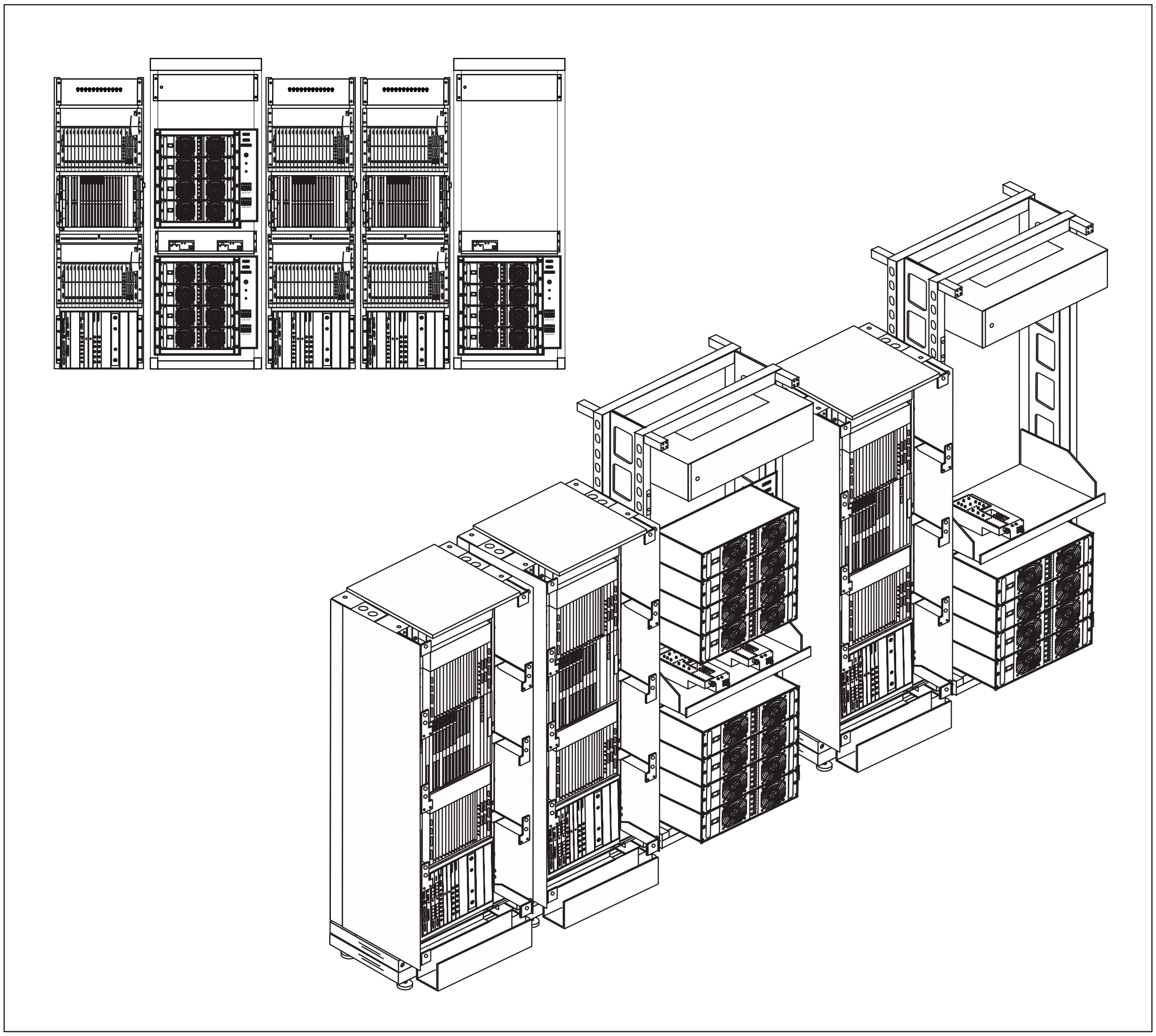
# RBS 884 Macro with MCPA, 1900 MHz

## PRELIMINARY User Guide (NOT FOR OPERATION)



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**The contents of this document are subject to revision without notice due to continued progress in methodology, design, and manufacturing.**

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*Part 1*

# Introduction

This section describes the information contained in the manual and the conventions used in its presentation.

# 1 Reason for Reissue

This is the first issue of this user guide.

# 2 About this User Guide

The target audience for the user guide is Radio Base Station (RBS) site installation, site testing, and site maintenance personnel.

This manual contains the information required to install, troubleshoot, and maintain the RBS 884 Macro with MCPA, 1900 MHz hardware.

## 2.1 User Guide Contents

It is assumed that before the user guide is used to perform any activities at a radio base station site, telephone transmission facilities, alternating current (AC) electrical line power, and grounding have been made available. Ensure the antenna system is installed.

When the radio base station equipment has been installed using the information in this manual, it will be left powered up ready for integration into the network by personnel at the Mobile Services Switching Center (MSC).

This user guide is divided into the following parts:

- Introduction – a description of the contents of the manual and how the manual can be used.
- General Product Information – a description of the various systems, platforms, and enclosures within the RBS 884 family of Radio Base Stations.
- System Description – a description of the hardware and functions of the RBS 884 Macro with MCPA, 1900 MHz equipment.
- Installation – procedures for the installation of the RBS equipment on the site.
- Administration – procedures for

- Integration and Verification– procedures for
- Operations and Maintenance– procedures for
- Troubleshooting – provides LED indications.
- Hardware Replacement – procedures for basic troubleshooting and replacement of equipment suspected to be faulty.
- Glossary of Terms – definitions of key terms used in the manual.
- Acronyms and Abbreviations – expanded versions of all of the acronyms and abbreviations used in the manual.
- Appendix A, RF Guidelines.
- Appendix B, Documentation Overview.
- Appendix C, User Feedback.
- Appendix D, Conversion Table

Many of the procedures in the user guide require site-specific data from the *Site Installation Documentation* relating to the particular radio base station site where the installation is to take place. This documentation should be available at the site.

The procedures in the user guide for installation and maintenance are normally intended to be performed sequentially, in the order presented.

# 3 How to Use The User Guide

This user's guide contains information required to install, test, operate, and troubleshoot the RBS 884 Macro with MCPA, 1900 MHz system. Prior to beginning a specific task or operation, do the following:

- Read the related Part or Appendix.
- Verify that all required materials and tools are available.
- Observe all dangers, warnings, and cautions for the task or operation.

The following document conventions apply to this user's guide: admonishments and typefaces. The admonishments alert the user to hazardous or damaging actions. The typefaces emphasize text to enhance the use of this user guide.

- **Admonishments**

  – **Danger** indicates that death or critical injury to the person or persons performing a task can result if procedures are not followed correctly.

  – **Warning** indicates that equipment can be seriously damaged, resulting in equipment or system failure or service interruption, if procedures are not followed correctly.

  – **Caution** indicates potential damage to the equipment, system, or data if procedures are not followed correctly.

- **Typefaces**

  Typeface indicates software menu selections that must be typed (entered) by the user.

  – **Bold** typeface emphasizes headings, admonishments, trademarks, and examples of command names.

  – *Italics* typeface indicates a reference to additional information provided in another section or document.

*Part 2*

# General Product Information

# 1 Introduction

The *General Product Information* provides general information on unconfigured radio base stations. Refer to the *RBS 884 Site Engineering Manual* for descriptions of the available working base station configurations and for information on RBS interfaces (for instance, power, transmission, and antennas).

# 2 Features

The RBS 884 Series is a series of products in the CMS 8800 family. The products in the RBS 884 Series are fully featured modular RBSs for both the analog AMPS EIA 553 and the digital D-AMPS EIA IS 136 systems (Advanced Mobile Phone System Electronics Industry Association 553 system and Digital American Mobile Phone System Electronics Industry Association Interim Standard 136 system).

A base station in the RBS 884 Series can support one, two, or three cells. A cell is a defined area covered by one antenna system, and each cell has one control channel for digital or one for analog, or both. There is one cell at an omni site, and one to three cells at a sectorized site.

The RBS 884 Series utilizes multi-mode, multi-functional transceivers (TRXs). The same hardware TRX module can be used for analog and digital voice, control and monitoring purposes.

The hot repair capability allows replacement of defective units when power is still applied.

The RBS 884 Series is designed for remote control monitoring allowing control and fine tuning of all functions and parameters, such as power output, frequencies, and switching of redundant units from the MSC.

A Radio Frequency Test Loop (RFTL) is an optional feature that enables precise output power settings, Voltage Standing Wave Ratio (VSWR) alarm, and Receive Signal Strength Indicator (RSSI) test measurements.

The device software is stored in non-volatile memory within the RBS, and the control part software is downloaded from the MSC, which ensures a short time to service at power-up.

# 3 Product Lines

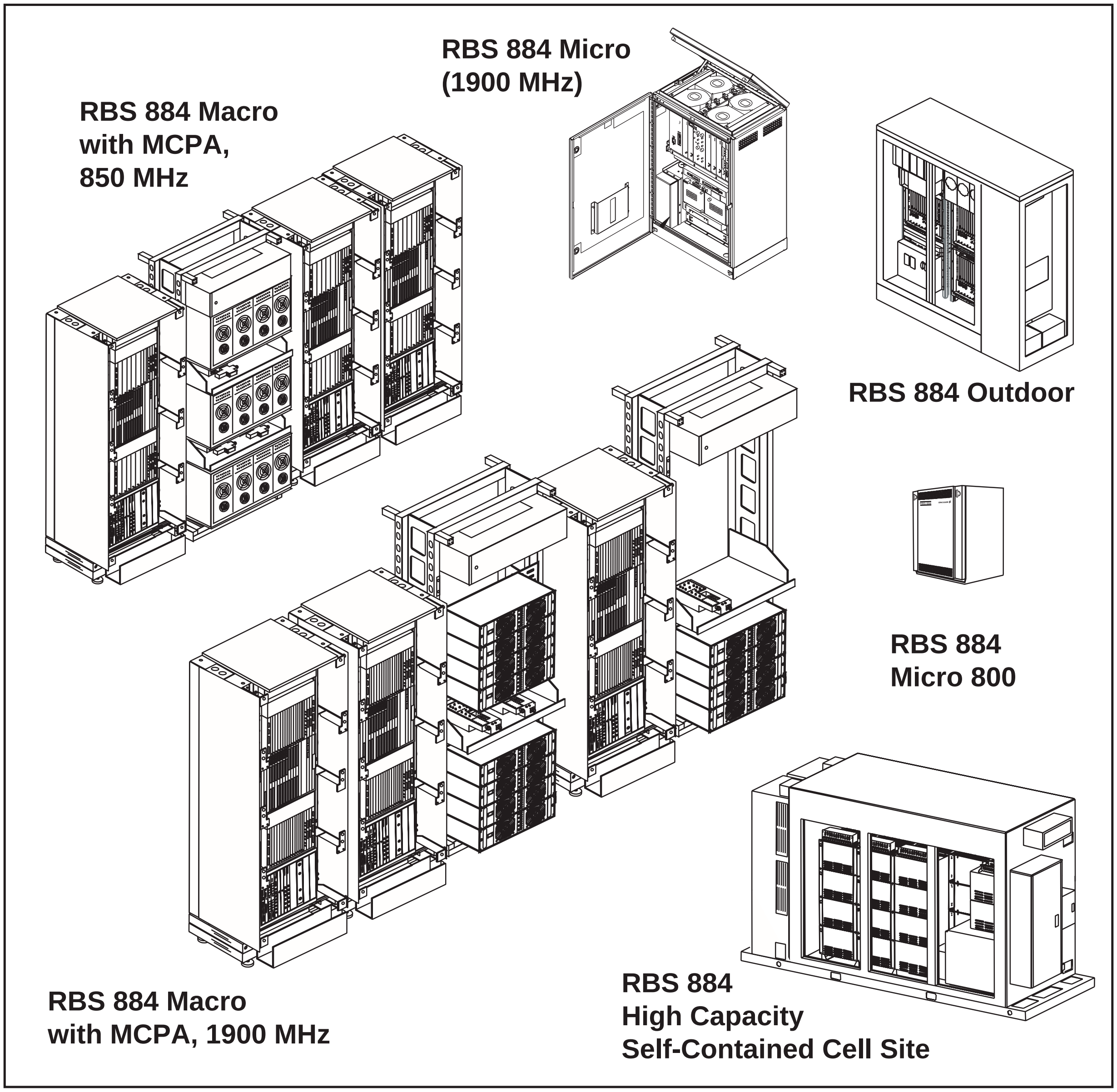


*Figure 2-1. Product Lines in the RBS 884 Series*

The RBS 884 Series includes product lines for macro and micro cells. See Figure 2-1 on page 2-4.

Note: The maximum number of carriers for each sector stated is the technical limitation for the defined standard configurations. The practical usable sector sizes may be limited by the frequency plan. The capacity of all product lines, with the exception of the RBS 884 Micro (1900 MHz) is calculated for analog systems. The capacity of the RBS 884 Micro (1900 MHz) is calculated for digital systems. See the integration information in the *RBS 884 Operations and Maintenance Manual* for system limitations in digital systems.

## 3.1 RBS 884 Macro

The macro cell products are intended for normal indoor installations and are built on-site with a number of cabinets of uniform size and design.

The **RBS 884 Macro 850 MHz** supports TDMA. This system operates at 824–894 MHz and provides up to 78 low power or medium power transceivers (3x24 carriers), or up to 96 high power and 6 low power transceivers (3x32 carriers).

The **RBS 884 Macro 1900 MHz** supports TDMA and operates at 1850–1990 MHz (A-, B-, or C-band). It provides up to 48 medium power transceivers (3x15 carriers).

A special configuration, High-Capacity Self Contained Cell Site (HC-SCCS), providing up to 31 transceivers in three sectors (3x31 carriers), can be installed in an outdoor container.

The **RBS 884 Macro DBC (Down Banded Cellular)** supports TDMA and is applicable to frequencies at 806–860 MHz. Up to 39 medium power transceivers (3x12 carriers) can be used in one installation.

The **RBS 884 Macro PACS (4-High)** is an RBS 884 Macro Pre-Assembled Cell Site (PACS) that supports 1900 MHz and 850 MHz TDMA using single-sector (omni-site) modules. Multi-sector systems can be configured using two or three omni-site modules. Each module consists of two racks with four cabinets in each rack. The Macro PACS (4-High) system is available in 1900 MHz medium power, 1900 MHz QUAD, 850 MHz medium power, and 850 MHz high power.

The **RBS 884 Macro with MCPA** is an RBS 884 Macro Pre-Assembled Cell Site (PACS) that supports 1900 MHz and 850 MHz TDMA using single-sector (omni-site) modules. The system uses a hybrid combiner and multi-carrier power amplifiers. Multi-sector systems can be configured using two or three omni-site RBS modules.

## 3.2 RBS 884 Micro

The RBS 884 Micro products are used wherever local capacity or coverage is required.

The **RBS 884 Micro 850 MHz** is intended for indoor installation, and typical applications include convention centers, office buildings, parking areas and tunnels. The RBS 884 Micro comprises one small main cabinet and two possible expansion cabinets of the same size. It is a completely functional cell, with a drop and insert transmission interface and RF equipment built-in. Up to 10 1.5W transceivers can be used in one cabinet (8 carriers). Up to 30 transceivers can be provided with two auxiliary cabinets (24 carriers). This gives a total capability of up to 23 analog or 68 digital voice channels (71 with E1 PCM links).

The **RBS 884 Micro with Multi Carrier Power Amplifier (MCPA) (850 MHz)** supports TDMA and operates at 824–894 MHz. It is a standard RBS 884 Micro (850 MHz) equipped with a MCPA for higher output power in one cell. The MCPA is a separate cabinet mounted below the RBS 884 Micro (850 MHz) cabinet. Up to three RBS 884 Micro (850 MHz) cabinets and one MCPA can be mounted in a 19-inch rack cabinet. An RBS 884 Micro with MCPA (850 MHz) can provide up to 23 analog or 68 digital voice channels (71 with E1 PCM links) in one cell.

The **RBS 884 Micro Outdoor (850 MHz)** supports TDMA and operates at 824–894 MHz. Designed for outdoor use, it is contained in an all-weather steel enclosure with an environmentally-controlled interior and can be installed in a wide variety of locations and climatic zones. The RBS 884 Micro (850 MHz) can be provided with up to 26 transceivers and a total of 24 carriers. This provides a total capacity of up to 23 analog or 68 digital voice channels (71 with E1 PCM links).

The **RBS 884 Micro (1900 MHz)** supports TDMA and operates at 1850–1910 MHz. The RBS 884 Micro (1900 MHz) is a self-contained base station intended primarily for outdoor use. The cabinet is cooled directly with outdoor air, using a combination of variable speed blowers and a variable power heater to maintain the cabinet air temperature within equipment operating limits. Typical applications include hot spot areas within mature 1900 MHz networks and areas not covered by the RBS 884 Macro. The RBS 884 Micro (1900 MHz) is comprised of one small main cabinet and up to two auxiliary primary cabinets of the same size. The cabinets can be easily mounted on poles, on the sides of buildings, on rooftops, or on concrete pads. The RBS 884 Micro (1900 MHz) is a complete functional cell, with a drop and insert transmission interface and built-in RF equipment. Up to 5 transceivers can be used in one cabinet providing 4 carriers. Up to 15 transceivers can be used in a three-cabinet installation providing 3x4 carriers. The three-cabinet installation allows up to 33 digital traffic channels.

***Part 3***

# System Description

# 1 Introduction

This section provides an overview of the RBS 884 Macro with MCPA, 1900 MHz radio base station (RBS). Areas covered include system architecture, configuration, functional units and technical specifications.

This RBS supports digital TDMA and operates at 1850–1990 MHz (divided into 6 sub-bands) and is part of the Mobile Base Station (MBS) subsystem. It handles the communication between a Mobile Switching Center (MSC) and Mobile Stations (MSs). This radio base station also supervises the quality of radio transmission during a call in progress. The MBS consists of hardware and software located in the MSC as well as in the RBS.

The Macro with MCPA, 1900 MHz system is available in the following configurations:

- 1, 2, and 3 Sector x 15 carriers
- 1, 2, and 3 Sector x 23 carriers
- 1, 2, and 3 Sector x 31 carriers

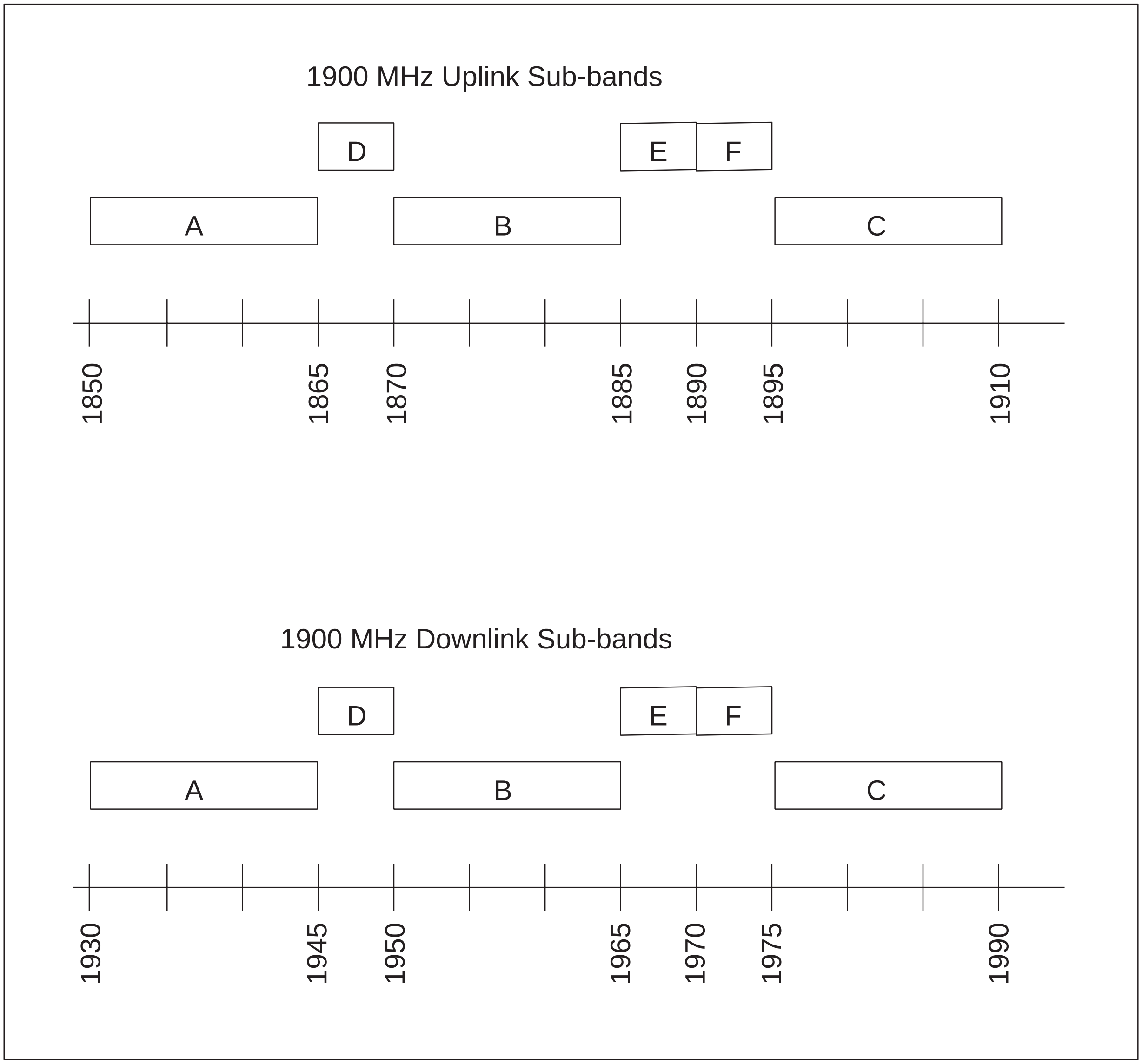


*Figure 3-1. 1900 MHz Sub-Band Spectrum*

# 2 System Architecture

The Macro with MCPA, 1900 MHz controls and handles communication between the MSC and the mobile stations. The configuration of the equipment in a specific system depends on the following:

- Number of sectors
- Number of voice channels in each sector
- Transmit power

- Number and type of antennas
- System mode (analog, digital, or both)

Figure 3-2 on page 3-5 shows the main RBS connections.

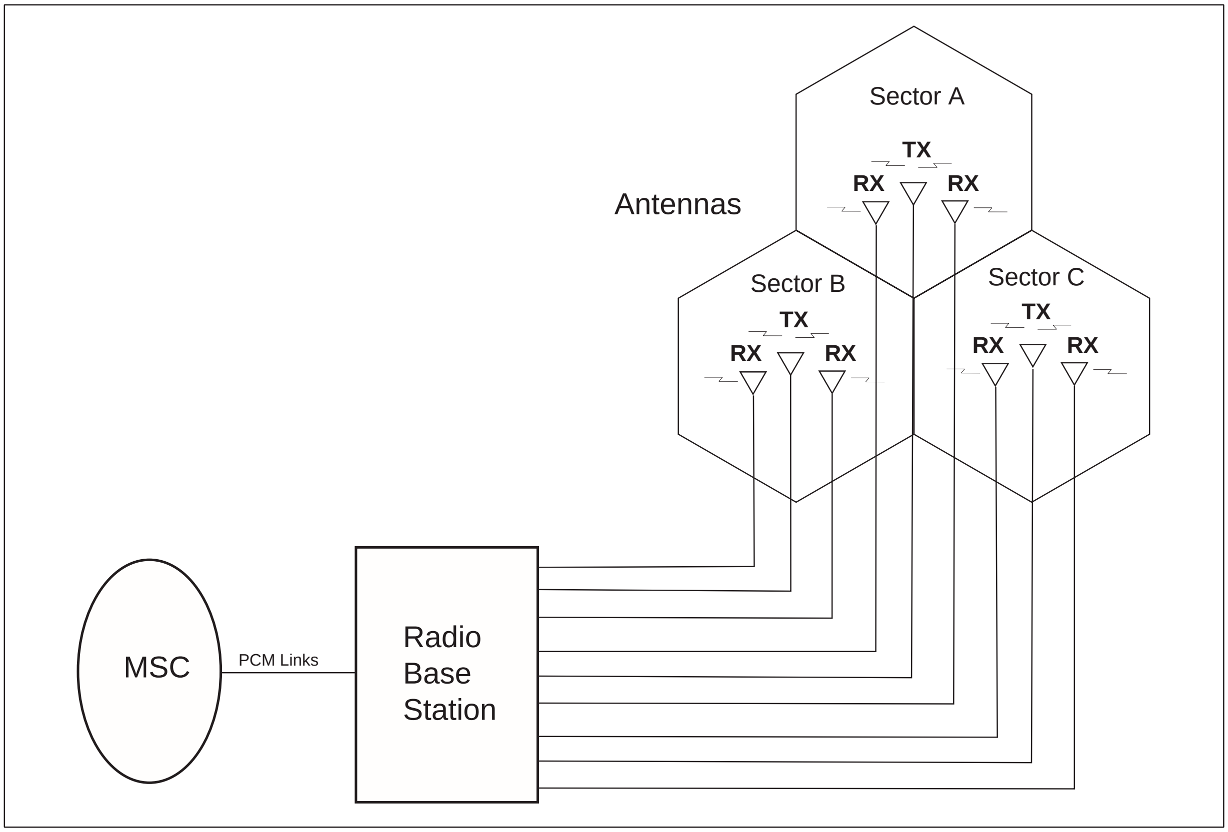


*Figure 3-2. General Overview of RBS 884 Configuration*

Figure 3-3 on page 3-6 shows the primary components of the MSC and RBS.

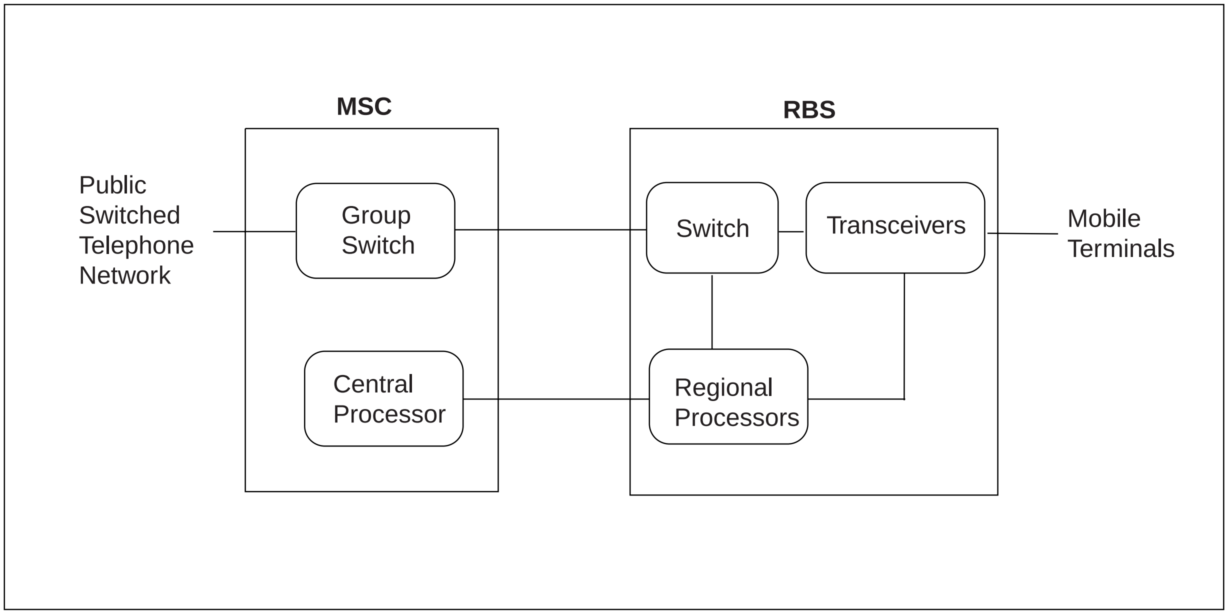


*Figure 3-3. General Overview of RBS 884 Configuration*

The Group Switch (GS) at the MSC is responsible for switching calls between subscriber terminals. The calls can be between two mobile subscribers or between a mobile subscriber and a subscriber in the public telephone network. The RBS contains several regional processors which are controlled by and work with the central processor. The regional processors control the switch and the transceivers (TRXs) in the base station. The switch in the base station ensures the speech signals from the MSC are connected to the correct TRX. The TRXs generate RF that is emitted by the base station antenna to the mobile terminals. The semipermanent connections are set up in the MSC.

Figure 3-4 on page 3-7 shows the logical parts of an RBS.

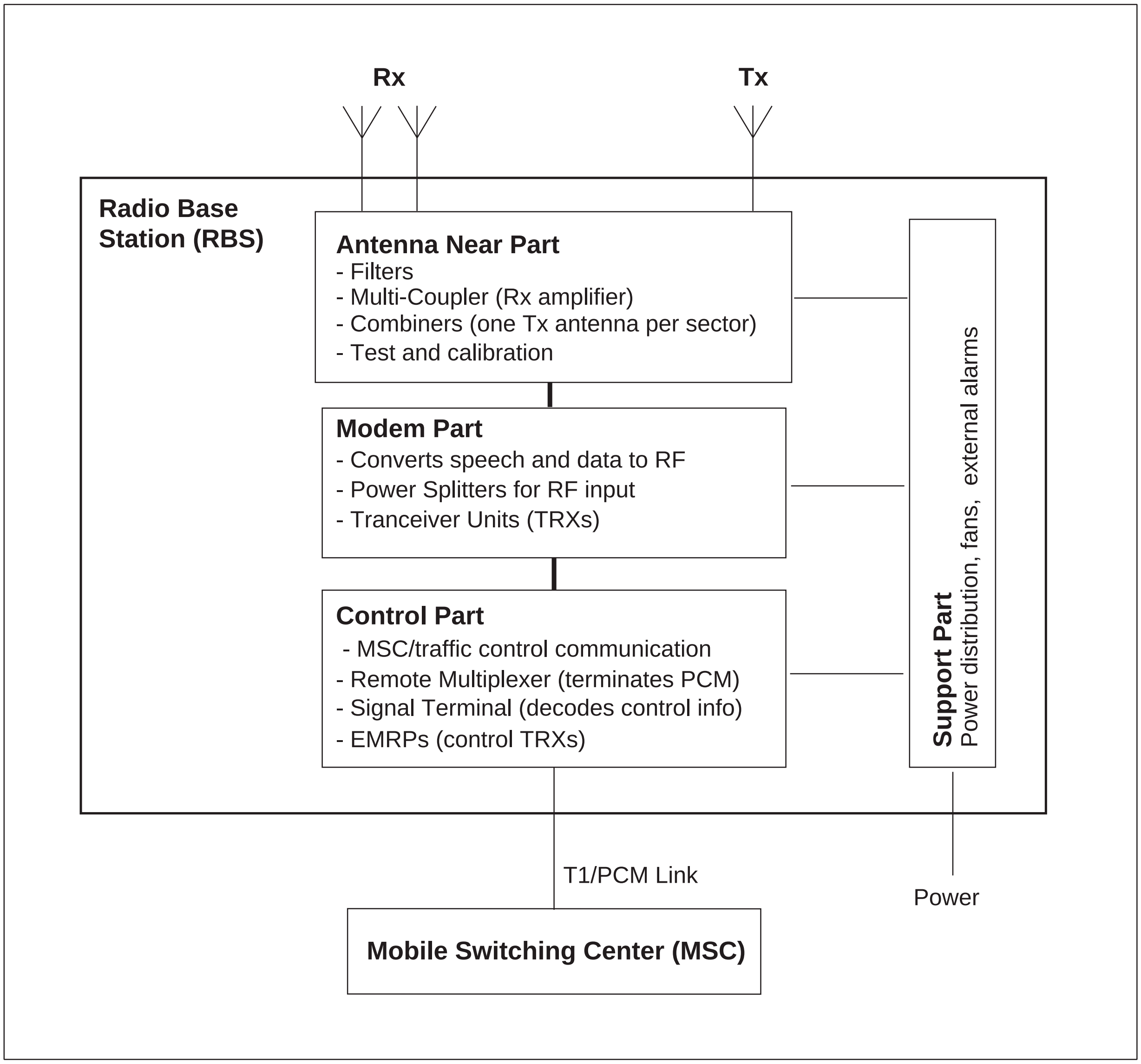


*Figure 3-4. Block Diagram of a Radio Base Station*

The logical parts of the RBS 884 Macro are as follows:

- Control Part (COP) – provides communication between the MSC and the RBS hardware for radio traffic control and statistical data gathering. In the RBS 884 Macro, the COP consists of Control and Radio Interface (CRI) cabinet.
- Modem Part (MOP) – converts digitized speech and data into radio frequency signals, hosts channel coding and decoding functions, and performs measurements on radio transmission quality. It is comprised of transceiver modules (TRXs) in the RBS and voice coders (TRABs) in the MSC. In the RBS 884 Macro, the MOP consists of the Transceiver cabinet (TCB).
- Antenna Near Part (ANP) – contains components associated with the RF signal paths, such as combiners, power splitters, multicouplers,

and bandpass filters. In the RBS 884 Macro with MCPA the ANP consists of the Antenna Near Part Cabinet (ANPC) and the Hybrid Combiner Cabinet (HCC). The combined ANP/RFTL/Filter unit provides RSSI measurement, output power measurement and calibration, VSWR supervision, and RF path testing. The main functions of the ANP are as follows:

- Combine multiple TRX output signals to a single TX antenna
- Filter TX and RX signals
- Pre-amplify and distribute RX signals
- Protect TRXs from reflected power
- Provide isolation between the TRXs
- Calibrate and supervise the TRXs and associated RF components

• Support Part (SP) – provides general support, such as power supply and cooling. The components of this part vary significantly between the product lines.

# 3 RBS Overview

The Macro with MCPA, 1900 MHz is a modular RBS that supports digital Time Division Multiple Access (TDMA). The RBS is an omni-site consisting of one standardized 19” rack of radio equipment and one 24” rack with MCPAs. Additional RBS equipment racks are combined a to form two- and three-sector systems.

## 3.1 Functional Overview

Figure 3-5 on page 3-9 is a functional block diagram of the Macro with MCPA.

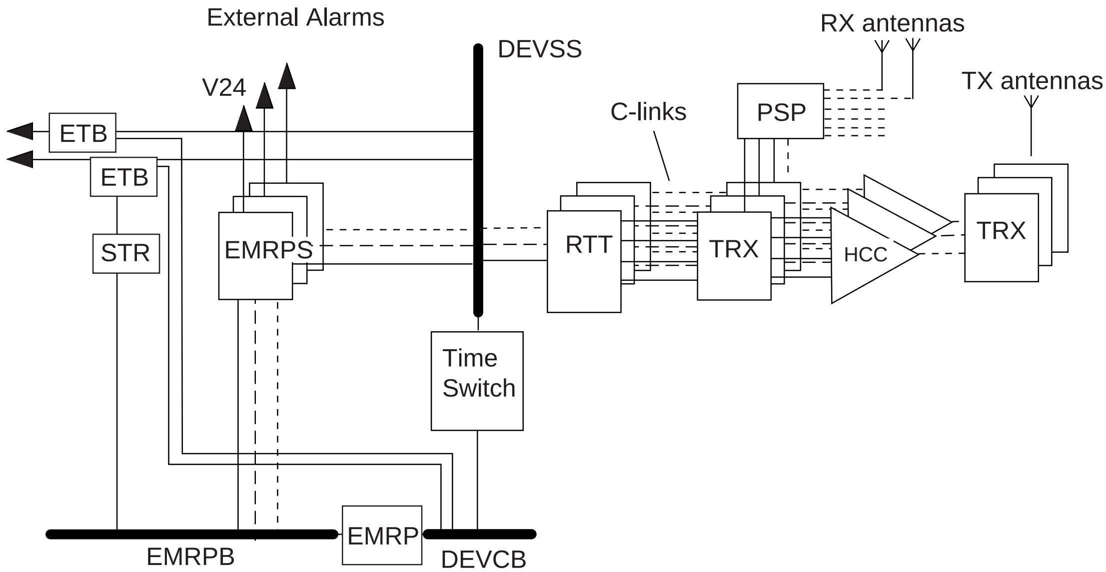


*Figure 3-5. Macro with MCPA, 1900 MHz*

Figure 3-6 on page 3-10 is an example of the units and their interaction in the Control Radio Interface (CRI) cabinet and Transceiver Cabinet (TCB).

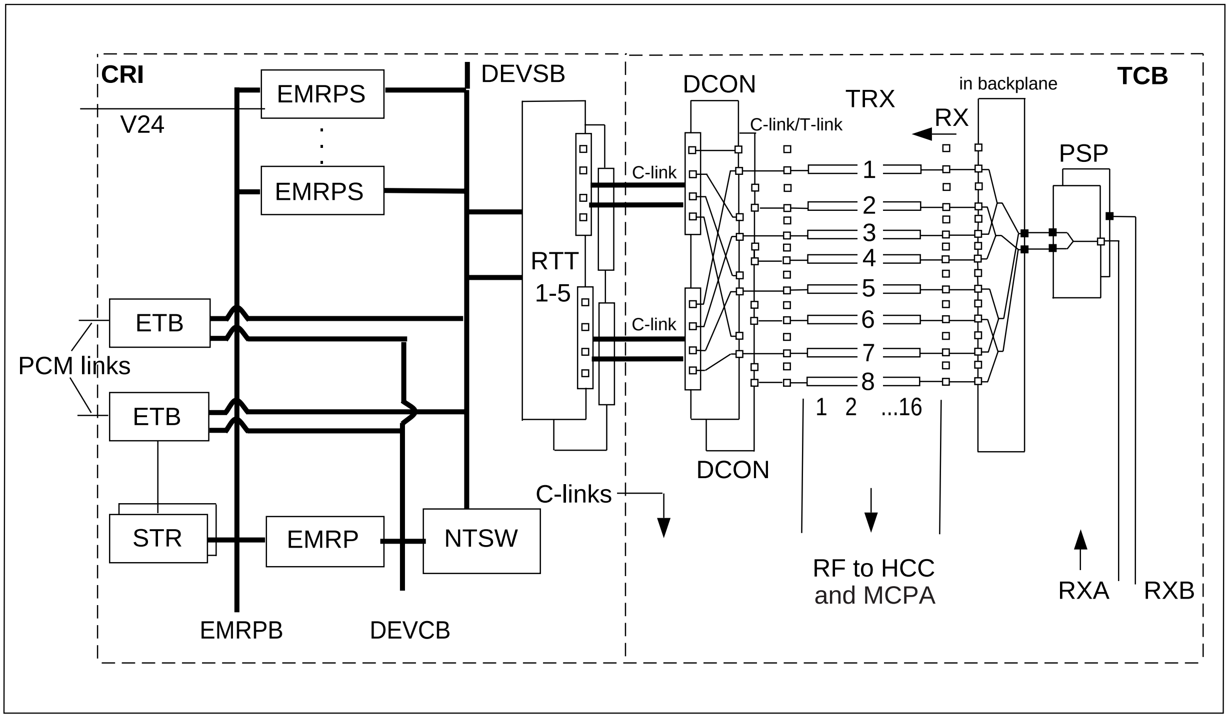


*Figure 3-6. CRI and TCB Functional Block Diagram*

The Exchange Terminal Boards (ETBs) end the PCM links and connect the RBS to the MSC. The control signals for the RBS are carried on one time slot of the PCM link, and are ended by the Signal Terminal Receiver (STR).

A set of Extension Module Regional Processor Speech Bus Interfaces (EMRPSs) is used to control the devices on a load sharing basis. Communication Links (C-links) connect device equipment (TRX, ALM, RFTL, and TIM) to the Radio Transceiver Terminals (RTTs).

A Node Clock Time Switch (NTSW) connects control paths from the EMRPSs to the devices. The time switch also routes the traffic data on paths set up between a time slot on an ETB and a device connected to an RTT. The time switch is controlled by a dedicated EMRP.

The received RF signal is split to all Transceiver modules (TRXs) by the Power Splitters (PSPs) and the Power Splitter backplane in the Transceiver Cabinet (TCB).The RF output from the TRXs are connected to the HCC.

Figure 3-7 on page 3-11 is an example of unit interaction in the HCC and ANPC. The configuration shows separate receive and transmit antennas.

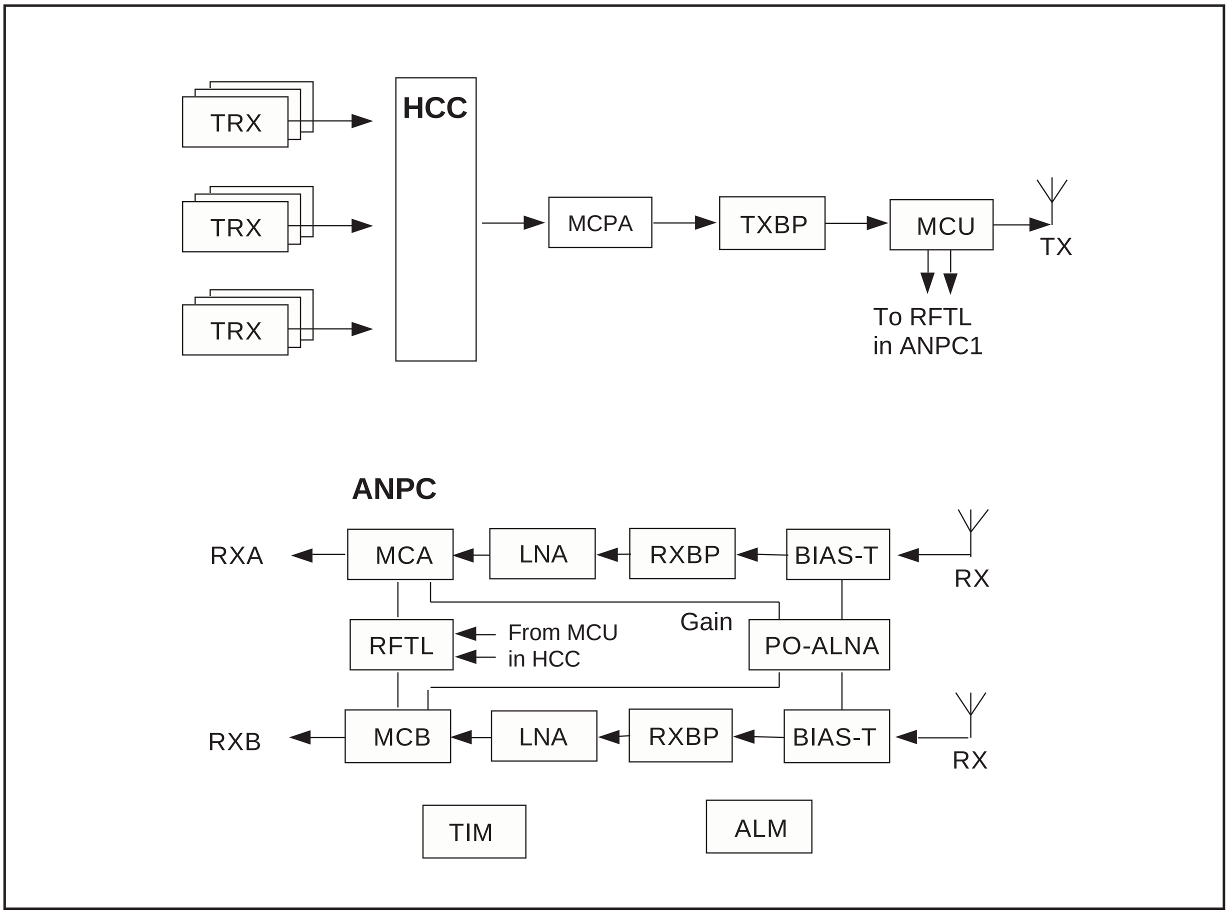


*Figure 3-7. HCC and ANPC Functional Block Diagram*

The receive antenna signal input is first passed through a Receiver Bandpass filter (RXBP). It is then fed to the Multicoupler A (MC A) and B (MC B) units, where the signal is amplified to compensate for Power Splitter (PSP) losses. The multicouplers also receive signals from the Radio Frequency Test Loop (RFTL) unit so that the receive path can be tested. Multicoupler outputs are fed to the PSPs, which distribute the signals to the TRXs through the TCB backplane. Each TRX receives both A- and B-branch receive signals and demodulate the signals to baseband.

TRX transmit outputs are connected to the combiners where they are combined into one signal. This signal is directed to the MCPA, Transmitter Bandpass (TXBP) filter, and Measurement Coupler Unit (MCU), after which it is output to the antenna. The MCU acts as an interface to the Radio Frequency Test Loop (RFTL), which performs various tests on the RF signals, such as measuring forward and reflected power.

## 3.2 Call Paths

### 3.2.1 Receive Path

As shown in Figure 3-8 on page 3-12, the received signal is passed through the Receiver Bandpass (RXBP) filters in the TMAs (if used) and ANPC. The signals are fed to MCUs, MC-A, and MC-B, that amplify the signal to compensate for Power Splitter (PSP) losses. The MCs also receive signals from the Radio Frequency Test Loop (RFTL). The MC outputs are fed to the PSPs which distribute the signals through the TCB backplane to the TRXs. Each TRX receives both A- and B-branch receive signals and demodulate the signals to baseband. Nominal gain from the receive antenna is 5.2 dB (6.5 dB with a TMA).

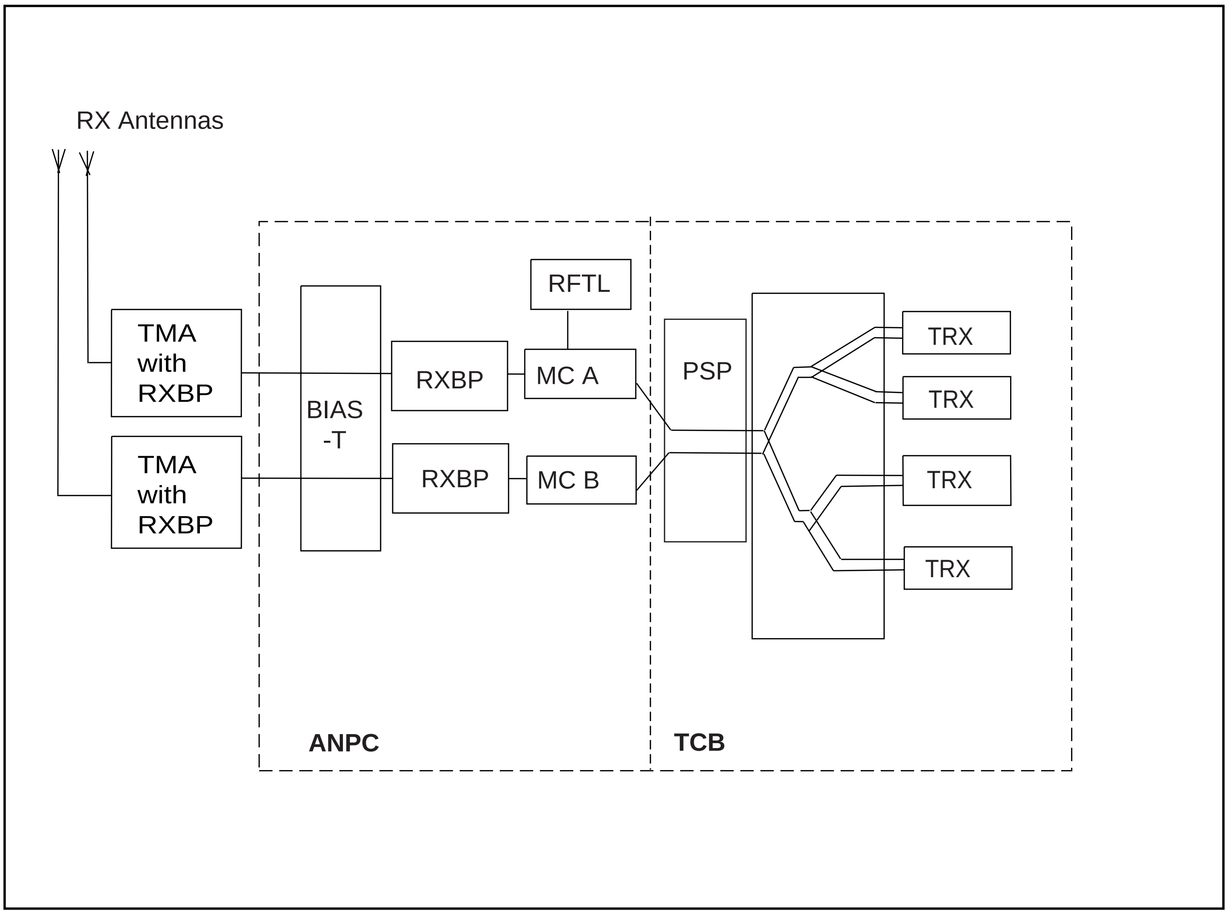


*Figure 3-8. Macro with MCPA, 1900 MHz Receive Path*

### 3.2.2 Transmit Path

As shown in Figure 3-9 on page 3-13, TRX transmit outputs are connected to the HCC which combines the signals into a single output. The signal is passed through the MCPA, TXBP filter, and MCU. The MCU provides an interface to the RFTL for measuring forward and reflected power. The signal is tranmitted to the TMA (if installed) and then to the tranmit antenna.

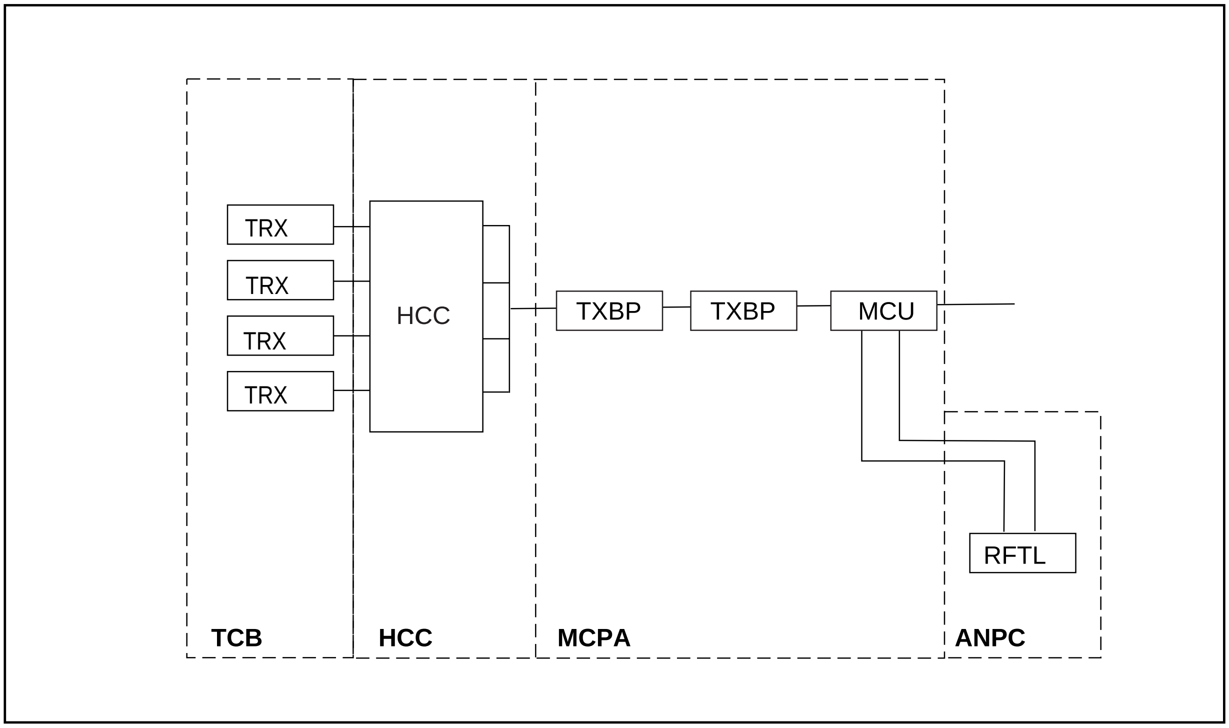


*Figure 3-9. Macro with MCPA, 1900 MHz Transmit Path*

## 3.3 Signaling

### 3.3.1 Control Signaling

Control signaling for RBS equipment is as follows:

- The MSC Central processor (CP) sends the control signal to the Signaling Terminal Central (STC) board.
- The STC board converts the signal format and sends the signal to the Exchange Terminal Circuit (ETC).
- The ETC inserts the control signal into a time slot on the PCM (T1) link to the Control Radio Interface (CRI).
- The control signal in the time slot is extracted by the Exchange Terminal Board (ETB) and sent to the Signaling Terminal Regional (STR).
- The STR converts the information back to processor format and outputs it on the Extension Module Regional Processor Bus (EMRPB).
- The EMRPB and the Extension Module Regional Processor with Speech Bus (EMRPS) boards are connected to the EMRPB.

- The EMRP controls equipment in the CRI cabinet including the Node Clock Time Switch (NTSW) and ETB boards
- The EMRPS is an EMRP with extended processor power and a speech bus interface. It is connected to both the EMRP bus and the TSW speech bus and controls equipment in the TCB and ANPC. These boards also facilitate communication with the MSC's Man-Machine Interface (MMI) by providing a V.24 interface for a teletype or Typewriter (TW) peripheral.

### 3.3.2 Speech Signaling

Speech signaling for RBS equipment is as follows:

- A speech or data signal from the Public Telephone Switching Network (PSTN) is received by the group switch (GS) at the MSC
- A digital call is:
  - Routed to the Transcoder and Rate Adaptation Board (TRAB)
  - Converted into compressed format used in the air interface either with Algebraic Code Excited Linear Prediction (ACELP) or Vector Sum Excited Linear Prediction (VSELP)
  - Combined with two other voice paths which share same frequency
  - Routed to the correct Exchange Terminal Circuit (ETC)
- The signal is sent over a T1 line to the Control and Radio Interface (CRI) where it is:
  - Routed to an Exchange Terminal Board (ETB)
  - Routed through the Time Switch (TSW)
  - Routed to a Radio Transceiver Terminal (RTT), which is an interface to a transceiver (TRX) in the Transceiver Cabinet (TCB) via a Communication Link (C-link)
- In the TCB the signal is passed through a Transceiver (TRX) where it is :
  - Converted to RF
  - Sent to the Hybrid Combiner (HCC)
- In the HCC, signals are combined 16:1 and then combined 2:1 (32:1) and sent to the MCPA
- The MCPA sends the signal to the TXBP and MCU where it is sent to the ANPC
- In the ANPC, RF is coupled to the antenna(s)

## 3.4 Synchronization

The Macro with MCPA, 1900 MHz platform provides the following synchronization:

- Network Synchronization
- Carrier Frequency Synchronization
- Air Frame Synchronization

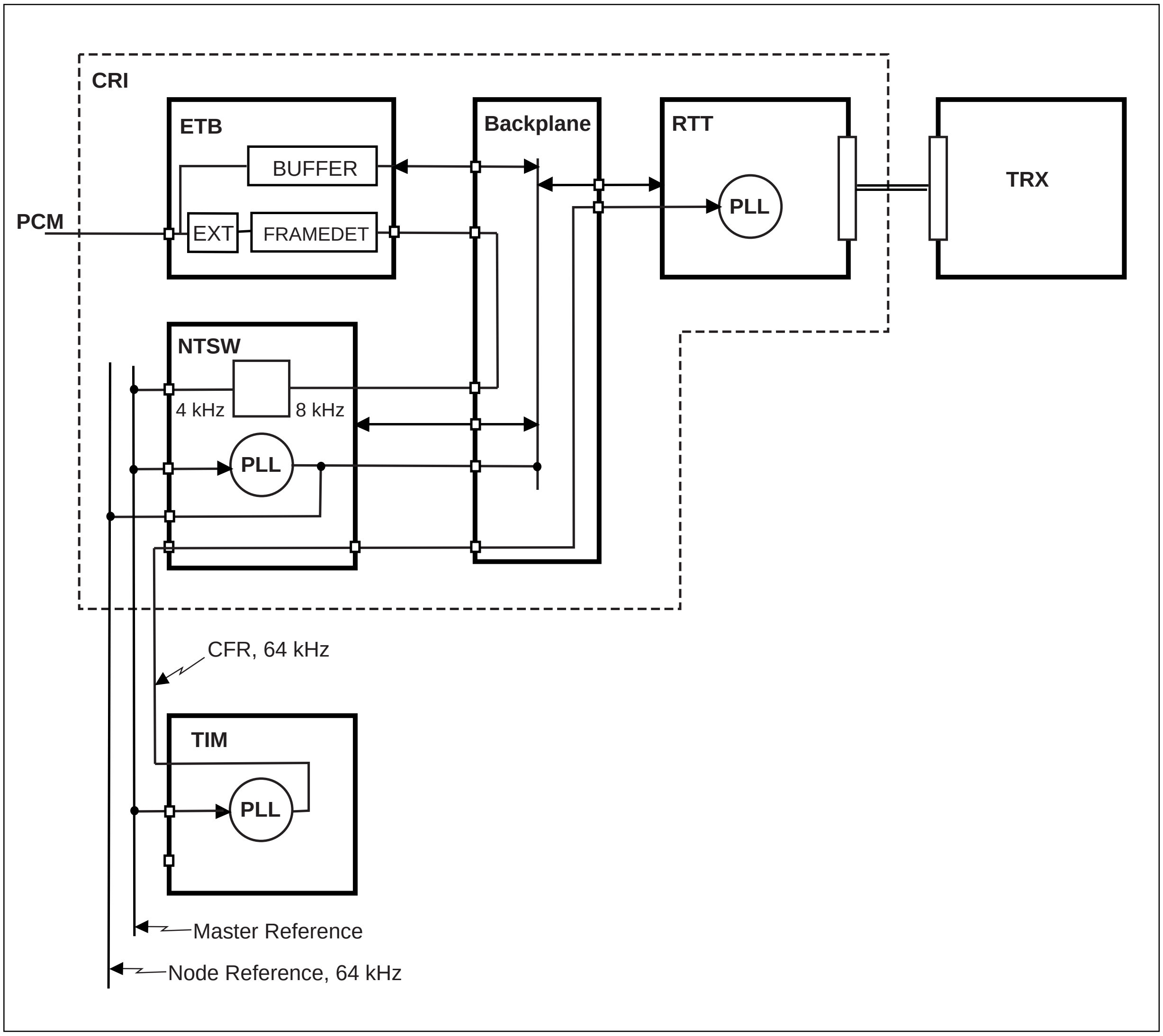


*Figure 3-10. Macro with MCPA, 1900 MHz Synchronization*

### 3.4.1 Network Synchronization

Network Synchronization is provided by the ETB with buffers and the NTSW clock for error-free transmission of data to and from the MSC. The clock is locked to the reference signal provided from the MSC. The signal is superimposed on the traffic link connecting the RBS to the MSC. Using this signal, the ETB creates a synchronization clock with a frequency of 8 kHz.

### 3.4.2 Carrier Frequency Synchronization

Carrier Frequency Synchronization is provided by the NTSW and TIM. The 8 kHz clock is scaled down to 4 kHz by the NTSW into a Master Reference (MR) signal (see Figure 3-10 on page 3-15). The MR is used by the TIM to generate a 64 kHz Carrier Frequency Reference (CFR) that is distributed to the TRXs via the RTTs and the C-Links.

Carrier Frequency Stabilization is handled by the TIM and holdover is at least 72 hours after a loss of the synchronization signal on the network. To obtain carrier frequency accuracy, the reference signal must be traceable to a source of Stratum 2 level or better.

### 3.4.3 Air Frame Synchronization

Air Frame Synchronization phase aligns all air frames transmitted from the RBS. The TIM provides the synchronization that is distributed to each TRX. The DCON board provides daisy-chain connections between TCBs.

## 3.5 CRI and PCM Link Configuration (T1)

The Extension Module Regional Processor (EMRP) bus is the local comunication link between the regional processors (RPs) and the Signal Terminal Regional (STR). The STR and the Signal Terminal Central (STC) in the MSC make up the control link between any RP and the central processor (CP).

The CRI can be configured with two EMRP buses, A and B, to facilitate multiple PCM links. Up to four (4) PCM (T1) links can be connected to three CRIs. Each CRI-CRI connection can cascade in both directions to allow time slots to be routed from any incoming PCM (T1) to any of the three sectors.

Figure 3-12 on page 3-18 shows the 3x15 configuration.

The first PCM (T1) link is connected to ETB-1 in CRI-a. Eight time slots are used in Sector A and the remaining sixteen time slots are routed to Sector B and Sector C. Eight time slots are routed from ETB-3 in CRI-a to ETB-2 in CRI-b. Also, eight time slots are routed from ETB-2 in CRI-a to ETB-2 in CRI-c. As a result, eight time slots are available in each sector.

The second PCM (T1) link is connected to ETB-1 in CRI-b. Eight time slots are used in Sector B and the remaining sixteen time slots are routed to Sector A and Sector C. Eight time slots are routed from ETB-2 in CRI-b to ETB-3 in CRI-a. Also, eight time slots are routed from ETB-3 in CRI-b to ETB-3 in CRI-c. It should be noted that this configuration re-routes the time slots from ETB-3 in CRI-b back to ETB-3 in CRI-a on the same physical link as the original eight time slots from Sector A to Sector B. This bidirectional configuration results in 16 time slots in each sector.

The third PCM (T1) link is connected to ETB-1 in CRI-c. Eight time slots are used in Sector C and the remaining sixteen time slots are routed to Sector A and Sector B. This bidirectional configuration results in 24 time slots in each sector.

**3x15 (T1 and ETB Connections)**

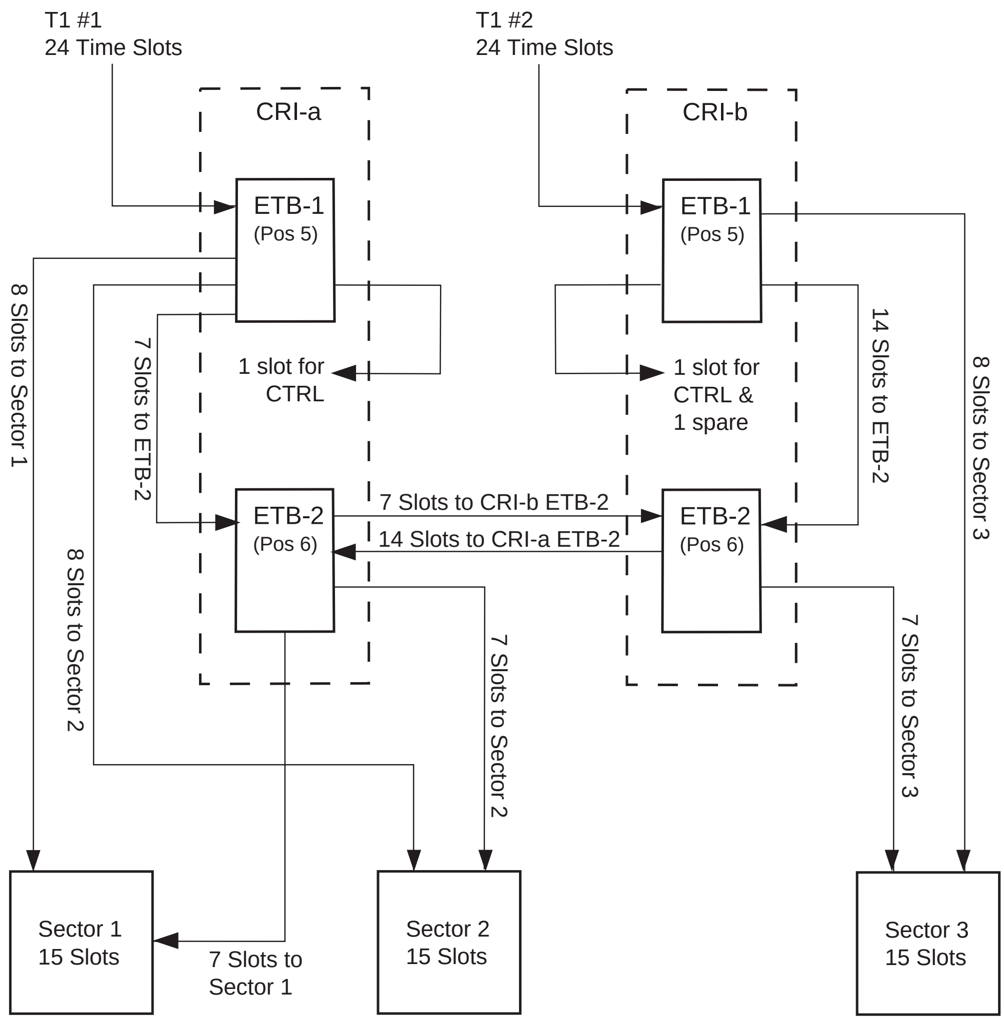


*Figure 3-11. 3x15 CRI-PCM (T1) Configuration*

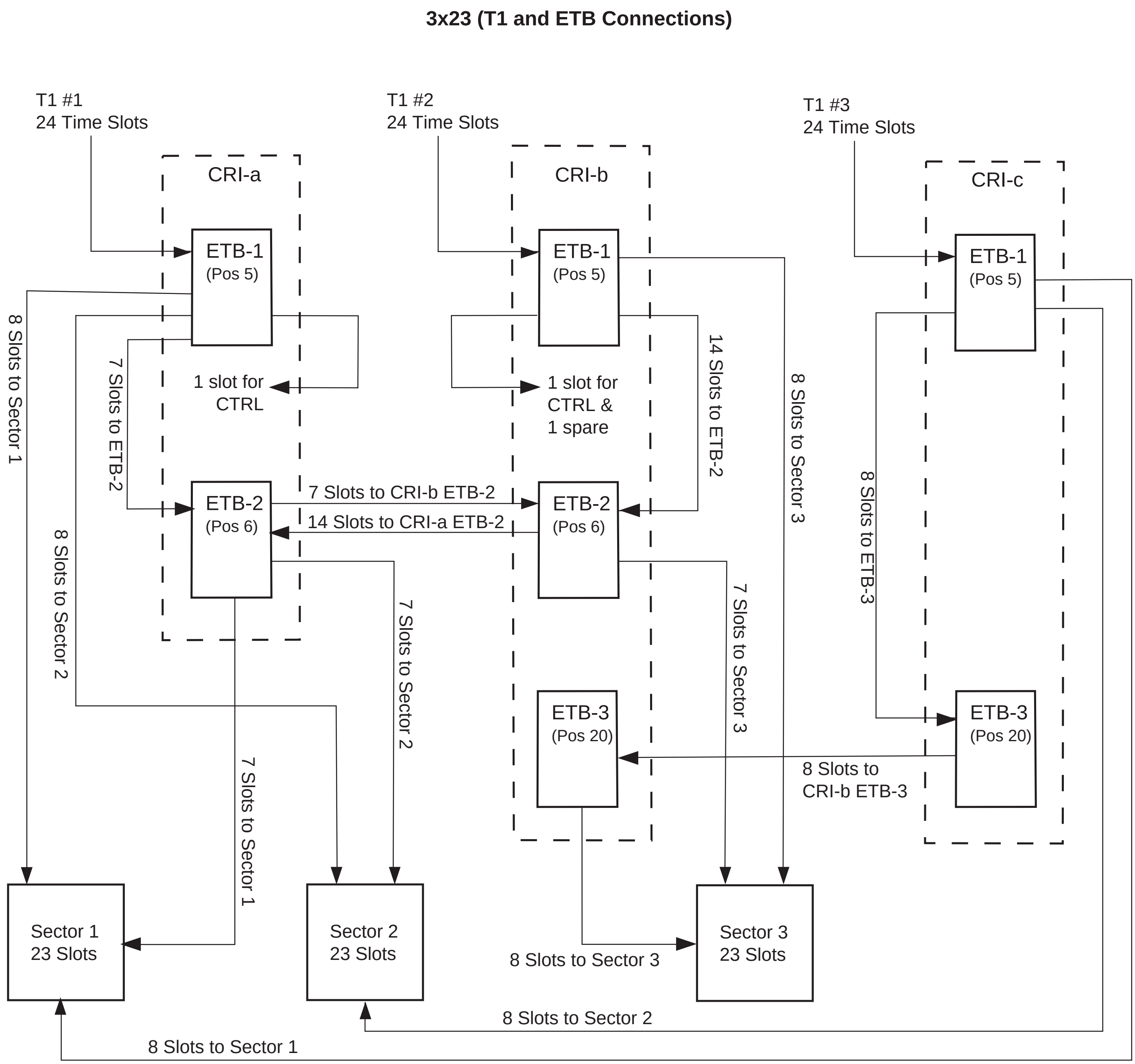


*Figure 3-12. 3x24 CRI-PCM (T1) Configuration*

Figure 3-13 on page 3-19 shows the 3x31 configuration. In addition to the connections for the 3x24 configuration, a fourth PCM (T1) link is connected to ETB-3 in CRI-c. Eight time slots are used in Sector C and the remaining sixteen time slots are routed to Sector A and Sector B. This bidirectional configuration results in 32 time slots in each sector.

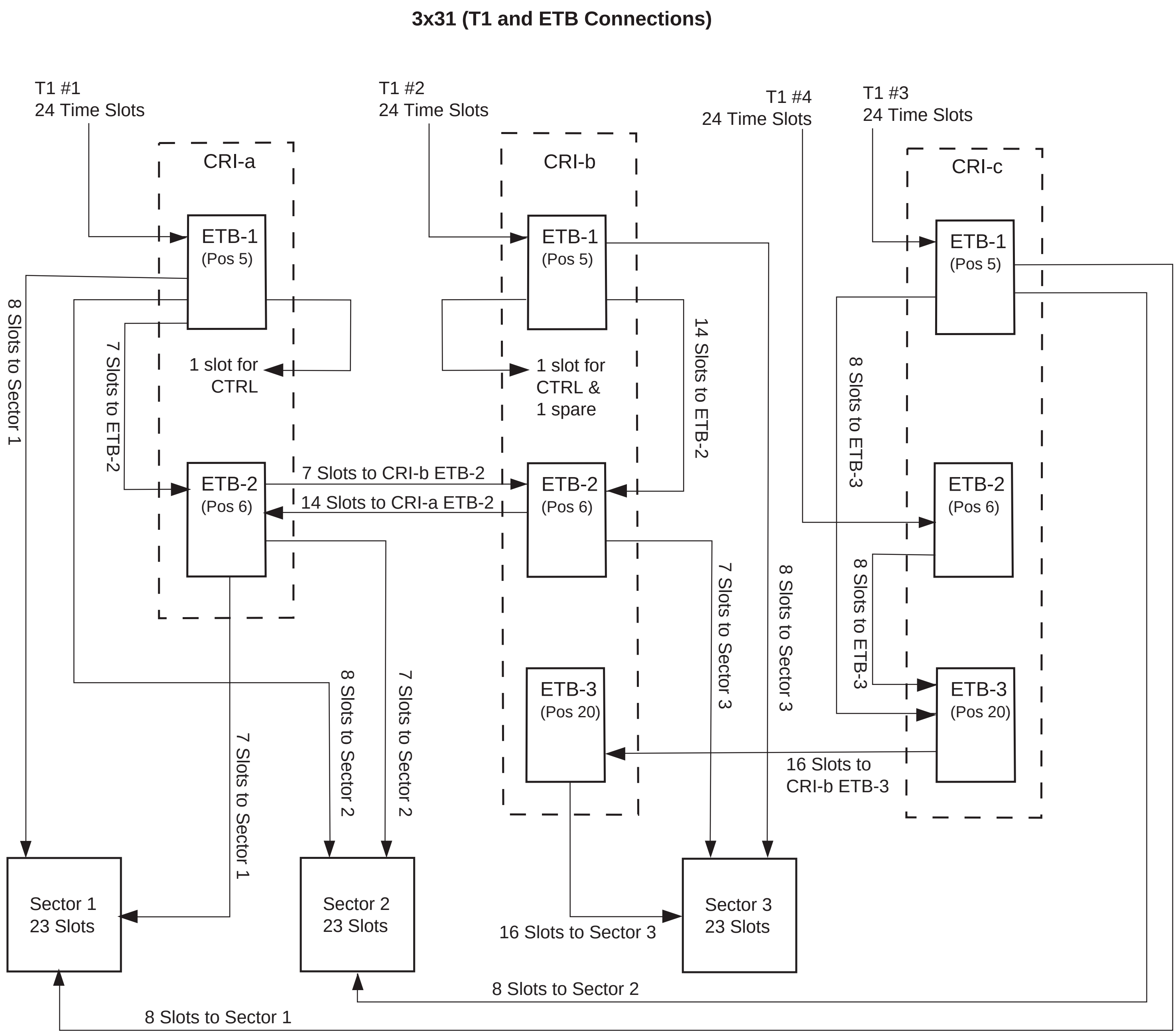


*Figure 3-13. 3x31 CRI-PCM (T1) Configuration*

# 4 Equipment Configuration

Figure 3-14 on page 3-20 shows a typical Macro with MCPA, 1900 MHz three-sector system configuration.

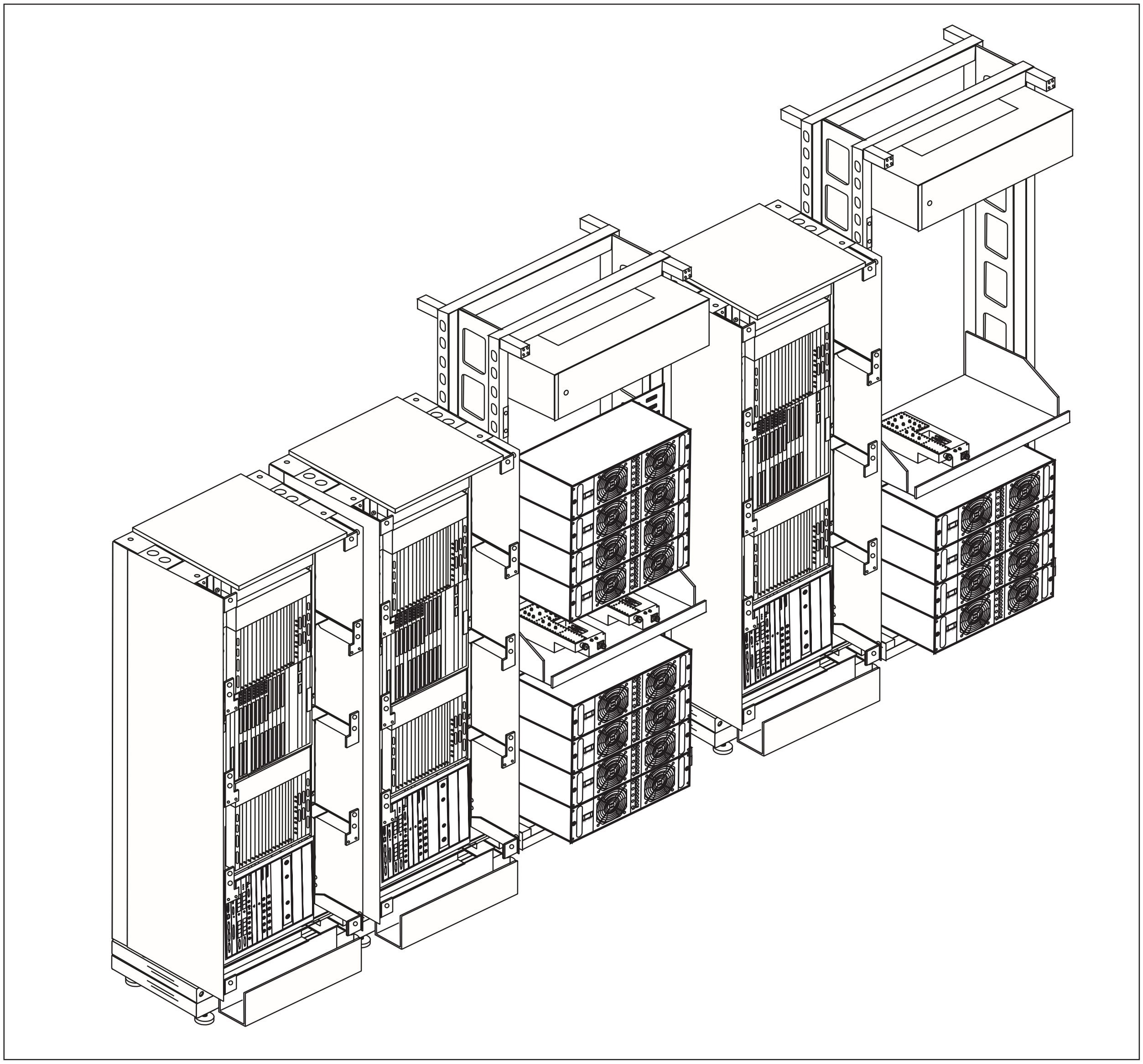

*Figure 3-14. Typical Macro with MCPA, 1900 MHz Configuration*

Typical 1900 MHz configurations are as follows:

- 1, 2, or 3 Sector(s) x 15 channels (1x15, 2x15, 3x15)
- 1, 2, or 3 Sector(s) x 23 channels (1x23, 2x23, 3x23)
- 1, 2, or 3 Sector(s) x 31 channels (1x31, 2x31, 3x31)

The Macro with MCPA supports up to 16 TRXs per Transceiver Cabinet (TCB) with two TCBs per sector. This configuration allows up to 30 carriers per sector with a 360 KHz channel spacing (4/12 reuse factor).

# 5 Equipment Description

The Macro with MCPA, 1900 MHz system is a modular single-sector RBS consisting of one to three 19-inch RBS racks and one or two 24-inch MCPA racks. As shown in Figure 3-15 on page 3-23, the RBS rack contains four equipment magazines, one hybrid combiner, and one POWD. A two-sector system consists of two RBS racks (two single sector modules) and a three-sector system consists of three RBS racks (three single-sector modules).

The RBS rack contains the following equipment:

- (1) Control Radio Interface Cabinet (CRI) containing:
  - Exchange Terminal Board (ETB)
  - Extension Module Regional Processor (EMRP)
  - Node Clock Time Switch (NTSW)
  - EMRP Speech Bus Interface (EMRPS)
  - Signal Terminal Regional (STR)
  - Radio Transceiver Terminal (RTT)
  - DC/DC Converter

Note: The Macro with MCPA CRI does not have a fan unit. As a result, the Fan Fail alarm is disabled.

- (2) Transceiver Cabinets (TCB) containing:
  - Transceiver Module (TRX)
  - Power Splitter (PSP)
  - RF Backplane
  - Power and Fan Connection Board (PFCON)
  - Data Connection Board (DCON)
  - Digital Verification Receiver (DVER)
- (1) Antenna Near Part Cabinet (ANPC) containing:
  - Power Connection Board (POC)
  - Alarm Module (ALM)
  - Timing Module (TIM)
  - Multicoupler (MC)
  - Receive BandPass filter (RXBP)

- (1) 32:1 Hybrid Combiner
- (1) Power Distribution Cabinets (POWD)

The Multi-Carrier Power Amplifier (MCPA) Rack contains the following equipment:

- (1) MCPA Cabinet with four (4) MCPA modules (per sector)
- High-Current POWD
- Transmit Bandpass Filter (TXBP)
- Measurment Coupler Unit (MCU)

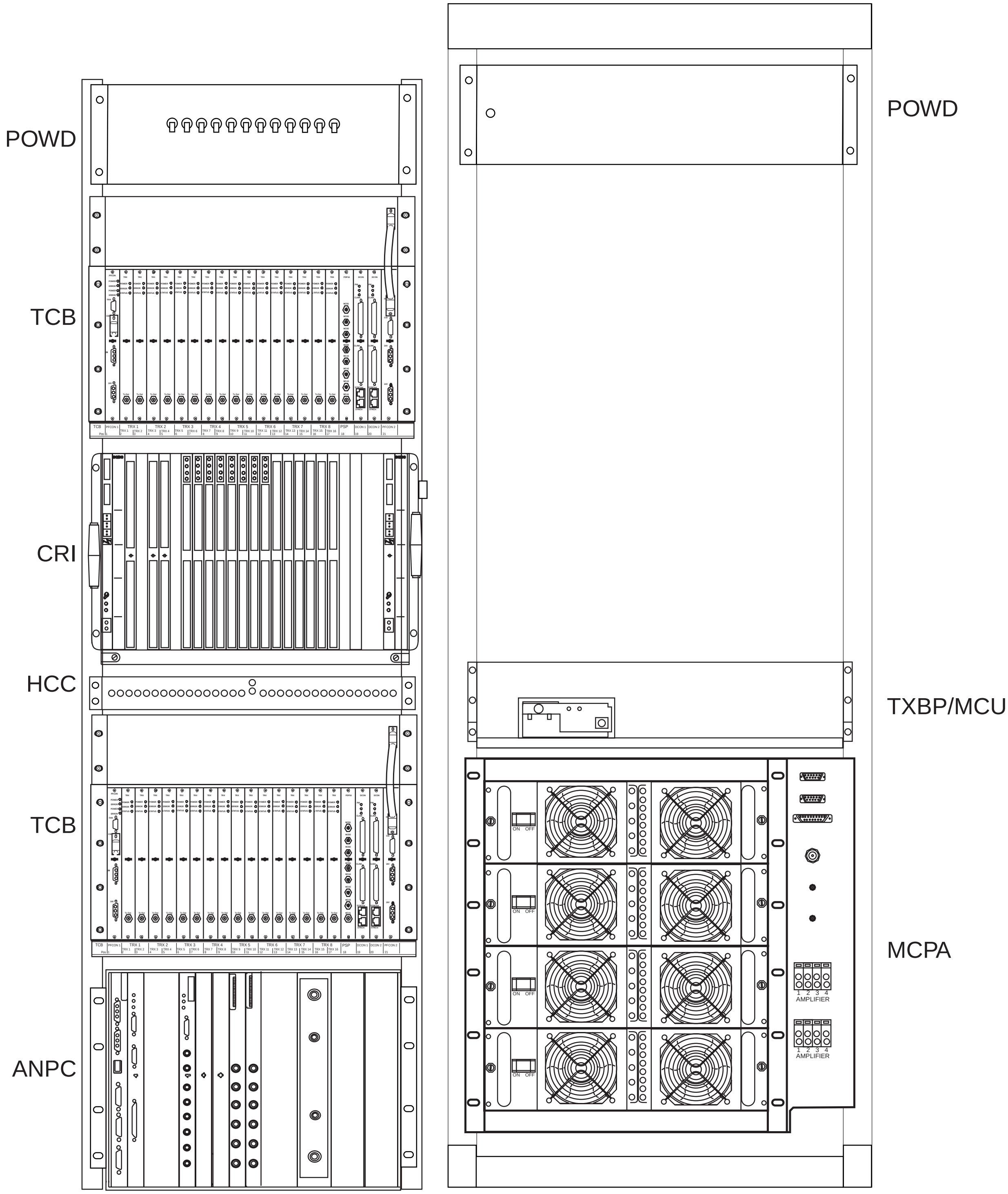


*Figure 3-15. Macro with MCPA, 1900 MHz Equipment (Omni-site)*

## 5.1 Control Radio Interface Cabinet (CRI)

The CRI controls communication between the MSC and the RBS. The CRI provides an interface to the transmission network (PCM), a time switch for setting up semi-permanent paths, and an interface to the devices (C-link). The clocks in the CRI are synchronized to the network by the TIM. Incoming clock are filtered and used as a reference frequency for the carriers. Figure 3-16 on page 3-24 shows the location of devices in a fully-equipped CRI. Device descriptions are provided in the following sections.

The Macro with MCPA CRI is not equipped with a Fan Unit. As a result, the Fan Fail signal is disabled.

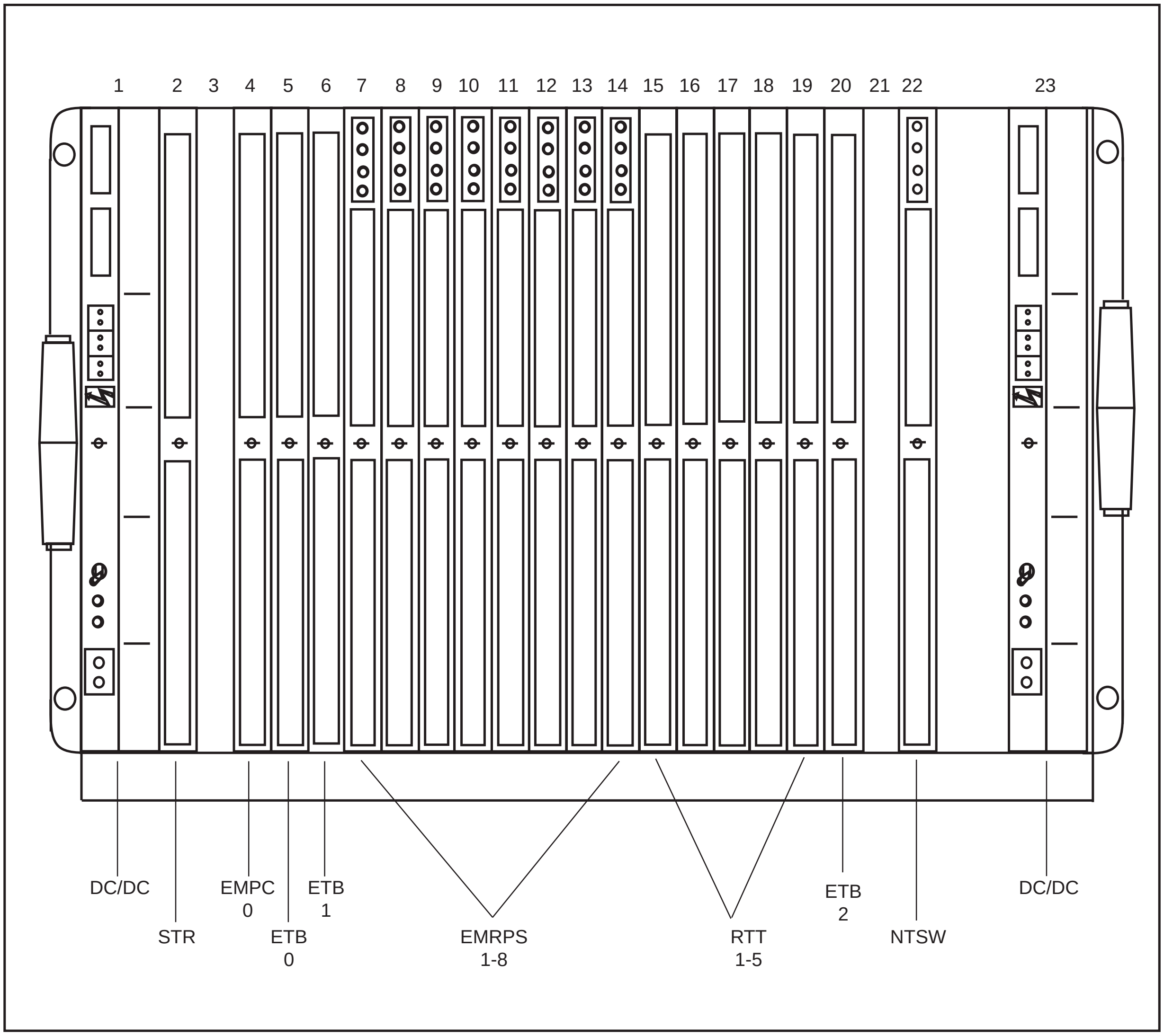


*Figure 3-16. CRI Board Layout*

## 5.1.1 Exchange Terminal Board (ETB)

The ETB is located in the CRI cabinet and is an interface to the transmission network. It is a demultiplexer that extracts the 64 kbit/sec control link from a 24/32 channel PCM link. Two variants are available: ETB/ETP for E1 and ETB/24 for T1. Refer to Part 3 – *Installation and Start-up* for E1/T1 DIP switch settings.

Note: The Macro with MCPA system utilizes cascaded CRIs and multiple PCM links. As a result, an additional ETB replaces the RTT unit at position 20 and an additional ETB is installed in position 5 in the second and third CRIs.

### 5.1.2 Extension Module Regional Processor (EMRP)

The EMRP is located in the CRI cabinet and handles the hardware in the base station on behalf of the central processor. It controls the time switch (NTSW) and the signaling hardware used for communication with the central processor. The EMRP is connected to the time switch by the Device Control Bus (DEVCB).

### 5.1.3 Node Clock Time Switch (NTSW)

The NTSW is located in the CRI cabinet and handles switching of time slots, clock synchronization, and stabilization of the carrier frequency reference.

The NTSW sets up semi-permanent connections between the transmission link and the RTTs for traffic signaling. The NTSW also sets up connections between the EMRPS and RTT for control signaling. Other support functions include PCM link redundancy handling between the RBS and MSC and to other RBS sites

Note: Since a Timing Module (TIM) is used with a Macro with MCPA, 1900 MHz system, the RITSW is replaced with a Node Clock Time Switch (NTSW).

### 5.1.4 EMRP Speech Bus Interface (EMRPS)

The EMRPS module is located in the CRI cabinet and is an EMRP with extended processor power and a speech bus interface. The EMRPS controls the transceivers and other support equipment in the base station. The EMRPS is connected to the EMRP bus and to the time switch speech bus. One EMRPS can control up to 5 TRXs (4 TRXs as 12 DVC), or up to 32 ANPC devices. The EMRPS can also control a combination of TRX and ANPC devices. A V.24 port and MMI port is provided.

### 5.1.5 Signal Terminal Regional (STR)

The STR is located in the CRI cabinet and handles control signaling to and from the MSC. The STR is an interface between the control link and the Extension Module Regional Processor Bus (EMRPB).

### 5.1.6 Radio Transceiver Terminal (RTT)

The RTT is located in the CRI cabinet and provides eight C-link connections. Each C-link connection carries control information and speech data to equipment in other cabinets (TRXs, ALMs, and RFTLs).

### 5.1.7 DC/DC Converter

The DC/DC converter is located in the CRI cabinet and converts the +24 V DC into other DC voltage levels used by the CRI.

## 5.2 Transceiver Cabinet (TCB)

The TCB contains the modem function that converts speech and data into RF signals. As shown in Figure 3-17 on page 3-27, the Macro with MCPA, 1900 MHz TCB contains up to (16) 200 mW TRXs.

Note: The first TCB in each sector uses one TRX as the DVER. All 16 TRXs are assigned to one sector.

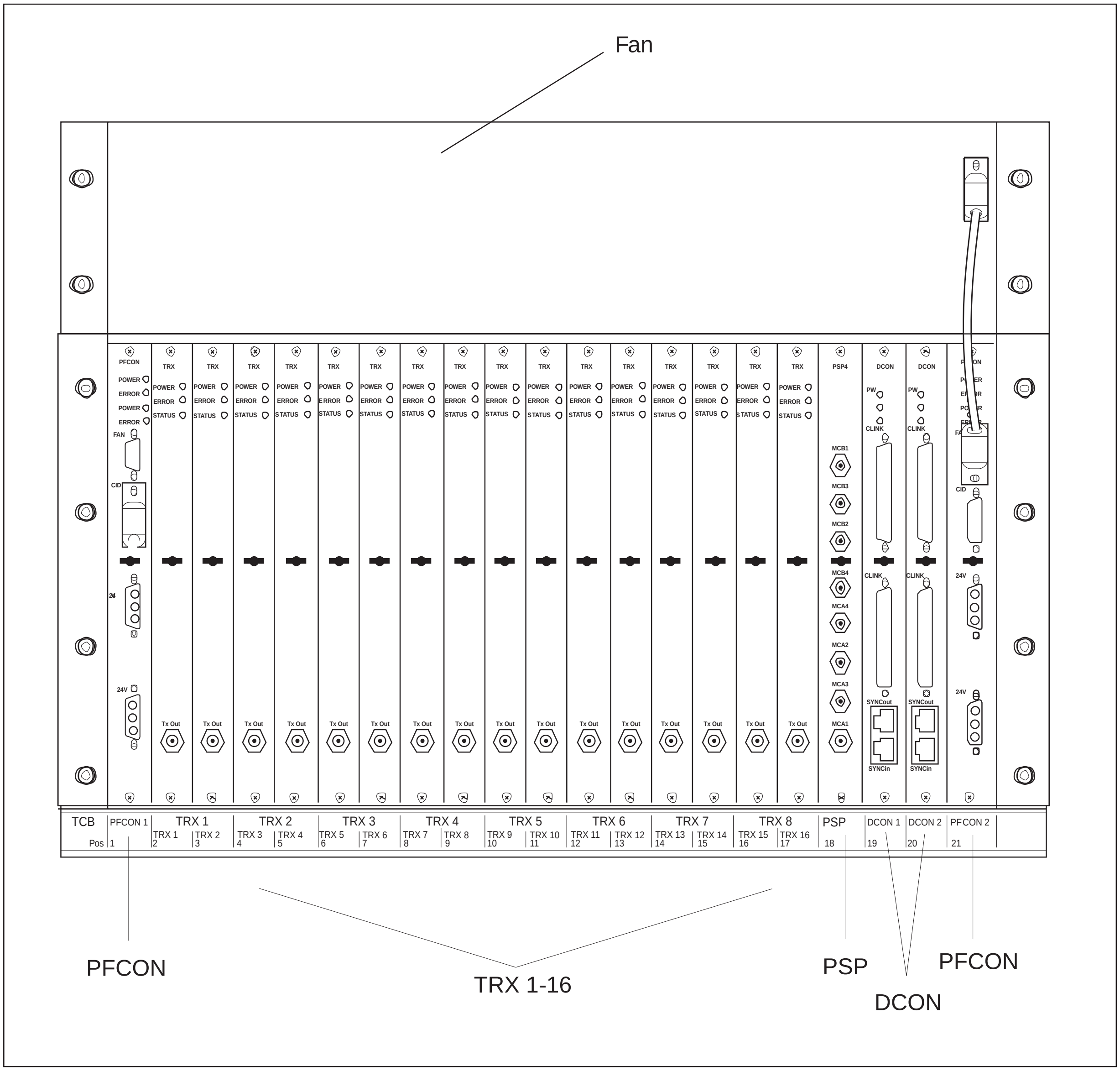


*Figure 3-17. Macro with MCPA, 1900 MHz TCB*

### 5.2.1 Transceiver Module (TRX)

The TRX transmits and receives radio signals to and from wireless mobile stations. It includes all functions for handling one radio channel, such as channel coding and decoding, modulation and demodulation, power amplification, diversity combination, and measurements. Each TRX is assigned to one carrier frequency and each channel is divided into three time slots for digital and one time slot for analog voice channels. All TRXs in a TCB are used in a single sector. The connected C-Link has two duplex 64 kbit/sec channels (time slots) connected. One timeslot is the digital control channel and the other timeslot is the voice channel.

### 5.2.2 Power Splitter (PSP8+))

The PSP8+ located in each TCB distributes the received RF to the power splitters in the RF backplane of the TCB. The PSP8+ in TCB-1 splits each branch into four outputs that are connected to the RF backplane.

### 5.2.3 RF Backplane

The RF Backplane, also called Power Splitter backplane, feeds the TRXs with receive signals. Incoming signals from the PSP outputs are connected to the RF backplane. The backplane also splits each signal to feed the TRXs.

### 5.2.4 Power and Fan Connection Board (PFCON)

The PFCON filters and bypasses power to the TRXs and to the fan. It also connects the air frame sync to the backplane for distribution to each TRX.

### 5.2.5 Data Connection Board (DCON)

The DCON provides the C-link connections for up to eight TRXs. The C-links come from the RTT units in the CRI.

### 5.2.6 Digital Verification Receiver (DVER)

The DVER TRX is used for digital signal verification and is assigned to the TRX fitted in the last TRX position of the first TCB in each sector.

## 5.3 Antenna Near Part Cabinet (ANPC)

A Macro with MCPA RBS module (omni site) contains one ANPC that functions as the radio transmitter/receiver interface. It also includes external alarm, test, and calibration functionality.

The ANPC filters, amplifies (in the receive path), and monitors the RF signal. Other functions include looping radio signals, output and reflected power measurement, and RSSI calibration.

The Macro with MCPA, 1900 MHz ANPC contains the following components:

- Multicoupler (2)
- Receiver Bandpass Filter (1)
- Radio Frequency Test Loop
- Timing Module (2 – Sector 1 only)

- Power Connection Board
- Alarm Module

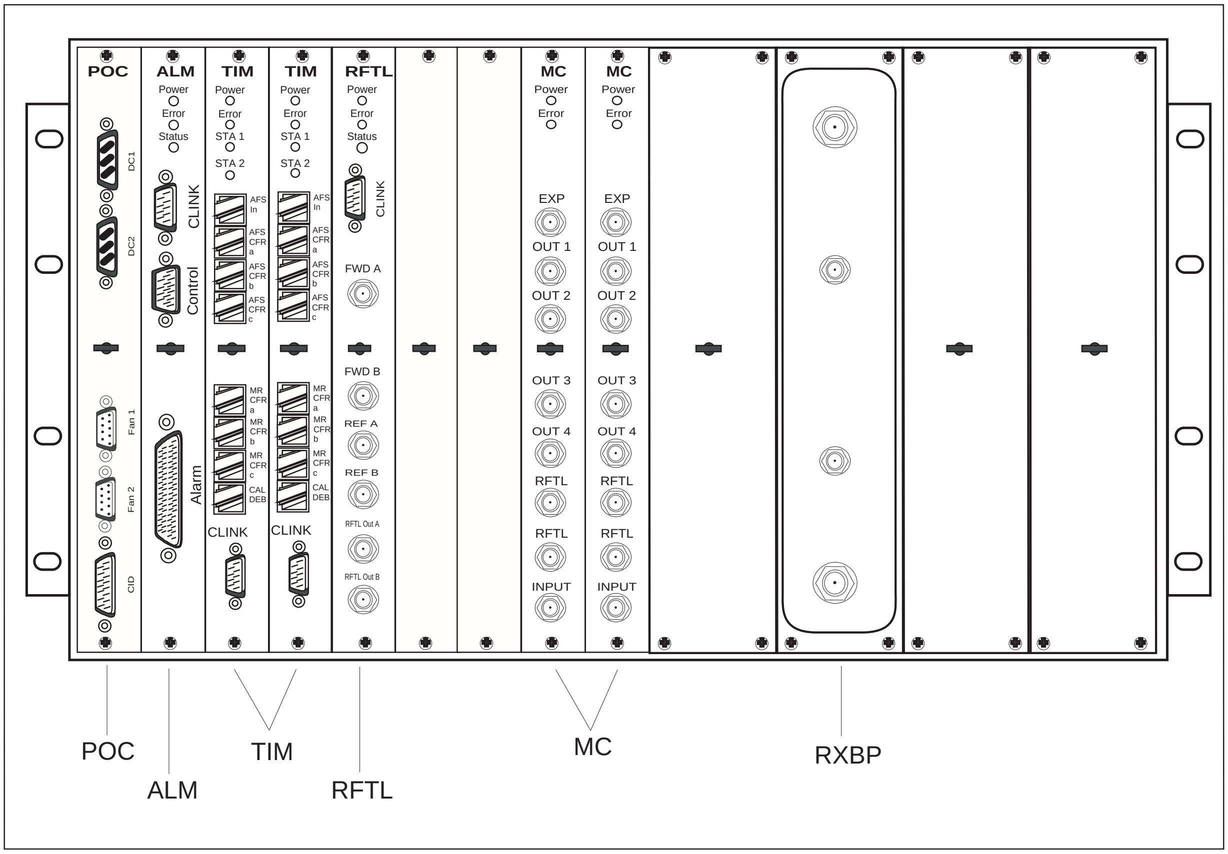


*Figure 3-18. Macro with MCPA, 1900 MHz ANPC*

### 5.3.1 Multicoupler (MC)

The MC amplifies and splits the received antenna signal before it is connected to the PSP. There are two MCs for each sector for improved reception through diversity.

### 5.3.2 Receiver Bandpass Filter (RXBP)

The RXBP filters the receive band. It comprises two bandpass filters, one for each branch. The RX inputs are connected to the antenna feeders. The RXBP also includes a directional coupler for connection to the RFTL.

### 5.3.3 Radio Frequency Test Loop

The RFTL has a C-link connection to the CRI for control. The RFTL provides measurement of forward and reverse output power, alarm supervision of the Voltage Standing Wave Ratio (VSWR), and Receive Signal Strength Indicator (RSSI) measurement.

### 5.3.4 Timing Module (TIM)

The TIM supports separate clocks for network synchronization and carrier frequency stabilization.

### 5.3.5 Power Connection Board

The Power Connection Board connects power to the ANPC.

### 5.3.6 Alarm Module (ALM)

The Alarm Module has 16 internal alarm inputs (for instance, fan and MC failure) and 32 external alarm inputs (for instance, fire alarms and intrusion alarms). The ALM is controlled over a C-link by the CRI.

## 5.4 Hybrid Combiner

The Hybrid Combiner cabinet contains two 16:1 combiners and one 2:1 combiner to connect 32 TRXs to one transmit antenna. The 16:1 combines 16 TRX outputs (with minimum insertion loss while providing suffcient isolation between the TRXs) and feeds the signal to a 2:1 combiner. A total of 32 carriers feed the Multi-Carrier Power Amplifier (MCPA).The Transmit Bandpass Filter (TXBP) and the Measurement Coupler Unit (MCU) are located in the MCPA rack. The combiner is also equipped with a –40 dB sample port.

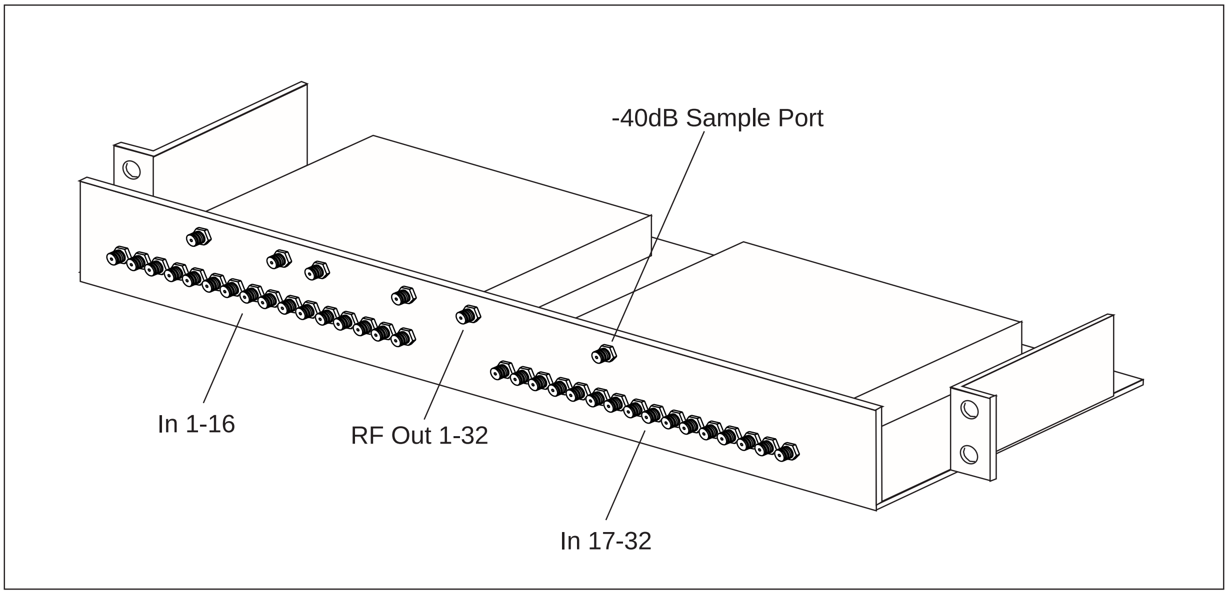


*Figure 3-19. Hybrid Combiner Unit*

## 5.5 Transmit Bandpass Filter (TXBP)

The Transmit Bandpass Filter (TXBP) attenuates the high level of out-of-band emissions associated with the MCPA. The TXBP consists of an eight-pole bandpass filter designed for 1930–1990 MHz. The TXBP has an RF inlet from the MCPA and an output which is fed to the MCU.

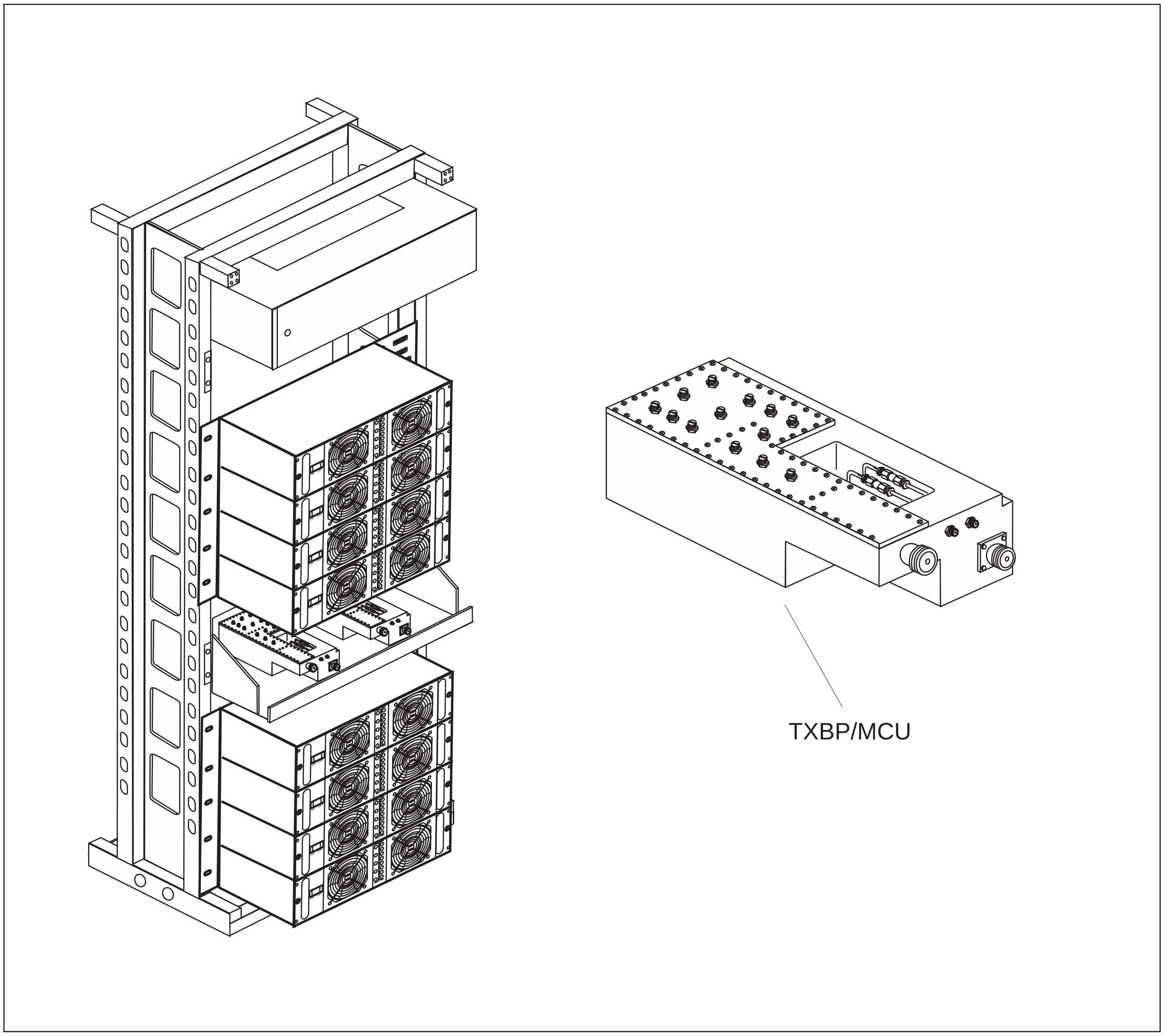


*Figure 3-20. TXBP and MCU*

## 5.6 Measurement Coupler Unit (MCU)

The Measurement Coupler Unit (MCU) measures reflected and forward power. It diverts a fraction of the forward and reflected transmit signals to the RFTL. The TX input is connected to the TXBP and the TX output is connected to the antenna feeder. The MCU contains a low-pass filter to attenuate harmonics.

## 5.7 Multi-Carrier Power Amplifier (MCPA)

The MCPA is a linear feed-forward power amplifier that operates in the 1930–1990 MHz band. The MCPA can simultaneously transmit multiple carriers at rated full power of up to 320 watts at the MCPA output and exceeds –63 dBc third order intermodulation distortion (IMD).

The MCPA design is modular and consists of up to four amplifiers mounted in a subrack. Each amplifier can operate independently at 80 watts output power. The four amplifiers in the Macro with MCPA system operate in parallel to increase peak power output and provide redundancy.

Performance monitoring is provided by a status connector on each amplifier module. The front panel of each amplifier contains unit level status indicators and an RF on/off/reset switch.

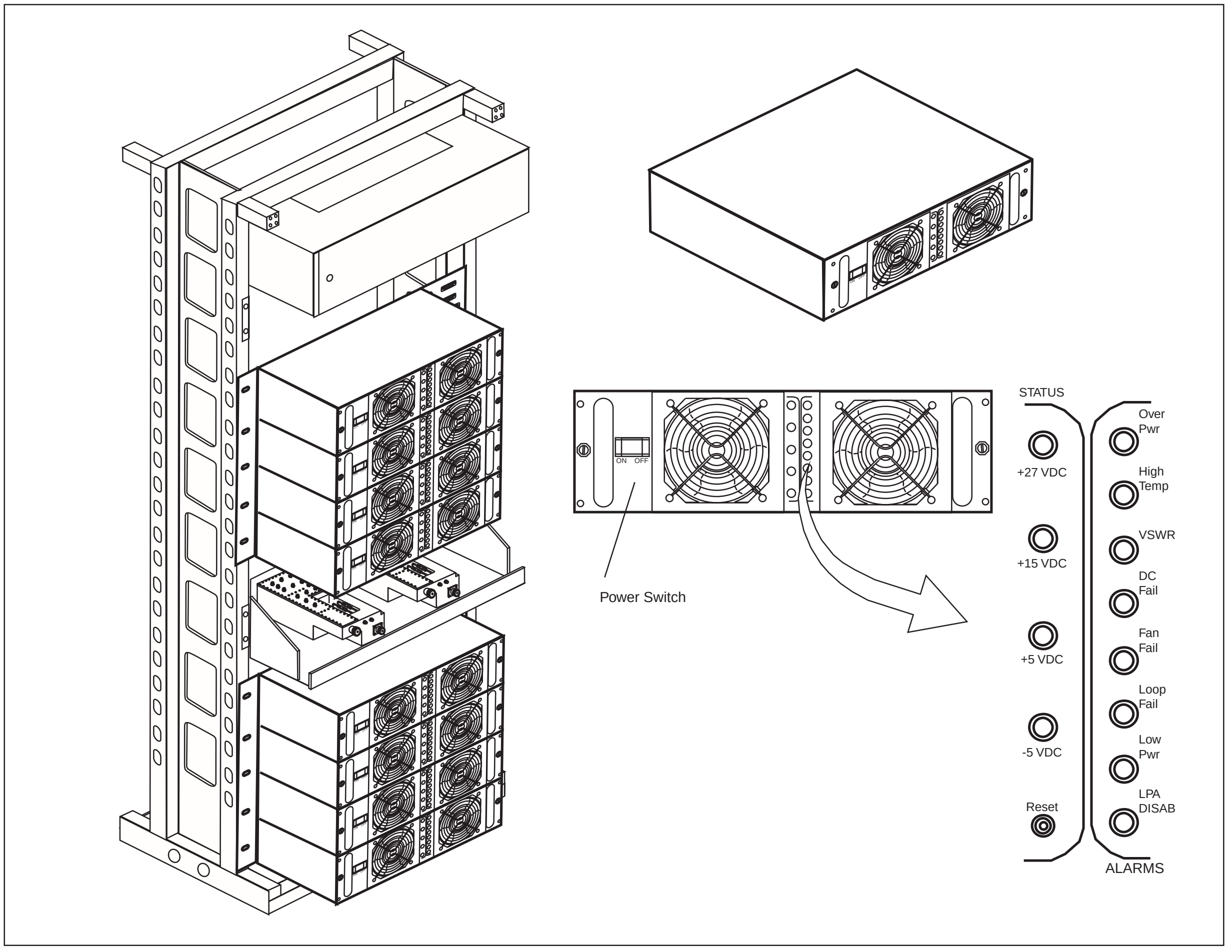


*Figure 3-21. MCPA Rack and Amplifier Modules*

## 5.8 RBS Power Distribution Cabinet (POWD)

The Power Distribution (POWD) cabinets provide power distribution, breaker protection and alarm indications for active areas of the radio base station. One POWD is mounted in the top of each 19-inch rack.

As shown in Figure 3-22 on page 3-34, each POWD contains twelve (12) 30-amp circuit breakers. The breaker assignments are as follows:

*Table 3-1. POWD Circuit Breaker Assignments*

| Circuit Breaker | Function |
|---|---|
| CB 1 | TCB 1 – PFCON 1 – DC 1 |
| CB 2 | TCB 1 – PFCON 1 – DC 2 |
| CB 3 | ANPC – DC 1 |
| CB 4 | ANPC – DC2 |
| CB 5 | TCB 2 – PFCON 1 – DC 1 |
| CB 6 | TCB 2 – PFCON 1 – DC 2 |
| CB 7 | CRIa – FILT L |
| CB 8 | CRIa – FILT R |
| CB 9 | TCB 2 – PFCON 2 – DC 1 |
| CB 10 | TCB 2 – PFCON 2 – DC 2 |
| CB 11 | TCB 1– PFCON 2 – DC 1 |
| CB 12 | TCB 1– PFCON 2 – DC 2 |

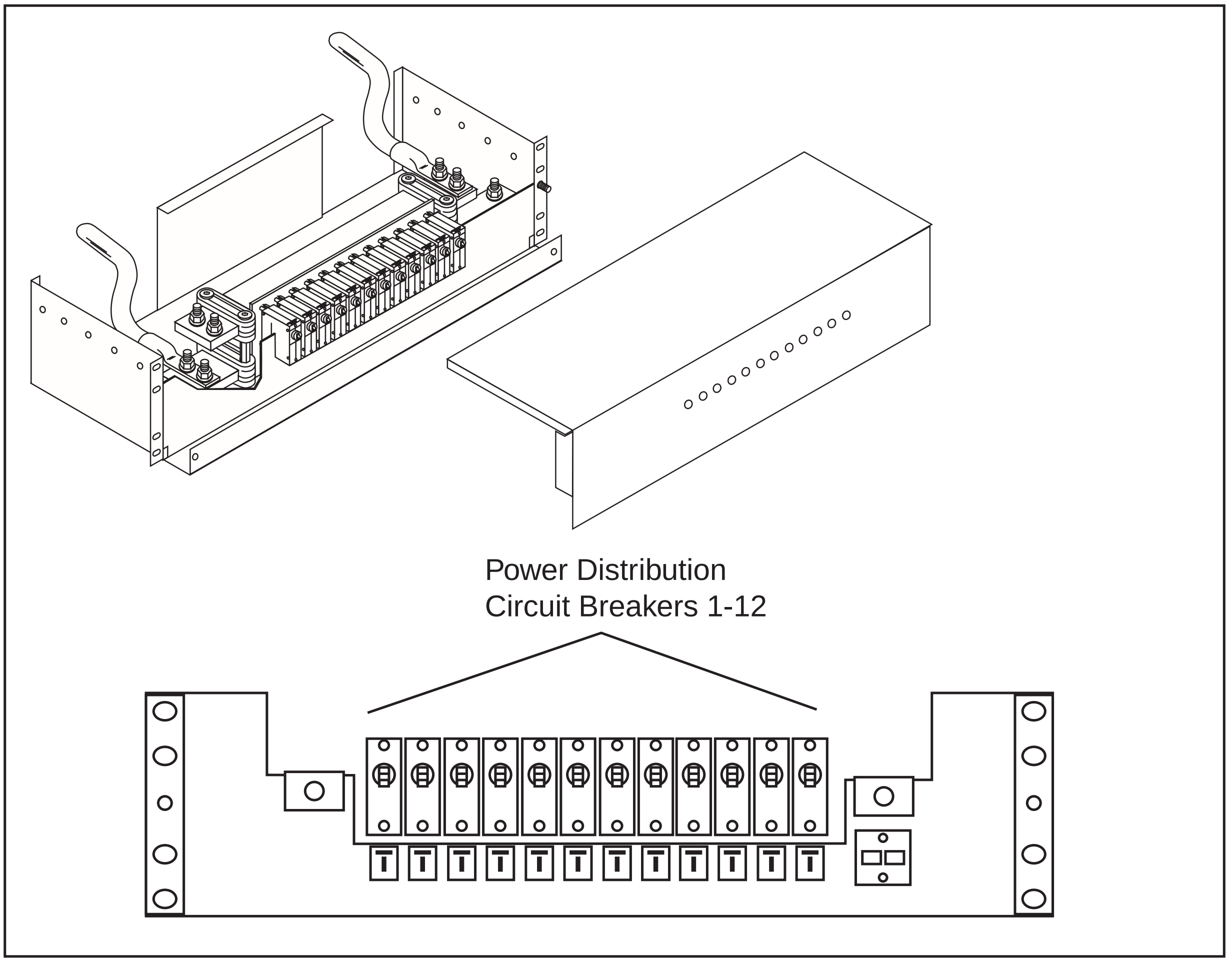


*Figure 3-22. RBS Power Distribution Cabinet*

## 5.9 MCPA Power Distribution Cabinet (HC-POWD)

The MCPA Power Distribution cabinet provides high current power distribution (HC-POWD) and circuit breaker protection for the MCPA amplifiers mounted in the MCPA rack. One POWD is mounted in the top of the 24-inch MCPA rack.

As shown in Figure 3-23 on page 3-35, each POWD contains sixteen (16) breaker positions with twelve (12) 60-amp circuit breakers (one for each MCPA amplifier). The breaker assignments are as follows:

*Table 3-2. POWD Circuit Breaker Assignments*

| Circuit Breaker | Function |
|---|---|
| CB 1 | Sector 1 – MCPA Amp Module 4 |
| CB 2 | Sector 1 – MCPA Amp Module 3 |
| CB 3 | Sector 1 – MCPA Amp Module 2 |
| CB 4 | Sector 1 – MCPA Amp Module 1 |

*Table 3-2. POWD Circuit Breaker Assignments (Continued)*

| | |
|---|---|
| CB 5 | Sector 2– MCPA Amp Module 4 |
| CB 6 | Sector 2– MCPA Amp Module 3 |
| CB 7–8 | Not used |
| CB 9 | Sector 2– MCPA Amp Module 2 |
| CB 10 | Sector 2– MCPA Amp Module 1 |
| CB 11 | Sector 3– MCPA Amp Module 4 |
| CB 12 | Sector 3– MCPA Amp Module 3 |
| CB 13 | Sector 3– MCPA Amp Module 2 |
| CB 14 | Sector 3– MCPA Amp Module 1 |
| CB 15–16 | Not used |

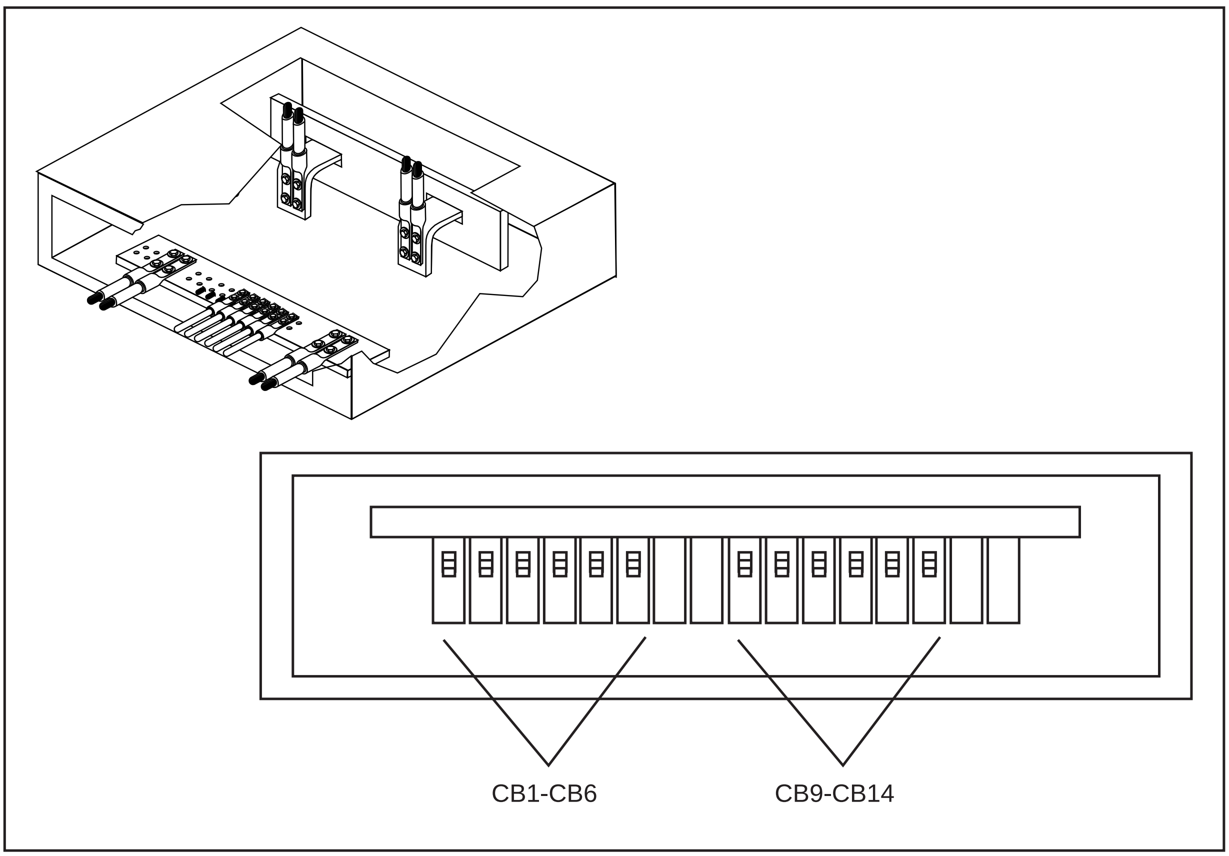


*Figure 3-23. MCPA Power Distribution Cabinet*

# 6 Technical Specifications

General technical specifications for the Macro with MCPA, 1900 MHz Medium Power system are shown in the following tables:

## 6.1 Electrical and RF Specifications

*Table 3-3. Macro with MCPA, 1900 MHz Technical Specifications*

| Description | Specification | |
|---|---|---|
| Number of transceivers (TRX) in each sector | up to 32 per sector<br>**Note:** Includes 30 carriers and one TRX in each sector for digital verification (DVER) and one TRX for signal strength receiver (SR). | |
| Number of transceivers (TRX) in each TCB | up to 16 in each cabinet (14+2 in TCB-1) | |
| Number of carriers | 31 in each sector (maximum) | |
| **Transmitting Characteristics** | | |
| Transmitting frequency band | 1930–1990 MHz | |
| Output Power at output port | 54 ±0.5 dBm (depending on configuration) | |
| Output power/carrier | 15 TRXs – 18.2 W<br>23 TRXs – 11.8 W<br>31 TRXs – 8.78 W | |
| Channel spacing | 360 kHz | |
| **Receiving Characteristics** | | |
| Receiving frequency band | 1850–1910 MHz | |
| Minimal receive channel spacing in one cell | 270 kHz | |
| Receiver sensitivity (fading, 8~100 km/h, with diversity, 3% BER) | —113 dBm | |
| **PCM Connection** | | |
| PCM Connection ANSI T1.403-1989 | Bit rate | 1.544 Mbit/s |
| | Board connector | RPV 301 302/1 |
| | Electrical characteristics | TR-NWT-000499 |
| Number of T1 Lines supported | Up to 4 | |
| Format | Alternate Mark Inversion (AMI) and B8ZS formats; however, B8ZS should be used when possible. Both the superframe and extended superframe are supported. Bit robbed signaling is not used. | |
| Synchronization | Traceable to a Stratum 2 reference | |
| **Powerwave® MCPA (Module Specifications)** | | |
| Frequency Range | 1930–1990 MHz | |

*Table 3-3.  Macro with MCPA, 1900 MHz Technical Specifications (Continued)*

| | |
|---|---|
| Total Maximum Input Power | -12 dBm |
| Power Output | 1 Module — 80 Watts (49.5 dBm)<br>2 Modules — 160 Watts (52.5 dBm)<br>3 Modules — 240 Watts (54.3 dBm)<br>4 Modules — 320 Watts (55.5 dBm) |
| Intermodulation Distortion and In-Band Spurious Emissions (30 KHz bandwidth) | -63 dBc (Min) @ +26 to +28 Vdc @ rated power<br>(24 carriers and 360 KHz channel spacing) |
| RF Gain | 54.5 dB |
| Gain Adjustment Range | 0 to -15 dB |
| Gain Variation | ±0.6 dB from 26 Vdc to 28 Vdc<br>-0.8 to +0.6 from 24 Vdc to 26 Vdc |
| Total Maximum Input Power | +3.0 dBm |
| Input Port Return Loss | -14 dB (Minimum) |
| Out of Band Spurious Emissions | <-60 dBc (minimum) @ +24 Vdc to +28 Vdc |
| Duty Cycle | Continuous |
| DC Input Voltage | +23 Vdc to 30 Vdc |
| DC Input Current | 180 Amps (45 Amps per module) @ 27 Vdc Input Voltage and 360 Watts Output |
| **TXBP Specifications (Bandpass / Attenuation)** | |
| 100 KHz – 824 MHz | > 45 dB |
| 824 MHz – 849 MHz | > 85 dB |
| 849 MHz – 854 MHz | > 45 dB |
| 910 MHz – 1700 MHz | > 45 dB |
| 1700 MHz to the 2nd Harmonic | > 30 dB |
| 2nd Harmonic to the 3rd Harmonic | > 5 dB |
| Insertion Loss | < 0.4 dB |
| Power | 350 Watt average (4QAM modulated) |
| Inter-Modulation generation for two-tone at x44dBm | IM3 < –130 dBm |
| **Combiner Specifications** | |
| Frequency Band | 869 – 894 MHz |
| Capacity | 32:1 (two 16:1, one 2:1) |
| Insertion Loss | 16.3 dB ±0.5 dB |
| Maximum Input Power | ≤ 2 Watts per Input Port |
| Input Return Loss | ≥ 17.5 dB |

*Table 3-3. Macro with MCPA, 1900 MHz Technical Specifications (Continued)*

| | | |
|---|---|---|
| Output Return Loss | ≥ 17.5 dB | |
| Isolation between Ports | ≥ 40 dB | |
| **Power Supply** | | |
| DC Supply voltage | Nominal | 27.2 V |
| | Normal operation | 26.2 V to 27.4 V |
| | Safe function | 21.7 V to 31.0 V |
| Power consumption (TRX) | Power OFF<br>Maximum | 17 W<br>30.4 W |
| Power consumption, Cabinets (fully equipped) | CRI | 155 W |
| | TCB (with 16 TRXs) | 571 W ) |
| | ANPC | 80 W |
| | POWD | 9 W |
| | MCPA Rack | 14.7 kW |

## 6.2 Mechanical and Environmental Specifications

*Table 3-4. Macro with MCPA, 1900 MHz Technical Specifications*

| Description | Specification | |
|---|---|---|
| **Dimensions and Weight** | | |
| External dimensions (single RBS stack) | Width | 23.50 in (597 mm) |
| | Height | 67 in (1702 mm) |
| | Depth | 15.75 in (400 mm) |
| RBS stack weight | Single Stack | 600 lbs (273 kg) |
| External dimensions (MCPA rack) | Width | 29 in (737 mm) |
| | Height | 72 in (2108 mm) |
| | Depth | 20 in (508 mm) |
| MCPA rack weight | Single Stack | 850 lbs (386 kg) |
| **Environment** | | |
| Climatic conditions during transport | Temperature: | -40°C to +70°C |
| | Temperature change | ≤1°C/min |
| | Relative humidity | 5 – 100% |
| | Absolute humidity | ≤35 g/m³ |
| | Time | ≤3 months |

*Table 3-4. Macro with MCPA, 1900 MHz Technical Specifications (Continued)*

| | | |
|---|---|---|
| Climatic conditions during storage | Temperature | -25°C to +60°C |
| | Temperature change | ≤0.5°C/min |
| | Relative humidity | 5-95% |
| | Absolute humidity | ≤29 g/m³ |
| | Time | ≤12 months |
| Climatic conditions during normal operation | Temperature | +5°C to +40°C |
| | | (TMA -33°C to +55°C) |
| | Temperature change | ≤0.5°C/min and ≤10°C/h |
| | Relative humidity | 15 – 80% |
| | Absolute humidity | 1 – 20 g/m³ |
| Mechanical conditions during transport and storage | Sinusoidal vibration | 20 m/s² 10 – 150 Hz |
| | Random vibration (ASD) | 2 m²/s³ 5 – 150 Hz |
| | Mechanical shock | 200 m/s² <11 ms |
| | Air pressure | 60 — 108 kPa (60 kPa corresponds to an altitude of 4500 m) |
| Mechanical conditions during normal operation | Sinusoidal vibration | 5 m/s² 10-150 Hz |
| | Random vibration (ASD) | 0.5 m²/s³ 5-150 Hz |
| | Seismic exposure (safe function) | 35 s 1 – 15 Hz (According to IEC 68-2-57) |
| | Air pressure | 60 – 108 kPa (60 kPa corresponds to an altitude of 4500 m) |
| **EMC** | | |
| Electromagnetic Emission | Radiated emission 30 MHz - 1 GHz | Class B digital device (According to FCC Part 15) |
| | Radiated emission 30 MHz - 1 GHz | -13 dBm (transmitter) (According to FCC Part 22) |
| | Conducted emission DC Supply | 120 Hz - 100 MHz: According to Bellcore 3.2.4 |
| | Conducted emission Telecommunication Lines | 120 Hz – 100 MHz: According to Bellcore 3.2.4 |
| Electromagnetic immunity, Enclosure | Radio frequency field 80 MHz - 1 GHz except RX band ±5% | 10 V/m (According to IEC 1000-4-3) |
| | ESD | 8 kV contact discharge (According to Bellcore 2.2 and 2.4, and IEC 1000-4-2 level 4) |