in the TRU transmit frequency tests. Refer to the tests in Chapter 5, *HSMO Tests*, in this manual.

Alarm Control Unit (ACU)

The ACU alarm input points for equipment such as fans, over-temperature and door switches should be verified once a year. Alarm output contacts and alarm reactions should be verified at the same time. Refer to the tests in Chapter 8, *ACU Tests*, in this manual.

Transmit path insertion loss

Check the insertion loss of the transmit path once a year or as required by base station carrier power level test results.

Fuses/breakers/fans

The ACU monitors the status of the fuses, breakers and fans. It is good practice whenever you are at the cell site to visually inspect the fuses, check that the correct breakers are on and that the fans are working.

Other equipment

Equipment not already specifically mentioned does not require periodic maintenance.

Transmission facilities

Transmission facilities include pressurized transmission lines, microwave radio equipment and any copper facilities. It is important that your facilities are in good condition, otherwise cell site performance might be compromised. See recommended maintenance intervals from the manufacturer for the specific equipment.

Microwave

Refer to the manufacturer’s instructions for periodic maintenance. Transmission level and noise tests should be conducted once a year.

Copper audio link

The susceptibility of copper to noise and level problems requires more frequent checks than digital or microwave facilities. Perform noise and level checks quarterly on the T-1 transmission facilities.

Power

Clean, reliable power is essential to your cell site. The following are generic periodic maintenance recommendations. Consult the manufacturer's documentation for specific maintenance and specifications.

Battery

The batteries used in the DualMode 800 Enclosure are virtually maintenance free. For routine check or maintenance procedures, refer to manufacturer's recommendation.

Rectifiers

The rectifiers used in the DualMode 800 Enclosure are virtually maintenance free. For information, refer to the *DualMode 800 Enclosure Functional Description*, 411-2051-100.

Fuses/breakers

Whenever you arrive an enclosure site, it is a good idea to verify that the circuit breakers are on and the fuses are good.

Cabling and connections

Whenever equipment is installed or changed, check the cabling and connections. Take note of any suspect cables that give you problems from time to time.

Inside grounding

Inside grounding performs two functions: it prevents noise from one unit getting into other equipment, and it ties all equipment together for protection. In addition to checking for and repairing any deterioration of the grounding system, you should also check to see that all new equipment installed at the site is grounded properly. (Refer to the DualMode 800 Enclosure Power and Ground Verification.)

Bay bonding

Individual bays in a line-up should be bonded together with 3/8 inch or larger bolts with star washers bearing on plated metal or conductive tape.

Cabling and connections

Each frame line-up should be grounded to the principle ground bar with #2 AWG insulated wire. There should be individual drops from this cable to each frame. The frame grounds should not be connected to the DC return bar at the top of the frames nor should they be attached to the halo ground when used.

Principle ground bar

All inside ground connections should lead back to the principle ground bar, which is then connected to the outside ground field and the AC ground. Check all connections and ensure that new or changed equipment is properly grounded. If there is a water pipe at the site, the principle ground bar should be connected to it.

Transmission line entrance

The transmission line to the antenna should be lightening-protected where it comes into the enclosure. Check the condition of the grounding connections once a year and also following any severe lightening storm activity.

Outside grounding

A typical cell site, with its tall metal structures and antennas, is an open invitation to a lightening strike. To avoid cell site degradation or total loss due to electrical storm activity, you should inspect your grounding system just before the local thunderstorm season. Checking the outside ground can be part of a site walk-around check, where you also check antennas, cables, structures, lighting and foundations.

Tower and associated structures

Use a pair of binoculars or a spotting scope to verify that the air terminal (lightning rod) and antennas are still attached to the tower and grounding system. Verify that:

- the antenna feed cables are grounded at both ends
- the cables and clamps attaching the tower and waveguide bridge to the grounding system are secure
- the cables and clamps connecting the guy wires to the grounding system are secure
- transmission cables are grounded at both the top and the bottom of the tower, and at the enclosure entrance

Building sheath, fences and other equipment

If the site has metal walls, roof or base, the metal components must be grounded. The cell site fence and any fuel tanks or other metal structures must be grounded as well. Check that grounding cables and clamps are secure.

Antennas and tower

Structure

Detailed inspection of towers should be performed every one to three years by an experienced inspector who can climb the tower and check all components. Cell site maintenance personnel can perform an effective partial inspection without leaving the ground, and this is recommended:

- once a year
- following a severe storm
- following a prolonged period of heavy icing

Use binoculars or a spotting scope if necessary. To perform a partial inspection:

- check the tower base for cracks, concrete break up and upheaval
- check all guy anchors for cracks or upheaval
- check guy tension and attachment
- check fasteners for security
- check all components for rust
- check for flaking paint (often a sign of over-stress)

Tower lighting

Visually confirm operation of the tower lights every time you are at the site after dark. When the tower is climbed for structural inspection, the lights should be thoroughly checked at the same time.

Grounding

Check all grounding that is accessible from the surface during your outside grounding check. When the tower is climbed for structural inspection, grounding on the higher parts of the tower should be checked at the same time.

Paint

Painted towers need to be re-painted every few years. Check the over-all condition of the paint on an annual basis and re-paint as necessary.

Feed

Check that the transmission line is adequately supported and protected between the enclosure and the antenna tower.

Antennas

When the tower is climbed for structural inspection, antennas should be inspected as well. Check for:

- correct orientation and tilt
- crack, dents and burns
- fasteners, attachment and security
- transmission line and ground attachment security
- audible gas leakage in pressurized systems

Pressurized transmission lines

If a pressurized transmission line to the antenna is used, check the nitrogen tank pressure and manifold pressure every visit. Check the dehydrator at the same time.

Site performance

The ultimate measure of the cell site's condition is the cell site's actual measured performance. Site performance should be tested once a year and can be gauged by the following tests. It should be taken into consideration that coverage and handoffs can be impacted by seasons and weather.

Fringe coverage

Using the most recent coverage maps, take a test mobile and drive to the fringe of the site coverage area with a call established to confirm coverage. Most mobiles are able to access signal strength function mode.

Handoff checks

Using the standard drive defined for the site or system acceptance procedures, with a call established drive across the cell boundaries. Confirm that the handoffs occur in the appropriate places and that there is sufficient hysteresis to prevent ping-ponging of calls. You can use a test mobile with channel-indicating firmware to check the exact location of the handoffs.

Antenna sweep

Measure the reflected power from the antenna across the entire cellular band (receive and transmit) to check for hidden damage or deterioration of the antennas. Refer to Chapter 7, *Antenna Tests*, in this manual.

Housekeeping

Heating/air conditioning

Proper temperature is essential to the functioning of the enclosure. Check any alarms due to the environment, such as high or low temperature, every time you are at the site.

Dust control

Keep dust levels to a minimum by mopping the floor once a month, taking care not to get the equipment wet. Whenever you remove a transceiver or power amplifier, wipe off the dust on the unit and shelf slides. Dust accumulation on circuit boards and heat sinks interferes with heat dissipation and shortens the life of the equipment. Dust in the air clogs fans and air conditioners, also raising the temperature.

Statutory requirements

Fire equipment, hazard signs and exit signs may be required by law. Make sure required signs are present and safety equipment is maintained.

Site licenses

Radio and tower and business licenses are often required to operate a cell site. It may be worth your while to check up on these once a year to ensure that they are being maintained, whether they are located on the site or with your company's legal department.

Trash and loose articles

Keep the inside of your enclosure as clean and tidy as possible. Trash and loose articles pose fire and tripping hazards and should be removed after every visit.

Site grounds keeping

Tall grass can present a fire hazard; poorly kept trees can lean on or fall on the enclosure. Snow and ice removal on and around the enclosure may be a statutory or legal liability requirement in some jurisdictions. Grounds keeping is often contracted out to a specialty firm.

Building service

If the enclosure uses AC mains service from overhead poles, take a look at the drop and service entrance once a year. Look for obviously damaged insulation and threats from overhanging trees.

Security

Check fences, gates, barbed wire and razor ribbon, both around the site and around the tower guy anchors. Check door locks and gate locks before leaving the site.

Manuals and records

Manuals and site logs should be organized and readily accessible to call-out staff. All records should be completed before leaving the site. All logs and records should be kept on-site for instant availability.

Schedule for periodic cell site maintenance

Regularly scheduled visits are important for the preventative maintenance of a cell site. However, if maintenance teams are responsible for a number of cell sites, maintenance schedules for the different sites should be staggered so that labour time is more effectively and efficiently managed. Table 2-1 shows an example of a maintenance schedule for six cell sites where the periodic routines are distributed evenly throughout a one year period.

Table 2-1
Maintenance schedule example

Cell	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
#1	1 yr	mo	mo	qtr	mo	mo	6 mo	mo	mo	qtr	mo	mo
#2	mo	mo	1 yr	mo	mo	qtr	mo	mo	6 mo	mo	mo	qtr
#3	mo	qtr	mo	mo	1 yr	mo	mo	qtr	mo	mo	6 mo	mo
#4	6 mo	mo	mo	qtr	mo	mo	1 yr	mo	mo	qtr	mo	mo
#5	mo	mo	6 mo	mo	mo	qtr	mo	mo	1 yr	mo	mo	qtr
#6	mo	qtr	mo	mo	6 mo	mo	mo	qtr	mo	mo	1 yr	mo

A cell site maintenance reference chart and preventive maintenance check lists are provided in the following pages.

DualMode 800 Enclosure Maintenance Reference Chart

	Every Visit	Monthly	Quarterly	Semi-Annual	Annual	Comments
Equipment Bays and Interface Module						
Fans/Breakers/Fuses	•					
HSMO Tests						
Oscillator Power Level (Ch. 5)					•	
Oscillator Frequency (Ch. 5)					•	
TRU Receive Tests - Analog						
Receive Sensitivity (Ch. 11)					•	
Receive Audio Level (Ch. 11)					•	
RSSI Curve (Ch. 11)					•	
SAT Detect (Ch.11)					•	
ST Detect (Ch.11)					•	
Audio Loopback (Ch.11)					•	
TRU Transmit Tests - Analog						
PA Carrier Power Level (Ch.11)			•			
Transceiver Carrier Level Test (Ch.11)				•		
Transmit Carrier Frequency (Ch.11)				•		
Modulation Limiting (Ch.11)					•	
Transmit Audio Deviation (Ch.11)					•	
Residual Modulation (Ch.11)					•	
Wideband Modulation (Ch.11)					•	
SAT Frequency Deviation (Ch.11)					•	
TRU Audio Alignment Tests - Analog						
Voice Forward Line Level (Ch.11)					•	
Voice Reverse Line Level (Ch.11)					•	
PA Power Output (Ch.11)					•	

- continued -

	Every Visit	Monthly	Quarterly	Semi-Annual	Annual	Comments
TRU Digital Tests - TDMA						
TDMA Modulation Accuracy (Ch.11)						Troubleshooting
Bit Error Rate (BER) (Ch.11)						Troubleshooting
ACU Tests						
Alarm Control Unit (Ch.8)					•	
Transmit Path Tests						
Insertion Loss (Ch.11)					•	
RMC Tests						
Insertion Loss (Ch.7)						Troubleshooting
Transmission Facilities						
Copper Audio Link (voice, T1)			•			
Power						
Fuses, Breakers	•					
Battery & Rectifiers		•				
Voltage and polarity on the bays		•				+ Commissioning
Inside Grounding						
Bay Bonding					•	
Cabling and Connections					•	
Principle Ground Bar					•	
Transmission Line Entrance					•	
Outside Grounding						
Tower and Associated Structures					•	
Building Sheath, Fences and other Equipment					•	

- continued -

	Every Visit	Monthly	Quarterly	Semi-Annual	Annual	Comments
Antennas and Tower						
Structure					•	
Tower Lighting	•					
Grounding					•	
Paint					•	
Feed					•	
Antennas				•		
Pressurized Transmission Lines	•					
Site Performance						
Fringe Coverage					•	
Handoff Checks					•	
Antenna Sweep					•	
Housekeeping						
Heating/Air Conditioning					•	
Dust Control		•				
Statutory Requirements					•	
Site Licenses					•	
Trash and Loose Articles	•					
Site Grounds Keeping	•					
Building Service					•	
Security	•					
Manuals and Records	•					
- End -						

DualMode 800 Enclosure Every Visit Checklist

Date:_____ **Performed by:**_____

Equipmene bays		
1	Check all breakers for correct position, that is, ON/OFF on all power equipment	
2	Check fuse indicators; replace fuses if necessary	
3	Check receive multicoupler fuse	
4	Verify that all cooling fans are working in each bay	
Enclosure and site		
5	Check that no high or low temperature alarm is present	
6	Check that the interior lights work	
7	Verify automated security system by tripping alarm (reset after test)	
8	Check air filters on air exchange/conditioner equipment	
9	Verify the presence of a fire extinguisher & check expiry date	
10	Check for leaks in the shields	
11	Check the condition around the enclosure	
12	Check for deterioration of paint on walls	
13	Check cable access ways through the walls for deterioration	
14	Inspect grounding system	
15	Perform general housekeeping duties to remove dust, dirt and trash	
16	Complete manuals, site logs, and records	
17	Turn tower lights on and verify that all lights are working	
18	Inspect antenna ground for corrosion	
19	Security checks on fences, windows, doors, tower guy anchors	
20	Check that site gate locks are secure	
21	Clean up any debris around the site area	
22	Check that there are no overhead lines down	
Pressurized transmission lines to antenna		
23	Check the nitrogen tank pressure, manifold, and the dehydrator	

DualMode 800 Enclosure MONTHLY Checklist

Date:_____ **Performed by:**_____

1	Perform the EVERY VISIT routine checks	
Power - Battery		
2	Check the battery voltages and note any discrepancies.	
3	Check terminals, connectors for signs of moisture or corrosion	
Power - BCM		
4	Check that the BCM output voltage is within specification	
Housekeeping		
5	Mop the floors at least once a month to keep dust levels to a minimum	

DualMode 800 Enclosure QUARTERLY Checklist

Date:_____ **Performed by:**_____

1	Perform the EVERY VISIT routine checks	
2	Perform the MONTHLY routine checks	
Equipment bay		
3	Voltage and Polarity checks at Main Power Terminals Step 6 of Voltage Checks Test (See Chapter 4)	
Transmission facilities		
4	Perform noise and level checks on T-1 transmission facilities (optional)	

DualMode 800 Enclosure SEMI-ANNUAL Checklist

Date:_____ **Performed by:**_____

1	Perform the EVERY VISIT routine checks	
2	Perform the MONTHLY routine checks	
3	Perform QUARTERLY routine checks	

DualMode 800 Enclosure ANNUAL Checklist

Date:_____ **Performed by:**_____

1	Perform the EVERY VISIT routine checks	
2	Perform the MONTHLY routine checks	
3	Perform QUARTERLY routine checks	
4	Perform SEMI-ANNUAL routine checks	
Equipment bays		
5	Test TRU and MCPA for power output TRU Output Power Test	
6	Test the ACU alarm input points Alarm Control Unit Tests	
7	Check the Insertion Loss of the Transmit Path Insertion Loss	
8	Check HSMO Frequency on mixed or all dual mode sites Oscillator Frequency Test	
Power - Rectifiers		
9	Test the alarm/cut out sections on the rectifiers by adjusting the high and low voltage	
Inside grounding		
10	Check that each bay line-up is grounded to the principle ground bar with #2 AWG insulated wire and individual drops from this cable to each bay	
11	Verify all inside ground connections lead back to the principle ground bar.	
12	Check all connections, ensure new or changed equipment is properly grounded	
13	Check that the transmission line to the antennas is lightning protected where it comes into the building.	
14	Check the condition of the grounding connections for corrosion	
Outside grounding		
15	Using binoculars or a spotting scope, verify that the air lightning rod and antennas are still attached to the tower and grounding system	
16	Verify that the antenna feed cables are grounded at both ends	
17	Verify that the cables and clamps attaching the tower and waveguide bridge to the grounding system are secure	

- continued -

18	Verify that the cables and clamps connecting the guy wires to the grounding system are secure	
19	Verify that transmission cables are grounded at both the top and bottom of the tower, and the building entrance	
20	Buildings with metal walls, roof or base, all metal parts are grounded	
21	Site fence, fuel tank or other metal structures are grounded	
22	Check that grounding cables and clamps are secure	
Antennas and tower		
23	Check the tower base for cracks, concrete break up and upheaval	
24	Check all guy anchors for cracks or upheaval	
25	Check guy tension and attachment	
26	Check fasteners for security	
27	Check all components for rust	
28	Check for flaking paint (often a sign of over-stress)	
29	Check the over-all condition of the paint; re-paint if necessary	
30	Check that the transmission line is adequately supported and protected between the cell site building and the antenna tower	
31	When tower is climbed, check grounding on the higher parts	
32	When tower is climbed, check the tower lights	
33	When tower is climbed, perform structural inspection of antenna: • Check for correct orientation and tilt • Check for cracks, dents, burns • Check for fasteners, attachment and security • Check for transmission line and ground attachment security • Check for audible gas leakage in pressurized system	
Site performance		
34	Confirm coverage by making calls from the fringe of the site coverage area	
35	Confirm handoffs by driving across the cell boundaries with a call established	
36	Perform an antenna sweep test	
- continued -		

Housekeeping - Environment		
37	Check for insects, mouse and birds nest in intake and exhaust systems	
38	Inspect temperature in all equipment bays	
Licenses and other requirements		
39	If the building uses AC mains service from overhead poles, take a look at the drop and service entrance for obvious damaged insulation	
40	Ensure the necessary licenses are maintained	
- End -		

Test equipment and precautions

The DualMode 800 Enclosure is basically operated by the Digital Multiplex Switch - Mobile Telephone Exchange (DMS-MTX*). It can also be operated by a service personnel at the cell site through an interface terminal to perform some operational functions and tests. This manual provides information on how to operate the cell site equipment and perform maintenance tasks and operational tests at the cell site. However, some of the tests may involve activities at the MTX switch. For details of the MTX activities, refer to the appropriate DMS-MTX manuals.

To operate and test cell site equipment, an interface terminal and some other test equipment are required. This chapter provides a list of recommended test equipment and precautions to be aware of when performing any tasks at the cell site.

Test equipment

It is assumed that the operator is familiar with the test equipment used in the test procedures. The following test equipment is recommended for performing the required tests. Any functionally equivalent unit may be used in its place. Double shielded coaxial cables are recommended for use between test equipment and the equipment being tested.

Note: Ensure test equipment is calibrated before performing any tests.

1. Communications Monitor (examples as listed below):
   - — IFR 1600, 1900
   - — Marconi 2955A e/w C-Message Filter option #54499-043S and OCXO option #52955-900A
   - — Motorola 2600
   - — Hewlett Packard 8921, 8935
2. Interface Terminal: VT100 Video Display Terminal or equivalent (lap-top PC with communications software) e/w null modem cable
   - — Set up the parameters of the terminal as follows:

- 9600 baud
- 8 data bits
- 1 stop bit
- No parity
- 80 columns
- Auto wraparound
- ANSI
- VT100 emulation

— Cable for connecting the Transmit Receive Unit (RJ45 Teledapt connector on the front panel of the TRU) to the Interface Terminal. Table 1-1 shows the pin-outs for different types of terminal connectors.

Table 3-1
DRU to Interface Terminal connection

DRU	Interface Terminal			Function
TRU front panel RS-232 port pin number	25 pin D-connector pin number	9 pin D-connector pin number	8 pin Macintosh connector pin number	
2	3	2	3	TX from DRU
3	2	3	5	RX to DRU
7	7	5	4	Ground

3. HP 3551A Transmission Test Set
4. Spectrum Analyzer 0 to 2 GHz, 70 dB dynamic range
5. Two 1.5 meter N-male to N-male RF Cables
6. Two 1.5 meter N-male to BNC-male RF Cables
7. Two 1.5 meter BNC-male to BNC-male RF cables
8. Narda 370BNN 50 ohm Terminations
9. Bird 8325 Coaxial Attenuator, 500 Watts, 30 dB,
10. Bird Thruline Wattmeter e/w 5, 50 and 250 Watt Elements
11. HP336 power meter
    HP436A power meter
12. Bird 4275 Adjustable Radio Frequency Sampler
13. Fluke 8050A Digital Multimeter

14. Directional Compass
15. Binoculars or Spotting Telescope
16. Frequency counter: 1 Hz resolution and 0.025 ppm reference

    Note: Frequency counter should be a factor of 10 more stable than the oscillator being measured, for example, Hewlett Packard 53181A with option 12 Frequency Counter.

17. PC or laptop with the MCPA software package and a null modem cable (see the MCPA section in Chapter 1, *Equipment operation*, for details)

Precautions

Equipment warm-up

Do not perform tests immediately after the installation of any equipment. The TRU, the MCPA, the ICRM and the test equipment should be powered up for at least half an hour before the tests. Inaccurate measurements may result if the warm-up period is less than 30 minutes.

Test equipment

Proper setup of the test equipment is critical in obtaining proper test results. Consistency of setup and techniques from one person to another is essential for obtaining proper system operation. Calibrate all test equipment before use.

CAUTION
Equipment damage
Make sure that the test equipment maximum allowable input levels are not exceeded. Add an attenuator to reduce the power if necessary.

Rule of thumb—subtracting 3 dB halves the power level:

- +45.0 dBm is approximately 32 watts
- +33.0 dBm is approximately 2 watts
- +30.0 dBm is approximately 1 watt
- +27.0 dBm is approximately 1/2 watt
- 0 dBm is approximately 0.001 watt (1 milliwatt)

RF radiation hazard

Radio Frequency (RF) radiation is hazardous to anyone working in the cell site. All RF cables should be connected properly and all unused RF ports should be terminated with an appropriate terminator.

CAUTION
RF radiation hazard
Do NOT disconnect any RF cables when transmitters are on.

Electrostatic Discharge (ESD) control

This section provides general guidelines and precautions for handling, transporting and storing components and printed circuit wiring boards that are susceptible to permanent damage when subjected to electrostatic discharge (ESD).

ESD sensitive equipment

Various electrical and electronic components are vulnerable to electrostatic discharge (ESD). These include:

- discrete components
- hybrid devices
- Integrated Circuits (ICs)
- boards assembled with these devices

Identification

Manufacturers vary in their methods of identifying static-sensitive equipment. They may apply stickers or mark components with various colors, but many do not indicate that their products are sensitive. Examples of identification are:

- circuit boards with ESD-sensitive devices have a red edge
- hybrids containing Metal-Oxide Semiconductors (MOS) devices are red, with the letters MOS on the back. Non-sensitive hybrids are white.
- pull-handles on circuit packs containing sensitive devices may have the letters MOS and the assembly part number printed in red
- assembly drawings may have manufacturing notes describing the circuits as ESD-sensitive

CAUTION
Equipment damage
When in doubt, any circuit board containing microelectronic components must be assumed to be vulnerable.

Static control materials and devices

Use conductive bags and containers to store and transport circuit boards or components. There are three common types of conductive bags: Velostat, Tyvek and Pink Polyethylene.

Note: Pink Polyethylene is not recommended for ESD control.

CAUTION
Electric shock hazard
Metalized or carbon bags are conductive and therefore must not contact live electrical circuits, or they may cause shorting, sparking, and shock hazards to personnel.

Static-free work stations

Static-sensitive devices must be removed from packages only at a static-free work area. The minimum equipment for a static-free work station is:

- conductive bench mat
- operator's conductive wrist strap

Ideally however, locations should be equipped as follows when necessary:

- wrist strap
- shoe grounding straps
- ionized air blower (where required)
- ground cord
- floor mats
- table mats

Where protective measures have not been installed, a suitable alternative would be the use of a Portable Field Service Grounding Kit (3M part number 8012). This consists of a portable mat and wrist strap. The mat has pockets to hold circuit boards.

Handling procedures

Degradation may occur at any time during the handling of electrostatic-discharge-sensitive devices and components. Boards or components should never come in contact with clothing, because normal grounding cannot dissipate the static charges on fabrics.

Before handling static-sensitive equipment, personnel must discharge themselves of any static charge. The most effective method is the use of a grounded wrist strap combined with correctly installed ground static control

mats at all work locations. The wrist strap must be permanently attached to the frame on the basis of one between two frames. Alternatively the straps may be connected on an as-required basis to the battery return (Ground) jack, where it is provided.

Handling

Electrostatic-discharge-sensitive devices must be handled only in static-free locations. These locations must be equipped with grounded table and floor mats and grounded wrist straps. Also a reasonable relative humidity (RH) level must be maintained, if economically feasible, of between 20% and 80% non-condensing. In places where humidification is not practical, the other static control measures must be carefully observed.

Electrostatic-discharge-sensitive equipment must be handled only after personnel have grounded themselves via wrist straps, or shoe straps and mats.

No electrostatic-discharge-sensitive device should be removed from its protective package, except in a static-free location. The recommended packaging is a form of Faraday cage that will protect the contents against any charge present under normal conditions. Damaged packaging must be replaced at once.

All common plastics and other prime generators (for example, nylon carpet, plastic mats) must be prohibited in the electrostatic-discharge-free area.

Use only static-shielding packing material.

Transporting

A circuit pack must be placed into an anti-static shielding bag before being removed from the work location and must remain in the bag until it arrives at a static-free repair/test center.

CAUTION
Equipment damage
At no time must an unprotected circuit board come in contact with clothing, plastics, or ungrounded personnel.

Where handles or finger holes are provided on circuit packs they must be used to remove and replace the boards, and care taken to avoid contact with the connectors and components.

Storage

Improper storage can cause failures in ESD-sensitive components. The guidelines for environmental factors (temperature, moisture, air pollutants) are as important during storage as they are for operating. Wider variations of

temperature may be allowable, depending on the type of device. In general, low temperatures do not damage inactive equipment provided that the device is slowly raised to normal room temperature before use.

Electrostatic discharge damage to unprotected sensitive devices may occur at any time. Therefore it is important to keep ESD-sensitive circuit boards and components in proper protective packages during storage. Discard suspect bags and use new ones. Whenever possible, units requiring protection should be identified on the protective packing.

> ***Note:*** A circuit board in a static shielding bag may be shipped or stored in a cardboard carton, but the carton must not enter a static-free area such as a bench top or repair zone.

References

For more information on ESD and its control, refer to the following documents:

- Test Methods for Static Control Products (Huntsman & Yenni, 3M Company)
- Protection and Handling of ESD-Sensitive Circuit Packs (Bell Canada, BCP069-8000-501)

Power-up procedure

Overview

Power-up procedures are used to inspect that the power cabling is correct and to verify voltage checks.

Complete the power-up procedure before any equipment is plugged into the equipment shelves.

Perform the procedure whenever a shelf or a unit such as the Alarm Control Unit (ACU), the DualMode Cell Site Monitor (DCSM), or the High Stability Master Oscillator (HSMO) is either removed or replaced. If the voltage or polarity of the DC power is incorrect, equipment damage may result.

DC power inspection

An orderly installation of DC power is required at the enclosure to ensure ease of expansion as traffic increases.

Step	Action	Observation
1	Verify that the DC power cables from the breaker panel on the power bay to the equipment bays have been run in an orderly fashion and are secured to the runway.	
2	Verify that the lugs have been installed correctly and, if terminated on aluminum busbars, have been treated with anti-oxidant.	
3	Verify that the minimum bending radius has not been exceeded on the power cables (see Table 4-1).	

Step	Action	Observation
4	Verify that the breaker positions on the power bay have been labeled and are cabled as indicated on the labels.	***Note:*** See Tables 5-12 to 5-4 for the RIP breaker panel assignments.
5	Verify that the equipment bays are bonded to the principle ground bar line-up feeder with a #6 AWG jumper.	

Table 4-1
Minimum bending radii of power cables

Wire Size	Inches	Millimeters	Wire Sizes	Inches	Millimeters
14 AWG	11/16	17.5	3/0 AWG	3 3/16	80.5
12 AWG	3/4	19.6	4/0 AWG	3 7/16	87.6
10 AWG	15/16	23.1	300 MCM	4 1/8	104.6
8 AWG	1 3/16	31.0	350 MCM	4 3/8	111.5
6 AWG	1 1/2	39.6	400 MCM	4 5/8	117.3
4 AWG	1 3/4	45.7	500 MCM	5 1/16	128.3
2 AWG	2 1/8	53.3	600 MCM	5 9/16	142.2
1 AWG	2 1/2	63.0	700 MCM	5 15/16	151.1
1/0 AWG	2 5/8	68.0	750 MCM	6 1/8	155.4
2/0 AWG	2 7/8	73.9	800 MCM	6 5/16	160.0

Voltage checks

This entire procedure is used for ***installation*** and ***commissioning*** only.

Figure 5-2 shows the DC breaker assignments on the RIPs. The breakers and the common ground bar distribute the power/grounding to the individual shelves through cables that exit out connectors in each side of the RIP. The cables are then routed down each side of the frame.

Table 4-2
RIP1 circuit breaker assignments and ratings

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
MCPA 1-1	TRU 1A	TRU 2A	TRU 3A	ICRM A	CSU A	Not used	Not used	Not used	Not used	LVD 1A	TCU 1A	TCU 1B	LVD 1B	Not used	Not used	Not used	Bay 1 Light	CSU B	ICRM B	TRU 3B	TRU 2B	TRU 1B	MCPA 1-2
80A	10A	10A	10A	20A	5A	—	—	—	—	5A	20A	20A	5A	—	—	—	5A	5A	20A	10A	10A	10A	80A

Table 4-3
RIP2 circuit breaker assignments and ratings

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
MCPA 2-1	TRU 4A	TRU 5A	TRU 6A	Not used	Not used	Not used	Not used	Not used	Not used	LVD 2A	TCU 2A	TCU 2B	LVD 2B	Not used	Not used	Not used	Not used	IM Light	Bay 2 Light	TRU 6B	TRU 5B	TRU 4B	MCPA 2-2
80A	10A	10A	10A	—	—	—	—	—	—	5A	20A	20A	5A	—	—	—	—	5A	5A	10A	10A	10A	80A

Table 4-4
RIP3 circuit breaker assignments and ratings

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
MCPA 3-1	TRU 7A	TRU 8A	TRU 9A	ACU A	ACU BIAS	DCSM	HSMO A	ERMC A	Not used	LVD 3A	TCU 3A	TCU 3B	LVD 3B	Not used	Bay 3 Light	ERMC B	HSMO B	ACU BIAS	ACU B	TRU 9B	TRU 8B	TRU 7B	MCPA 3-2
80A	10A	10A	10A	20A	5A	10A	5A	5A	—	5A	20A	20A	5A	—	5A	5A	5A	5A	5A	10A	10A	10A	80A

Note: All breakers are rated at a potential of 65 Vdc.

Step	Action	Observation
1	Turn OFF the breakers on the RIP panel and to the cell site equipment.	
2	Unplug all the TRUs and the MCPA modules from their respective shelves.	

Step	Action	Observation
3	Disconnect the power cables from the ACU, RMC, HSMO, DCSM, DRUM, ICRM, and TRU shelves.	***Caution:*** Arrange these cables so there is no chance of them shorting out on anything.
4	Measure the resistance to ground on the following power plug pins: **CE Frame** Pin 4 ACU Pin 5 ACU and RMC Pin 6 ACU, RMC, DCSM, HSMO and DRUM TB1-5 ICRM TB1-7 ICRM **RF Frame** Pin 3 TRU shelves Pins 2,3 MCPA modules	Less than 0.5 Ohms
5	Turn ON the mains breakers assigned to the cell site equipment and the RIP breakers.	
6	Measure and record the Voltage and Polarity of the power terminals with respect to the DC Return bar at the top of each frame.(CE and RF)	+26.5 to 29 Vdc
7	Turn ON the breakers on the breaker RIP panel	
8	Measure the voltage on the following power plug pins: **CE Frame** Pin 1 ACU (+Bias) Pin 2 ACU, HSMO, RMC, DCSM, and DRUM **(B Power)**, TB1-1 ICRM **(B Power)** Pin 3 ACU, HSMO, RMC, DCSM, and DRUM **(A Power)** TB1-3 ICRM **(A Power)** **RF Frame** Pin 2 Transceiver shelves Pins 1,4 MCPA modules	+26.5 to 29 Vdc
9	Turn OFF the breakers on the RIP panel and to the cell site equipment.	
10	If the checks pass then reconnect the cables to all the units and plug the TRUs into their shelves. Turn the power back ON.	

Master Oscillator tests

Overview

Cell site transceivers require a stable reference in order to accurately produce transmit carrier frequencies and to select receive frequencies.

The master oscillator produces this stable reference for the TRUs to ensure that all channels operate on their assigned frequencies and do not interfere with other channels.

The TRU shelf associated with the master oscillator output under test will be out-of-service for the duration of the tests. It is good practice to use an unused port for the frequency test if available.

Oscillator frequency specifications

High Stability Master Oscillator (HSMO): 4.8 MHz ± 1.2 Hz

The HSMO for digital operation must be tested using a Rubidium counter reference or equivalent which provides a stable reference of <0.025 ppm.

The HSMO can also be tested using TRU carrier frequency measured with the communications monitor. This requires measuring the frequency error of the carrier in the expanded spectrum. The offset of 0.25 ppm (1.2 Hz/4.8 MHz) translates to ±220 Hz.

CAUTION
The HSMO is adjusted at the factory for frequency accuracy. If the frequency test fails, do NOT adjust the unit, it must be replaced with a new serviceable one.

Oscillator power level test

See Figure 5-1 for set-up.

Step	Action	Observation
1	Connect the communications monitor to the output port under test on the back of the master oscillator. Select the spectrum analyzer function and set to 4.8MHz.	
2	Measure the output of the master oscillator and record on the test form.	-1 dBm ±3 dB

Note: The remaining 15 ports should be terminated with 50-ohm termination for a correct power reading.

Reference oscillator tests

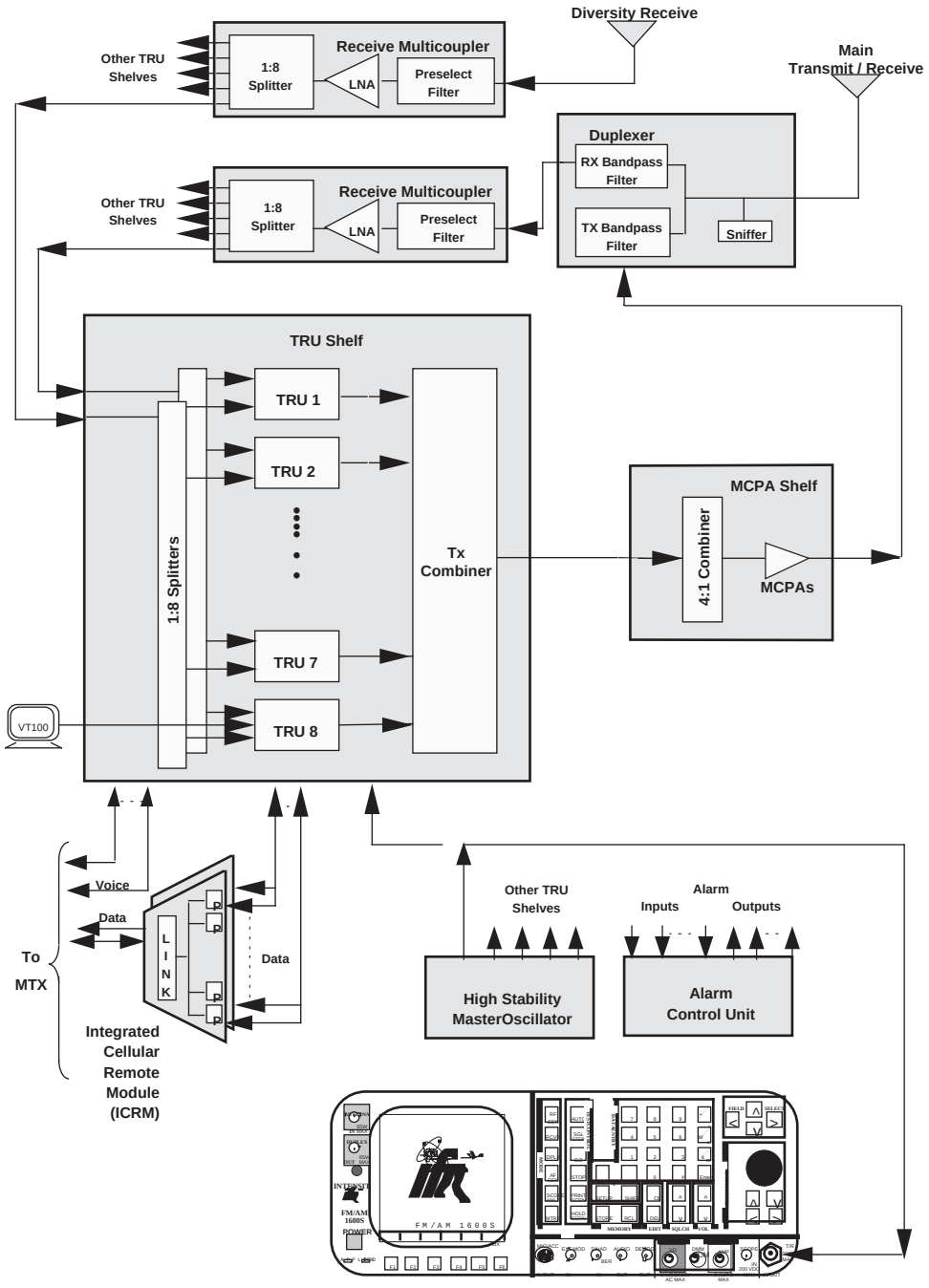
See Figure 5-1 for set-up.

Step	Action	Observation
1	Using a frequency counter, measure the oscillator frequency at outputs 1 to 16 at the rear of the shelf.	HSMO output frequency: 4.8 MHz ±1.2 Hz

Note 1: The frequency counter should provide a resolution of 1 Hz and a stable reference of < 0.025 ppm.

Note 2: The HSMO is adjusted at the factory for frequency accuracy. If the frequency test fails, do not adjust the unit but replace with a new unit.

Figure 5-1
Oscillator power level and frequency test setup



Communications Monitor (IFR 1600)

Oscillator frequency test procedure using TRUs

This test is to be used to test frequency on TRUs:

1. Select and offline a TRU to use for the test.
2. Connect the interface terminal to the RS-232 port on the front panel of the TRU under test. See Chapter 11, *DualMode Radio Unit Tests*, in this manual.
3. Set up TRU for test (refer to Chapter 11 in this manual).

HSMO frequency test — transceiver carrier method

This test ensures that the HSMO is operating at the assigned frequency of 4.8 MHz ±1.2 Hz. See Figure 5-2 for set-up.

Step	Action	Observation
1	Ensure that the communication monitor can listen to the TRU under test by either the sniffer or through an antenna.	
2	Set the communication monitor to monitor the forward channel under test.	
3	Use the frequency meter/frequency error meter to measure the offset.	±220 Hz of the assigned frequency
4	Record the assigned frequency (in MHz) and the frequency error (in Hz) on the test forms.	
5	If the results are questionable then repeat for at least one more transceiver.	

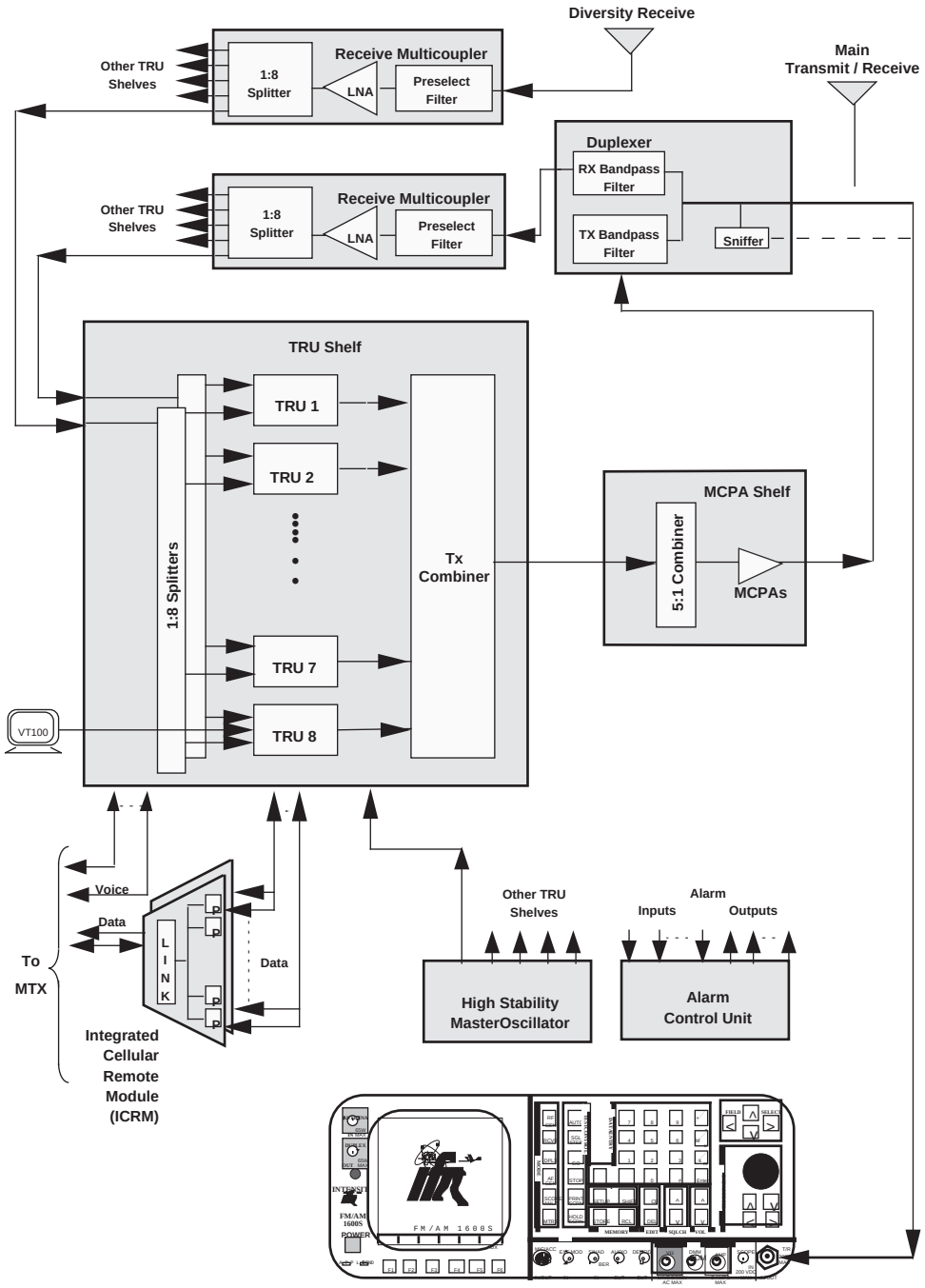
Note: The measured frequency deviation from the assigned channel may not fall within the ±0.25 PPM specification. This is due to the following:

- IFR accuracy at ±0.20 PPM translates to ±175 Hz uncertainty
- a +100 Hz offset to ensure proper baseband operation

These translate into a slightly different deviation measured with the IFR1600:

- -75 to +275 Hz **good**
- -165 to +365 Hz **questionable**
- beyond above **swap**

Figure 5-2
Oscillator frequency test setup — transceiver carrier method



Communications Monitor (IFR 1600)

Antenna and transmission line tests

CAUTION
RF Radiation Hazard
All transceiver transmitters must be turned off before disconnecting or connecting transmit cables to avoid RF induced injuries.

Antenna direct current continuity

These tests are required for new antennas or antennas suspected of faulty operation. **The tests are service affecting.**

The most important consideration of antenna direct current continuity is not so much the antenna but the transmission line shield. Of course, the antenna must be electrically connected to the coaxial transmission line, but most important, the transmission line shield must be grounded for lightning protection.

The other DC tests serve as more of a record of the resistance of the shield and center conductor. They may indicate future grounding problems or identify a change in the antenna dipole condition (open, now shorted or in the opposite way).

Step	Action	Observation
1	Visually inspect the bonding of the transmission line to the mast ground riser at both the top and bottom of the tower.	The transmission line must be bonded at both the top and bottom. A set of binoculars or a spotting telescope may be required to verify the upper bonding.
2	Inside the building, measure the DC resistance of the outer conductor to the principle ground.	Less than or equal to 0.5 Ω
3	Measure and record the DC resistance of the center conductor (pin)to the outer conductor(shield).	
4	Also check the alignment of the center pin of the heliax connector. If necessary re-align the centre pin so that the female pin in the antenna jumper cable connector is not damaged.	Repair or replace heliax, connectors, ground systems as required.

Antenna return loss

The antenna return loss is measured to verify that the antenna is properly matched to the system and to identify open connectors.

Antenna return loss test

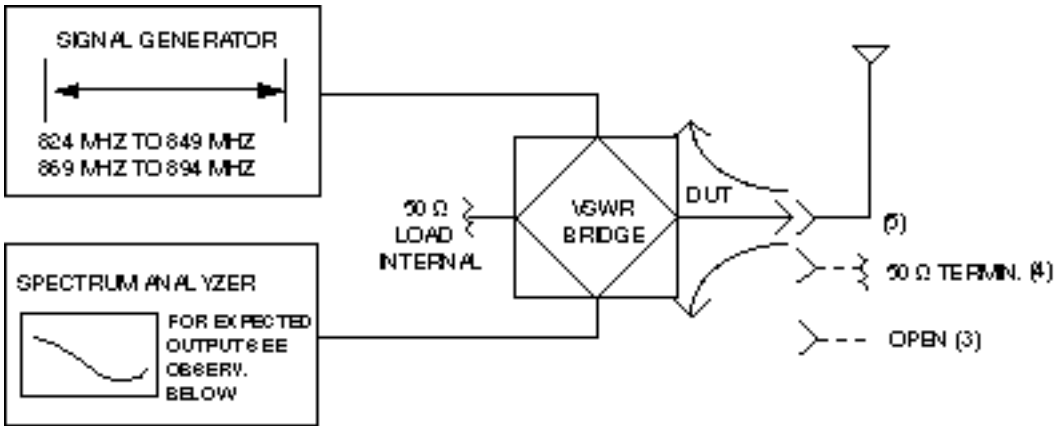
CAUTION
This test is service affecting when the antenna is disconnected.

This test uses the signal generator, the spectrum analyzer and the VSWR bridge to sweep the antenna for return loss at both the receive (824 to 849 MHz) and transmit (869 to 894 MHz) frequency bands. Figure 6-1 shows the set up for the test.

Test Equipment: RF Signal Generator
Spectrum Analyzer
VSWR Bridge

If any of the test equipment is not available, a Thruline Wattmeter may be used (refer to the *Thruline Wattmeter Method* section).

Figure 6-1
Antenna return loss block diagram



Step	Action	Observation
1	Connect the signal generator, the spectrum analyzer and a 50 ohm load to the VSWR bridge.	See Figure 6-1.
2	Set the signal generator output level to 0 dBm.	
3	With the device under test (DUT) VSWR bridge port connected to an open, adjust the display on the spectrum analyzer to the top of the screen.	
4	Connect a 50 ohm termination to the open port on the VSWR bridge and step the generator through the receive and transmit band to verify the test set-up for return loss.	Return loss should be greater than 35 dB over the bands.
5	Remove the termination from the VSWR bridge, connect the antenna jumper cable to the open port and again step the generator across the transmit and receive bands.	
6	Record the minimum return loss of the antenna and transmission line in the system.	Return loss: 824 to 849 MHz RX 869 to 894 MHz TX Greater than or equal to 14.5 dB + (2 x TX line loss)
7	Repeat the test for each antenna installed for the cell site.	
8	If the test fails, check the antenna matching, cables and connectors.	

Thruline wattmeter method (Antenna return loss)

This is a service affecting test using a Thruline Wattmeter. It can be used with transmit antennas only. **Ensure that all transmitters are OFF before inserting the Thruline in the transmission path.**

Step	Action	Observation
1	Connect the Thruline between the duplexer and the antenna.	
2	Measure the forward and reverse power using the appropriate element with one or more transmitters turned on.	Reflected power less than 4% of forward power

Antenna sweep

This is a service affecting test. **Ensure that all transmitters are OFF before disconnecting the antenna cable.**

Step	Action	Observation
1	Set up and calibrate a network analyzer (HP8753C or equivalent) to sweep 823 to 895 MHz.	
2	Notify the Control Center to OFFLINE the cell site.	
3	Disconnect the antenna jumper cable. (Located at the duplexer for the tx/rx antenna or at the RMC for the diversity receive antenna.)	
- continued -		

Step	Action	Observation
4	Perform a return loss sweep on the Network Analyzer. Note the worst frequencies by placing 2 markers each on the transmit and receive frequencies. then print a hard copy of the upper left quadrant.	Measured return loss of the antenna can be calculated as: RL (ant) = -14 dB - 2 times the antenna cable loss or: Compare you results with that of the RF Path calculated return loss of the cell site logbook (check the RF PAth Analysis sheet). If the results are bad compared to the log book values connect the test cable directly to the main transmission line and resweep. It is possible to have a bad jumper. If the result s are still bad then the problem could be either with the transmission line or the antenna.
5	Do a TDR sweep of the antenna. Print a hard copy of the lower left quadrant.	
6	Do a SWR sweep of the antenna. Print a hardcopy of the upper quadrant. The result should not be higher than 1.5:1	
7	Do a Smith Chart of the antenna. Print a hard copy of the lower right quadrant. The results must be close to 50 ohms (±50 ohms).	
8	Reconnect all the jumpers to their proper location then inform the Control Center to RTS the Cell Site.	If the transmit antenna is bad and the receive antenna is good on the transmit band, restore service by using the receive antenna until the transmit antenna is repaired.
- End -		

Enhanced Receive Multicoupler (ERMC) tests

ERMC description

The Enhanced Receive MultiCoupler (ERMC) modifies the receive RF signal for the front-end of the TRU shelf transceivers. The ERMC provides selectivity, signal gain and signal distribution so that the receive signal is adequate for the transceiver front-end.

ERMC overall gain measurement test

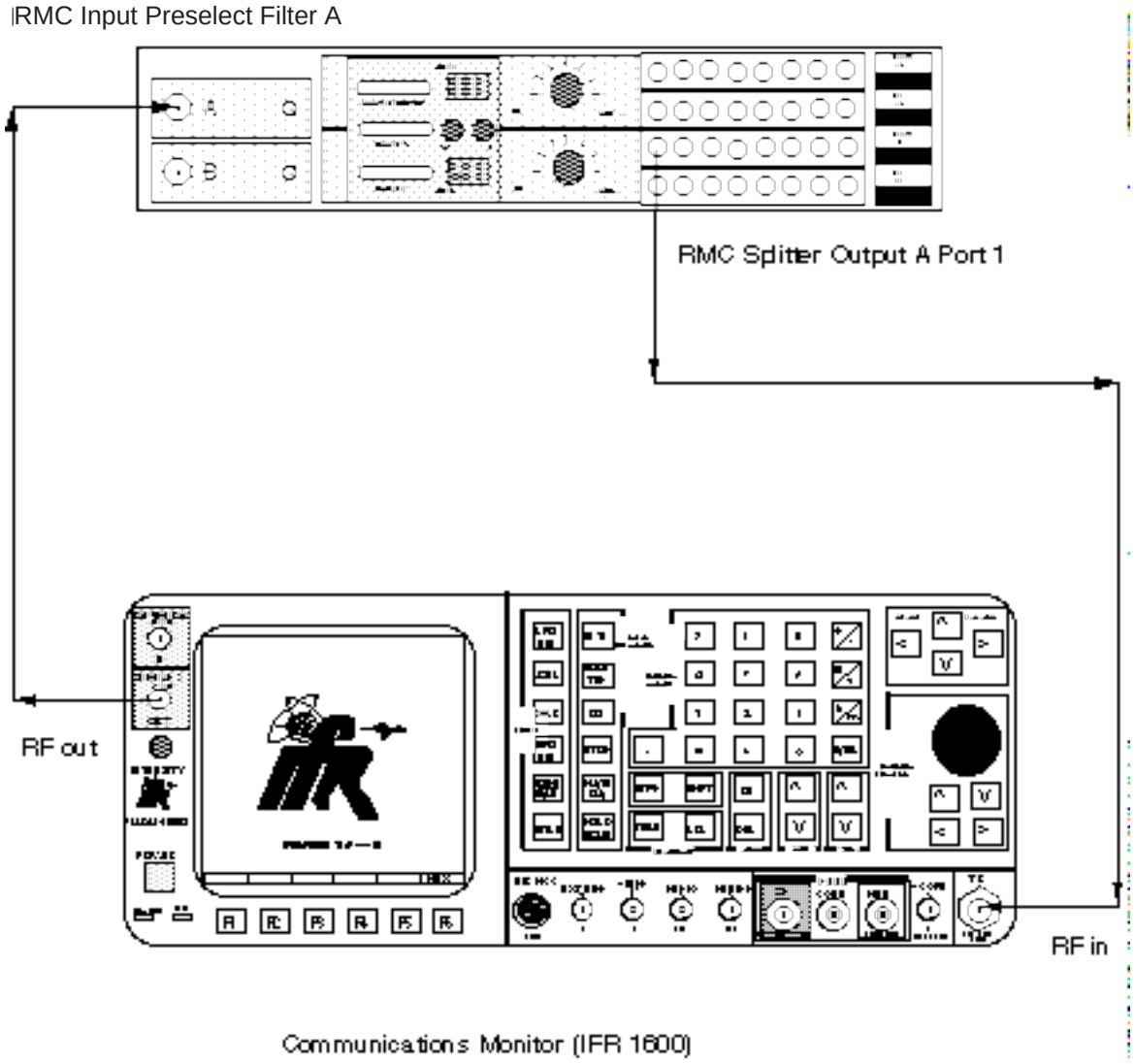
This test is required for a cell site suspected of faulty operation. **The test is service affecting.**

Step	Action	Observation
1	Notify the Control Center to OFFLINE the cell site.	
2	Disconnect the antenna feed cables from the selectivity filter inputs.	
3	Disconnect the cable from the ERMC splitter port to be tested.	
4	Using a 50-ohm cable, connect the communications monitor Duplex Output port to the selectivity filter input of the ERMC (either A or B side). See Figure 7-1.	
5	Using a 50-ohm cable, connect the communications monitor T/R port to one of the splitter ports corresponding to the A or B path selected. See Figure 7-1.	
- continued -		

Step	Action	Observation
6	Set up the communications monitor to output an RF signal less than -60 dBm sweeped from 824 to 849 MHz.	
7	Using the communication monitor in spectrum analyzer mode sweep the RMC and note any irregularities in the gain.	Gain measured may vary depending on cell site requirements for RF sensitivity versus IMD. See the *RF Engineering Guidelines for 800 MHz Cellular Systems*, 411-2131-007.
8	Repeat for all splitter ports and for both A and B diversity paths.	
9	Replace the antenna feed and splitter output cables and then inform the Control Center to RTS the Cell Site.	
- End -		

Note: If an irregularity in the ERMC gain exists, call Nortel Networks RF Engineering Support for assistance.

Figure 7-1
RMC overall gain measurement test



ERMC gain adjustment

This section refers to the *RF Engineering Guidelines for 800 MHz Cellular Systems*, 411-2131-007, specifically the Talk-in Talk-out (TITO) adjustment. Gain setting are factory preset to 16 dB but specific cell site requirements may differ. Refer to the *800 MHz ERMC Deployment Guide*, 411-2131-940, for more information on the ERMC.

Note: Use caution when attempting to adjust the ERMC variable attenuator. Overall system performance may suffer seriously, therefore a thorough understanding of the RF Engineering Guidelines should be acquired.

CAUTION
Service affecting
This test is service affecting and will take two TRU Radios off line. This test should be done when there is a problem; not as a regular maintenance routine.

Talk-In/Talk-out (TITO) balance test

The main purpose of the Talk-In/Talk-Out (TITO) test is to ensure that the ERMCs are tuned correctly. If they are not, the user could get noisy channels usually due to co-channel interference, low RF levels, or both. This usually happens to sites with large coverage where the multicoupler does not have sufficient gain to balance to talk-in path.

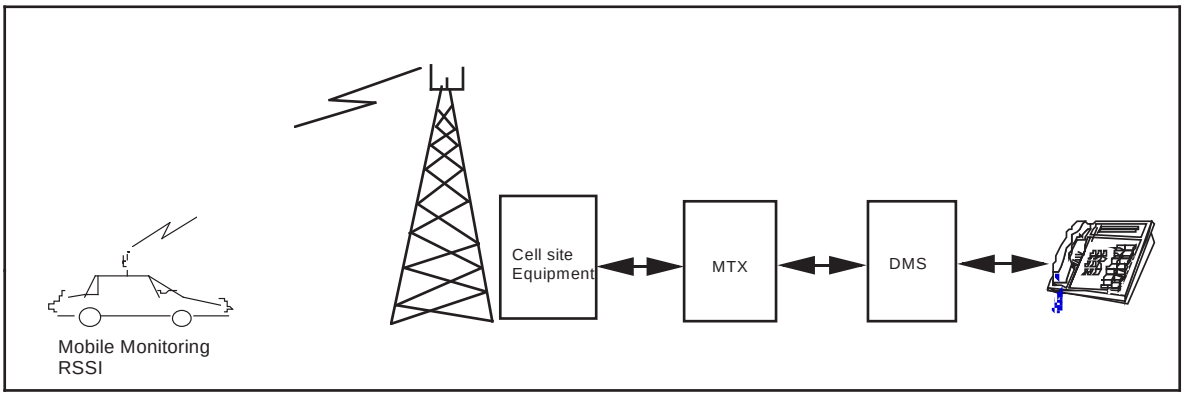
This test is required when there is a problem with the receive path and the ERMCs are suspected of faulty operation.

If the ERMCs are suspected to be faulty this test will verify if they actually are. There are two tasks that are done at the same time with this test after a call has been set-up.

1. You are monitoring a channel and RSSI (Receive Signal Strength Indicator) from the mobile.
2. You are monitoring the same channel and RSSI at the cell site.

Figure 7-2 shows the call setup for a TITO balance test.

Figure 7-2
Talk-In/Talk-out call setup



In order to guarantee minimum noise and reflection, the mobile should be in about the middle of the cell's coverage area, away from any tall buildings or shadow zones from hills or mountains.

TITO test procedure

Step	Action	Observation
1	At the MTX place an idle TRU in the off-line state.	The TRU will be in the idle state.
2	Make a call from the mobile to a phone at the switch and leave phone off hook.	Switch end will receive a call from the mobile to setup a call for monitoring.
3	At the cell site test TRU, connect a terminal and place in the debug mode. See Terminal Interface Operation in Chapter 1.	
4	When the call has been setup put the mobile into monitor mode and take note of the RSSI measurements.	Record the RSSI measurements at the mobile.
5	Set the test TRU, to the same channel as the one with the call on it from the mobile.	TRU will display same channel.
6	Set the TRU up to monitor the RSSI measurements. See RSSI tests for set up in Chapter 11 of this manual.	This turns on all antenna ports.
- continued -		

Step	Action	Observation
7	Monitor and record 20 RSSI measurements simultaneously at both the mobile and the test TRU. The mobile should be driven through a predetermined path to repeat the test for other channels available.	Record and average the levels in the chart.
- End -		

Note: If an imbalance exists, call Nortel Networks RF Engineering Support for assistance in re-balancing the ERMC output.

Always ensure that the site is balanced for the worst case. The radio TX path must be equal to or stronger than the Talk-In path. If there are significant differences in the Talk-out (base TX) levels on different antennas, check for a defective RF component such as an antenna, a cable, or a combiner.

Alarm Control Unit (ACU) tests

Overview

The Alarm Control Unit (ACU) provides discrete alarm monitoring, reporting and control functions at a cell site. The site ACU concentrates all alarm input points at the cell site and updates the MTX of any status change over redundant data links. The MTX can also poll for the condition of the ACU and request current status information or change the status of any output control contact. For a complete description of the ACU, refer to the *DualMode 800 Enclosure Functional Description*, 411-2051-100.

Alarm Control Unit test setup

Connect a VT100 terminal (or equivalent) using a null modem cable to the ACU local terminal connector.

Step	Action	Observation
1	Set up the terminal as per the requirements to the right.	BAUD Rate: TX 9600 RX 9600 Scroll: smooth Auto repeat: on ANSI Auto Wrap: off Receiver Parity: ignore Parity: disabled Character Bits: 8 bits Interface: on Scroll Key: VT100 Form Feed: line feed Control Characters: executed Local Echo: off RTS-CTS Handshake: off 8 Bits Tx: space
- continued -		

Step	Action	Observation
2	Press the RESET key on the ACU to activate the Maintenance Screen on the terminal.	The ACU Maintenance Screen as per the following diagram Figure 8-1 will appear.
3	Using the keyboard arrows, select the Input and Monitor menu items on the screen. Verify the remote alarms with respect to the site alarm records.	See Chapter 1, *Equipment operation*, for a description of all the menus.
4	Test all equipped alarm points on the ACU. This can be done by performing action such as turning DC breaker OFF, removing fuses, opening doors.	Bold display - alarm ON Normal display - alarm OFF
5	Apply +27 Vdc to each equipped alarm input at the rear of the ACU. Verify that each alarm indicates the correct status on the VT100 screen.	Bold display - alarm ON Normal display - alarm OFF
6	Open and close each selected output and verify its action by observing an open or short on the rear output connector, J8.	
- End -		

Figure 8-1
ACU First maintenance screen

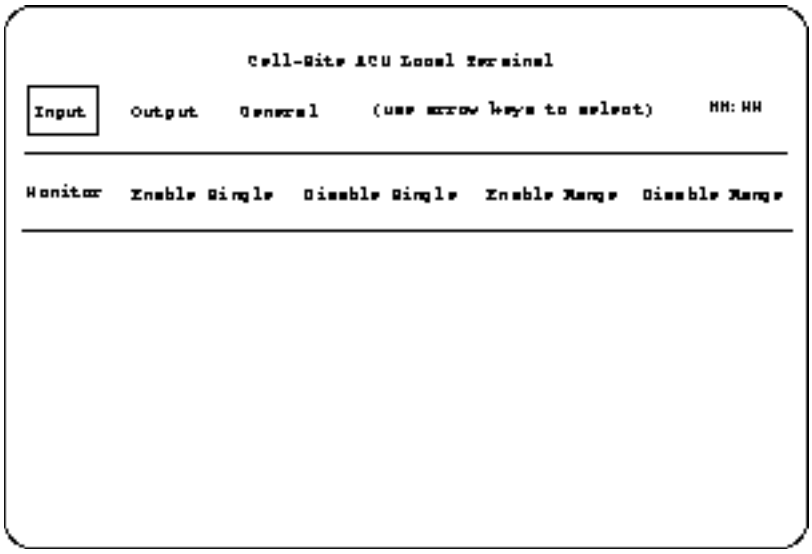
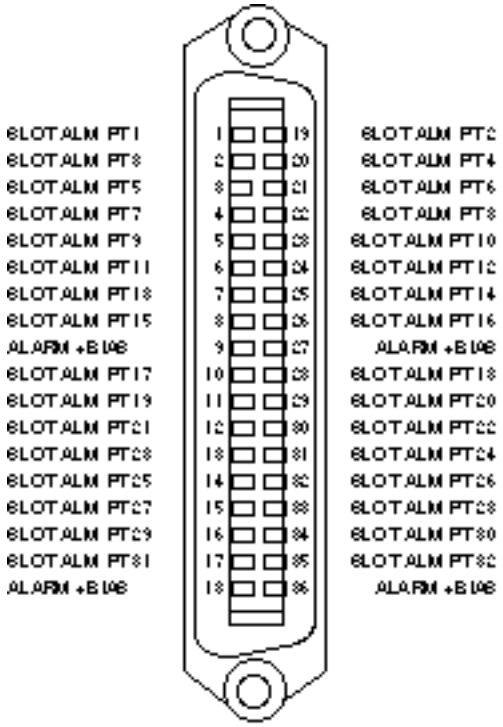


Figure 8-2 shows the pin assignments of a typical alarm connector.

Figure 8-2
Typical alarm connector (36-Pin)



Performing tests using a DCSM

Introduction

The DualMode Cell Site Monitor (DCSM) can operate in either stand-alone mode or directed mode. In stand-alone mode, the handset on the front panel is used to conduct manual calls. In directed mode, the MTX assumes control of the DCSM to perform a variety of non-obtrusive tests of the site. The MTX directed tests on the CCH, VCH, and LCR can be invoked from the respective level of the MAP position. Additionally from the CTT level VCH tests can be initiated with the option of testing a number of Devices Under Test (DUT) in sequence. The tests can also be set-up to be automatically run using the scheduler feature of Table CTTSCHED.

By making a call to the DCSM in the stand-alone mode or performing tests at the MTX in the directed mode, the Control Channel (CCH) and Voice Channels (VCH) of a cell site can be verified to be operating correctly.

Stand-alone mode tests

In stand-alone mode the mobile unit in the DCSM functions in the same manner as a subscriber mobile telephone in the cellular system. For this reason, the mobile unit in the DCSM has to be activated in the same manner as a subscriber mobile telephone. The cellular system will not recognize the mobile unit or allow it to function unless the programming on the Numerical Assignment Modules (NAM) is completed. Refer to Chapter 1, *Cell site operation*, for the programming of the NAMs.

In stand-alone mode the DCSM acts as a subscriber mobile registered in the partition. Once the mobile of the DCSM has acquired and locked onto a CCH in the partition it can be used to make a call through test through the handset of the mobile. Making a call verifies that the system is up and running.

Stand-alone ACCH/DCCH selection

When a partition is equipped with both an ACCH and a DCCH do the following:

1. select NAM 4 and enter the programming selection mode

2. scroll to the ScnDCCH field

   — if you want to verify the **ACCH** set **ScnDCCH** to **0** or

   — if you want to verify the **DCCH** set **ScnDCCH** to **1**

   Note: In ScnDCCH mode you should set the field 1STDCCH to the channel number of the DCCH you wish to perform the call through test on. If you have a sectored site you must repeat the NAM programming for each specific DCCH you wish to perform the stand-alone call through test.

DCSM auto answer facilities

In both the directed or stand-alone modes the DCSM will automatically answer all incoming calls. If the incoming call uses an analog call resource (AVC), the DCSM will generate a 1004 Hz tone for five seconds on the reverse path. The forward audio will then be looped to the reverse audio for the remainder of the call. If the incoming uses a TDMA call resource (DTC), the DCSM will automatically answer the incoming call, but will not generate a tone, or loop the forward and reverse audio paths.

Nortel Networks recommends that the MRLT, MRHT, MRLP and MRLR VCH tests be used for verifying the performance of analog voice channels.

Performing tests using the DCSM in the directed mode

The directed-mode tests using the DCSM can be further divided into two categories:

- MTX trunk tests
- Control channel tests

Control channel testing uses the DCSM to monitor the Overhead Message Train (OMT) on the ACCH and the FBCCH and EBCCH sub channels on a DCCH. A site control channel can also be tested for its power level in both the forward and reverse direction.

MTX trunk tests use the DCSM mobile as a loop-around to measure various indicators of the trunk path performance. Specifically the RF performance of the DUT can be measured by advantageously using the parameters of Table CTTPARMS.

Monitoring functions

With the MON ON command from the CTU MAP level, you may enable the ICP to drive the periodic CCH audit order function. Command parameters specify if a cell or a particular cell/sector is to be monitored. You must also

specify if monitoring is to be performed for ACCHs, DCCHs, or both. In the event that both CCH types are required to be monitored, the periodic audit will proceed in a round robin fashion by first monitoring all the ACCHs within the scope of the command, and then all the DCCHs.

When a DCSM is monitoring an ACCH, it detects:

a. loss of CCH synchronization

b. SID errors

c. mismatches between the CCH onto which the ICP commanded the cell site monitor to lock and the CCH onto which the cell site monitor is locked

When a DCSM is monitoring a DCCH, it also detects:

a. errors in the number of F-BCCH slots

b. errors in the number of E-BCCH slots

c. errors in the E-BCCH RCI locked

These errors are communicated to the CM as unsolicited messages.

When MON is ON, the ICP periodic audit process entails commanding the DCSM to monitor the current CCH in sequence. Once the DCSM mobile is locked onto the CCH, the ICP commands an audit order to be issued over the CCH. If the audit order response is not received over the reverse CCH, then a retry is attempted. Two consecutive failures results in the ICP reporting an unsolicited audit order failure message to the CM. The message type identifies either the CCH or the DCSM as the suspected cause of the failure. OMs are consulted to determine if originations, or page responses, or registrations were occurring during the period of the audit for the CCH under test. If these OMs were being incriminated, then a failure of the DCSM is presumed, otherwise a failure of the CCH is presumed.

If the DCSM mobile does not successfully lock onto the CCH, a new unsolicited message is sent to the CM with a message type indicating the failure to synchronize.

The goal is to revisit each CCH approximately every two minutes.

Posting the DCSM

To use the DCSM to perform tests requires that the DCSM is in service (INSV) state. The DCSM can be posted before a test is initiated from the Maintenance and Administration (MAP) terminal (see Procedure 9-1).

Procedure 9-1
Posting the DCSM

Step	Action	Observation
1	At the MAP terminal, post the DCSM by entering: >**MAPCI;MTC;MTX;CELL <cell_number>** >**CTU;POST <DCSM_number>**	
2	Ensure that the posted DCSM is in the INSV (in service) state. If not, place the DCSM to the INSV state by entering: >**BSY;RTS**	

Control Channel tests

The Digital or Analog Control Channel can be monitored and tested using the DCSM located in the same partition in which the DCCH/ACCH serves.

The following tests are available from the MTX MAP position.

CCH MAP level:

- forward DCCH/ACCH RF power measurement (POWER)
- reverse DCCH/ACCH RF power measurement (RSSI)
- ACCH Overhead Message Train monitoring (CCHOMT)
- DCCH F-BCCH and E-BCCH parameter reporting (DCCHPARM)

CTU MAP level:

- Background round robin monitoring (MON)

Preparing for Control Channel tests

Before any of the Control Channel tests can be invoked from the MAP terminal, the DCSM as well as the DCCH or ACCH to be tested must be posted. The Control Channel test setup is described in Procedure 9-2.

Procedure 9-2
Control Channel test set-up

Step	Action	Observation
1	At the MAP terminal, post the DCSM by entering: >**MAPCI;MTC;MTX;CELL <cell_number>** >**CTU;POST <DCSM_number>**	
2	Make sure that the posted DCSM is in the INSV (in service) state. If not, place the DCSM to the INSV state by entering: >**BSY;RTS**	
3	Post the Control Channel to be tested by entering: >**CCH;POST <channel_number>**	
4	Make sure that the posted CCH is in the INSV state. If not, place the CCH to the INSV state by entering: >**BSY;RTS**	
5	If the DCSM is in a sectored configuration, force the DCSM to scan the DCCH of the sector that is to be tested by entering: >**MON ON <x, y, z, u, v, or w>,<A,D,BOTH>** (Sector Designation) (ACCH, DCCH, or Both) For example: >**MON ON X D** (You must only monitor the CCH under test)	A = monitor ACCH only D = monitor DCCH only Both = monitor both CCH types through background monitoring
6	The DCSM is now ready to test the desired CCH.	

Note: For MTX04 monitoring only needs to be invoked to run the CCH power test. For earlier MTX releases, monitoring must be invoked for all CCH tests.

Measuring Forward Control Channel RF power

The DCSM can be directed to take a Power measurement on the currently active CCH. Raw RSSI readings are returned from the DCSM and are translated into dBm at the CM. Procedure 9-3 is used to test the forward power.

Procedure 9-3
Measuring forward CCH RF power

Step	Action	Observation
1	Make sure that the DCCH and the DCSM have been posted and are in the INSV state as per the Control Channel Test Setup Procedure.	
2	At the CCH LEVEL OF THE MAP, enter: >**TST POWER**	

Measuring Reverse Control Channel power

For this test the DCSM is directed to terminate a call. The MTX then directs the CCH to measure the TX power of the DCSMs page response (RECC or RACH). The readings are in a raw format and are translated into dBm at the CM. Procedure 9-4 is used to test the reverse power.

Procedure 9-4
Measuring reverse CCH RF power

Step	Action	Observation
1	Make sure that the DCCH and the DCSM have been posted and are in the INSV state as per the Control Channel Test Setup Procedure.	
2	At the CCH LEVEL OF THE MAP, enter: >**TST RSSI**	

Round Robin Monitoring

The MON command is executed from the CTU level of the MAP position with a posted INSV DCCH or ACCH.

The MON command forces the DCSM to scan specific CCHs as specified in the command options.The MON command sequence is as per Procedure 9-5.

Procedure 9-5
Round Robin Monitoring

Step	Action	Observation
1	Make sure that the DCCH or ACCH and the DCSM have been posted and are in the INSV state as per the Control Channel Test Setup Procedure.	
2	If the DCSM is in a sectored configuration, force the DCSM to scan the DCCH of the sector that is to be tested by entering: >**MON ON <x, y, z, u, v, or w>, <A,D,BOTH>** (Sector Designation), (ACCH, DCCH, or Both)	A = monitor ACCH only D = monitor DCCH only Both = monitor both CCH types
3	Example: MTX120 JUL04 12:12:30 1123 INFO Terminal Maintenance Event CELL 15 CTU 0 PRTN: Y EVENT: Unsol Wrong CCH REASON: CCH Number Wrong	

Querying ACCH OMT parameters

The DCSM can also be queried for the latest ACCH OMT parameters (see Procedure 9-6).

Procedure 9-6
Querying ACCH OMT parameters

Step	Action	Observation
1	Make sure that the ACCH and the DCSM have been posted and are in the INSV state as per the Control Channel Test Setup Procedure.	
2	At the ACCH level of the MAP position enter: >**TST CCHOMT**	
3	The system responds by displaying the information on the MAP terminal. Check the log values reported against the system datafill.	Results displayed on MAP terminal.

Querying FDCCH parameters

The DCSM can also be queried for the latest F-BCCH and E-BCCH parameters (see Procedure 9-7). Reported parameters include all mandatory F-BCCH and E-BCCH messages. This test is only valid for IS-136.1 DCCHs.

Procedure 9-7
Querying the DCSM parameters

Step	Action	Observation
1	Ensure that the DCCH, VCH and the DCSM have been posted and are in the INSV state as per the Control Channel Test Setup Procedure.	
2	At the DCCH level of the MAP position enter: >**TST DCCHPARM <option>{F,E,ALL}**	Options: F - request is for FBCCH parameters E - request is for EBCCH parameters ALL - request is for FBCCH and EBCCH parameters
3	The system responds by generating an MTX170 log. Check the log values reported against the system datafill.	

MTX CTT tests

MTX CTT (Cellular Terminal Tests) tests use the DCSM as a test mobile to test AVCHs by looping around a tone generated by the MTX Trunk Test Terminal (TTT). These tests measure the performance of the specified AVCH and associated trunks. The performance criteria measurable are:

- wireline trunk audio performance (loss) and associated noise (MALT, MAHT)
- wireless trunk RF performance (loss) and associated noise (MRLT, MRHT)
- forward and reverse RF strength performance (MRLP, MRLR)
- system call set-up capability (MTRM, DTRM)

Naming conventions

All MTX trunk tests use a four letter acronym to describe the functionality of the test. Each letter of the test acronym is explained in Table 9-1.

Table 9-1
Naming convention of the MTX trunk tests

Letter #	Designation
1	M = MTX — test a MTX VCH trunk D = DCCH — set-up VCH trunk
2	A = Audio — test the audio link of the trunk (DCSM is not a requirement) R = RF — test the RF link of the trunk
3	L = Low — use a low level tone for the test H = High — use a high level tone for the test
4	T = Transmission — measure transmission loss and noise R = Receiver — measure the reverse RF power level of the VCH P = Power — measure the forward RF power level of the VCH
Note: DTRM and MTRM violate this naming convention.	

MTX Audio Low Test and MTX Audio High Test (MALT/MAHT)

This test does not require a DCSM. The MALT and MAHT test measures the following MTX trunk parameters:

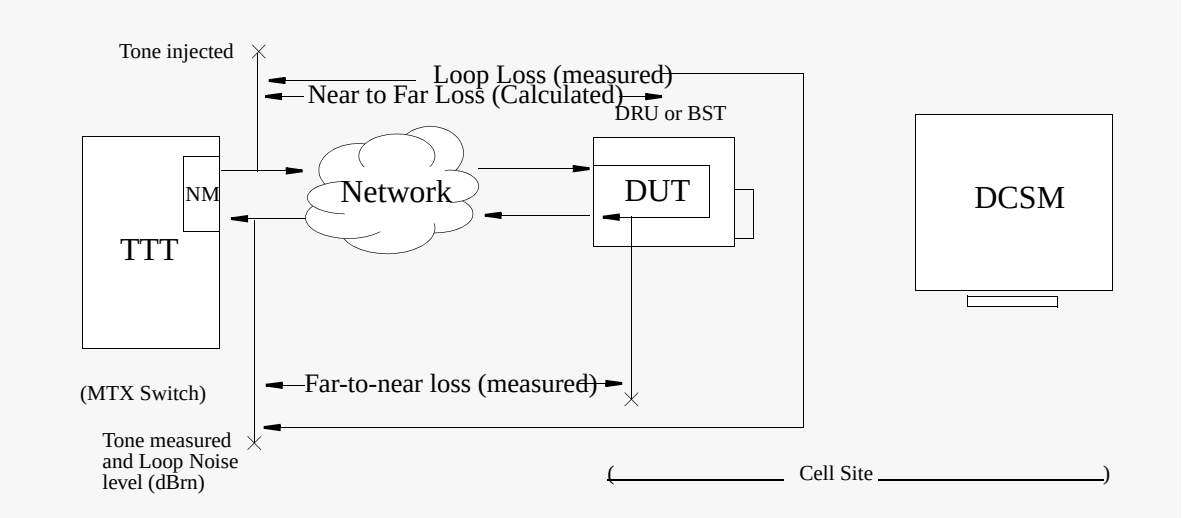
- far-to-near-loss
- loop loss
- loop noise

The MALT and MAHT tests can be invoked in the following ways:

- from a posted transceiver at the VCH MAP level
- from the CTT level (the first available VCH is selected)
- automatically using Table CTTSCHED (also selects first available VCH)

The MALT and MAHT test use the TTT to inject a low and high level (the level and frequency is determined by the CTTPARMS tuple) audio tone respectively onto the MTX trunk. The audio tone is looped from the forward to the reverse audio by the DUT (that is, the TRU) located at the cell site and the returned level is measured by the TTT. The TTT also makes a measurement of the noise level accompanying the audio signal at the return end of the loop. The MALT and MAHT tests do not use the DCSM as part of the test path. Figure 9-1 shows the test path and the measured path measurements.

Figure 9-1
MALT and MAHT CTTPARMS Fields



Running the MALT and MAHT test

Before either the MALT or MAHT test is run be sure that the appropriate test parameters are datafilled in Table CTTPARMS.The MALT test is invoked at the VCH level of the MAP position on a posted channel. Procedure 9-8 lists the step by step manual method of invoking the MALT and MAHT tests.

Figure 9-2
MALT Test Output MTX303 Log

```
MTX303  JUN29  12:12:12   2500  CTT  TRANSMISSION TEST
  CELL:  20x   TEST:  MALT    VCH: 10   HW:  DRU      PASS
  PA_EML:  -20 dB  LP_EML: -20dB TONE: 10  dBm
  LP_LOSS:  0.0 dB  FN_LOSS:  -0.3 dB  NF_LOSS: 0.3 dB
  NML: 25 dB     NIAL: 30 dB     NOISE:  21 dBRN
```

Procedure 9-8
Initiating the MALT/MAHT test

Step	Action	Observation
1	Go to the MAP level of the MTX radio (VCH) to be tested: (example) **MAPCI;MTC;MTX;CELL 100;VCH**	
2	Post the radio to be tested: (example) **POST 2**	
3	Invoke the MALT/MAHT test on the posted radio: **TST MALT** or **TST MAHT**	The MTX will indicate that the test is underway.
4	Wait for the results of the MALT/MAHT test. The MTX will display them once the test is complete.	See Figure 9-2.
5	If the results fail check that the CTTPARMS fields are correctly datafilled. Then repeat the test to verify the failure.	

Refer to the *DualMode 800 Enclosure Troubleshooting Guide*, 411-2051-900, for more information of the fields in MTX303 Log. Below are the descriptions of the fields of MTX303 which give the actual measure results:

LP_LOSS - The Loop Loss measured in dB
FN_LOSS - The Far-to-Near Loss in dB, calculated from LP_Loss - NF_Loss
NF_LOSS - The Near-to-Far Loss measured in dB
NOISE - The Loop Noise Level measured in dBrn

Figure 9-3
MAHT Test Output MTX303 Log

```
MTX303  JUN29  12:12:12   2500  CTT  TRANSMISSION TEST
  CELL:  20x   TEST:  MAHT    VCH: 10   HW:  DRU      PASS
  PA_EML:  -20 dB  LP_EML: -20dB TONE: 10  dBm
  LP_LOSS:  0.0 dB  FN_LOSS:  -0.3 dB  NF_LOSS: 0.3 dB
  NML: 25 dB     NIAL: 30 dB     NOISE:  21 dBRN
```

Troubleshooting action

If the test fails then it should be repeated for verification. Should the test still fail the following hardware components may be at fault:

- the TRU
- ICRM packs (the AX50s, AX47s, AX87s)
- the T1 transmission equipment used
- the ICP cards (the AX50s)

The signal may be rerouted to eliminate and pinpoint faulty hardware components, or the equipment may be swapped one at a time with known good units and the test repeated. When the test passes the faulty unit may have been found.

The MTX RF Low and High Tests (MRLT and MRHT)

The MTX RF Low and High tests measure an audio tone which has been looped at the DCSM. The test verifies the RF path on the forward and reverse links of the DUT. The test therefore verifies the RF portion of the circuit. The MRLT test measures the following three parameters of the circuit:

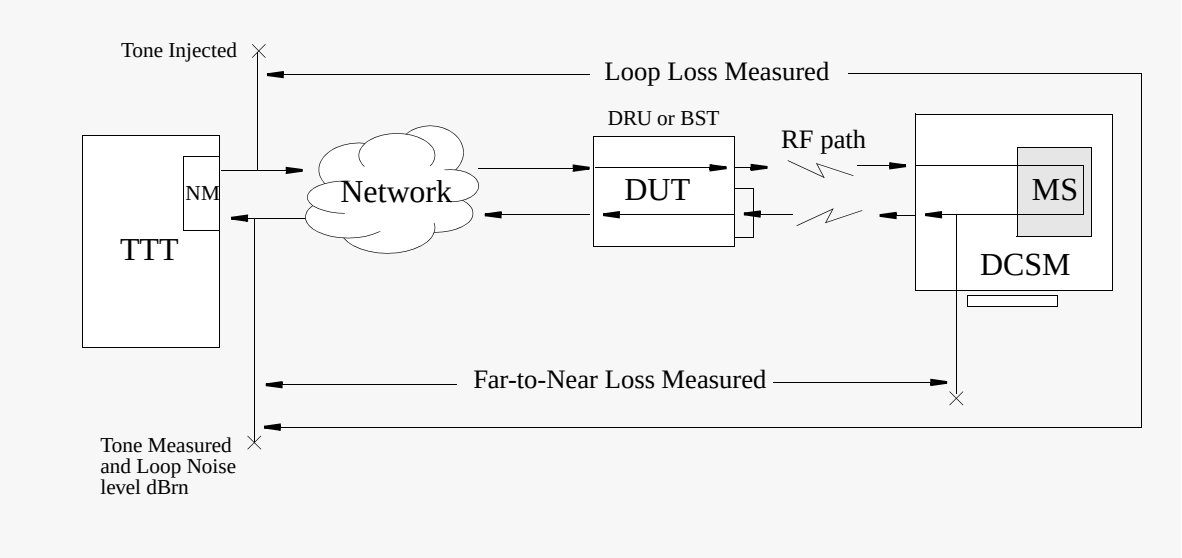
- the Loop Loss
- the Loop Noise
- the Path Far-to-Near Loss

The MRLT and MRHT tests can be invoked in the following ways:

- from a posted transceiver at the VCH MAP levels
- from the CTT level (all available VCH are tested starting with the first available)
- automatically using Table CTTSCHED (this also selects the first available VCH)

Once the test is invoked a call is terminated to the DCSM mobile. The DCSM then transmits a 1004 Hz tone at 2.9 kHz deviation for 5 seconds, after which the FWD audio is looped to the REV audio. The TTT then transmits a tone (level and frequency determined in Table CTTPARMS) which is transmitted on the forward RF path by the DUT to the DCSM. The DCSM subsequently loops the forward audio to the reverse audio and transmits the tone to the DUT through the reverse RF path. The returned audio is finally measured by the TTT. The values measured are returned in the log report which is subsequently reported to the technician at the MAP terminal through MTX Log 303. Figure 9-4 shows the test path and the measured path measurements.

Figure 9-4
MRLT and MRHT CTTPARMS fields



How to Invoke the MRLT/MRHT test

Before the test is run the appropriate CTTPARMS tuple must be datafilled with the correct values. With the CTTPARMS tuple correctly datafilled and selected through CTTGROUP the test may be initiated either manually from the MAPCI level (VCH or CTT) or automatically using CTTSCHED. Procedure 9-9 outlines the manual method of invoking the MRLT and MRHT tests.

Procedure 9-9
Initiating the MRLT/MRHT tests

Step	Action	Observation
1	Go to the MAP level of the MTX radio (VCH) to be tested: (example) **`MAPCI;MTC;MTX;CELL 100;VCH`**	
2	Post the radio to be tested: (example) **`POST 2`**	
3	Invoke the MRLT/MRHT test on the posted radio: TST MRLT or TST MRHT	The MTX will respond that the test is underway.
4	Wait for the results of the MRLT/MRHT test. The MTX will display them once the test is complete.	See Figure 9-5.
5	If the results fails check to see if the CTTPARMS fields are correctly set.Then repeat the test to verify the failure.	

Figure 9-5
MRLT Test Output MTX303 Log

```
MTX303  JUN29  12:12:12   2500  CTT  TRANSMISSION TEST
  CELL:  20x   TEST:  MRLT    VCH: 10   HW:  DRU      PASS
  PA_EML:  -20 dB  LP_EML: -20dB TONE: 10  dBm
  LP_LOSS:  0.5 dB  FN_LOSS:  -0.3 dB  NF_LOSS: 0.2 dB
  NML:  3.0 dB     NIAL:  5.0 dB     NOISE:  22 dBRN
```

Refer to the *DualMode 800 Enclosure Troubleshooting Guide*, 411-2051-900, for more information of the fields in MTX303 Log. Below are the descriptions of the fields of MTX303 which give the actual measure results:

LP_LOSS - The Loop Loss measured in dB
FN_LOSS - The Far-to-Near Loss measured in dB
NF_LOSS - The Near-to-Far Loss calculated in dB (LP_Loss-FN_Loss)
NOISE - The Loop Noise Level measured in dBrn

Figure 9-6
MRHT Test Output MTX303 Log

```
MTX303  JUN29  12:12:12   2500  CTT  TRANSMISSION TEST
  CELL:  20x   TEST:  MRHT    VCH: 10   HW:  DRU      PASS
  PA_EML:  -20 dB  LP_EML: -20dB TONE: 10  dBm
  LP_LOSS:  0.5 dB  FN_LOSS:  -0.3 dB  NF_LOSS: 0.2 dB
  NML:  3.0 dB     NIAL:  5.0 dB     NOISE:  22 dBRN
```

Refer to the *DualMode 800 Enclosure Troubleshooting Guide*, 411-2051-900, for more information of the fields in MTX303 Log.

Troubleshooting action

If the test fails then it should be repeated for verification. Should the test still fail the following hardware components may be at fault:

- TRU (CCH, or VCH)
- related Power Amplifier(s)
- Combiner
- ICRM packs (the AX50s, AX47s, AX87s)
- T1 transmission equipment used
- ICP cards (the AX50s)
- DCSM

The signal may be rerouted to eliminate and pinpoint faulty hardware components, or the equipment may be swapped one at a time with known good units and the test repeated. When the test passes the faulty unit may have been found. Additionally, determine if the MALT or MAHT test has passed or not to isolate the path failure location further.

TEST MRLP

This is the MTX RF Transmitter test. The test measures the following:

- the Tx Power(dBm) of the Forward RF link

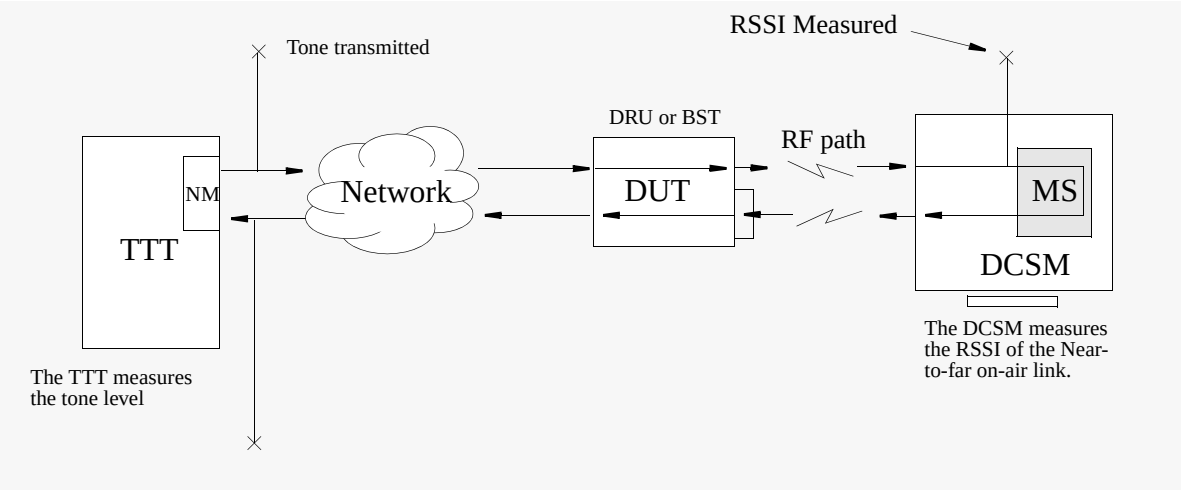
The MRLP test can be invoked in the following ways:

- from a posted transceiver at the VCH MAP level
- from the CTT level (all available VCH are tested starting with the first available)
- automatically using Table CTTSCHED (this also selects the first available VCH)

Once the test is invoked a call is terminated to the DCSM mobile. The DCSM then transmits a 1004 Hz tone at 2.9 kHz deviation for five seconds, after which the FWD audio is looped to the REV audio. The TTT then transmits a tone (level and frequency determined in Table CTTPARMS) which is transmitted on the forward RF path by the DUT to the DCSM. The DCSM subsequently loops the forward audio to the reverse audio and transmits the tone to the DUT through the reverse RF path. Once the link has been verified, the DCSM is instructed by the MTX to measure the level of the forward RF signal. The measured level is returned to the MTX by the DCSM for reporting. Refer to Figure 9-7 for a diagram of the test operation.

The test either passes or fails depending on the level returned is within the limits set by the MRLP tuple in Table CTTPARMS. Table CTTGROUP defines the RF power level which the DCSM should measure.

Figure 9-7
MRLP Test Measurements



How to invoke the MRLP test

Before the test is run the appropriate CTTPARMS tuple must be datafilled with the correct criteria. With the CTTPARMS tuple correctly datafilled and selected through CTTGROUP, the test may be initiated either manually from the MAP level (VCH or CTT) or automatically using CTTSCHED. Procedure 9-9 outlines the manual method of invoking the MRLP test.

Procedure 9-10
Initiating the MRLP test

Step	Action	Observation
1	Go to the MAP level of the MTX radio (VCH) to be tested: (example) **MAPCI;MTC;MTX;CELL 100;VCH**	
2	Post the radio to be tested: (example) **POST 2**	
3	Invoke the MRLP test on the posted radio: **TST MRLP**	The MTX will respond that the test is underway.
4	Wait for the results of the MRLP test. The MTX will display them once the test is complete.	See Figure 9-8.
5	If the results fails check to see if the CTTPARMS fields are correctly set. Then repeat the test to verify the failure.	

Figure 9-8
MRLP Test results MTX302 Log

```
MTX302  JUN29  12:12:12   2500   CTT  RF POWER TEST
CELL:  20x    TEST:  MRLP   VCH: 10   HW:  BST   PASS
VPL  :  0       Tx PWR:  -50 dBm   EXP PWR: -58 dBm
Q1PWR:  0  dB   Q2PWR:  2 dB
```

Refer to the *DualMode 800 Enclosure Troubleshooting Guide*, 411-2051-900, for more information of the fields in MTX303 Log. Below are the descriptions of the fields of MTX302 which give the actual measure results:

Tx PWR - The measured forward RF power in dBm

Troubleshooting action

If the test fails then it should be repeated for verification. Should the test still fail the following hardware components may be at fault:

- TRU (ACH & VCH)
- Power Amplifier

- Combiner
- ICRM packs (the AX50s, AX47s, AX87s)
- T1 transmission equipment used
- ICP cards (the AX50s, AX27s)
- DCSM

The signal may be rerouted to eliminate and pinpoint faulty hardware components, or the equipment may be swapped one at a time with known good units and the test repeated. When the test passes the faulty unit may have been found. Additionally, determine if the MALT or MAHT test has passed or not to isolate the path failure location further.

TEST MRLR

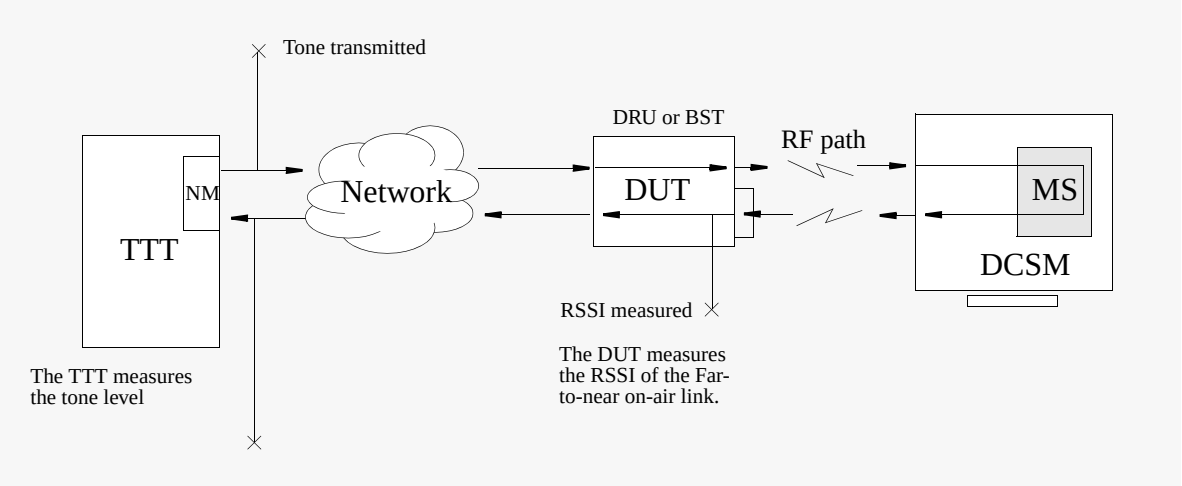
The MTX Radio receiver test. The test measures the following:

- the RSSI (dBm) of the reverse RF path
- the Loop Loss in dB

Once the test is invoked a call is terminated to the DCSM mobile. The DCSM then transmits a 1004 Hz tone at 2.9 kHz deviation for five seconds, after which the FWD audio is looped to the REV audio. The TTT then transmits a tone (level and frequency determined in Table CTTPARMS) which is transmitted on the forward RF path by the DUT to the DCSM. The DCSM subsequently loops the forward audio to the reverse audio and transmits the tone to the DUT through the reverse RF path. Once the link has been verified, the DUT is instructed by the MTX to measure the RSSI of the received RF signal on the reverse RF path. The measured RSSI is returned to the MTX for reporting along with the looped level measured by the TTT. Refer to Figure 9-9 for a diagram of the test operation.

The test either passes or fails depending on the RSSI level returned is within the limits set by the MRLR tuple in Table CTTPARMS. Table CTTGROUP defines the RF power level which the DCSM should transmit on the reverse path.

Figure 9-9
MRLR Test Measurements



How to invoke the MRLR test

Before the test is run, the appropriate CTTPARMS tuple must be datafilled with the correct criteria. With the CTTPARMS tuple correctly datafilled and selected through CTTGROUP, the test may be initiated either manually from the MAP level (VCH or CTT) or automatically using CTTSCHED. Procedure 9-11 outlines the manual method of invoking the MRLR test.

Procedure 9-11
Initiating the MRLR test

Step	Action	Observation
1	Go to the MAP level of the MTX radio (VCH) to be tested: (example) **`MAPCI;MTC;MTX;CELL 100;VCH`**	
2	Post the radio to be tested: (example) **`POST 2`**	
3	Invoke the MRLR test on the posted radio: **`TST MRLR`**	The MTX will respond that the test is underway.
4	Wait for the results of the MRLR test. The MTX will display them once the test is complete.	See Figure 9-10.
5	If the results fails check to see if the CTTPARMS fields are correctly set. Then repeat the test to verify the failure.	

Figure 9-10
MRLR Test results MTX302 Log

```
MTX302  JUN29  12:12:12   2500   CTT  RF POWER TEST
CELL:  20x    TEST:  MRLR VCH: 10   HW:  BST    PASS
VPL  :  0       Tx PWR:  -50 dBm   EXP PWR: -58 dBm
Q1PWR:  0  dB   Q2PWR:  2 dB
```

Refer to the *DualMode 800 Enclosure Troubleshooting Guide*, 411-2051-900, for more information of the fields in MTX303 Log. Below are the descriptions of the fields of MTX302 which give the actual measure results:

Tx PWR - The measured reverse RF level in dBm

Troubleshooting action
If the test fails then it should be repeated for verification. Should the test still fail the following hardware components may be at fault:

- the TRU (ACH & VCH)
- ICRM packs (the AX50s, AX47s, AX87s)
- the T1 transmission equipment used
- the ICP cards (the AX50s)
- the DCSM

The signal may be rerouted to eliminate and pinpoint faulty hardware components, or the equipment may be swapped one at a time with known good units and the test repeated. When the test passes the faulty unit may have been found.

MTX Call Processing Mobile Termination Test (MTRM or DTRM)

For this test the DCSM is used to terminate a call. This test provides verification of all call set-up commands and messages between the cell site CCH, the AVCH under test and the ICP. Call set-up is through the ACCH (MTRM) or DCCH (DTRM) to an AVCH.

For this test, use:

- **MTRM** if the partitions ACCH is to set-up the call termination test or
- **DTRM** if the partitions DCCH is to set-up the call termination test

The mobile termination test is invoked from the VCH level of the MAP position (test DTRM or MTRM). The posted VCH must be an AVCH. If the posted VCH is a DTCH or DualMode VCH, the call will be in digital mode. The user will be notified if an attempt is made to run the MTRM or DTRM test on an AVCH which is servicing a call.

Invoking the DTRM test

Now that the DCSM (scanning the DCCH of the partition) and the VCH are posted the Call Termination test may be performed:

Procedure 9-12
Invoking the DTRM or MTRM tests

Step	Action	Observation
1	At the VCH MAP level enter: **`TST DTRM`** or **`TST MTRM`**	The MAP terminal will respond with an MTX301 Log displaying the results of the DCCH or ACCH call setup.

ICRM tests

There are no operational tests for the Integrated Cellular Remote Module (ICRM) at the cell site. If you want to check the operation of the ICRM, contact the operator at the MTX for assistance.

DRU tests

Introduction

The DualMode Radio Unit (DRU) is a cell site transceiver and power amplifier combination that operates in either a TDMA (digital) mode or in a conventional AMPS (analog) mode. For a DualMode 800 Enclosure, the DRU is packaged in two sub-modules, the Transmit Receive Unit (TRU) and the Multi-Channel Power Amplifier (MCPA) module.

TRUs are datafilled as analog only, digital only, or dual-mode from the Maintenance and Administration Position (MAP) terminal which is typically located at the Digital Multiplex System-Mobile Telephone Exchange (DMS-MTX). When datafilled as dual-mode, TRUs operate dynamically in either AMPS or TDMA mode, based upon control from the switch. Whether operating in AMPS or TDMA mode, the TRU uses the same internal DSP-based circuitry to process both voice and data.

The use of Digital Signal Processing (DSP) technology greatly reduces maintenance requirements. Due to functions being performed by software code, rather than circuits composed of discrete elements that cause drift over time and with temperature change, radio performance levels are improved and routine maintenance schedules can be eliminated.

The DSP architecture of the TRU and microprocessor control of the MCPA allow for very stable performance and consistency from one unit to another. No manual adjustments are required on the TRU or the MCPA. There are, in fact, no manual adjustable components in the TRU or MCPA. All adjustments to operational parameters are made through the TRU terminal interface.

The most important item governing correct DRU operation is a proper, non-corrupt, software load within the TRU. The TRU software load is downloadable from the MAP position through a Peripheral Module (PM) load tape. TRUs can be upgraded or reloaded with their operating software without requiring anyone to visit a cell site.

Figure 11-1 and Figure 11-2 show the front panel layouts of the TRU2 and the TRU3 respectively. Figure 11-3 shows the front panel layout of the MCPA.

Figure 11-1
Front panel layout of the TRU2 (NTAX98AA)

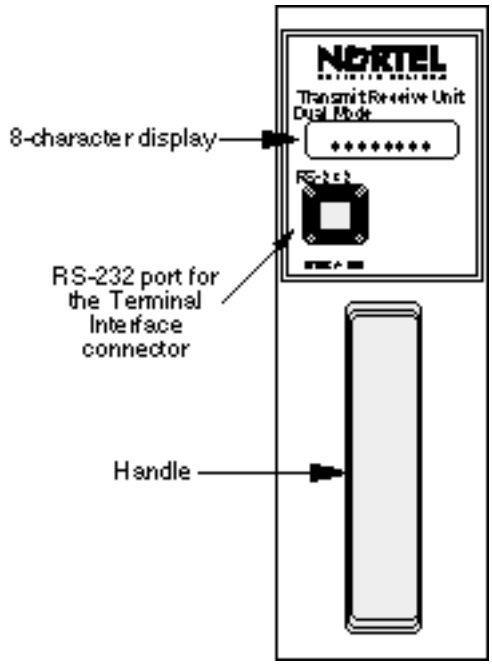


Figure 11-2
Front panel layout of the TRU3 (NTAW99AA)

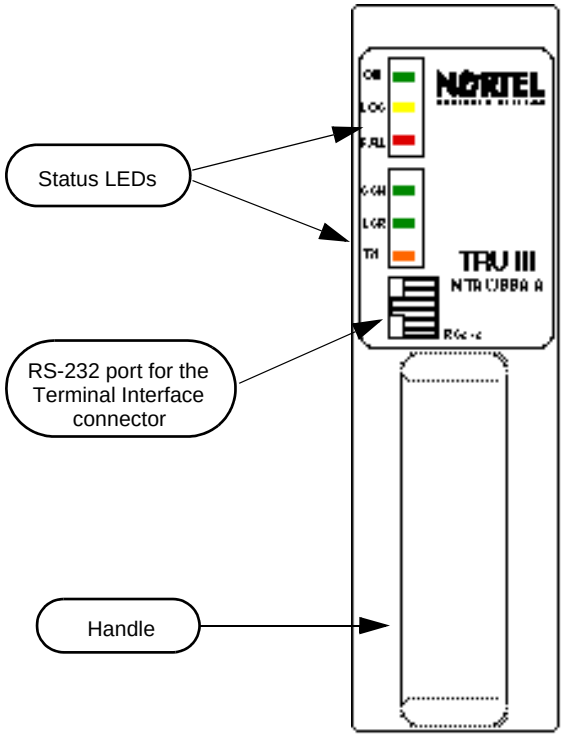
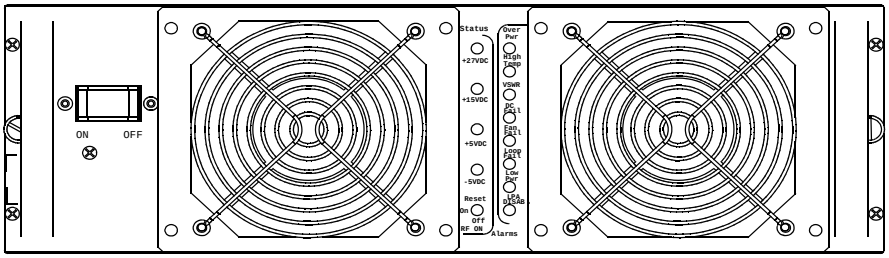


Figure 11-3
MCPA front panel layout



Functionality of the DRU

The TRU provides a Time Compressed Multiplex (TCM) interface with the Integrated Cellular Remote Module (ICRM). It also provides dual-receive paths and diversity switching, and controls the Operation, Administration, and Maintenance (OA&M) functions for the DRU. Control and signaling messages communicated between the ICRM and the TRU are through a TCM D-channel. Voice and data signals are communicated between the ICRM and the TRU through a TCM B-channel.

Depending on the mode, the AMPS or TDMA baseband signal generated by the TRU in a DualMode 800 Enclosure is modulated in the TRU. The modulated signal is then sent to the MCPA. The MCPA amplifies and transmits the signal to the mobile in the appropriate AMPS (analog) or $\pi/4$ DQPSK (digital) format. The TRU receives composite RF signals from the mobile, extracts embedded control messages, and routes the control and voice signals to the ICRM.

Audio sensitivity of the TRU

In AMPS mode, as a speaker talks, the FM carrier varies as a function of the audio waveform produced by the speaker's voice. This variance is known as the frequency deviation that corresponds to a specific audio level. Typical audio levels range anywhere from -18 dBm0 to -22 dBm0.

For TDMA, the speech signal is encoded using the VSELP coding algorithm. The VSELP codec per the IS-54-B standard is optimized for a value being equated to an audio level of -18 dBm0. Therefore, if an AMPS radio is not set to an audio sensitivity of -18 dBm0, there will be some noticeable contrast in audio level (loudness) when handoff occurs between the two modes.

To minimize the contrast between the two modes, Nortel Networks recommends that the audio level in an analog network be adjusted to -18 dBm0, corresponding to ±2.9 kHz deviation, in each direction of transmission. This recommendation concurs with the Joint Experts Meeting as reported to the CTIA in March 1992. For TRUs working in the AMPS

mode to be fully IS-54-B compliant, the audio sensitivity is factory set to -18 dBm0. However, the audio sensitivity can be adjusted by performing the Transmit and the Receive Audio Level tests as described later in this chapter.

Test considerations

This manual outlines the tests that should be performed on a DualMode Radio Unit (DRU) when it is installed or replaced. It describes tests that can be performed on the DRU, although not required, in a DualMode 800 Enclosure. Also described are system checks related to a complete cell site system containing DRUs. The tests ensure that the DRU provides service to mobile users and meets the basic operating parameters. The tests are divided into the following sections in this manual:

- Installation/Replacement tests—check the operational parameters of the DRU
- Transmit tests—check the transmit parameters of the DRU
- Receive tests—check the receive parameters of the TRU
- Power output test—checks the transmit power level of the MCPA at the duplexer
- Digital tests— the bit error rate loopback test checks that the transmit and receive paths of the TRU meet the specifications. A digital call through test checks that TDMA call processing is performed correctly.

  Note: The tests apply to both the TRU2 and TRU3 unless otherwise stated for the individual unit. Currently the TRU3 does not support AMPS operation and therefore performing the AMPS-related tests (for example, SAT/ST frequencies, TX/RX audio levels) are not required on the TRU3.

Due to the operating characteristics of the DRU being determined by software, very few tests are needed upon installation of a TRU or a MCPA into a TRU shelf or a MCPA shelf respectively.

Tests that can be performed on a DRU as operational checks are outlined in this chapter. These tests are not required upon installation, replacement, or on a periodic basis, but are outlined for troubleshooting purposes.

CAUTION
Some of the tests are service affecting at the cell/sector level. If you do need to perform these tests, schedule your work at a low traffic period to minimize service interruption to your customers.

Due to the tests affecting the ability to process calls, it is necessary to “busy out” and “off-line” the DRUs, from the MTX, before testing begins.

Whenever a test is performed on a DRU, record the test parameter. You should test only one DRU at a time. Unless specified elsewhere, testing should be carried out within the +15° C (+59° F) to +35° C (+95° F) temperature range.

Power and Ground Verification (Chapter 4), Master Oscillator Testing and (Chapter 5) may be required before conducting some DRU tests.

Test equipment required

Proper setup of the test equipment is critical in obtaining proper test results. Consistency of setup and techniques from one person to another is essential for obtaining proper system operation.

It is assumed that the operator is familiar with the test equipment used in the test procedures. The following test equipment is recommended for performing the tests. Any functionally equivalent unit may be used in its place. Double shielded coaxial cables are recommended for use between test equipment and the cell site equipment being tested.

> ***Note:*** Ensure that all test equipment is calibrated before use. Cable loss must be accounted for in the MCPA RF output power tests.

For a list of the required test equipment, refer to Chapter 3, *Test Equipment and Precautions,* in this manual.

This section describes the tests that can be performed on a DualMode Radio Unit (DRU). These tests can be used to verify the performance of a DRU but they are not required on a periodic basis.

> ***Note:*** The DRU, the ICRM and the test equipment should be powered up for at least half an hour before the tests. Inaccurate measurements may result if the warm-up period is less than 30 minutes.

A VT100 Video Display Terminal (or equivalent) is required to perform the tests. Refer to the Test Equipment section in Chapter 3, *Test Equipment and Precautions*, for setting up the parameters of the terminal. For a complete list of the Terminal Interface commands, refer to the Transmit Receive Unit section in Chapter 1, *Equipment operation*.

TRU self test

A built-in self test can be performed on a TRU (EEPROM CRC check for a TRU2 and a CRC check for a TRU3).

Use the following procedure to perform the self test:

1. Connect the interface terminal to the RS-232 port on the front panel of the TRU under test.

2. Place the TRU into the command line mode by pressing the “Break” key on the interface terminal. The terminal will display the following:
```
TRU Terminal Interface
©Copyright 1990,1991 Bell Northern Research, Inc.
>
```

3. To place the TRU into the fullscreen monitor mode, enter:

   >**SET LT OFF** (disables the LAPD timeout)

   >**SET FS ON** (invokes fullscreen display)

   This places the TRU into the fullscreen AMPS mode (refer to Figure 1-8).

TRU EEPROM CRC Check

4. Check the top right corner of the screen and verify that the EEPROM CRC Check has passed. The EEPROM CRC Check on the screen (refer to Figure 1-8 in Chapter 1, *Equipment operation*) will show:

   ```
   EEPROM CRC Check: PASSED
   ```

   Record the result. If the check fails, replace the TRU.

5. Disconnect the interface terminal from the TRU under test.

DRU configurations for analog tests

The Transmit Receive Unit (TRU) must be correctly configured for each test. This section covers the general test set-ups for the TRU.

Nominal Application Gain

In a DualMode 800 Enclosure, all TRUs are set to “**patype none**” mode during installation. In this mode, the nominal application gain is set to a default value of -12 dB and the TRU maximum transmit power is set to a default value of +15 dBm. Do not change these default settings during the tests.

With default settings in the “patype none” mode, the output of the TRU is set to [+15 - (-12)] = +27 dBm at the TRU backplane. Therefore, when checking the TRU output with the “query pastatus” command, please remember that the +15 dBm TRU output has been compansated for by the -12 dB norminal application gain to give an actual TRU output of +27 dBm at default.

TRU setup

All the DualMode Radio Unit (DRU) tests are performed through an interface terminal. Before performing any tests, connect an interface terminal to the RS-232 port on the front panel of the TRU. Place the TRU into the command line mode by pressing the “Break” key on the terminal. To place the TRU into the fullscreen analog (AMPS) mode, at the command line prompt (>), enter:

>**SET LT OFF** (disables the LAPD timeout)

>**SET PATYPE NONE** (configures TRU to the modulated mode for no per-carrier PA application)

>**SET FS ON** (invokes fullscreen display)

Check the configurations of the TRU from the interface terminal. For each individual test, change the specific configuration(s) as required. Table 11-1 shows the TRU configurations in the initial setup and in the individual tests. Status or values in bold indicate the change to that specific configuration during the tests. Refer to Table 1-2 in Chapter 1, *Equipment operation*, for a complete description of the fullscreen commands.

With reference to Table 11-1, verify that the DRU configurations are as listed in the initial setups from the interface terminal:

Carrier status
If the carrier (shown in the PA field on the screen) is on, turn it off by entering:
>**C**

The PA field on the screen should show:
```
PA: off
```

Compandor
If the Compandor is off, turn it on by entering:
>**K**

The Compandor field on the screen should show:
```
Compandor: on
```

SAT Transmit
If the SAT TX is on, turn it off by entering:
>**G**

The SAT TX field on the screen should show:
```
SAT TX: 6000 (off)
```

Table 11-1
DRU configurations for analog tests

	TRU Configurations						Receive Status		TRU Power Settings				TX/RX Audio	
	SAT TX	Tone Gen	Loop back	Compan-dor	Wide Band Data	Detect SAT, ST, RSSI	Antenna Path	Receive Ports	Power Index	Power Step	Max Power	Carrier On/Off	Audio Status	Audio Sens
Commands	**G**	**I**	**J**	**K**	**L**	**P**	**N**	**M**	**E**	**U**	**F**	**C**	**R**	**T**
TX Tests Initial Setup	*OFF*	*OFF*	*OFF*	*ON*	*OFF*	*OFF*	*A*	*1 4*	*0*	*4*	*15.0*	*OFF*	*OFF*	*-18.0*
TX Carrier Frequency	OFF	OFF	OFF	ON	OFF	OFF	A	1 4	0	4	15.0	**ON**	OFF	-18.0
Wideband Modulation	OFF	OFF	OFF	ON	**ON**	OFF	A	1 4	0	4	15.0	**ON**	OFF	-18.0
SAT Transmit	**ON**	OFF	OFF	ON	OFF	OFF	A	1 4	0	4	15.0	**ON**	OFF	-18.0
Residual Modulation	OFF	OFF	OFF	ON	OFF	OFF	A	1 4	0	4	15.0	**ON**	OFF	-18.0
TX Audio Level	OFF	OFF	OFF	ON	OFF	OFF	A	1 4	0	4	15.0	**ON**	**TX**	-18.0
Modulation Limiting	OFF	OFF	OFF	ON	OFF	OFF	A	1 4	0	4	15.0	**ON**	**TX**	-18.0
1 kHz Tone Gen	OFF	**RF**	OFF	ON	OFF	OFF	A	1 4	0	4	15.0	**ON**	OFF	-18.0
End of TX Tests	*OFF*	*OFF*	*OFF*	*ON*	*OFF*	*OFF*	*A*	*1 4*	*0*	*4*	*15.0*	*OFF*	*OFF*	*-18.0*
RX Tests Initial Setup	*OFF*	*OFF*	*OFF*	*ON*	*OFF*	*OFF*	*A*	*1 4*	*0*	*4*	*15.0*	*OFF*	*OFF*	*-18.0*
Receive Sensitivity	OFF	OFF	**RF**	ON	OFF	OFF	A	1 4	0	4	15.0	**ON**	OFF	-18.0
RX/TX Audio Sens	OFF	OFF	**RF**	ON	OFF	OFF	A	1 4	0	4	15.0	**ON**	**TX RX**	-18.0
RX Audio Level	OFF	OFF	OFF	ON	OFF	OFF	A	1 4	0	4	15.0	OFF	**TX RX**	-18.0
RSSI Detect	OFF	OFF	OFF	ON	OFF	**RSSI**	A	1 4	0	4	15.0	OFF	**RX**	-18.0
SAT Detect	OFF	OFF	OFF	ON	OFF	**SAT**	A	1 4	0	4	15.0	OFF	OFF	-18.0
ST Detect	OFF	OFF	OFF	ON	OFF	**ST**	A	1 4	0	4	15.0	OFF	OFF	-18.0
End of RX Tests	*OFF*	*OFF*	*OFF*	*ON*	*OFF*	*OFF*	*A*	*1 4*	*0*	*4*	*15.0*	*OFF*	*OFF*	*-18.0*
Power Test Initial Setup	*OFF*	*OFF*	*OFF*	*ON*	*OFF*	*OFF*	*A*	*1 4*	*0*	*4*	*15.0*	*OFF*	*OFF*	*-18.0*
TRU Power Output	OFF	OFF	OFF	ON	OFF	OFF	A	1 4	0	4	15.0	**ON**	OFF	-18.0
End of Power Test	*OFF*	*OFF*	*OFF*	*ON*	*OFF*	*OFF*	*A*	*1 4*	*0*	*4*	*15.0*	*OFF*	*OFF*	*-18.0*

Loopback
If the Loopback status is either BCH or RF, turn it off by entering:

```
>J
```

The TRU will request an antenna path choice (either BCH, RF or OFF). To turn the Loopback off, enter:

```
>OFF
```

The Loopback field on the screen should show:

```
Loopback: off
```

Tone Gen
If the Tone Generation status is either BCH or RF, turn it off by entering:

```
>I
```

The TRU will request an antenna path choice (either BCH, RF or OFF). To turn the Tone Gen off, enter:

```
>OFF
```

The Tone Gen field on the screen should show:

```
>Tone Gen: off
```

Antenna Path
If the Antenna Path status is not Path A, select Path A by entering:

```
>N
```

The TRU will request an antenna path choice (either A, B or DIV). To select Path A, enter:

```
>A
```

The Antenna Path field on the screen should show:

```
>Antenna Path: A
```

Antenna Port
If the Antenna Port status is not Ports 1 and 4, select Ports 1 and 4 by entering:

```
>M
```

The TRU will request the port numbers (enter a port number 1, 2 or 3 for antenna path A, and a port number 4, 5 or 6 for antenna path B). Enter the antenna ports as two numbers separated by a space (first number indicates antenna port in path A and second number indicates antenna port in path B):

```
>1 4
```

The Antenna Port field on the screen should show:

```
>Antenna Port A: 1 B: 4
```

Transmit Power Level Index
If the TxPwrIndex status is not 0, set it to 0 by entering:

```
>E
```

The TRU will request a specific power level (0..7). To set power level to 0, enter:

```
>0
```

The TxPwrIndex field on the screen should show:

```
TxPwrIndex: 0
```

Transmit Power Step Size
If the TxPwrStep status is not 4, set it to 4 by entering:

```
>U
```

The TRU will request a power step size (1..4 in 0.25 dB increments). To set power step size to 4, enter:

```
>4
```

The TxPwrStep field on the screen should show:

```
TxPwrStep: 4
```

Maximum Transmit Power
If the PA Max power status is not 15.0 dBm, set it to 15.0 dBm by entering:

```
>F
```

The TRU will request a power level (-1.0...27.0 in dBm). To set Max power to 15.0, enter:

```
>15.0
```

The MaxTxPwr field on the screen should show:

```
MaxTxPwr: 15.00
```

Audio Status
If the TX and RX audio status is either ‘TX’, ‘RX’ or ‘TX RX’, turn the audio off by entering:

```
>R
```

The DRU will request for either ‘TX’, ‘RX’, ‘BOTH’ or ‘OFF’. Enter:

```
>OFF
```

The Audio field on the screen should show:

```
Audio: off
```

TX Audio Sensitivity

If the TX Audio Sens status is not -18.0, and no other level has been specified, set the TX audio sensitivity to -18.0 dBm by entering:

```
>T
```

The DRU will respond as follows:

```
Enter TX or RX and a decimal dBm value (TX:-28...
-10);(RX:-28...-16)
```

Enter:

```
>TX -18.0
```

The Audio Sens TX status on the screen will show:

```
Audio Sens Tx: -18.0
```

RX Audio Sensitivity

If the RX Audio Sens status is not -18.0, and no other level has been specified, set the RX audio sensitivity to -18.0 dBm by entering:

```
>T
```

The DRU will respond as follows:

```
Enter TX or RX and a decimal dBm value (TX:-28...
-10);(RX:-28...-16)
```

Enter:

```
>RX -18.0
```

The Audio Sens RX status on the screen will show:

```
Audio Sens Rx: -18.0
```

DRU transmit tests

This section describes the transmit tests that can be performed on the DualMode Radio Unit (DRU). RF output power tests are described in the DRU RF output power test section.

Note: The tests can be performed separately but the DRU transmit test setup procedure must be performed before each individual test.

WARNING
RF radiation hazard
Do NOT disconnect any RF cables when transmitters are on.

Service impacts

Directly testing the TRU through the antenna port of the duplexer will put the entire cell/sector out of service.

Indirectly testing the TRU through the sniffer port of the duplexer will affect only the TRU under test. However, the measurement may not be as accurate because the level is approximately 50 dB down with a tolerance of up to ±5 dB.

Transmit test setup procedure

CAUTION
Service interruption
The service of the entire cell/sector of the TRU under test will be affected. Perform the tests during low traffic period.

1. At the MTX, busy and off-line the TRU under test and the TRUs connected to the same MCPA shelf.

   Note: The service supported by the MCPA shelf will be affected.

2. Connect the interface terminal to the RS-232 port on the front panel of the TRU under test. Verify that the DRU configurations for TX tests initial setup are as listed in Table 11-1.

   Note: Ensure that all the TRUs connected to the MCPA shelf are off.

3. Connect the receive input of the communications monitor to the antenna port of the duplexer. Use a low loss double shielded cable, RG-214 or equivalent. Figure 11-4 shows the connection setup for the transmit tests.

   Note: If you do not want to interrupt service, connect to the sniffer port on the duplexer instead. The level is approximately 50 dB down with a tolerance of up to ±5 dB.

4. From the terminal, select the channel assigned to the TRU under test by using the B command.

   >B

   The TRU will request a channel number. Enter the channel number for the frequency assigned to the TRU under test (1...799 or 990...1023). Refer to Appendix A for the channel-to-frequency conversion information.

   >xxxx

   On a successful channel change, the Channel and Synth Lock fields will be updated:

   `Channel: xxxx` (DRU channel number indicated)
   `Synth Lock: YES` (Sync Lock changes to 'YES')

5. On the communications monitor, set the transmit RF frequency to the frequency corresponding to that of the TRU under test.

6. Turn on the TRU (the transmit carrier) with the C command.

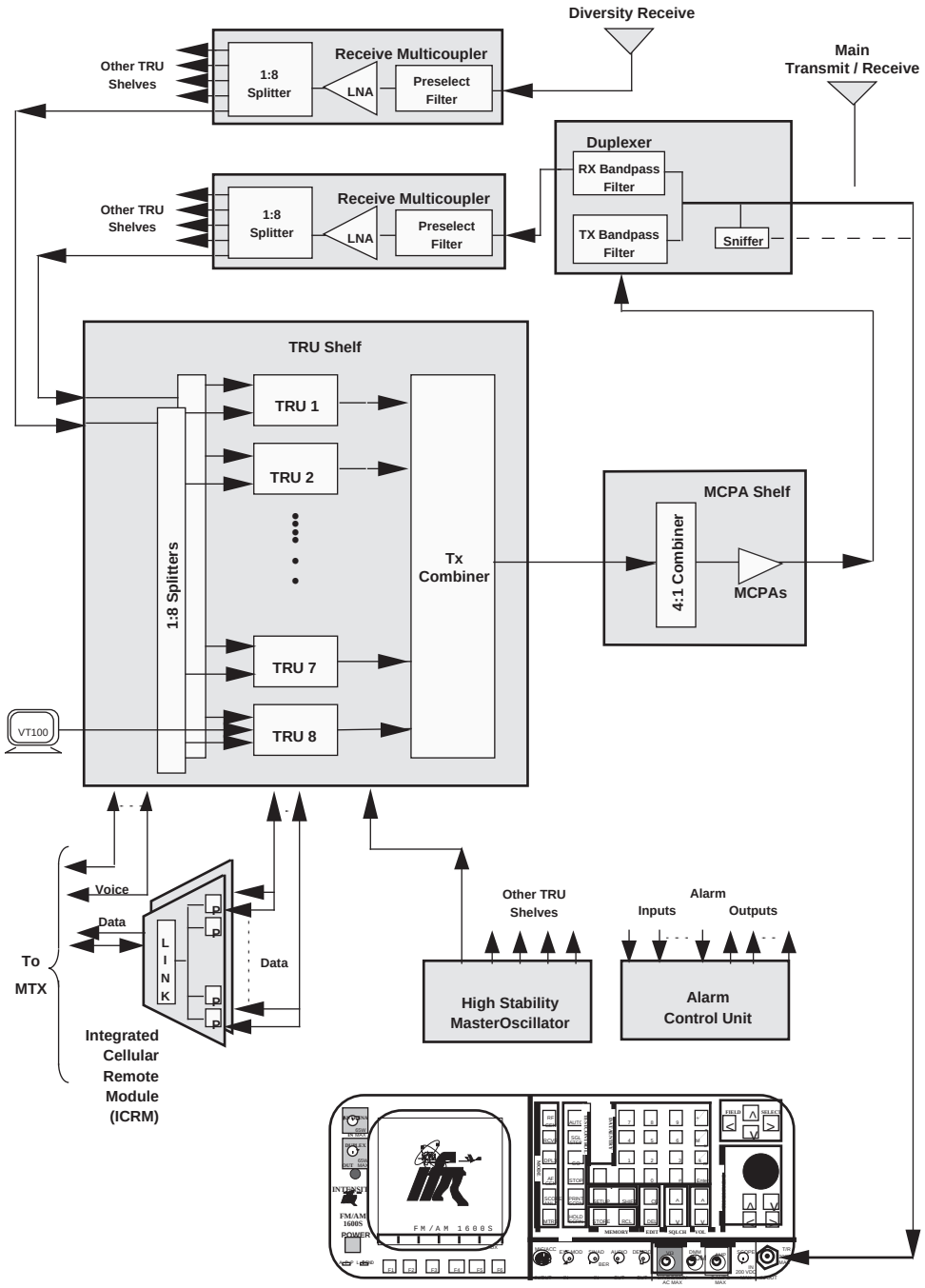
   >C

   The PA status on the screen will change to:

   `PA: on`

7. Proceed with the transmit tests.

Figure 11-4
DRU transmit tests setup (service affecting)



Communications Monitor (IFR 1600)

Transmit Carrier Frequency test

This test ensures that the TRU is transmitting at the assigned frequency.

Step	Action	Observation
1	Ensure that the TRU configurations are as listed in Table 11-1 for the Transmit Carrier Frequency test.	
2	Check the transmit carrier frequency on the communications monitor. **The frequency error (FREQ ERR) is also shown on some communications monitors.**	±220 Hz of the assigned frequency.
3	Record the assigned frequency (in MHz) and the frequency error (in Hz) on the test forms.	

Wideband Modulation test

This test ensures that the transmit carrier deviation of the TRU is within specifications when the TRU is transmitting wideband data.

Step	Action	Observation
1	Ensure that the TRU configurations are as listed in Table 11-1 for the Wideband Modulation test.	

2	From the interface terminal, use the L command to select Wideband Data.
	>**L**
		TRU begins to transmit wide band data and the screen shows:
		`continuing Wideband Data TX..`
		`(press return to quit)`

3	Check the carrier frequency deviation as displayed on DEV (deviation) meter.	Deviation between 7.2 kHz and 8.8 kHz.
4	Record the deviation on the test forms.	
5	Press the “Return” key to stop the wideband data transmission.	TRU stops transmitting wide band data and the screen shows: `Wideband data is off`

SAT Frequency and Deviation tests

Supervisory Audio Tones (SAT) are used for out-of-band signaling. This test ensures that the SAT frequency and deviation transmitted by the TRU are within specifications.

Step	Action	Observation
1	Ensure that the TRU configurations are as listed in Table 11-1 for the SAT Transmit test.	
2	From the interface terminal, use the G command to turn on the SAT. >**G**	The screen shows: `SAT TX: 6000 (on)`
3	Check the SAT frequency as displayed on the AF (frequency) meter.	SAT frequency should be 6000 Hz ±5 Hz.
4	Check the SAT carrier frequency deviation as displayed on the deviation (DEV) meter.	Deviation between 1.8 kHz and 2.2 kHz.
5	Record the frequency and the deviation on the test forms.	
6	Use the H command to input a different SAT frequency. >**H**	The terminal will prompt with: `Enter a SAT frequency (5970, 6000, or 6030)`
7	Select 5970 Hz SAT frequency by entering: >**5970**	The screen shows: `SAT TX: 5970 (on)`
8	Repeat steps 3 to 5 for the 5970 Hz SAT frequency and deviation tests.	SAT frequency: 5970 Hz ±5 Hz Deviation between 1.8 kHz and 2.2 kHz.
9	Repeat steps 6 to 8 for the 6030 Hz SAT frequency and deviation tests by selecting 6030 Hz SAT frequency.	SAT frequency: 6030 Hz ±5 Hz Deviation between 1.8 kHz and 2.2 kHz.
10	Use the G command to turn off the SAT. >**G**	The screen shows: `SAT TX: 6030 (off)`

Residual Modulation test

This test ensures that the transmit carrier deviation of the TRU is within specifications when the transmit audio of the TRU is muted.

Step	Action	Observation
1	Ensure that the TRU configurations are as listed in Table 11-1 for the Residual Modulation test.	
2	Check the carrier frequency deviation as displayed on the DEV meter.	Deviation between -0.5 kHz and +0.5 kHz.
3	Record the deviation on the test forms.	

Transmit Audio Level test

This test ensures that the transmit carrier deviation of the TRU meets the audio level specifications during a subscriber conversation in the AMPS mode.

The AMPS mode of the TRU is currently set to a default value of -18 dBm0, corresponding to ±2.9 kHz deviation, which is compliant to IS-138 Standards.

Step	Action	Observation
1	Ensure that the TRU configurations are as listed in Table 11-1 for the Transmit Audio Level test. ***Note:*** Loopback and SAT TX must be set to off in this test. Use the J and the G commands to set Loopback and SAT TX to off, if necessary.	The desired trunk should still be posted as in the Tx Audio Level Test step 4.
2	From the interface terminal, use the R command to turn on (unmute) the TX audio. >**R**	The terminal will prompt for audio path: `Enter TX, RX, BOTH or OFF`
3	Enter the option “TX”: >**TX**	The Audio status on the screen shows: `Audio: TX`
- continued -		

Step	Action	Observation
4	This step is performed at the MTX. From the MAP position or with a second terminal logged into the switch, test the trunk that is assigned to the TRU being tested by entering: **`MAPCI;MTC;TRKS;TTP;POST`** (CLLI name) (Trunk member number)**`;TGEN 1004 -180`**	MAP Trunk Test Position is displayed. The MAP screen will indicate the trunk member selected and that the trunk is selected. It will also indicate the tone generated and the level of the tone.
5	Check the carrier frequency deviation as displayed on the DEV meter.	Deviation between 2.61 kHz and 3.19 kHz.
6	Record the deviation on the test forms.	
7	If the deviation is different from the site specific Forward audio level setting, repeat this test after all the transmit tests have been completed. Set the deviation to the specific operational level with the T command from the interface terminal.	The transmit audio level is shown on the terminal screen as: `Audio Sens Tx: -18.0` (change this level as required—a change of 1 dBm is approximately a change of 0.27 kHz in deviation)
8	From the interface terminal, use the R command to turn off (mute) the TX audio. >**R**	The terminal will prompt for audio path: `Enter TX, RX, BOTH or OFF`
9	Enter the option “OFF”: >**OFF**	The audio status on the screen shows: `Audio: off`
- End -		

Modulation Limiting test

Modulation Limiting is the ability of the transmitter to effectively operate within the system deviation limits. This test ensures that the transmit carrier deviation of the TRU meets the system specifications.

Step	Action	Observation
1	Ensure that the TRU configurations are as listed in Table 11-1 for the Modulation Limiting test. ***Note:*** Loopback and SAT TX must be set to off in this test. Use the J and the G commands to set Loopback and SAT TX to off, if necessary.	
2	From the interface terminal, use the R command to turn on (unmute) the TX audio. >**R**	The terminal will prompt for audio path: `Enter TX, RX, BOTH or OFF`
3	Enter the option “TX”: >**TX**	The Audio status on the screen shows: `Audio: TX`
4	This step is performed at the MTX. Using the TGEN command at the MAP position terminal, change the output level and observe the Carrier Frequency Deviation for each of the levels listed. **TGEN 1004 -100.....** **TGEN 1004 -50.....** **TGEN 1004 0.....** **TGEN 1004 10.....** **TGEN 1004 20.....** **TGEN 1004 30.....** **TGEN 1004 50.....**	The Carrier Frequency Deviation will increase to a maximum value at a certain tone level and then the deviation value will decrease. However, the maximum value must be less than 12.0 kHz at all tone levels.
5	Check the maximum carrier frequency deviation as displayed on the DEV meter.	Deviation must be less than 12.0 kHz at all levels.
6	Record the maximum deviation obtained on the test forms.	
7	On the MAP position terminal, enter: >**RLS**	The MAP screen will indicate that the trunk is released and returns to its original state.
8	From the interface terminal, use the R command to turn off (mute) the TX audio. >**R**	The terminal will prompt for audio path: `Enter TX, RX, BOTH or OFF`
9	Enter the option “OFF”: >**OFF**	The Audio status on the screen shows: `Audio: off`

1 kHz Tone Generation test

This test ensures that the frequency and deviation of the 1 kHz test tone generated by the TRU are within specifications.

Step	Action	Observation
1	Ensure that the TRU configurations are as listed in Table 11-1 for the 1 kHz Tone Gen test.	
2	From the interface terminal, use the I command to generate an on-channel 1 kHz tone at 8 kHz deviation. >**I**	The TRU will prompt for the antenna path choice: `Enter BCH, RF, or OFF`
3	Enter the RF option to test the tone on the RF side of the TRU. >**RF**	The Tone Generation status on the screen shows: `Tone Gen: RF`
4	Check the 1 kHz Tone Gen frequency as displayed on the AF meter.	The frequency should be 1000 Hz ±1 Hz.
5	Check the carrier frequency deviation as displayed on the DEV meter.	Deviation between 7.2 kHz and 8.8 kHz.
6	Record the frequency and the deviation on the test forms.	
7	Use the I command to turn off the on-channel 1 kHz tone at 8 kHz deviation. >**I**	The TRU will prompt for the antenna path choice: `Enter BCH, RF, or OFF`
8	Enter the “OFF” option to turn off the tone on the RF side of the TRU. >**OFF**	The Tone Generation status on the screen shows: `Tone Gen: OFF`

Setting TX audio deviation to site operational level

After the transmit tests, ensure that the deviation level recorded in the Transmit Audio Level test is the same as the site specific operational level. If the levels are different, perform the Transmit Audio Level test and change the level to the site specific operational level by using the T command.

Set the TX audio sensitivity with the T command.

>**T**

The TRU will prompt as follows:

```
Enter TX or RX and a decimal dBm value (TX:-28...
-10);(RX:-28...-16)
```

Enter:

>**TX -xx.x** (change this value as required to obtain the operational transmit audio level)

Note: A change of 1 dBm is approximately a change of 0.27 kHz deviation.

The Audio Sens TX status on the screen will show:

`Audio Sens Tx: -xx.x` (site specific operational level)

Use the C command to turn off the carrier of the TRU.

>**C**

The PA (TRU transmitter) status on the screen will show:

```
PA: off
```

Use the Y command to perform a reset on the TRU after the tests.

>**Y**

At the command prompt, perform a warm reset on the TRU by entering:

>**W**

The TRU will return to its normal working condition after the reset. Disconnect the interface terminal from the TRU.

At the MTX, put the TRU back to service.

DRU receive tests

This section describes the receive tests that can be performed on the DualMode Radio Unit (DRU).

Note: The tests can be performed separately but the DRU receive test setup procedure must be performed before each individual test.

WARNING
RF radiation hazard
Do NOT disconnect any RF cables when transmitters are on.

Service impacts

The receive tests cause a reduction in the receive performance of the shelf containing the radio under test because of the loss of receive diversity.

The TRU transmit tests must be performed before the receive tests to verify the TRU's transmit path. This is because the TRU uses an RF loopback to access the base-band receive signal. Failure to verify the TRU transmit path may result in invalid test data.

Receive test setup procedure

CAUTION
Service interruption
The service of the shelf housing the TRU under test will be affected. Perform the tests during low traffic period.

1. At the MTX, busy and off-line the TRU under test.
2. Connect the interface terminal to the RS-232 port on the front panel of the TRU under test. Verify that the TRU configurations for RX tests initial setup are as listed in Table 11-1.
3. Connect the transmit output of the communications monitor to the antenna input connector on the back of the TRU shelf for the antenna under test. Connect the receive input of the communications monitor to the sniffer port of the duplexer for the TRU under test. Use low loss double shielded cables, RG-214 or equivalent. Figure 11-5 shows the setup for the receive tests.
4. From the terminal, select the channel assigned to the DRU under test by using the B command.

   >B

The DRU will request a channel number. Enter the channel number for the frequency assigned to the DRU under test (1...799 or 990...1023). Refer to Appendix A for the channel-to-frequency conversion information.

```
>xxxx
```

On a successful channel change, the Channel and Synth Lock fields will be updated:

`Channel: xxxx` (DRU channel number indicated)
`Synth Lock: YES` (Sync Lock changes to 'YES')

5. On the communications monitor, set the receiver RF frequency to the frequency corresponding to that of the DRU under test. For an IFR 1600, by selecting the transmitter frequency, the receiver frequency will automatically be set.
6. Proceed with the receive tests.

After performing a receive test on the A path of the receiver, perform the test again on the B path. From the terminal, use the N command to change the Antenna Path to 'B' and use the M command to select antenna port 4 for the new receive path.

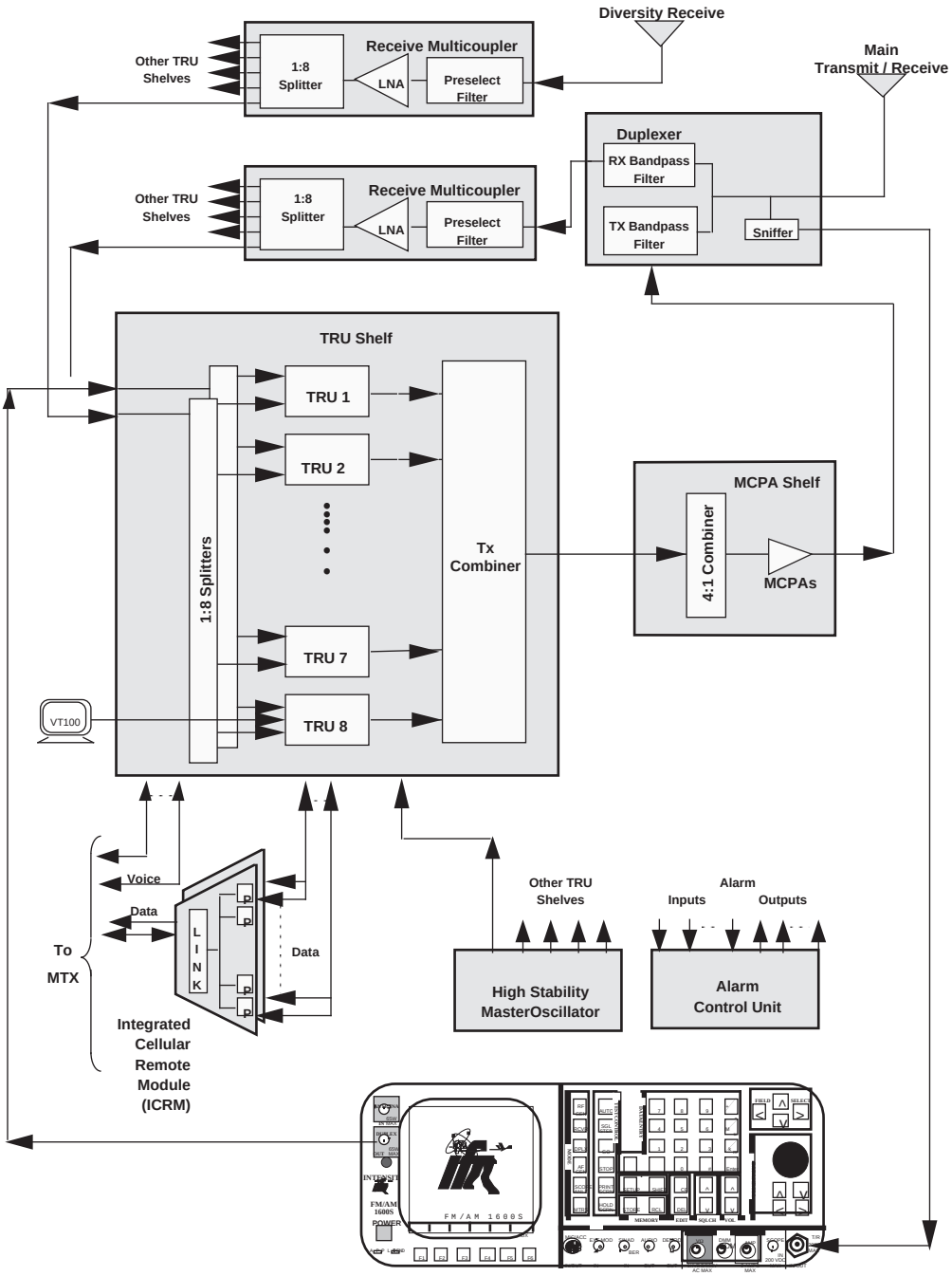
Note: Change the connection to the antenna input port 4 accordingly.

For sectored sites, perform also the following:

1. Use the N command to change the Antenna Path to 'A' and use the M command to change the antenna ports to 2 and 5. Perform the receive tests.
2. Use the N command to change the Antenna Path to 'B' and ensure that the antenna ports are still 2 and 5. Perform the receive tests.
3. Use the N command to change the Antenna Path to 'A' and use the M command to change the antenna ports to 3 and 6. Perform the receive tests.
4. Use the N command to change the Antenna Path to 'B' and ensure that the antenna ports are still 3 and 6. Perform the receive tests.

   Note: Change the connection to the antenna input ports accordingly.

Figure 11-5
DRU receive tests setup (shelf/site service affecting)



Communications Monitor (IFR 1600)

Receive sensitivity test

The usable sensitivity of a receiver is the minimum level of a standard RF signal required to produce 12 dB SINAD, C-message weighted. This test ensures that the DRU meets the minimum requirement of receive sensitivity.

Step	Action	Observation
1	Ensure that the DRU configurations are as listed in Table 11-1 for the Receive Sensitivity test. ***Note:*** SAT TX must be set to off in this test. Use the G command to set SAT TX to off, if necessary.	
2	Use the J command to turn RF loopback on. Use the R command to unmute TX RX audio. Use the C command to turn PA carrier on.	Loopback field shows: RF Audio status field shows: TX RX PA status field shows: ON
3	Select the SINAD meter on the communications monitor.	
4	Using the communications monitor, apply a -50 dBm on-channel RF signal modulated with a 1 kHz tone at ±8 kHz deviation to the DRU under test.	The SINAD reading should be much greater than 12 dB.
5	Reduce the level of the RF signal until a 12 dB SINAD (C-message weighted) is indicated on the SINAD meter. Check the RF signal level on the communications monitor.	The RF signal level must be: less than -105 dBm
6	Record the RF signal level on the test forms.	

Receive and transmit audio line sensitivity test

This test ensures that both the receive audio signal level and the transmit audio signal level of the DRU meet the required specifications in the AMPS mode.

Step	Action	Observation
1	Ensure that the DRU configurations are as listed in Table 11-1 for the Receive and Transmit Audio Line Sensitivity test. ***Note:*** SAT TX must be set to off in this test. Use the G command to set SAT TX to off, if necessary.	
2	Use the J command to turn RF loopback on. Use the R command to unmute TX RX audio. Use the C command to turn PA carrier on.	Loopback field shows: `RF` Audio status field shows: `TX RX` PA status field shows: `ON`
3	Using the communications monitor, apply a -60 dBm on-channel RF signal modulated with a 1 kHz tone at ±2.9 kHz deviation to the DRU under test.	
4	Check the frequency deviation on the transmit side of the DRU under test.	The deviation must be: between 2.60 kHz and 3.20 kHz.
5	Record the deviation on the test forms.	

Receive audio level test

This test ensures that the receive audio level of the DRU is compatible with the Mobile Telephone Exchange (MTX) network in the AMPS mode. The AMPS mode of the DRU is currently set to a default value of -18 dBm0, corresponding to ±2.9 kHz deviation.

Step	Action	Observation
1	Ensure that the DRU configurations are as listed in Table 11-1 for the RX Audio Level test.	
2	Use the C command to turn PA carrier off. Use the J command to turn RF loopback off.	PA status field shows: `OFF` Loopback field shows: `OFF`
3	Use the R command to turn on the RX audio. `>`**`R`**	The DRU will prompt for the audio path: `Enter TX, RX, BOTH, or OFF`
- continued -		

Step	Action	Observation
4	Enter the “RX” option to turn on the RX audio. >**RX**	The Audio status on the screen shows: `Audio: RX`
5	Using the communications monitor, apply a -60 dBm on-channel RF signal modulated with a 1 kHz tone at ±2.9 kHz deviation to the DRU under test.	
6	This step is performed at the MTX. From the MAP position or with a second terminal logged into the switch the trunk that is assigned to the DRU being tested, enter: **MAPCI;MTC;TRKS;TTP;POST** (CLLI name) (Trunk member number)**;LOSS**	 MAP Trunk Test Position is displayed. The MAP screen will indicate the trunk member selected and that the trunk is seized. It will also indicate the tone received and the level of the tone.
7	Check the level received at the switch as displayed on the MAP position terminal.	Level must be: between -17.0 dBm and -19.0 dBm.
8	Record the audio level on the test forms.	
9	If the level is different from the site specific Reverse audio level setting, repeat this test after all the receive tests have been completed. Set the level to the specific operational level with the T command from the interface terminal.	The receive audio level is shown on the terminal screen as: `Audio Sens Rx: -18.0` (change this level as required—a change of 1 dBm is approximately a change of 0.27 kHz in deviation)
10	Use the R command to turn off the RX audio. >**R**	The DRU will prompt for the audio path:? `Enter TX, RX, BOTH, or OFF`
11	Enter the “OFF” option to turn off the RX audio. >**OFF**	The Audio status on the screen shows: `Audio: off`
- End -		

RSSI test

The RSSI (Receive Signal Strength Intensity) is the RF signal strength used by the DRU for signal monitoring. This test ensures that the RSSI characteristics of the DRU under test are within specifications. Due to the transceiver splitter and shelf cable losses, the RSSI reading is 11 dB lower than the test signal applied.

Step	Action	Observation
1	Ensure that the DRU configurations are as listed in Table 11-1 for the RSSI detect test.	
2	Using the communications monitor, apply a -60 dBm on-channel RF signal to the DRU under test.	
3	Use the P command to measure the RSSI signal reading. >**P**	The DRU will prompt for the measurement to query: `Enter R, SAT, ST, or A`
4	Enter the “R” option to query the RSSI measurement. >**R**	RSSI measurement is displayed and the output message will show: `continuing Query..(hit return to exit)`
5	Check the RSSI measurement displayed on the terminal screen and record it on the test forms.	Requirement as shown in Table 11-2.
6	On the communications monitor, change the RF signal input level as shown in Table 11-2 and record the RSSI measurement on the test forms.	Requirement as shown in Table 11-2.

Table 11-2
RSSI characteristics

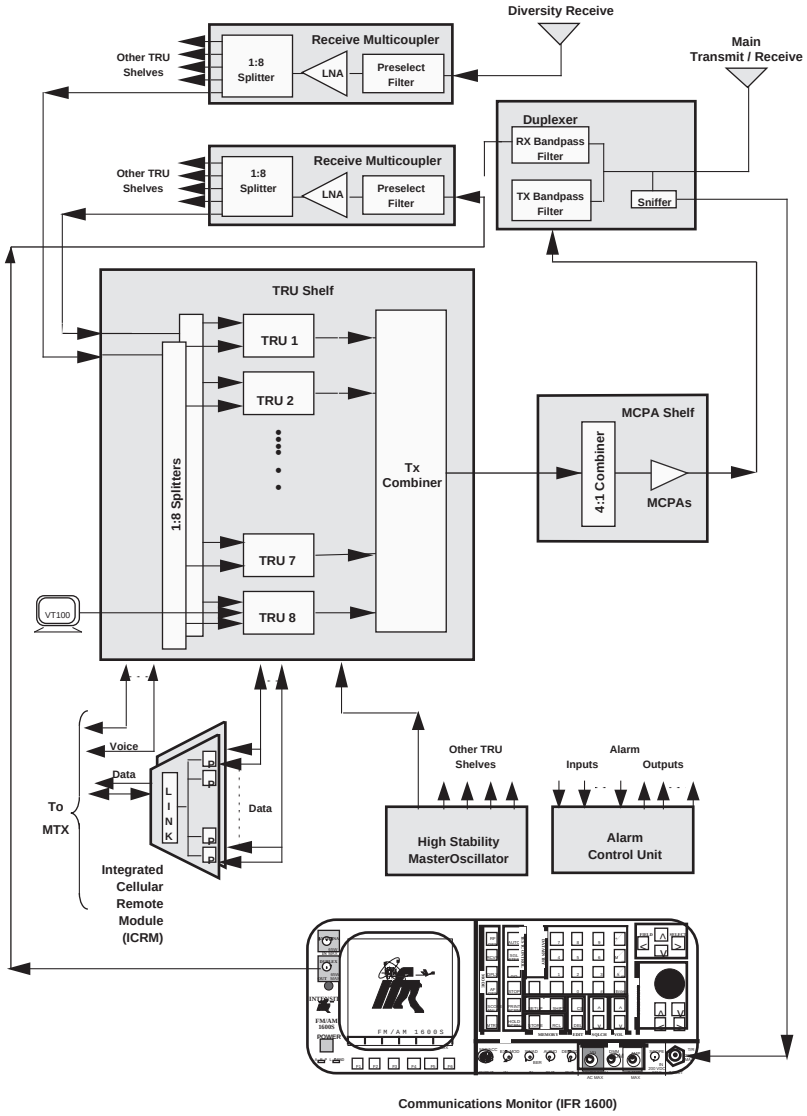
RSSI field specification: Nominal value ±5 dB.

RF signal input (in dBm)	RSSI measurement (in dBm)		
	Maximum	Nominal	Minimum
-60.0	-66.0	-71.0	-76.0
-70.0	-76.0	-81.0	-86.0
-80.0	-86.0	-91.0	-96.0
-84.0	-90.0	-95.0	-100.0
-90.0	-96.0	-101.0	-106.0
-100.0	-106.0	-111.0	-116.0

RSSI offset calibration

The RSSI offset compensates for the overall receive path gain as measured from the Receive Multicoupler (RMC) input to the TRU input. It compensates for the cell site characteristics, such as the RMC and the receive path cabling. Figure 11-6 shows the setup for the RSSI offset calibration.

Figure 11-6
RSSI offset setup



Note: IFR 1600 or any equivalent communications monitor can be used.

Step	Action	Observation
1	Put the DRU under test out of service at the MTX.	
2	Connect a low loss RF cable from the IFR output Duplex 65W Max jack to the RMC input port A.	The RF cable loss should be known and will be used for calculation later.
3	Connect the interface terminal to the RS-232 port on the front panel of the TRU under test.	
4	Place the transceiver in Debug mode by pressing the BREAK key.	
5	On the Debug terminal type "**SET FS ON**" and type press the <RETURN> key. If the command is not issued right-a-way then the BREAK key may have to be typed again.	
6	From the terminal, select the channel assigned to the DRU under test by using the B command. >**B** <return> Enter the channel number >**XXXX**	The DRU will request a channel number (1…799 or 991…1023) On a successful channel change, the `Channel` and `Synth Lock` fields will be updated: `Channel: xxxx` (DRU channel number indicated) `Synth Lock: YES` (Sync Lock changes to 'YES')
7	Ensure that the DRU configurations are as listed in Table 11-3 for the RSSI characteristics test.	
8	On the communications monitor, set the receiver RF frequency to the frequency corresponding to that of the TRU under test.	For an IFR 1600, by selecting the transmitter frequency, the receiver frequency will automatically be set.
9	Using the communications monitor, apply a -60 dBm on-channel RF signal modulated with a 1kHz tone at ±2.9 kHz deviation to the DRU under test.	
10	Use the P command to measure the RSSI signal reading. >**P** <return>	The DRU will prompt for the measurement to query: `Enter R, SAT, ST, or A`
- continued -		

Step	Action	Observation
11	Enter the “R” option to query the RSSI measurement. >**R** <return>	RSSI measurement is displayed and the output message will show: `continuing Query..(hit return to exit)`

12	Check the RSSI measurement displayed on the terminal screen and record it.	`RX RSSI : - 57.0`
		`RX SAT : N`
		`RX ST : N`

13	Use the O command to enter the value of dB1= (input level - measured RSSI reading - RF cable loss value) as the RSSI offset for path A, antenna 1. >**O** <return> >**A dB1 0 0** The RSSI offset should be kept to ±5 dB to keep RSSI values between -130 dBm and -30 dBm.	Example: Input level: -60dBm Measured RSSI value: -57dBm Typical RF cable loss: 1dB then dB1 = -60 - (-57) - 1 = - 4dB Enter path (A or B) and three separate dB values (± 0…100).
14	On the communications monitor, change the RF signal level as shown in Table 11-4 and record the RSSI measurement from the Debug terminal.	Requirement as shown in Table 11-4
15	Change the Antenna path with the N command to path ‘B’ from the Debug terminal. >**N** <return>	The DRU will request an antenna path choice. Enter path (A,B, or DIV).
16	Enter the antenna path >**B** <return> Change the connection to the RMC input port B accordingly.	Current Receiver path: B
17	Repeat step 7 to step 12 for the new antenna path.	
- continued -		

Step	Action	Observation
18	Use the O command to enter the value of dB4 = (input level - measured RSSI reading - RF cable loss value) as the RSSI offset for path B, antenna 4. >**O** <return> >**B dB4 0 0**	`Antenna Port 1 2 3 4 5 6` `RSSI offset dB1 0 0 dB4 0 0`
19	For sectored sites only, perform the remaining portion of this procedure. OMNI cells will only have two antennas and need not perform the following steps in this procedure.	
20	Change the Antenna path with the N command to path 'A' from the Debug terminal. >**N** <return>	The DRU will request an antenna path choice. Enter path (A,B, or DIV).
21	Enter the antenna path. >**A** <return>	Current Receiver path: A
22	Change the antenna ports to 2 and 5 with the M command from the Debug terminal. >**M** <return>	The DRU will request the port numbers. Enter a path A port number (1|2|3) and a path B port number (4|5|6).
23	Enter the antenna ports as two numbers separated by a space >**2 5** <return>	
24	Repeat step 9 to step 18 for all radios being tested. Change the connection to the RMC input port accordingly.	When using the O command to enter the RSSI offset for path A, antenna port 2 and path B, antenna port 5, make sure to re-enter the RSSI offset for path A, antenna port 1 (dB1) and for path B, antenna port 4 (dB4). For example: >**O** >**A DB1 DB2 0** where DB2 = RSSI offset for port 2 and DB1 = previous value set for port 1. >**O** >**B DB4 DB5 0** where DB5 = RSSI offset for port 5 and DB4 = previous value set for port 4.
- continued -		

Step	Action	Observation
25	Change the Antenna path with the N command to path 'A' from the Debug terminal. >**N** <return>	The DRU will request an antenna path choice. Enter path (A,B, or DIV).
26	Enter the antenna path. >**A** <return>	Current Receiver path: A
27	Change the antenna ports to 2 and 5 with the M command from the Debug terminal. >**M** <return>	The DRU will request the port numbers. Enter a path A port number (1|2|3) and a path B port number (4|5|6).
28	Enter the antenna ports as two numbers separated by a space. >**3 6** <return>	
29	Repeat step 9 to step 18 for all radios being tested. Change the connection to the RMC input port accordingly.	When using the O command to enter the RSSI offset for path A, antenna port 3 and path B, antenna port 6, make sure to re-enter the RSSI offset for path A, antenna ports 1, 2 (dB1 and dB2) and for path B, antenna ports 4, 5 (dB4 and dB5). For example: >**O** >**A DB1 DB2 DB3** where DB3 = RSSI offset for port 3, DB2 = previous value set for port 2, and DB1 = previous value set for port 1. >**O** >**B DB4 DB5 DB6** where DB6 = RSSI offset for port 6, DB5 = previous value set for port 5, and DB4 = previous value set for port 4.
- End -		

Table 11-3 shows the DRU configuration for RSSI characteristics and Table 11-4 shows the RSSI measurement characteristics.

Table 11-3
DRU configuration for RSSI characteristics

	TRU Configurations						TX/RX Audio	
	SAT TX	Tone Gen	Loop back	Compander	WideBand Data	Detect RSSI	Audio Status	Audio Sens
Command	G	I	J	K	L	P	R	T
RSSI detect	OFF	OFF	OFF	ON	OFF	RSSI	OFF	-18.0

Table 11-4
RSSI measurement characteristics

RF signal input (in dBm)	RSSI measurement (in dBm)		
	Maximum	**Nominal**	**Minimum**
-60	-57	-60	-63
-70	-67	-70	-73
-80	-77	-80	-83
-84	-81	-84	-87
-90	-87	-90	-93
-100	-97	-100	-103

RSSI field specification: Nominal value ±3 dB

SAT detect test

This test ensures that the DRU meets the minimum requirement of detecting a Supervisory Audio Tone signal.

Step	Action	Observation
1	Ensure that the DRU configurations are as listed in Table 11-1 for the SAT detect test.	
2	Use the P command to query the SAT signal. >**P**	The DRU will prompt for the signal to query: `Enter R, SAT, ST, or A`
3	Enter the "SAT" option to query the SAT signal. >**SAT**	The RX SAT status shows: `N` The output message shows: `continuing Query..(hit return to exit)`
4	Using the communications monitor, apply a -90 dBm on-channel RF signal modulated with a 5970 Hz tone at ±1.8 kHz deviation to the DRU under test.	The RX SAT status on the screen should show: `RX SAT: 0`
5	Reduce the level of the RF signal until a "N" is indicated at the RX SAT status on the screen.	The RX SAT status on the screen shows: `RX SAT: N`
6	Check the RF signal level on the communications monitor.	The RF signal level must be: less than -105 dBm
7	Record the RF signal level on the test forms.	
8	Using the communications monitor, apply a -90 dBm on-channel RF signal modulated with a 6000 Hz tone at ±1.8 kHz deviation to the DRU under test.	The RX SAT status on the screen should show: `RX SAT: 1`
9	Reduce the level of the RF signal until a "N" is indicated at the RX SAT status on the screen.	The RX SAT status on the screen shows: `RX SAT: N`
10	Check the RF signal level on the communications monitor.	The RF signal level must be: less than -105 dBm
11	Record the RF signal level on the test forms.	
12	Using the communications monitor, apply a -90 dBm on-channel RF signal modulated with a 6030 Hz tone at ±1.8 kHz deviation to the DRU under test.	The RX SAT status on the screen should show: `RX SAT: 2`
- continued -		

Step	Action	Observation
13	Reduce the level of the RF signal until a “N” is indicated at the RX SAT status on the screen.	The RX SAT status on the screen shows: `RX SAT: N`
14	Check the RF signal level on the communications monitor.	The RF signal level must be: less than -105 dBm
15	Record the RF signal level on the test forms.	
- End -		

ST detect test

This test ensures that the DRU meets the minimum requirement of detecting a Signaling Tone signal.

Step	Action	Observation
1	Ensure that the DRU configurations are as listed in Table 11-1 for the ST detect test.	
2	Use the P command to query the ST signal. >**P**	The DRU will prompt for the signal to query: `Enter R, SAT, ST, or A`
3	Enter the “ST” option to query the ST signal. >**ST**	The RX ST status shows: `N` The output message shows: `continuing Query..(hit return to exit)`
4	Using the communications monitor, apply a -90 dBm on-channel RF signal modulated with a 10 kHz tone at ±7.2 kHz deviation to the DRU under test.	The RX ST status on the screen should show: `RX ST: Y`
5	Reduce the level of the RF signal until a “N” is indicated at the RX ST status on the terminal screen.	The RX ST status on the screen shows: `RX ST: N`
6	Check the RF signal level on the communications monitor.	The RF signal level must be: less than -105 dBm
7	Record the RF signal level on the test forms.	
8	Press the “Return” key from the terminal to discontinue the measurement.	The output message will show: `Query Status is OFF`

Setting RX audio level to site operational level

After the receive tests, ensure that the audio level recorded in the Receive Audio Level test is the same as the site specific operational level. If the two levels are different, perform the Receive Audio Level test and change the receive audio level to the site specific operational level by using the T command.

Set the RX audio sensitivity with the T command.

>**T**

The DRU will prompt as follows:

```
Enter TX or RX and a decimal dBm value (TX:-28...
-10);(RX:-28...-16)
```

Enter:

>**RX -xx.x** (change this value as required to obtain the operational receive audio level)

Note: A change of 1 dBm is approximately a change of -0.27 kHz deviation.

The Audio Sens RX status on the screen will show:

`Audio Sens Rx: -xx.x` (site specific operational level)

Use the Y command to perform a reset on the DRU after the tests.

>**Y**

At the command prompt, perform a warm reset on the DRU by entering:

>**W**

The DRU will return to its normal working condition after the reset. Disconnect the interface terminal from the DRU.

At the MTX, put the DRU back to service.

Transmit RF output power test

This test measures the power output of the TRU, the MCPA and the transmit path insertion loss. Since it interrupts service for the shelf and potentially (depending on system configuration) the whole site, it should be used only when a problem is suspected and then only during a low traffic period.

WARNING
RF radiation hazard
Do NOT disconnect any RF cables when transmitters are on.

CAUTION
Service interruption
The service of the shelf/site under test will be affected. Perform the tests during low traffic period.

This section describes the Transmit RF output power test that can be performed on the DualMode Radio Unit (DRU). The Transmit RF output power test setup procedure must be performed before the test.

Transmit RF output power test setup procedure

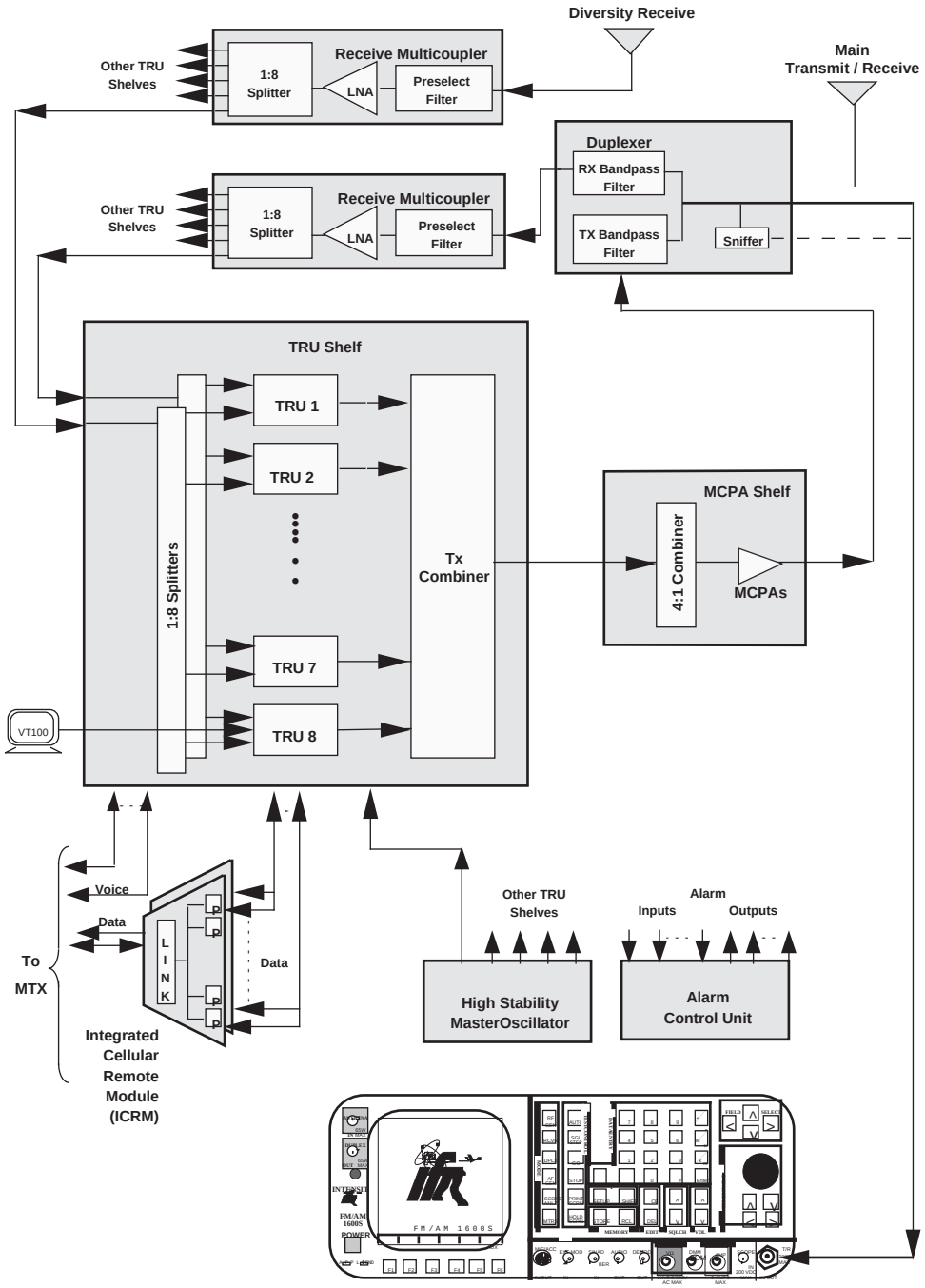
1. At the MTX, busy and off-line the TRU under test.
2. Connect the interface terminal to the RS-232 port on the front panel of the TRU under test. Verify that the DRU configurations for TRU power test initial setup are as listed in Table 11-1.

   Note: Ensure that the TRU transmitter is off.

3. Connect the receive input of the communications monitor to the antenna port of the duplexer. Use a low loss double shielded cable, RG-214 or equivalent. Figure 11-7 shows the connection setup for the RF output power test.

   Note: If you do not want to interrupt service, connect to the monitor port of the duplexer instead. The measurement may not be as accurate because the level is approximately 50 dB down with a tolerance of up to ±5 dB.

Figure 11-7
Transmit RF output power test setup



Communications Monitor (IFR 1600)

4. From the terminal, select the channel assigned to the TRU under test by using the B command.

   >B

   The TRU will request a channel number. Enter the channel number for the frequency assigned to the DRU under test (1...799 or 990...1023). Refer to Appendix A for the channel-to-frequency conversion information.

   >xxxx

   On a successful channel change, the Channel and Synth Lock fields will be updated:

   `Channel: xxxx` (DRU channel number indicated)
   `Synth Lock: YES` (Sync Lock changes to 'YES')

5. On the communications monitor, set the transmit RF frequency to the frequency corresponding to that of the TRU under test.

6. Proceed with the RF output power test.

Requirements on the Transmit RF output power test

When performing the Transmit RF output power test, make sure that power initialization has been performed (refer to Chapter 1). Also, take into account the number of channels supported by the MCPA and the component (cable, duplexer) loss along the transmit path.

Table 11-5 lists the maximum per-channel power levels per carrier measured at the output port of the MCPA shelf for different channel counts and MCPA combinations in a DualMode 800 Enclosure. The power per channel calculation is based on the following assumption:

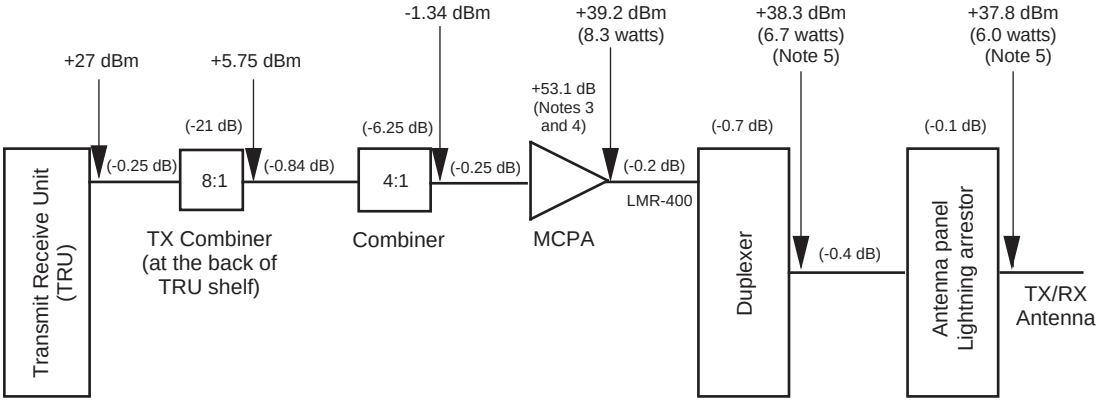
- output of TRU at +15 dBm and nominal gain at -12 dB, giving an overall TRU output of +27 dBm

Table 11-5
DualMode 800 Enclosure per-carrier power level at the output port of the MCPA shelf

	1 MCPA module	2 MCPA modules
8 channels	12.50 W	25.00 W
16 channels	6.25 W	12.50 W
24 channels	4.17 W	8.33 W
32 channels	3.12 W	6.25 W

Figure 11-8 shows the per-channel transmit power level at the output of each component for a 24-channel cell/sector using two MCPA modules.

Figure 11-8
Transmit power level of a DualMode 800 Enclosure with 24-channel per cell/sector using two MCPA modules



Notes:
1. Typical gains and losses shown — not maximum or minimum.
2. Per-channel TX power level shown with TRU output at +27 dBm.
3. MCPA gain includes the MCPA module gain and the splitter, combiner, and cable losses within the MCPA shelf.
4. Additional loss due to amplitude/phase imbalance (typically 0 to 0.5 dB) not shown.
5. Output power at duplexer antenna port may be 0 to 0.5 dB lower due to amplidtue/phase imbalance.

Transmit RF output power test

This test ensures that the output power level of the TRU, the MCPA, and the transmit path loss are within specifications.

Step	Action	Observation
1	Ensure that the TRU configurations are as listed in Table 11-1 for the Power Output test.	

2	Turn on the TRU transmitter with the C command
	>**C**
		The PA status should be as follows:
		`PA: on`
		`TxPwrIndex: 0`
		`TxPwrStep: 4.00`
		`MaxTxPwr: 15.00`

3	Measure the output power of the channel on the communications monitor.	Power level should be within site specifications (refer to Table 11-5).
4	Record the power level on the test forms.	
5	Turn off the TRU transmitter with the C command. >**C**	The PA status on the screen will show: `PA: off`

Setting TRU power step size and Max power to site operational level

After the output power tests, ensure that the TRU power step size and the TRU Max power are set back to the site specific operational level. Check the TRU power step size setting previously defined for the site. Set the TRU power step size setting to the site specific operational step size setting with the U command from the interface terminal.

Set the TRU Power Step with the U command.

>**U**

The TRU will prompt for a power step size:

`1..4`

Enter:

>**x.xx** (change this value as required to obtain the operational power step size)

The power step size on the screen will show:

`TxPwrStep: x.xx` (site specific power step size)

Check the TRU Max power setting previously defined for the site. Set the TRU output power to the site specific operational power with the F command from the interface terminal.

Set the TRU Max Power with the F command.

>**F**

The TRU will prompt for a power level:

`-1.0...27.0 in dBm`

Enter:

>**xx.x** (change this value as required to obtain the operational output power level)

The MaxTxPwr status on the screen will show:

`MaxTxPwr: xx.xx` (site specific operational level)

Use the Y command to perform a reset on the TRU after the tests.

>**Y**

At the command prompt, perform a warm reset on the TRU by entering:

>**W**

The TRU will return to its normal working condition after the reset. Disconnect the interface terminal from the TRU.

At the MTX, put the TRU back to service.

DRU digital tests

This section describes the digital tests that can be performed on the DualMode Radio Unit (DRU) and other system components to verify TDMA operation. A DualMode Radio Unit Monitor (DRUM) is required to perform the Bit Error Rate test and a TDMA or a Dual Mode cellular phone is required to perform the TDMA call test. The test requires operator commands initiated at the DRU, DRUM and MTX.

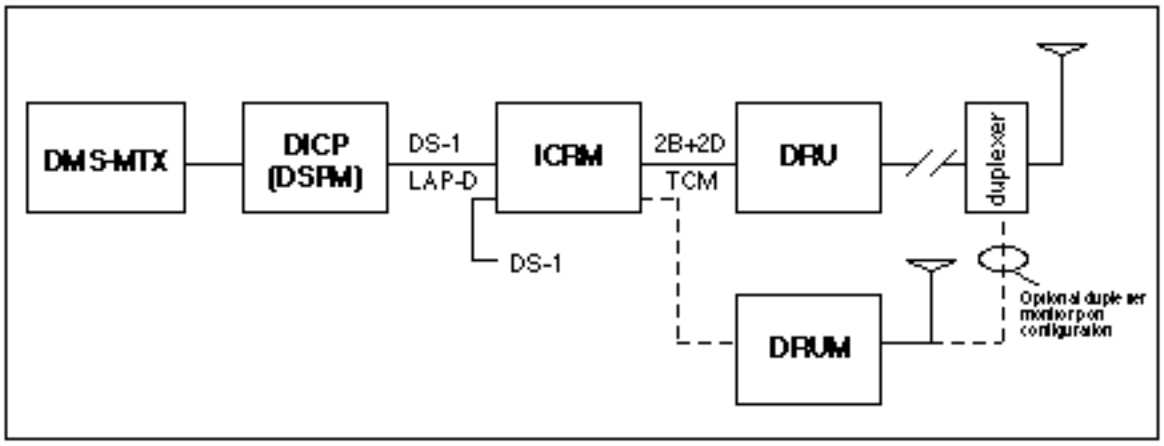
Digital test considerations

A 2-way splitter located on the DRUM is used to combine the bi-directional link from the duplexer and from the DualMode Cell Site Monitor (DCSM) to give a single interface for both. The 2-way splitter connects to either an antenna or a duplexer monitor port to provide an RF interface to the DRUs. The NTAX40CA DRUM uses the antenna connection; while the NTAX40DA DRUM uses the duplexer monitor port.

A Bit Error Rate loopback test is initiated at the MTX on an in-service (INSV) DRU that has been taken out of call processing mode by the test being run. The test is carried out over the entire transmission loop from the MTX Digital Signal Processing Module (DSPM) through a DRU to the DRUM. Measurements of a Pseudo-Random Bit Stream are taken in both the near-to-far and far-to-near directions. Bi-directional transmit and receive tests are performed; uni-directional tests are automatically performed only if the bi-directional test fails. Figure 11-9 shows the digital loopback paths.

Note: The TRU3 does not support this loopback test method. It only supports the on-site BER test method.

Figure 11-9
Digital loopback paths



Bit error rate test at the MTX switch

Bit Error Rate (BER) is defined as the ratio of erroneous bits to the total number of received bits in a transmission system. Typically, BER tests are performed on suspect equipment. However, external factors such as strong electromagnetic conditions, multi-path effects and environmental conditions like lightning may also cause high BER levels and need to be considered when a BER test fails.

In the outbound direction (from Digital Signal Processing Module to DualMode Radio Unit), the BER test generates a pseudo-random bit stream (PRBS) onto the selected TDMA time slot. In the inbound direction, the BER test expects to receive the same bit pattern. After a short self-synchronization time period, the bit error rate is measured.

Note: The TRU3 does not support this test (that is, the MRBT test).

Step	Action	Observation

1	Ensure that the following tables have been datafilled.
	
	Table CTTPARMS
	
	Table PMLOADS
	
	Table TERMATTR
	
	Table CSMINV
		Tuples shown are examples only. They may look different on your screen.
		
		Table CTTPARMS has a tuple for the cell under test and range TESTNAME says “MRBT”
		`TABLE CTTPARMS`
		`PARMNAME TSTPARMS`
		`---`
		`MRBT MRVT MRBT 6000000 6000 6000 NOSTOP`
		
		`TABLE: PMLOADS`
		`LOADNAME DEVICE`
		`---`
		`DM2_AE25 D000PMLOADS`
		
		`TABLE: TERMATTR`
		`ATTRIBUTE PEC_CODE LOAD PADPEC CSPM HWTYPE`
		`---`
		`AE25 AX40DA DM2_AE25 NOPAD ICRM DRUM`
		
		`TABLE: CSMINV`
		`CSMKEY MIN SERNO TERMATTR CARD PORT ALARMPT`
		`---`
		`495 0 214 234 0095 142 571 AE25 8 15 0`

2	Ensure that the DRUM is in service. >**MAPCI;MTC;MTX** >**POST CELL** {cell #}**;CTU** {ctu #}	Verify that the DRUM indicates INSV.

- continued -

Step	Action	Observation
3	Enter the log reporting system and setup a device to report MTX 230 logs. >**LOGUTIL** >**ADDREP** <device name> **MTX 230** >**STARTDEV** <device name> >**QUIT**	LOGUTIL 1 report added <device name> started >
4	Enter the DRU POST level: >**POST VCH ALL** or **POST VCH** {no.}	Post position is displayed on the MAP terminal.
5	Perform the bit error rate test on the DRU from the MTX. >**TST MRBT MRBT 2**	Test submitted, watch LOGs for results. ***Note:*** MRBT test on the first Voice channel must be completed before going to the next Voice channel.
6	Review the results on the Log device started earlier. A sample of the log is displayed right.	Log MTX 230 printed on the log device. MTX230 OCT23 12:52:14 9408 INFO CTE Test results TESTNAME: MRBT CELL = 495 VCH 6 DRU PRTN = Z CTTPARMS: MRBT TDMA CHANNEL: 2 RESULTS: TEST STAGE: TX STATUS: PASSED REASON: # BITS TRANSMITTED: 6000000 # BIT ERRORS: 9 BER: 9.0*10E-6 # RESYNCS: 0 The bit error rate must be less than 0.6% or less than 36000 errors in 6000000.
7	Record the results on test forms.	
8	Test the next DRU by typing: >**NEXT** or **POST VCH** (no.)	The next DRU will be posted.
9	Repeat steps 5 to 7 for testing the next DRU.	
10	When tests are complete, turn logs off by entering: >**LOGUTIL** >**STOPDEV** <device name> >**DELREP** <device name> **MTX 230** >**QUIT**	LOGUTIL Device Stopped 1 Report deleted >
- End -		

Bit error rate test at the cell site

The BER test performed at the cell site verifies the BER performance of the DRU and the paths between the DRU and the communications monitor. It does not verify the BER performance of the links between the DRU and the DSPM.

In the inbound (RX) direction (from the communications monitor to the TRU), the communications monitor generates a pseudo-random bit stream (PRBS) onto the selected TDMA time slot of the TRU. This PRBS is looped from the receiver of the TRU to the transmitter of the TRU and sent back to the communications monitor. In the outbound (TX) direction, the communications monitor expects to receive the same bit pattern. After a short self-synchronization time period, the bit error rate is measured.

Service impacts

This BER test causes a reduction in the receive performance of the shelf containing the TRU under test because of the loss of receive diversity.

The TRU transmit and receive tests must be performed before the BER test to verify the TRU's transmit and receive paths. This is because the TRU uses an RF loopback to access the base-band receive signal. Failure to verify the TRU transmit and receive paths may result in invalid test data.

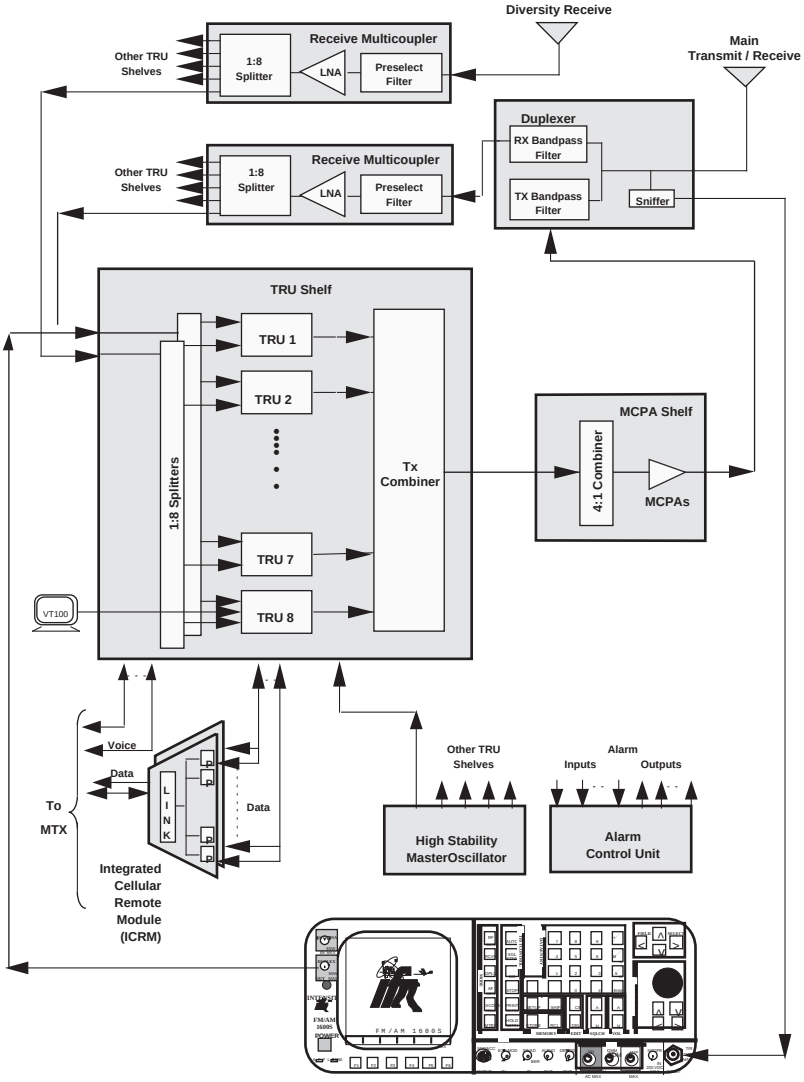
CAUTION
Service interruption
The service of the shelf housing the TRU under test will be affected. Perform the tests during low traffic period.

Figure 11-10 shows the BER test setup at the cell site

Note: The sniffer port is at a level of -50 dBm lower than the level at the antenna port of the duplexer. Make sure that this level meets the minimum input level requirement of your communications monitor. If the level is lower than the minimum requirement, connect the input of the communications monitor to the antenna port of the duplexer. **In this case, the entire cell/sector will be out of service for the duration of the test**.

WARNING
RF radiation hazard
Do NOT disconnect any RF cables when transmitters are on.

Figure 11-10
BER test setup at the cell site



Communications Monitor (IFR 1900)

Note: This test works with an IFR1900 or HP8935 communications monitor with the required software. It does not work with an older IFR or HP model.

Step	Action	Observation
1	Connect the test setup as shown in Figure 11-10.	
2	Set up the communications monitor for BER measurement. Refer to the user's manual of your communications monitor for the setup procedure.	***Note:*** Set the output of the communications monitor to -110 dBm.
3	Set up the TRU as listed below: >**set LT off** >**set PATYPE NONE** >**set PERS TTC** >**set CHANNEL xxxx** (the B command) >**set TXPOWIDX 0** (the E command) >**set BCH loop off** (the J command) >**set RF loop on** (the J command) >**set PA on** (the C command)	***Note:*** You can also use the Fullscreen mode to set up the TRU.
4	Press the appropriate key (for example: GO, START) on the communications monitor to begin the BER test.	The bit error rate must be less than 3% when output level of the communications monitor is at -110 dBm. Record the test result when the PRBS (Total bits generated) reaches around 1,000,000 bits. If BER is out of specifications, replace the TRU and perform the test again. If problem persists, perform troubleshooting.
5	Perform the test on the other timeslots of the TRU. Use the Set Slot (H) command to change the slots. Remember to change the settings on the communications monitor accordingly.	Record the test result.
6	Normalize the system.	The A-side splitter on the TRU shelf is connected back to the RMC output.
7	Connect the output of the communications monitor to the B-side splitter on the TRU shelf and perform the test (Steps 2 to 5) on the B-side receiver of the TRU.	Record the test result.
8	After completing the test on the B-side receiver of the TRU, normalize the system.	The B-side splitter on the TRU shelf is connected back to the RMC output.
- End -		

TDMA modulation accuracy test

The TDMA modulation accuracy test measures the π/4 DQPSK modulation of the signals received from the TRU. To perform this test, you must use a test equipment that can measure TDMA modulation accuracy, such as the IFR1600 with TDMA software.

Note: The IFR1600 is used as a reference in this testing procedure. If you are using another model of test equipment, refer to the user manual of that equipment for the appropriate test setup and display.

Step	Action	Observation
1	Connect a VT100 (or equivalent) terminal to the RS-232 port on the front panel of the TRU under test.	

2	By pressing the “Break” key on the terminal keyboard, you can access the command line mode.	The terminal will display (the TRU2 display is shown as an example):
		`TRU Terminal Interface`
		`(C) Copyright 1990,1991 Bell Northern Research, Inc.`
		`>`

3	At the prompt (>), type: `>set lt off`	
4	Type: `>set pa off`	The TRU transmitter is turned off. This step ensures that the TRU is not radiating RF power when disconnecting the RF cable.
5	Connect the TRU under test through the sniffer port of the duplexer to the input connector of the test equipment (the T/R port on the IFR1600).	

6	Select the Modulation Accuracy function on the test equipment.
	
	For the IFR1600:
	(i) select the ‘RCVR’ function with the IFR MODE key
	(ii) press the ‘F5’ key that is labeled ‘Sp Tst’
	(iii) select ‘MODULATION ACCURACY’ by pressing the ‘4’ key from the Data Entry Keys.
		The Modulation Accuracy display screen on the IFR1600 shows:
		
		`MODULATION ACCURACY`
		`CHANNEL 1`
		`I/Q OFFSET=`
		`FREQUENCY ERROR=`
		`RMS PHASE ERROR=`
		`RMS MAGNITUDE ERROR=`
		`RMS ERROR VECTOR MAGNITUDE=`

- continued -

Step	Action	Observation
7	On the test equipment, enter the channel number that is to be tested. For the IFR1600: (i) use the Data Entry Keys to input the channel (ii) press the green ‘ENTER’ key to enter the input.	
8	On the terminal, type: >**set pers ttc**	Personality configuration was successful. The personality of the TRU changes to a TDMA Traffic Channel.
9	Type: >**set channel xxxx** “xxxx” is the channel number of the TRU under test.	Channel change was successful. The channel of the TRU changes to the desired number.
10	Type: >**set txpowidx 0**	`PA power change was successful.` The power index of the TRU changes to 0.

11	Type:
	>**set maxtxpow 15**
		`Set Max power (input value and value used): 15.0  15.0`
		
		`PA Max Power (dBm): 15.0`
		
		The output power of the TRU changes to 27.0 dBm.

12	Type: >**run inject to dsp 1 52 b6 0 0 1**	
13	Type: >**set pa on**	`Status change was successful.` The TRU transmitter is turned on.
- continued -		

Step	Action	Observation

14	Start the test by pressing the F1 function key labeled “RUN” on the IFR1600. (For the operation of other types of test equipment, refer to their user manuals.)
	
	The following will be measured in this test:
	I/Q Offset—20 x Log of the I/Q offset magnitude indicates the amount of carrier feed through.
	Frequency Error—Difference between the received carrier frequency and the ideal carrier frequency.
	RMS Phase Error—RMS value of the absolute phase errors.
	RMS Magnitude Error—RMS value of the difference between the ideal magnitude and the received magnitude.
	RMS Error Vector Magnitude—RMS value of the magnitude of the error vectors.
		Test results will be displayed as follows:
		
		`MODULATION ACCURACY`
		`I/Q OFFSET= (less than -30 dBc)`
		`FREQUENCY ERROR= (+220 to -220 Hz)`
		`RMS PHASE ERROR= (N/A)`
		`RMS MAGNITUDE ERROR= (N/A)`
		`RMS ERROR VECTOR MAGNITUDE= (less than 12.5%)`

15	Repeat Step 14 ten times and take the average over the ten readings.	
16	Once the test is completed, a π/4 DQPSK I/Q plot can be performed by pressing the “F2” function key on the IFR1600. ***Note***: For more information on plotting results, see the IFR1600 dual mode cellular system analyzer manual. (For the operation of other types of test equipment, refer to their user manuals.)	
17	Type: >**`set pa off`**	`Status change was successful.` The TRU transmitter is turned off.
18	Disconnect the test equipment from the sniffer port of the duplexer.	
19	Type: >**`execute reset`**	This command removes the run inject command and resets the TRU.
20	Disconnect the terminal interface from the TRU.	
- End -		

TDMA call test

This test is used to verify the origination and termination of a digital call through the DRU under test.

Step	Action	Observation
1	Originate a call with a TDMA cellular phone. It may be necessary to make several calls before the system selects the DRU under test.	The LED display on the front panel of the TRU will indicate that the DRU is selected.
2	Check that the audio quality of the call is good.	
3	Terminate the call.	The LED display on the front panel of the TRU should indicate that the call is terminated by returning the DRU to the idle state.

Enclosure maintenance

Field Replaceable Unit (FRU)

The components of a DualMode 800 Enclosure are not designed to be repaired in the field. The only maintenance that can be performed is to replace components or the Field Replaceable Units (FRU). Refer to the *DualMode 800 Enclosure Troubleshooting Guide*, 411-2051-900, to determine if a component needs to be replaced. Table 12-1 lists all the FRUs and their Product Engineering Codes (PEC) or Common Product Codes (CPC).

Note 1: L/L — Like for Like (Advance replacement or mail-in)
M/O — Merchandise Order/Consumable items (items that are disposable and not repairable, such as light bulbs, fuses, filters)

Note 2: For L/L units, please contact your Nortel Networks Customer Service Operations (CSO) office for replacement.
For M/O items, please contact Nortel Networks Wireless Supply and Demand office or purchase the items locally if available.

Note 3: Cables are M/O items. They are not listed in this table. If you need to replace a cable, check the PEC/CPC on the cable or contact Nortel Networks Wireless Supply and Demand office.

Table 12-1
DualMode Urban field replaceable units

Description	PEC/CPC	Service	Remark
Rack Interface Panel (RIP) 1	NTL102AA	L/L	
Rack Interface Panel (RIP) 2	NTL102AB	L/L	
Rack Interface Panel (RIP) 3	NTL102AC	L/L	
Circuit Breaker 10A	A0666060	M/O	
Circuit Breaker 15A	A0666061	M/O	
Circuit Breaker 50A	A0734636	M/O	

Table 12-1
DualMode Urban field replaceable units (continued)

Description	PEC/CPC	Service	Remark
Circuit Breaker 120A	A0381990	M/O	
Power Filter PCP	NTFB14AA	M/O	
Duplexer, B Band	NTFC04AC	L/L	
Duplexer, Full Band	NTFC04AD	L/L	
Termination, 50-ohm	A0689593	M/O	
Multi-Channel Power Amplifier (MCPA) Shelf	NTL107AC	L/L	
4:1 Combiner assembly	NTL107AE	L/L	
MCPA Module 110 Watt	NTL107AA	L/L	
MCPA Initialization Software	NTFC07BC	L/L	
Transmit Receive Unit (TRU) Shelf	NTFC05AG	L/L	
Fan unit module	NTFB24AA	M/O	
Fan module PCP	NTFB25AA	M/O	
Transmit combiner 800 module	NTLA7106	M/O	
TRU2	NTAX98AA	L/L	
TRU3	NTAW99AA	L/L	
Alarm Control Unit (ACU)	NT3P89CA	L/L	
Output Contact card	NT3P20EA	L/L	
Enhanced ACU Input card	NT3P20FB	L/L	
High Stability Master Oscillator (HSMO)	NT3P89DA	L/L	
DualMode Cell Site Monitor (DCSM)	NT3P70BC	L/L	
Enhanced Receive Multicoupler (ERMC) — 8 ports	NT3P20XD	L/L	
ERMC 8 Port Expansion Kit	NT3P20XB	L/L	For NT3P20XD to expand to 16 ports
ERMC — 16 ports	NT3P20XC	L/L	
Integrated Cellular Remote Module (ICRM) shelf	NTTG86AA	L/L	

Table 12-1
DualMode Urban field replaceable units (continued)

Description	PEC/CPC	Service	Remark
Remote Module Digital Port (RMDP) card	NT8X47CA	L/L	
Remote Module Time Switch Controller (RMTC)	NTAX88CA	L/L	For ICRMO+ and ICRM+
DS1 Interface card	NT6X50AB	L/L	Not applicable to ICRMO+
PCM30 (E1) Interface card	NT6X27BB	L/L	For ICRMO+
Power convertor	NT2X70CA	L/L	
Alarm (RMAC) card	NTAX92AA	L/L	Located in Remote Module Frame Supervisor (RMFS)
TCM-RS232 Conversion (RMTP) card	NTAX91AA	L/L	Located in RMFS
Rectifier Shelf	NTL106AB	L/L	
Rectifier Module	NTL106AA	L/L	
Power Control Shelf	NTTF60AA	L/L	
Battery Compensation Module	NTTF60AB	L/L	
Low Voltage Disconnect card	NTTF60AC	L/L	
Channel Service Unit (CSU) 4-Slot Shelf	NTLA7011	L/L	
Shelf Interface Unit (SIU) for 4-Slot Shelf	NTLA7013	L/L	
T-Smart T1 SIU card	A0383869	L/L	
E-Smart E1 SIU card	NTLA7012	L/L	
Solar Shield Kit	NTTF12AB	L/L	

General precautions

There are some general precautions that need to be aware of when replacing components.

RF radiation hazard

Radio Frequency (RF) radiation is hazardous to anyone working in the cell site. Before removing any RF cable, ensure that the related power amplifier is turned off. All RF cables should be connected properly and all unused RF ports should be terminated with an appropriate terminator.

CAUTION
Do NOT disconnect any RF cables when transmitters are on.

Electrostatic Discharge (ESD) control

When handling any circuit board, take care to prevent damage from static discharge. Observe the following rules.

1. To prevent electrostatic discharge, do not attach ribbon cables to circuit boards until the circuit boards are in place.
2. To dissipate any static charge, wear a wrist strap in contact with the skin.
3. Connect the wrist strap ground cord to the equipment cabinet ground.

CAUTION
Do not let the circuit board come into contact with clothing at any time, as the grounding strap cannot dissipate static charges on fabrics.

Cable/connector identification

Label all cables and connectors before disconnecting them from any cell site equipment. This will minimize the time required for tracing the connections and also reduce the possibility of incorrect connections.

Replacing faulty common equipment (CE) units

CAUTION
Service interruption
The enclosure may be completely out-of-service when a unit such as the RIP, the HSMO, or the ICRM is removed. Replace these units during low traffic period.

For the replacement of a common equipment unit, use the following procedure:

1. At the MTX, put the cell site or the unit out-of-service as required.
2. **If replacing the Rack Interface Panel (RIP), switch off the supply to the bay at the rectifier. If replacing other units, switch off both the 'A' and 'B' circuit breakers to that unit at the RIP.**

CAUTION
Hot insertion replacement may cause damage to the components and a possible service interruption.

3. Label and disconnect the cables/connectors connected to the unit.
4. Remove the screws mounting the unit to the bay and then remove the unit from the bay.
5. Replace a new or known working unit on to the bay and fix it with the mounting screws.
6. Reconnect the cables/connectors to their appropriate locations. Ensure that they are connected properly.
7. Switch on the circuit breakers to the unit at the RIP or switch on the power supply to the RIP at the rectifier.

   Note: For the DCSM, program the mobile unit of the replacement DCSM to the same parameters as the existing mobile unit after switching on the power supply. Refer to Chapter 1, *Equipment operation*, for the programming procedure.

8. At the MTX, ensure that the datafill information on the replacement unit is correct.
9. At the MTX, put the cell site back into service.
10. Verify that the replacement unit is functioning correctly.
11. Return the faulty unit to your Nortel Networks Customer Service Operations office for repair.

Replacing faulty radio frequency (RF) units

CAUTION
Service interruption
The enclosure may be completely out-of-service when a unit such as the RIP, a duplexer, or a MCPA is removed. Replace these units during low traffic period.

For the replacement of a radio frequency (RF) unit, use the following procedure:

1. At the MTX, put the cell site or the unit out-of-service as required.
2. **If replacing the Rack Interface Panel (RIP), switch off the supply to the RIP at the rectifier. If replacing a TRU or MCPA shelf, switch off the circuit breaker to that unit at the RIP.**

CAUTION
Hot insertion replacement may cause damage to the components and a possible service interruption.

3. Label and disconnect the cables/connectors connected to the unit.
4. Remove the screws mounting the unit to the frame and then remove the unit from the frame.
5. Replace a new or known working unit on to the frame and fix it with the mounting screws.
6. Reconnect the cables/connectors to their appropriate locations. Ensure that they are connected properly.
7. Switch on the circuit breaker to the unit at the RIP or switch on the power supply to the RF Frame at the power plant.
8. At the MTX, ensure that the datafill information on the replacement unit is correct.
9. At the MTX, put the cell site back into service.
10. Verify that the replacement unit is functioning correctly.
11. Return the faulty unit to your Nortel Networks Customer Service Operations office for repair.

Replacing the TRU or MCPA shelf

The channels associated with the TRU or MCPA shelf should be out-of-service during the off-line replacement. This is of major significance if it is supporting the control channel of the site/sector. In that case, ensure the system switches to a back-up channel.

Follow the procedure when replacing a TRU or MCPA shelf:

1. At the MTX, put the affected channels out-of-service.
2. Switch off the circuit breaker of the shelf at the RIP.
3. Label and disconnect the cables/connectors connected to the backplane of the shelf.
4. Remove the TRUs or MCPA modules from the shelf.
5. Loosen the screws mounting the shelf to the RF frame and then remove the shelf from the frame.
6. Replace a new or known working shelf on to the frame and fix it with the mounting screws.
7. Replace the TRUs or MCPA modules back to the shelf and fix them with the mounting screws.
8. Reconnect the cables/connectors to their appropriate locations on the backplane of the shelf. Ensure that they are connected properly.
9. Switch on the circuit breaker of the shelf at the RIP.
10. At the MTX, put the affected channels in-service.

General rules for replacing a TRU or an MCPA module

The following rules must be followed when replacing a TRU or a MCPA module:

- Pull evenly and firmly on the module handle to pull the module out of the backplane connector. If excessive resistance is felt, stop and investigate the reason.
- Slide the module directly and squarely into and out of the shelf guide slot.
- When inserting a module, carefully line up the module connectors and the backplane connectors before trying to seat the module. The module should seat easily into the shelf. Do not force the module into the shelf. If the connectors are out of alignment, damage to the module and the backplane will result.

Replacing the TRU

The Transmit Receive Unit (TRU) can be changed with the DC power on. The channel associated with the TRU should be out-of-service during the off-line replacement. This is of major significance if it is a control or locate channel. In that case, ensure the system switches to a back-up channel.

Follow the procedure when replacing a TRU:

1. At the MTX, put the affected channel(s) out-of-service.
2. Loosen the tab at the top edge of the TRU and move it away from the TRU.
3. Using the handle on the front of the TRU, gently pull the module out of the backplane connector and then slide it out of the shelf.
4. Place the replacement unit in the shelf guides.
5. Slide the unit into the shelf until it reaches the backplane connector.
6. Line up the TRU connector with the backplane connector and carefully mate the connectors. Do not force the module into the shelf. If this is not done with care, the pins of the connector may be damaged.
7. Move the tab over the top edge of the TRU and tighten the tab.
8. Perform the operational checks on the TRU.
9. At the MTX, put the channel/DRU in-service.
10. Perform a call through test on the TRU replaced. It may be necessary to make several calls before the system selects the channel number assigned to the DRU.

Replacing the MCPA module

The channels associated with the Multi-Channel Power Amplifier (MCPA) module should be out-of-service during the off-line replacement. This is of major significance if it is supporting the control channel of the site/sector. In that case, ensure the system switches to a back-up channel.

Follow the procedure when replacing a MCPA:

1. At the MTX, put the affected channels out-of-service.
2. Turn the RF ON switch on the front panel of the MCPA module to OFF.
3. Switch off the circuit breaker of the MCPA module at the RIP.
4. Loosen the screws mounting the MCPA module to the MCPA shelf and then remove the module from the shelf.
5. Replace a new or known working MCPA module on to the shelf and fix it with the mounting screws.
6. Switch on the circuit breaker of the MCPA module at the RIP.
7. Turn the RF ON switch on the front panel of the MCPA module to ON.
8. Perform the operational checks on the MCPA.
9. At the MTX, put the affected channels in-service.

Returning a faulty unit to your Nortel Networks CSO office

After the replacement, return the faulty unit to your Nortel Networks Customer Service Operations (CSO) office for repair. Consult your Sales Manager or Account Manager for the specific return and repair process.

Remember to attach the Customer Return (CR) number to the faulty unit.

For United States customers, ship to:

Nortel Networks
Attn. Customer Service Operations
400 N. Industrial
Richardson, Texas 75081

For Bell Canada customers, ship through Telco Internal Mail/Expedite Votre Courier-Interna to:

Nortel Networks
Customer Service Operations
c/o Wesbell Transport
1630 Trinity Rd., Unit #3, Door #4
Mississauga, Ontario L5T 1L6
Attn.: Replacement and Repair Operations
Dept.: S898

For Mexico customers, ship to:

Nortel Networks
Toltecas #113?Col. San Pedro De Los Pinos
Casi Esq Calle 4
Mexico

For Asia Pacific customers, ship to:

Nortel Networks
Attn.: Technical Assistance Service
Warwick House 17/F
28 Tong Chong Street
Quarry Bay, Hong Kong

For Non-Bell Canada/CALA/International customers, ship to:

Nortel Networks
Customer Service Operations
c/o Wesbell Transport
1630 Trinity Rd., Unit #3, Door #4
Mississauga, Ontario L5T 1L6
Attn.: Replacement and Repair Operations
Dept.: S898

Appendix A: Frequency table

System's channel and frequency

System	Channel	Receive frequency	Transmit frequency
Not Used	990	824.010 MHz	869.010 MHz
A”	991 to 1023	824.040 to 825.000 MHz	869.040 to 870.000 MHz
A	1 to 333	825.030 to 834.990 MHz	870.030 to 879.990 MHz
B	334 to 666	835.020 to 844.980 MHz	880.020 to 889.980 MHz
A’	667 to 716	845.010 to 846.480 MHz	890.010 to 891.480 MHz
B’	717 to 799	846.510 to 848.970 MHz	891.510 to 893.970 MHz

Channel frequency calculation (in the following, N = channel number)

1.	When the channel is between 1 and 799: Receive frequency (in MHz) = 0.03N + 825.000 Transmit frequency (in MHz) = 0.03N + 870.000
2.	When the channel is between 990 and 1023: Receive frequency (in MHz) = 0.03(N - 1023) + 825.000 Transmit frequency (in MHz) = 0.03(N - 1023) + 870.000

AMPS frequency allocation

Band ‘A’ Non-wireline carriers	Control channels	313-333
	Voice channels	001-312
	Voice channels, expanded spectrum	667-716 991-1023
Band ‘B’ Wireline carriers	Control channels	334-354
	Voice channels	355-666
	Voice channels, expanded spectrum	717-799

Chan	RX	TX	Chan	RX	TX	Chan	RX	TX	Chan	RX	TX
1	825.03	870.03	51	826.53	871.53	101	828.03	873.03	151	829.53	874.53
2	825.06	870.06	52	826.56	871.56	102	828.06	873.06	152	829.56	874.56
3	825.09	870.09	53	826.59	871.59	103	828.09	873.09	153	829.59	874.59
4	825.12	870.12	54	826.62	871.62	104	828.12	873.12	154	829.62	874.62
5	825.15	870.15	55	826.65	871.65	105	828.15	873.15	155	829.65	874.65
6	825.18	870.18	56	826.68	871.68	106	828.18	873.18	156	829.68	874.68
7	825.21	870.21	57	826.71	871.71	107	828.21	873.21	157	829.71	874.71
8	825.24	870.24	58	826.74	871.74	108	828.24	873.24	158	829.74	874.74
9	825.27	870.27	59	826.77	871.77	109	828.27	873.27	159	829.77	874.77
10	825.30	870.30	60	826.80	871.80	110	828.30	873.30	160	829.80	874.80
11	825.33	870.33	61	826.83	871.83	111	828.33	873.33	161	829.83	874.83
12	825.36	870.36	62	826.86	871.86	112	828.36	873.36	162	829.86	874.86
13	825.39	870.39	63	826.89	871.89	113	828.39	873.39	163	829.89	874.89
14	825.42	870.42	64	826.92	871.92	114	828.42	873.42	164	829.92	874.92
15	825.45	870.45	65	826.95	871.95	115	828.45	873.45	165	829.95	874.95
16	825.48	870.48	66	826.98	871.98	116	828.48	873.48	166	829.98	874.98
17	825.51	870.51	67	827.01	872.01	117	828.51	873.51	167	830.01	875.01
18	825.54	870.54	68	827.04	872.04	118	828.54	873.54	168	830.04	875.04
19	825.57	870.57	69	827.07	872.07	119	828.57	873.57	169	830.07	875.07
20	825.60	870.60	70	827.10	872.10	120	828.60	873.60	170	830.10	875.10
21	825.63	870.63	71	827.13	872.13	121	828.63	873.63	171	830.13	875.13
22	825.66	870.66	72	827.16	872.16	122	828.66	873.66	172	830.16	875.16
23	825.69	870.69	73	827.19	872.19	123	828.69	873.69	173	830.19	875.19
24	825.72	870.72	74	827.22	872.22	124	828.72	873.72	174	830.22	875.22
25	825.75	870.75	75	827.25	872.25	125	828.75	873.75	175	830.25	875.25
26	825.78	870.78	76	827.28	872.28	126	828.78	873.78	176	830.28	875.28
27	825.81	870.81	77	827.31	872.31	127	828.81	873.81	177	830.31	875.31
28	825.84	870.84	78	827.34	872.34	128	828.84	873.84	178	830.34	875.34
29	825.87	870.87	79	827.37	872.37	129	828.87	873.87	179	830.37	875.37
30	825.90	870.90	80	827.40	872.40	130	828.90	873.90	180	830.40	875.40
31	825.93	870.93	81	827.43	872.43	131	828.93	873.93	181	830.43	875.43
32	825.96	870.96	82	827.46	872.46	132	828.96	873.96	182	830.46	875.46
33	825.99	870.99	83	827.49	872.49	133	828.99	873.99	183	830.49	875.49
34	826.02	871.02	84	827.52	872.52	134	829.02	874.02	184	830.52	875.52
35	826.05	871.05	85	827.55	872.55	135	829.05	874.05	185	830.55	875.55
36	826.08	871.08	86	827.58	872.58	136	829.08	874.08	186	830.58	875.58
37	826.11	871.11	87	827.61	872.61	137	829.11	874.11	187	830.61	875.61
38	826.14	871.14	88	827.64	872.64	138	829.14	874.14	188	830.64	875.64
39	826.17	871.17	89	827.67	872.67	139	829.17	874.17	189	830.67	875.67
40	826.20	871.20	90	827.70	872.70	140	829.20	874.20	190	830.70	875.70
41	826.23	871.23	91	827.73	872.73	141	829.23	874.23	191	830.73	875.73
42	826.26	871.26	92	827.76	872.76	142	829.26	874.26	192	830.76	875.76
43	826.29	871.29	93	827.79	872.79	143	829.29	874.29	193	830.79	875.79
44	826.32	871.32	94	827.82	872.82	144	829.32	874.32	194	830.82	875.82
45	826.35	871.35	95	827.85	872.85	145	829.35	874.35	195	830.85	875.85
46	826.38	871.38	96	827.88	872.88	146	829.38	874.38	196	830.88	875.88
47	826.41	871.41	97	827.91	872.91	147	829.41	874.41	197	830.91	875.91
48	826.44	871.44	98	827.94	872.94	148	829.44	874.44	198	830.94	875.94
49	826.47	871.47	99	827.97	872.97	149	829.47	874.47	199	830.97	875.97
50	826.50	871.50	100	828.00	873.00	150	829.50	874.50	200	831.00	876.00

Chan	RX	TX	Chan	RX	TX	Chan	RX	TX	Chan	RX	TX
201	831.03	876.03	251	832.53	877.53	301	834.03	879.03	351	835.53	880.53
202	831.06	876.06	252	832.56	877.56	302	834.06	879.06	352	835.56	880.56
203	831.09	876.09	253	832.59	877.59	303	834.09	879.09	353	835.59	880.59
204	831.12	876.12	254	832.62	877.62	304	834.12	879.12	354	835.62	880.62
205	831.15	876.15	255	832.65	877.65	305	834.15	879.15	355	835.65	880.65
206	831.18	876.18	256	832.68	877.68	306	834.18	879.18	356	835.68	880.68
207	831.21	876.21	257	832.71	877.71	307	834.21	879.21	357	835.71	880.71
208	831.24	876.24	258	832.74	877.74	308	834.24	879.24	358	835.74	880.74
209	831.27	876.27	259	832.77	877.77	309	834.27	879.27	359	835.77	880.77
210	831.30	876.30	260	832.80	877.80	310	834.30	879.30	360	835.80	880.80
211	831.33	876.33	261	832.83	877.83	311	834.33	879.33	361	835.83	880.83
212	831.36	876.36	262	832.86	877.86	312	834.36	879.36	362	835.86	880.86
213	831.39	876.39	263	832.89	877.89	313	834.39	879.39	363	835.89	880.89
214	831.42	876.42	264	832.92	877.92	314	834.42	879.42	364	835.92	880.92
215	831.45	876.45	265	832.95	877.95	315	834.45	879.45	365	835.95	880.95
216	831.48	876.48	266	832.98	877.98	316	834.48	879.48	366	835.98	880.98
217	831.51	876.51	267	833.01	878.01	317	834.51	879.51	367	836.01	881.01
218	831.54	876.54	268	833.04	878.04	318	834.54	879.54	368	836.04	881.04
219	831.57	876.57	269	833.07	878.07	319	834.57	879.57	369	836.07	881.07
220	831.60	876.60	270	833.10	878.10	320	834.60	879.60	370	836.10	881.10
221	831.63	876.63	271	833.13	878.13	321	834.63	879.63	371	836.13	881.13
222	831.66	876.66	272	833.16	878.16	322	834.66	879.66	372	836.16	881.16
223	831.69	876.69	273	833.19	878.19	323	834.69	879.69	373	836.19	881.19
224	831.72	876.72	274	833.22	878.22	324	834.72	879.72	374	836.22	881.22
225	831.75	876.75	275	833.25	878.25	325	834.75	879.75	375	836.25	881.25
226	831.78	876.78	276	833.28	878.28	326	834.78	879.78	376	836.28	881.28
227	831.81	876.81	277	833.31	878.31	327	834.81	879.81	377	836.31	881.31
228	831.84	876.84	278	833.34	878.34	328	834.84	879.84	378	836.34	881.34
229	831.87	876.87	279	833.37	878.37	329	834.87	879.87	379	836.37	881.37
230	831.90	876.90	280	833.40	878.40	330	834.90	879.90	380	836.40	881.40
231	831.93	876.93	281	833.43	878.43	331	834.93	879.93	381	836.43	881.43
232	831.96	876.96	282	833.46	878.46	332	834.96	879.96	382	836.46	881.46
233	831.99	876.99	283	833.49	878.49	333	834.99	879.99	383	836.49	881.49
234	832.02	877.02	284	833.52	878.52	334	835.02	880.02	384	836.52	881.52
235	832.05	877.05	285	833.55	878.55	335	835.05	880.05	385	836.55	881.55
236	832.08	877.08	286	833.58	878.58	336	835.08	880.08	386	836.58	881.58
237	832.11	877.11	287	833.61	878.61	337	835.11	880.11	387	836.61	881.61
238	832.14	877.14	288	833.64	878.64	338	835.14	880.14	388	836.64	881.64
239	832.17	877.17	289	833.67	878.67	339	835.17	880.17	389	836.67	881.67
240	832.20	877.20	290	833.70	878.70	340	835.20	880.20	390	836.70	881.70
241	832.23	877.23	291	833.73	878.73	341	835.23	880.23	391	836.73	881.73
242	832.26	877.26	292	833.76	878.76	342	835.26	880.26	392	836.76	881.76
243	832.29	877.29	293	833.79	878.79	343	835.29	880.29	393	836.79	881.79
244	832.32	877.32	294	833.82	878.82	344	835.32	880.32	394	836.82	881.82
245	832.35	877.35	295	833.85	878.85	345	835.35	880.35	395	836.85	881.85
346	832.38	877.38	296	833.88	878.88	346	835.38	880.38	396	836.88	881.88
247	832.41	877.41	297	833.91	878.91	347	835.41	880.41	397	836.91	881.91
248	832.44	877.44	298	833.94	878.94	348	835.44	880.44	398	836.94	881.94
249	832.47	877.47	299	833.97	878.97	349	835.47	880.47	399	836.97	881.97
250	832.50	877.50	300	834.00	879.00	350	835.50	880.50	400	837.00	882.00

Chan	RX	TX	Chan	RX	TX	Chan	RX	TX	Chan	RX	TX
401	837.03	882.03	451	838.53	883.53	501	840.03	885.03	551	841.53	886.53
402	837.06	882.06	452	838.56	883.56	502	840.06	885.06	552	841.56	886.56
403	837.09	882.09	453	838.59	883.59	503	840.09	885.09	553	841.59	886.59
404	837.12	882.12	454	838.62	883.62	504	840.12	885.12	554	841.62	886.62
405	837.15	882.15	455	838.65	883.65	505	840.15	885.15	555	841.65	886.65
406	837.18	882.18	456	838.68	883.68	506	840.18	885.18	556	841.68	886.68
407	837.21	882.21	457	838.71	883.71	507	840.21	885.21	557	841.71	886.71
408	837.24	882.24	458	838.74	883.74	508	840.24	885.24	558	841.74	886.74
409	837.27	882.27	459	838.77	883.77	509	840.27	885.27	559	841.77	886.77
410	837.30	882.30	460	838.80	883.80	510	840.30	885.30	560	841.80	886.80
411	837.33	882.33	461	838.83	883.83	511	840.33	885.33	561	841.83	886.83
412	837.36	882.36	462	838.86	883.86	512	840.36	885.36	562	841.86	886.86
413	837.39	882.39	463	838.89	883.89	513	840.39	885.39	563	841.89	886.89
414	837.42	882.42	464	838.92	883.92	514	840.42	885.42	564	841.92	886.92
415	837.45	882.45	465	838.95	883.95	515	840.45	885.45	565	841.95	886.95
416	837.48	882.48	466	838.98	883.98	516	840.48	885.48	566	841.98	886.98
417	837.51	882.51	467	839.01	884.01	517	840.51	885.51	567	842.01	887.01
418	837.54	882.54	468	839.04	884.04	518	840.54	885.54	568	842.04	887.04
419	837.57	882.57	469	839.07	884.07	519	840.57	885.57	569	842.07	887.07
420	837.60	882.60	470	839.10	884.10	520	840.60	885.60	570	842.10	887.10
421	837.63	882.63	471	839.13	884.13	521	840.63	885.63	571	842.13	887.13
422	837.66	882.66	472	839.16	884.16	522	840.66	885.66	572	842.16	887.16
423	837.69	882.69	473	839.19	884.19	523	840.69	885.69	573	842.19	887.19
424	837.72	882.72	474	839.22	884.22	524	840.72	885.72	574	842.22	887.22
425	837.75	882.75	475	839.25	884.25	525	840.75	885.75	575	842.25	887.25
426	837.78	882.78	476	839.28	884.28	526	840.78	885.78	576	842.28	887.28
427	837.81	882.81	477	839.31	884.31	527	840.81	885.81	577	842.31	887.31
428	837.84	882.84	478	839.34	884.34	528	840.84	885.84	578	842.34	887.34
429	837.87	882.87	479	839.37	884.37	529	840.87	885.87	579	842.37	887.37
430	837.90	882.90	480	839.40	884.40	530	840.90	885.90	580	842.40	887.40
431	837.93	882.93	481	839.43	884.43	531	840.93	885.93	581	842.43	887.43
432	837.96	882.96	482	839.46	884.46	532	840.96	885.96	582	842.46	887.46
433	837.99	882.99	483	839.49	884.49	533	840.99	885.99	583	842.49	887.49
434	838.02	883.02	484	839.52	884.52	534	841.02	886.02	584	842.52	887.52
435	838.05	883.05	485	839.55	884.55	535	841.05	886.05	585	842.55	887.55
436	838.08	883.08	486	839.58	884.58	536	841.08	886.08	586	842.58	887.58
437	838.11	883.11	487	839.61	884.61	537	841.11	886.11	587	842.61	887.61
438	838.14	883.14	488	839.64	884.64	538	841.14	886.14	588	842.64	887.64
439	838.17	883.17	489	839.67	884.67	539	841.17	886.17	589	842.67	887.67
440	838.20	883.20	490	839.70	884.70	540	841.20	886.20	590	842.70	887.70
441	838.23	883.23	491	839.73	884.73	541	841.23	886.23	591	842.73	887.73
442	838.26	883.26	492	839.76	884.76	542	841.26	886.26	592	842.76	887.76
443	838.29	883.29	493	839.79	884.79	543	841.29	886.29	593	842.79	887.79
444	838.32	883.32	494	839.82	884.82	544	841.32	886.32	594	842.82	887.82
445	838.35	883.35	495	839.85	884.85	545	841.35	886.35	595	842.85	887.85
446	838.38	883.38	496	839.88	884.88	546	841.38	886.38	596	842.88	887.88
447	838.41	883.41	497	839.91	884.91	547	841.41	886.41	597	842.91	887.91
448	838.44	883.44	498	839.94	884.94	548	841.44	886.44	598	842.94	887.94
449	838.47	883.47	499	839.97	884.97	549	841.47	886.47	599	842.97	887.97
450	838.50	883.50	500	840.00	885.00	550	841.50	886.50	600	843.00	888.00

Chan	RX	TX	Chan	RX	TX	Chan	RX	TX	Chan	RX	TX
601	843.03	888.03	651	844.53	889.53	701	846.03	891.03	751	847.53	892.53
602	843.06	888.06	652	844.56	889.56	702	846.06	891.06	752	847.56	892.56
603	843.09	888.09	653	844.59	889.59	703	846.09	891.09	753	847.59	892.59
604	843.12	888.12	654	844.62	889.62	704	846.12	891.12	754	847.62	892.62
605	843.15	888.15	655	844.65	889.65	705	846.15	891.15	755	847.65	892.65
606	843.18	888.18	656	844.68	889.68	706	846.18	891.18	756	847.68	892.68
607	843.21	888.21	657	844.71	889.71	707	846.21	891.21	757	847.71	892.71
608	843.24	888.24	658	844.74	889.74	708	846.24	891.24	758	847.74	892.74
609	843.27	888.27	659	844.77	889.77	709	846.27	891.27	759	847.77	892.77
610	843.30	888.30	660	844.80	889.80	710	846.30	891.30	760	847.80	892.80
611	843.33	888.33	661	844.83	889.83	711	846.33	891.33	761	847.83	892.83
612	843.36	888.36	662	844.86	889.86	712	846.36	891.36	762	847.86	892.86
613	843.39	888.39	663	844.89	889.89	713	846.39	891.39	763	847.89	892.89
614	843.42	888.42	664	844.92	889.92	714	846.42	891.42	764	847.92	892.92
615	843.45	888.45	665	844.95	889.95	715	846.45	891.45	765	847.95	892.95
616	843.48	888.48	666	844.98	889.98	716	846.48	891.48	766	847.98	892.98
617	843.51	888.51	667	845.01	890.01	717	846.51	891.51	767	848.01	893.01
618	843.54	888.54	668	845.04	890.04	718	846.54	891.54	768	848.04	893.04
619	843.57	888.57	669	845.07	890.07	719	846.57	891.57	769	848.07	893.07
620	843.60	888.60	670	845.10	890.10	720	846.60	891.60	770	848.10	893.10
621	843.63	888.63	671	845.13	890.13	721	846.63	891.63	771	848.13	893.13
622	843.66	888.66	672	845.16	890.16	722	846.66	891.66	772	848.16	893.16
623	843.69	888.69	673	845.19	890.19	723	846.69	891.69	773	848.19	893.19
624	843.72	888.72	674	845.22	890.22	724	846.72	891.72	774	848.22	893.22
625	843.75	888.75	675	845.25	890.25	725	846.75	891.75	775	848.25	893.25
626	843.78	888.78	676	845.28	890.28	726	846.78	891.78	776	848.28	893.28
627	843.81	888.81	677	845.31	890.31	727	846.81	891.81	777	848.31	893.31
628	843.84	888.84	678	845.34	890.34	728	846.84	891.84	778	848.34	893.34
629	843.87	888.87	679	845.37	890.37	729	846.87	891.87	779	848.37	893.37
630	843.90	888.90	680	845.40	890.40	730	846.90	891.90	780	848.40	893.40
631	843.93	888.93	681	845.43	890.43	731	846.93	891.93	781	848.43	893.43
632	843.96	888.96	682	845.46	890.46	732	846.96	891.96	782	848.46	893.46
633	843.99	888.99	683	845.49	890.49	733	846.99	891.99	783	848.49	893.49
634	844.02	889.02	684	845.52	890.52	734	847.02	892.02	784	848.52	893.52
635	844.05	889.05	685	845.55	890.55	735	847.05	892.05	785	848.55	893.55
636	844.08	889.08	686	845.58	890.58	736	847.08	892.08	786	848.58	893.58
637	844.11	889.11	687	845.61	890.61	737	847.11	892.11	787	848.61	893.61
638	844.14	889.14	688	845.64	890.64	738	847.14	892.14	788	848.64	893.64
639	844.17	889.17	689	845.67	890.67	739	847.17	892.17	789	848.67	893.67
640	844.20	889.20	690	845.70	890.70	740	847.20	892.20	790	848.70	893.70
641	844.23	889.23	691	845.73	890.73	741	847.23	892.23	791	848.73	893.73
642	844.26	889.26	692	845.76	890.76	742	847.26	892.26	792	848.76	893.76
643	844.29	889.29	693	845.79	890.79	743	847.29	892.29	793	848.79	893.79
644	844.32	889.32	694	845.82	890.82	744	847.32	892.32	794	848.82	893.82
645	844.35	889.35	695	845.85	890.85	745	847.35	892.35	795	848.85	893.85
646	844.38	889.38	696	845.88	890.88	746	847.38	892.38	796	848.88	893.88
647	844.41	889.41	697	845.91	890.91	747	847.41	892.41	797	848.91	893.91
648	844.44	889.44	698	845.94	890.94	748	847.44	892.44	798	848.94	893.94
649	844.47	889.47	699	845.97	890.97	749	847.47	892.47	799	848.97	893.97
650	844.50	889.50	700	846.00	891.00	750	847.50	892.50	800	Resrvd	Resrvd

Chan	RX	TX	Chan	RX	TX	Chan	RX	TX	Chan	RX	TX
801	Resrvd	Resrvd	851	Resrvd	Resrvd	901	Resrvd	Resrvd	951	Resrvd	Resrvd
802	Resrvd	Resrvd	852	Resrvd	Resrvd	902	Resrvd	Resrvd	952	Resrvd	Resrvd
803	Resrvd	Resrvd	853	Resrvd	Resrvd	903	Resrvd	Resrvd	953	Resrvd	Resrvd
804	Resrvd	Resrvd	854	Resrvd	Resrvd	904	Resrvd	Resrvd	954	Resrvd	Resrvd
805	Resrvd	Resrvd	855	Resrvd	Resrvd	905	Resrvd	Resrvd	955	Resrvd	Resrvd
806	Resrvd	Resrvd	856	Resrvd	Resrvd	906	Resrvd	Resrvd	956	Resrvd	Resrvd
807	Resrvd	Resrvd	857	Resrvd	Resrvd	907	Resrvd	Resrvd	957	Resrvd	Resrvd
808	Resrvd	Resrvd	858	Resrvd	Resrvd	908	Resrvd	Resrvd	958	Resrvd	Resrvd
809	Resrvd	Resrvd	859	Resrvd	Resrvd	909	Resrvd	Resrvd	959	Resrvd	Resrvd
810	Resrvd	Resrvd	860	Resrvd	Resrvd	910	Resrvd	Resrvd	960	Resrvd	Resrvd
811	Resrvd	Resrvd	861	Resrvd	Resrvd	911	Resrvd	Resrvd	961	Resrvd	Resrvd
812	Resrvd	Resrvd	862	Resrvd	Resrvd	912	Resrvd	Resrvd	962	Resrvd	Resrvd
813	Resrvd	Resrvd	863	Resrvd	Resrvd	913	Resrvd	Resrvd	963	Resrvd	Resrvd
814	Resrvd	Resrvd	864	Resrvd	Resrvd	914	Resrvd	Resrvd	964	Resrvd	Resrvd
815	Resrvd	Resrvd	865	Resrvd	Resrvd	915	Resrvd	Resrvd	965	Resrvd	Resrvd
816	Resrvd	Resrvd	866	Resrvd	Resrvd	916	Resrvd	Resrvd	966	Resrvd	Resrvd
817	Resrvd	Resrvd	867	Resrvd	Resrvd	917	Resrvd	Resrvd	967	Resrvd	Resrvd
818	Resrvd	Resrvd	868	Resrvd	Resrvd	918	Resrvd	Resrvd	968	Resrvd	Resrvd
819	Resrvd	Resrvd	869	Resrvd	Resrvd	919	Resrvd	Resrvd	969	Resrvd	Resrvd
820	Resrvd	Resrvd	870	Resrvd	Resrvd	920	Resrvd	Resrvd	970	Resrvd	Resrvd
821	Resrvd	Resrvd	871	Resrvd	Resrvd	921	Resrvd	Resrvd	971	Resrvd	Resrvd
822	Resrvd	Resrvd	872	Resrvd	Resrvd	922	Resrvd	Resrvd	972	Resrvd	Resrvd
823	Resrvd	Resrvd	873	Resrvd	Resrvd	923	Resrvd	Resrvd	973	Resrvd	Resrvd
824	Resrvd	Resrvd	874	Resrvd	Resrvd	924	Resrvd	Resrvd	974	Resrvd	Resrvd
825	Resrvd	Resrvd	875	Resrvd	Resrvd	925	Resrvd	Resrvd	975	Resrvd	Resrvd
826	Resrvd	Resrvd	876	Resrvd	Resrvd	926	Resrvd	Resrvd	976	Resrvd	Resrvd
827	Resrvd	Resrvd	877	Resrvd	Resrvd	927	Resrvd	Resrvd	977	Resrvd	Resrvd
828	Resrvd	Resrvd	878	Resrvd	Resrvd	928	Resrvd	Resrvd	978	Resrvd	Resrvd
829	Resrvd	Resrvd	879	Resrvd	Resrvd	929	Resrvd	Resrvd	979	Resrvd	Resrvd
830	Resrvd	Resrvd	880	Resrvd	Resrvd	930	Resrvd	Resrvd	980	Resrvd	Resrvd
831	Resrvd	Resrvd	881	Resrvd	Resrvd	931	Resrvd	Resrvd	981	Resrvd	Resrvd
832	Resrvd	Resrvd	882	Resrvd	Resrvd	932	Resrvd	Resrvd	982	Resrvd	Resrvd
833	Resrvd	Resrvd	883	Resrvd	Resrvd	933	Resrvd	Resrvd	983	Resrvd	Resrvd
834	Resrvd	Resrvd	884	Resrvd	Resrvd	934	Resrvd	Resrvd	984	Resrvd	Resrvd
835	Resrvd	Resrvd	885	Resrvd	Resrvd	935	Resrvd	Resrvd	985	Resrvd	Resrvd
836	Resrvd	Resrvd	886	Resrvd	Resrvd	936	Resrvd	Resrvd	986	Resrvd	Resrvd
837	Resrvd	Resrvd	887	Resrvd	Resrvd	937	Resrvd	Resrvd	987	Resrvd	Resrvd
838	Resrvd	Resrvd	888	Resrvd	Resrvd	938	Resrvd	Resrvd	988	Resrvd	Resrvd
839	Resrvd	Resrvd	889	Resrvd	Resrvd	939	Resrvd	Resrvd	989	Resrvd	Resrvd
840	Resrvd	Resrvd	890	Resrvd	Resrvd	940	Resrvd	Resrvd	990	Resrvd	Resrvd
841	Resrvd	Resrvd	891	Resrvd	Resrvd	941	Resrvd	Resrvd	991	824.04	869.04
842	Resrvd	Resrvd	892	Resrvd	Resrvd	942	Resrvd	Resrvd	992	824.07	869.07
843	Resrvd	Resrvd	893	Resrvd	Resrvd	943	Resrvd	Resrvd	993	824.10	869.10
844	Resrvd	Resrvd	894	Resrvd	Resrvd	944	Resrvd	Resrvd	994	824.13	869.13
845	Resrvd	Resrvd	895	Resrvd	Resrvd	945	Resrvd	Resrvd	995	824.16	869.16
846	Resrvd	Resrvd	896	Resrvd	Resrvd	946	Resrvd	Resrvd	996	824.19	869.19
847	Resrvd	Resrvd	897	Resrvd	Resrvd	947	Resrvd	Resrvd	997	824.22	869.22
848	Resrvd	Resrvd	898	Resrvd	Resrvd	948	Resrvd	Resrvd	998	824.25	869.25
849	Resrvd	Resrvd	899	Resrvd	Resrvd	949	Resrvd	Resrvd	999	824.28	869.28
850	Resrvd	Resrvd	900	Resrvd	Resrvd	950	Resrvd	Resrvd	1000	824.31	869.31

Chan	RX	TX	Chan	RX	TX	Chan	RX	TX	Chan	RX	TX
1001	824.34	869.34	1007	824.52	869.52	1013	824.70	869.70	1019	824.88	869.88
1002	824.37	869.37	1008	824.55	869.55	1014	824.73	869.73	1020	824.91	869.91
1003	824.40	869.40	1009	824.58	869.58	1015	824.76	869.76	1021	824.94	869.94
1004	824.43	869.43	1010	824.61	869.61	1016	824.79	869.79	1022	824.97	869.97
1005	824.46	869.46	1011	824.64	869.64	1017	824.82	869.82	1023	825.00	870.00
1006	824.49	869.49	1012	824.67	869.67	1018	824.85	869.85			

Note: RX = Mobile Transmit frequency
TX = Base Station Transmit frequency

Appendix B: Test forms

This section shows the test forms for the operational tests of a DualMode 800 Enclosure:

- Power and grounding checks
- HSMO checks
- Antenna checks
- DRU checks — Transmit tests
- DRU checks — Receive tests
- DRU checks — Digital tests

Power and grounding checks (Chapter 4)

Cell:	**Date:**	**Performed by:**

Frame voltage and polarity test	**Bay 1**	**Bay 2**	**Bay 3**
A Power: +27 Vdc ±0.5 Vdc			
B Power: +27 Vdc ±0.5 Vdc			

Bay 1 voltage check	**TRU Shelf 1**	**TRU Shelf 2**	**TRU Shelf 3**	**MCPA Shelf 1**	**ICRM**	**CSU**	**LVD 1**	**TCU 1**
A Power: +27 ±0.5 Vdc								
B Power: +27 ±0.5 Vdc								
Resistance to ground: <0.5 Ω								

Bay 2 voltage check	**TRU Shelf 4**	**TRU Shelf 5**	**TRU Shelf 6**	**MCPA Shelf 2**	**LVD 2**	**TCU 2**	**LVD 3 (Bay 3)**	**TCU 3 (Bay 3)**
A Power: +27 ±0.5 Vdc								
B Power: +27 ±0.5 Vdc								
Resistance to ground: <0.5 Ω								

Bay 3 voltage check	**TRU Shelf 7**	**TRU Shelf 8**	**TRU Shelf 9**	**MCPA Shelf 3**	**ACU**	**DCSM**	**HSMO**	**ERMC**
A Power: +27 ±0.5 Vdc								
B Power: +27 ±0.5 Vdc								
Resistance to ground: <0.5 Ω								

HSMO checks (Chapter 5)

Cell:	**Date:**	**Performed by:**

HSMO power level and frequency checks								
HSMO output	**Position 1**	**Position 2**	**Position 3**	**Position 4**	**Position 5**	**Position 6**	**Position 7**	**Position 8**
Power level: -1 dBm ±3 dB								
Frequency: 4.8 MHz ±1.2 Hz								
HSMO output	**Position 9**	**Position 10**	**Position 11**	**Position 12**	**Position 13**	**Position 14**	**Position 15**	**Position 16**
Power level: -1 dBm ±3 dB								
Frequency: 4.8 MHz ±1.2 Hz								

Antenna checks (Chapter 6)

Cell:	**Date:**	**Performed by:**

Antenna		**TX/RX 1**	**TX/RX 2**	**TX/RX 3**	**RX 1**	**RX 2**	**RX 3**
DC continuity (Resistance—center pin to shield): ≤0.5 Ω							
DC continuity (Resistance—shield to principle ground): ≤0.5 Ω							
Antenna return loss: >14.5 dB + 2 TX line loss	824 - 849 MHz						
	869 - 894 MHz						
Antenna return loss (Thruline wattmeter): Reflected power <4% of forward power							

DRU checks — Transmit tests (Chapter 11)

Cell:	**Date:**	**Performed by:**
RF Frame:	**TRU Shelf:**	

TRU transmit tests	**TRU 1**	**TRU 2**	**TRU 3**	**TRU 4**	**TRU 5**	**TRU 6**	**TRU 7**	**TRU 8**
Serial number:								
Channel number:								
TX frequency (MHz):								
EEPROM CRC check:								
TX carrier frequency error: -220 to +220 Hz								
Wideband modulation: Deviation 7.2 to 8.8 kHz								
SAT at 5970 Hz: Frequency 5965 to 5975 Hz Deviation 1.8 to 2.2 kHz								
SAT at 6000 Hz: Frequency 5995 to 6005 Hz Deviation 1.8 to 2.2 kHz								
SAT at 6030 Hz: Frequency 6025 to 6035 Hz Deviation 1.8 to 2.2 kHz								
Residual modulation: Deviation -0.5 to +0.5 kHz								
Transmit audio level: Deviation 2.61 to 3.19 kHz								
Modulation limiting: Deviation less than 12 kHz								
1 kHz tone generation test: Frequency 999 to 1001 Hz Deviation 7.2 to 8.8 kHz								
Transmit carrier power measured at antenna port of duplexer								
Per channel power level: Within site specifications								

DRU checks — Receive tests (Chapter 11)

Cell:	**Date:**	**Performed by:**
RF Frame:	**TRU Shelf:**	

TRU receive tests	**TRU 1**	**TRU 2**	**TRU 3**	**TRU 4**	**TRU 5**	**TRU 6**	**TRU 7**	**TRU 8**
Serial number:								
Channel number:								
RX frequency (MHz):								
EEPROM CRC check:								
Receive sensitivity (Level): Less than -105 dBm								
RX/TX audio sensitivity: Deviation 2.6 to 3.2 kHz								
Receive audio level: Level -17.0 to -19.0 dBm								
RSSI curve: Input (dBm) — RSSI (dBm) -60 — -66 to -76 -70 — -76 to -86 -80 — -86 to -96 -84 — -90 to -100 -90 — -96 to -106 -100 — -106 to -116								
SAT detect 5970 Hz (level lost all): Less than -105 dBm								
SAT detect 6000 Hz (level lost all): Less than -105 dBm								
SAT detect 6030 Hz (level lost all): Less than -105 dBm								
ST detect 10 kHz (level lost all): Less than -105 dBm								

DRU checks — Digital tests (Chapter 11)

Cell:	**Date:**	**Performed by:**
RF Frame:	**TRU Shelf:**	

TRU digital tests	**TRU 1**	**TRU 2**	**TRU 3**	**TRU 4**	**TRU 5**	**TRU 6**	**TRU 7**	**TRU 8**
Serial number:								
Channel number:								
Bit Error Rate measure: Less than 6000 in 1,000,000								
TDMA modulation accuracy								
I/Q offset: Less than -30 dBc								
Frequency error: +220 to -220 Hz								
RMS EVM: Less than 12.5%								
Digital call completed								
Clear audio: (Yes or no)								

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Wireless Solutions

DualMode 800 Enclosure Maintenance Manual

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