Chapter 10

Base Radio

This chapter covers the following topics:

10.1 Base Radio – Overview

Figure 176: Base Radio

The Base Radio provides reliable digital radio capabilities in a compact software-controlled design. High channel capacity is provided through voice compression techniques and Time Division Multiplexing (TDM).

On the Base Radio front panel there are connectors and indicators. The indicators provide a means for monitoring various status and operating conditions of the Base Radio, and also aid in isolating failures.

For more information on Base Radio indicators and connectors, see Base Radio – Indicators and Connectors on page 325 in this chapter.

10.2

Base Radio – Theory of Operation

The Base Radio (BR) provides reliable digital communications capabilities. Each Base Radio contains the following subcomponents:

- Transceiver consisting of a Base Radio Controller, a triple receiver, and an exciter
- Power Amplifier (PA)

In the MTS 2 and 4, the Base Radio (BR) operates in conjunction with the Site Controller (SC) through a properly terminated 100Base-T Ethernet link.

Figure 177: Base Radio Front Panel

On the front panel, there is a DC power input, three parallel receiver (RX) inputs, a high power transmitter output signal from the power amplifier, a service port, two interfaces to the Site Controllers, and LED indicators. For more information on the LED indicators, see Table 99: Base Radio – LED Indicators on page 325.

The following figures show overall block diagrams of the Base Radios for both architectures: BR-Arch-1 and BR-Arch-2.

Figure 178: BR-Arch-1 Base Radio – Functional Block Diagram

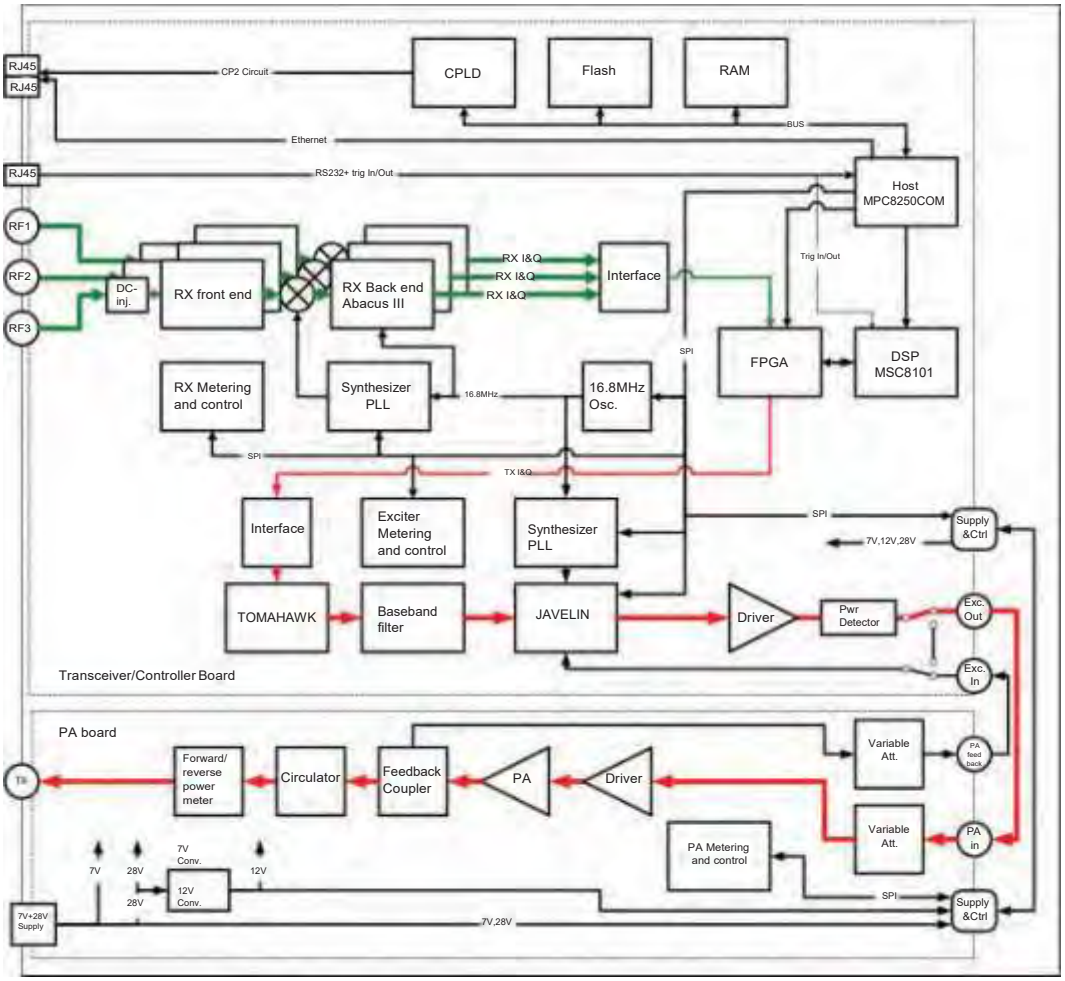
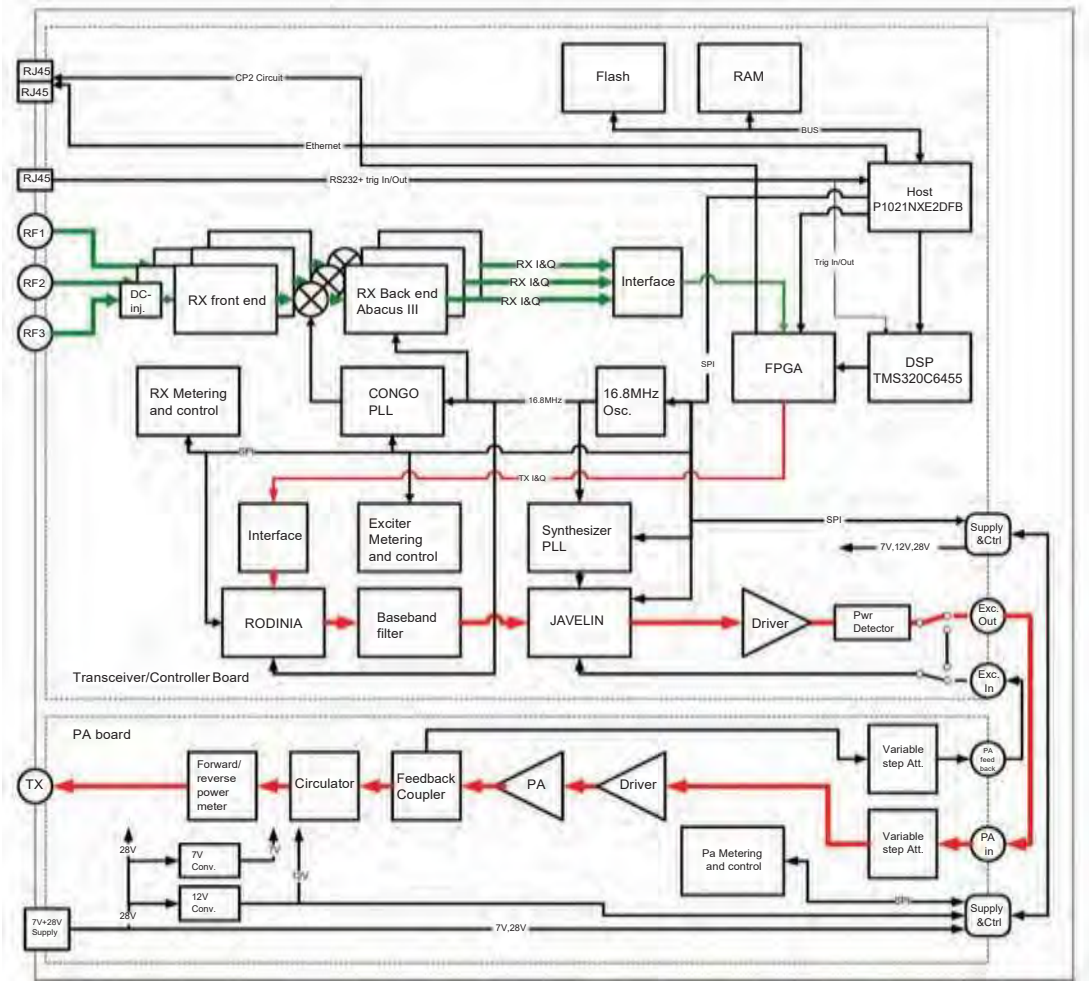


Figure 179: BR-Arch-2 Base Radio – Functional Block Diagram



Upon the power-up, BRC bootloader begins to download application code from SC over the Ethernet LAN. After successful download, the code is executed. Once the BRC application is started, it gets configuration parameters from SC. The configured BRC application allows the Base Radio to perform call processing functions.

Should any alarm conditions arise during BRC application, operation, they are reported to SC over Ethernet LAN. Alarm conditions may also be verified locally through the Service Access port linked to a service computer using the `get alarms` MMI command.

The Base Radio operates in a TDMA (Time Division Multiple Access) mode. This mode, combined with voice compression techniques, provides an increased channel capacity ratio of as much as 4 to 1. Both the receive and transmit signals of the Base Radio are divided into four individual timeslots. Each receive slot has a corresponding transmit slot; this pair of slots comprises a logical RF channel.

The Base Radio uses single, dual, and triple diversity reception for increased talkback coverage area and improved quality. The Transceiver contains a three-branch receiver section in which all receivers are used for triple diversity reception.

All receivers within a given Base Radio are programmed to the same receive frequency. The signals from each receiver are fed to the BRC where a diversity combining algorithm is performed on the signals. The resultant signal is processed for error correction and then sent to the Site Controller through the Ethernet LAN with the appropriate control information regarding its destination.

The transmit section of the Base Radio is comprised of the Exciter (EXC) and Power Amplifier (PA). The EXC processes the information to transmit from the BRC in the proper modulation format. This

low-level signal is sent to the Power Amplifier where it is amplified to the desired output power level. The PA is a continuous-keyed linear amplifier. A power control routine monitors the output power of the Base Radio and adjusts it as necessary to maintain the proper output level.

For information on the performance specifications, see Technical Specifications on page 398.

NOTICE: The Base Radio is prepared for TEDS.

10.2.1
Transceiver (XCVR)

The transceiver provides the receive, transmit, and control functions for the Base Radio. The transceiver consists of three elements:

- Receiver-performs the receive function
- Exciter-performs the transmit function
- BR Controller-performs the control function

The receiver incorporates three separate receiver channels for use in diversity reception. The bias for the LNAs in the Preselectors is supplied by bias circuitry in the receiver. A +7 V dc voltage is the output on the QMA receive input connectors.

The receiver performs highly selective bandpass filtering and dual down conversion of the station receive RF signal. A custom receiver IC outputs the baseband information in a digital data format and sends it to the Base Radio controller.

The exciter in conjunction with the Power Amplifier (PA), provides the modulation and transmitter functions for the Base Radio.

The transceiver contains the Base Radio Controller (BRC). The BRC serves as the main controller of the Base Radio. The BRC provides signal processing and operational control for the other Base Radio circuit blocks.

The operating software and configuration data are contained within the BRC flash memory. The software defines operating parameters for the BR, such as output power and operating frequency.

NOTICE: To protect the key encryption key in use in the infrastructure, it is recommended that this key is overwritten using the Key Variable Loader (KVL) device (through the front serial port) before shipping for repair.

IMPORTANT: BR-Arch-1 Base Radios: To avoid the risk of causing a high bit error rate to occur, do not use 385.572 MHz and 419.175 MHz as receiving frequencies in the Base Radios of the MTS.

10.2.2
Power Amplifier

The Power Amplifier (PA) in conjunction with the exciter provides the transmitter functions for the Base Radio. The Power Amplifier accepts the low-power modulated RF signal from the exciter and amplifies the signal for transmission through the RF output connector. Base Radios in BR-Arch-2 architecture use single, high-power amplifiers capable of running efficiently in low-power settings.

Power Amplifiers in BR-Arch-1 Base Radios

Power Amplifiers in BR-Arch-1 are available in both high and low power versions. High-power PAs in 400 MHz band are available on two different frequency bands. The following table contains a list of all available PAs in BR-Arch-1 Base Radios.

Table 97: Power Amplifiers in BR-Arch-1 Architecture

MTS Band	Power Configuration	Frequency Bands
260 MHz	low-power	260 MHz – 275 MHz
400 MHz	high-power	350 MHz – 379 MHz
		380 MHz – 470 MHz
	low-power	380 MHz – 470 MHz
800 MHz	low-power	806 MHz – 870 MHz
900 MHz	low-power	932 MHz – 942 MHz

Figure 180: Low-power PA Functional Block Diagram

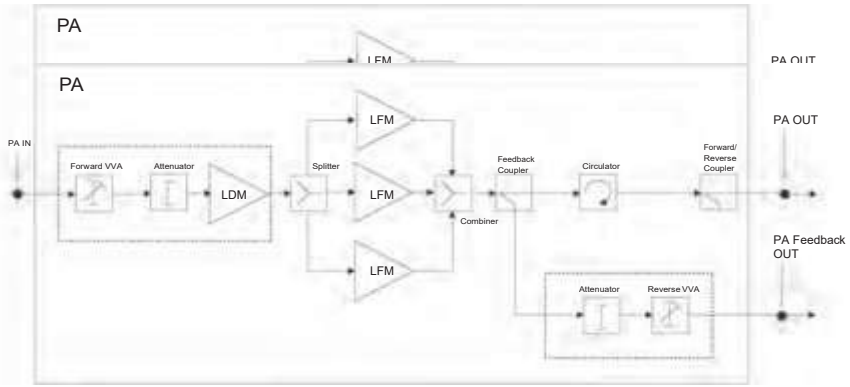


Figure 181: High-power PA Functional Block Diagram

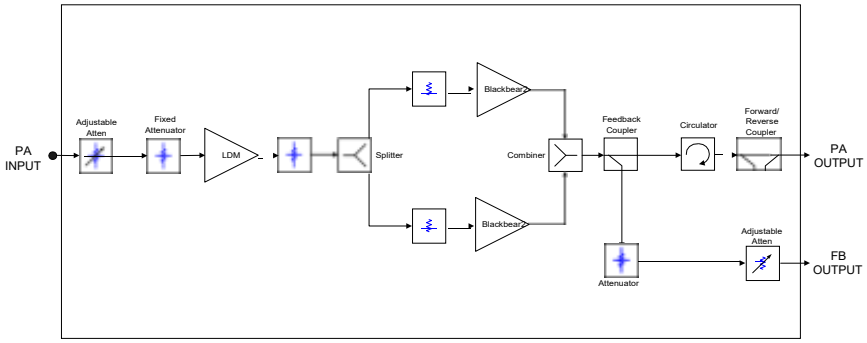
Power Amplifier in BR-Arch-2 Base Radios

Power Amplifiers in BR-Arch-2 are available in a single, high-power version capable of running efficiently in low-power setting. This version comes in different frequency bands. The following table contains a list of all available PAs in BR-Arch-2 Base Radios.

Table 98: Power Amplifiers in BR-Arch-2 Architecture

MTS Band	Power Configuration	Frequency Bands
400 MHz	high-low power	320 – 400 MHz
		380 – 470 MHz

Figure 182: Mid-power PA Functional Block Diagram



10.3

Base Radio – Indicators and Connectors

Table 99: Base Radio – LED Indicators

#	LED/Port name	Type	Controlled by	Indication
LED 1	Tx	Red/ Green	SW	BR keying: • OFF: BR is not keyed • AMBER: BR is keyed without service • GREEN: BR is keyed
LED 2	Aux	Red/ Green	SW	• OFF: No alarms • AMBER: not used • RED: not used
LED 3	Status	Red/ Green	SW Red LED will turn on before SW change any indication	BR status: • OFF: Status unknown, power off • GREEN: BRC main application is running • AMBER: Waiting for SWDL this is where the BR will wait if no Site Controller is present • RED: SW not started, power on
LED 4	BR Alarm	Red/ Green	SW	• OFF: No alarms • AMBER: BR minor alarm: PA, Exciter, RX, BRC Reduced performance • RED: BR failed: PA, Exciter, RX, BRC

#	LED/Port name	Type	Controlled by	Indication
LED5	SC 1	Green	HW, Enet IC	• OFF: Ethernet link not present • GREEN: Ethernet link present
LED6	SC 1	Yellow	HW, Enet IC	• OFF: Ethernet activity not present • YELLOW: Ethernet activity present
LED7	SC 2	Green	HW, Enet IC	• OFF: Ethernet link not present • GREEN: Ethernet link present
LED8	SC 2	Yellow	HW, Enet IC	• OFF: Ethernet activity not present • YELLOW: Ethernet activity present

Table 100: Base Radio – Connectors

Name of Connector	Type		To/From	Comment
SC1	RJ45		Site Controller	Ethernet/CP2 interface
SC2	RJ45		Site Controller	Ethernet/CP2 interface
Service	RJ45		BRC	Provides service access. See Table 101: Base Radio – Service Cable Pinouts on page 327 for service cable pinout information.
RX1	QMA		Preselector/ Duplexer	RF RX signal and +7 V dcl
RX2	QMA		Preselector/ Duplexer	RF RX signal and +7 V dc
RX3	QMA		Preselector/ Duplexer	RF RX signal and +7 V dc
Tx	QMA		Hybrid Combiner/ Cavity Combiner	RF TX signal
Power	MOLEX		Power Supply Unit	
	Pin 1 - 3	GND		
	Pin 4	+7 V		
	Pin 6 - 7	+28.5 V		

Name of Connec-tor	Type	To/From	Comment
	Pin 5, 8 - 14	not used	

Table 101: Base Radio – Service Cable Pinouts

RJ45 PIN	D-SUB 9 FEMALE PIN	Description
1		
2		
3		
4	3	Rx
5	5	GND
6		
7	2	Tx
8	5	GND
9		

10.4 Replacing the Base Radio

For a list of available Field Replaceable Units (FRUs), see Field Replaceable Units (FRUs) on page 446.

Process:

1. Remove the Base Radio module, see Removing the Base Radio on page 328.
2. Reinstall the new Base Radio, see Reinstalling the Base Radio on page 328.
3. Perform the procedures from the Configuring and Verifying the Base Radio on page 234 section.
4. If Encryption and/or Authentication is used, see *MTS LiTE, MTS 2, and MTS 4 Restoration* manual (for DIPS/DIPC/X Core systems) or *Service Manual* (DIPM system) for details on loading Ki's into MTS.

10.4.1 Electrostatic Discharge Precaution

The Base Radio circuitry contains many CMOS and other electrostatic discharge sensitive devices. Take precautionary measures to prevent damage of Base Radio modules by static discharge when servicing the equipment.

Observe the following additional precautions:

- Wear a wrist strap (Motorola Part No. 4280385A59 or equivalent) at all times when servicing the Base Radio to minimize static build up.
- A jack is provided at top left of module cage marked with the ground symbol.
- Keep spare modules in factory packaging for transporting. When shipping modules, always pack in original packaging.

For more information, see Static Precautions and ESD Strap on page 460.

10.4.2
Restoring the Base Radio

Process:

1. Remove the Base Radio.

   See Removing the Base Radio on page 328.
2. Reinstall the Base Radio.

   See Reinstalling the Base Radio on page 328.

10.4.2.1
Removing the Base Radio

Procedure:

1. Remove power from the MTS by switching off the Power Supply Unit.

   NOTICE: To perform a hotswap of a Base Radio, do not turn off the Power Supply. Connect a terminal to the Service Port and log in. Make sure the Base Radio is not transmitting by entering the MMI command:

   - From the Base Radio Core or Boot1 use: `dekey`
   - From the Test Application use: `power -otxch1 -a0.0`

   For more information on this command, see *MMI Commands Manual*.
2. Unplug the cables at front of the Base Radio.
3. Remove the TORX screws securing the faulty module to the chassis; these are located on the top and bottom of the front plate of the faulty module. Save the screws for reuse.
4. **CAUTION:** The module can be very hot. To avoid injury, allow the module to cool down before servicing.

   Pull out the module.

10.4.2.2
Reinstalling the Base Radio

Procedure:

1. Insert the replacement Base Radio by aligning the side rails with the appropriate rail guides inside the Base Radio chassis.
2. Gently push the replacement module completely into the Base Radio chassis assembly using the module handle(s).
3. Secure the replacement module using two TORX screws removed during module removal. Tighten the screws to a torque of 2.7 Nm.
4. Reconnect the cables to the BR front plate.
5. Switch on the Power Supply Unit.

   NOTICE: Do not perform this step when doing a hotswap.